APPENDIX F: Specialists' impact assessment reports

CONTENTS

1. AGRICULTURE AND SOIL SPECIALIST IMPACT ASSESSMENT REPORT 6

1.1. EXECUTIVE SUMMARY 6
1.2. LIST OF ABBREVIATIONS 7
1.3. INTRODUCTION 7
1.4. APPROACH AND METHODOLOGY 8
1.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT 9
1.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS 14
1.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS 14
1.8. ASSESSMENT OF CUMULATIVE IMPACTS 15
1.9. IMPACT ASSESSMENT SUMMARY 17
1.10. MITIGATION MEASURES AND MANAGEMENT ACTIONS 20
1.11. CONCLUSIONS AND RECOMMENDATIONS 20
1.12. APPENDIX A: SPECIALIST IMPACT ASSESSMENT CRITERIA 20
1.13. APPENDIX B: SPECIALIST DECLARATION 21
1.14. APPENDIX C: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017 22
1.15. APPENDIX D: SPECIALIST CURRICULUM VITAE 23

2. FAUNA & FLORA SPECIALIST IMPACT ASSESSMENT REPORT 24

2.1. EXECUTIVE SUMMARY 24
2.1. LIST OF ABBREVIATIONS 25
2.2. INTRODUCTION 25
2.3. APPROACH AND METHODOLOGY 28
2.4. DESCRIPTION OF THE AFFECTED ENVIRONMENT 32
2.5. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS 46
2.6. IDENTIFICATION AND ASSESSMENT OF IMPACTS 47

2.7. ASSESSMENT OF CUMULATIVE IMPACTS 55
2.8. COMPARATIVE ASSESSMENT OF ALTERNATIVES 56
2.9. IMPACT ASSESSMENT SUMMARY 57
2.10. MITIGATION MEASURES AND MANAGEMENT ACTIONS 62
2.11. CONCLUSIONS AND RECOMMENDATIONS 64
2.12. APPENDIX A: SPECIALIST IMPACT ASSESSMENT CRITERIA 66
2.13. APPENDIX B: SPECIALIST DECLARATION 66
2.14. APPENDIX C: SPECIALIST CURRICULUM VITAE 68
2.15. APPENDIX D: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017 69
2.16. APPENDIX E: LIST OF PLANT SPECIES 70
2.17. APPENDIX F: LIST OF MAMMALS 73
2.18. APPENDIX G: LIST OF REPTILES 78
2.19. APPENDIX H: LIST OF AMPHIBIANS 80

3. AVIFAUNA SPECIALIST IMPACT ASSESSMENT REPORT 82

3.1. EXECUTIVE SUMMARY 82
3.1. LIST OF ABBREVIATIONS 86
3.2. INTRODUCTION 86
3.3. APPROACH AND METHODOLOGY 89
3.4. DESCRIPTION OF THE AFFECTED ENVIRONMENT 92
3.5. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS 106
3.6. IDENTIFICATION AND ASSESSMENT OF IMPACTS 107
3.7. ASSESSMENT OF CUMULATIVE IMPACTS 117
3.8. IMPACT ASSESSMENT SUMMARY 120
3.9. MITIGATION MEASURES AND MANAGEMENT ACTIONS 124
3.10. CONCLUSIONS AND RECOMMENDATIONS 129
3.11. APPENDIX A: REFERENCES 133
3.12. APPENDIX B: SPECIALIST IMPACT ASSESSMENT CRITERIA 134
3.13. APPENDIX C: SPECIALIST DECLARATION 135
3.14. APPENDIX D: SPECIALIST CURRICULUM VITAE 136
3.15. APPENDIX E: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017 139
3.1. APPENDIX F: BIRD DATA FOR THE PAULPUTS SITE 140

4. INLAND AQUATIC ECOSYSTEMS' SPECIALIST IMPACT ASSESSMENT REPORT 149

4.1. EXECUTIVE SUMMARY 149
4.2. LIST OF ABBREVIATIONS AND GLOSSARY 151

4.3. INTRODUCTION 153

4.4. APPROACH AND METHODOLOGY 154

4.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT 160

4.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS 171

4.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS 173

4.8. ASSESSMENT OF CUMULATIVE IMPACTS 181

4.9. IMPACT ASSESSMENT SUMMARY 183

4.10. MITIGATION MEASURES AND MANAGEMENT ACTIONS 203

4.11. CONCLUSIONS AND RECOMMENDATIONS 213

4.12. REFERENCES 214

4.13. APPENDIX A: SPECIALIST DECLARATION 216

4.14. APPENDIX B: SPECIALIST CURRICULUM VITAE 217

4.15. APPENDIX C: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017 218

4.16. APPENDIX D: GUIDELINES FOR FIXED POINT PHOTOGRAPHY 219

4.17. APPENDIX E: SCORING OF IMPACTS FOR IMPACT ASSESSMENT 220

5. HERITAGE SPECIALIST IMPACT ASSESSMENT REPORT 224

5.1. EXECUTIVE SUMMARY 224

5.2. LIST OF ABBREVIATIONS AND GLOSSARY 225

5.3. INTRODUCTION 226

5.4. APPROACH AND METHODOLOGY 230

5.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT 232

5.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS 244

5.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS 245

5.8. ASSESSMENT OF CUMULATIVE IMPACTS 248

5.9. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS 248

5.10. IMPACT ASSESSMENT SUMMARY 248

5.11. MITIGATION MEASURES AND MANAGEMENT ACTIONS 253

5.12. CONCLUSIONS AND RECOMMENDATIONS 254

5.13. APPENDIX A: REFERENCES 255

5.14. APPENDIX B: SPECIALIST IMPACT ASSESSMENT CRITERIA 256

5.15. APPENDIX C: SPECIALIST DECLARATION 256

5.16. APPENDIX D: SPECIALIST CURRICULUM VITAE 258

5.17. APPENDIX E: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017 260

5.18. APPENDIX F: PALEONTOLOGY STUDY SPECIALIST REPORT 261

5.19. APPENDIX G: ARCHEOLOGICAL FINDS 270

6. VISUAL SPECIALIST IMPACT ASSESSMENT REPORT 278

6.1. EXECUTIVE SUMMARY 278
6.2. LIST OF ABBREVIATIONS 279
6.3. INTRODUCTION 279
6.4. APPROACH AND METHODOLOGY 282
6.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT 284
6.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS 290
6.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS 290
6.8. ASSESSMENT OF CUMULATIVE IMPACTS 299
6.9. COMPARATIVE ASSESSMENT OF ALTERNATIVES 302
6.10. IMPACT ASSESSMENT SUMMARY 302
6.11. MITIGATION MEASURES AND MANAGEMENT ACTIONS 306
6.12. CONCLUSIONS AND RECOMMENDATIONS 307
6.13. APPENDIX A: SPECIALIST IMPACT ASSESSMENT CRITERIA 307
6.14. APPENDIX B: SPECIALIST DECLARATION 308
6.15. APPENDIX C: SPECIALIST CURRICULUM VITAE 309
6.16. APPENDIX D: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017 310

7. TRAFFIC SPECIALIST IMPACT ASSESSMENT REPORT 311

7.1. EXECUTIVE SUMMARY 311
7.2. LIST OF ABBREVIATIONS 311
7.3. INTRODUCTION 311
7.4. APPROACH AND METHODOLOGY 313
7.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT 314
7.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS 324
7.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS 324
7.8. ASSESSMENT OF CUMULATIVE IMPACTS 330
7.9. IMPACT ASSESSMENT SUMMARY 332
7.10. MITIGATION MEASURES AND MANAGEMENT ACTIONS 339
7.11. CONCLUSIONS AND RECOMMENDATIONS 341
7.12. APPENDIX A: SPECIALIST IMPACT ASSESSMENT CRITERIA 341
7.13. APPENDIX B: SPECIALIST DECLARATION 342
7.14. APPENDIX C: SPECIALIST CURRICULUM VITAE 343
7.15. APPENDIX D: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017 348

8. SOCIO-ECONOMIC SPECIALIST IMPACT ASSESSMENT REPORT 349

8.1. EXECUTIVE SUMMARY 349

8.2. LIST OF ABBREVIATIONS 350

8.3. INTRODUCTION 351

8.4. APPROACH AND METHODOLOGY 354

8.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT 356

8.6. IDENTIFICATION AND ASSESSMENT OF IMPACTS 361

8.7. ASSESSMENT OF CUMULATIVE IMPACTS 379

8.8. IMPACT ASSESSMENT SUMMARY 381

8.9. MITIGATION MEASURES AND MANAGEMENT ACTIONS 385

8.10. CONCLUSIONS AND RECOMMENDATIONS 392

8.11. APPENDIX A: REFERENCES 392

8.12. APPENDIX B: SPECIALIST IMPACT ASSESSMENT CRITERIA 393

8.13. APPENDIX C: DISCLAIMER 394

8.14. SPECIALIST DECLARATION 395

8.15. APPENDIX D: SPECIALIST CURRICULUM VITAE 396

8.16. APPENDIX E: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017 398

8.17. APPENDIX F: REIPPPP ECONOMIC DEVELOPMENT SCORECARD FOR EVALUATION OF SOLAR PV PROJECT BIDS 400

1. AGRICULTURE AND SOIL SPECIALIST IMPACT ASSESSMENT REPORT

1.1. EXECUTIVE SUMMARY

The proposed Paulputs Solar PV Facility will be located on land zoned and used for agriculture (grazing). South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed development is on land which is of extremely low agricultural potential and is totally unsuitable for cultivation.

The key findings of this study are:

- Soils of the proposed development site are dominated by predominantly shallow, sandy, red soils on underlying rock and hardpan that are of the Hutton soil form.
- The major limitation to agriculture is the extremely limited climatic moisture availability.
- As a result of this limitation, the study area is totally unsuitable for cultivation and agricultural land use is limited to low density grazing.
- The proposed development footprint is classified with a predominant land capability evaluation value of 4, which is very low to low.
- There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development.
- The significance of all agricultural impacts is kept low by the fact that the proposed site is on land of such limited agricultural potential.
- Two potential negative impacts of the development on agricultural resources and productivity were identified as:
    - Loss of agricultural land use caused by direct occupation of land by the development footprint;
    - Soil degradation resulting from erosion and topsoil loss.
- One potential positive impact of the development on agricultural resources and productivity was identified as:
    - Generation of alternative / additional land use income through the energy facility, which will improve cash flow and financial sustainability of farming enterprises on site.
- All impacts were assessed as having low or very low significance.
- Cumulative impact is also assessed as low, predominantly because of the low agricultural potential of the area. It is considered far more preferable to incur a loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, and is much scarcer, to renewable energy development elsewhere in the country.
- Recommended mitigation measures include implementation of an effective system of storm water run-off control and the maintenance of vegetation cover to mitigate erosion; and topsoil stripping and re-spreading to mitigate loss of topsoil.
- Due to the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which preclude authorisation of the proposed development and therefore, from an agricultural impact point of view, the development should be authorised.
- There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation.
- The overall significance of the impact on agriculture for the construction, operation and decommissioning phase is assessed as very low.

1.2. LIST OF ABBREVIATIONS

DAFF	Department of Agriculture, forestry and Fisheries
DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
MW	Mega Watts
PV	Photovoltaic

1.3. INTRODUCTION

- **Scope and Objectives**

This report presents the Agriculture and Soil Impact Assessment undertaken by Johann Lanz as part of the Environmental Impact Assessment for the proposed development of the three 100 MW Paulputs Solar PV Energy Facilities and associated electrical infrastructure. The location of the proposed renewable energy facility is shown in Figure 1.

The objectives of this study are to identify and assess all potential impacts of the proposed activities on agricultural resources including soils and agricultural production potential, and to provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified potential impacts.

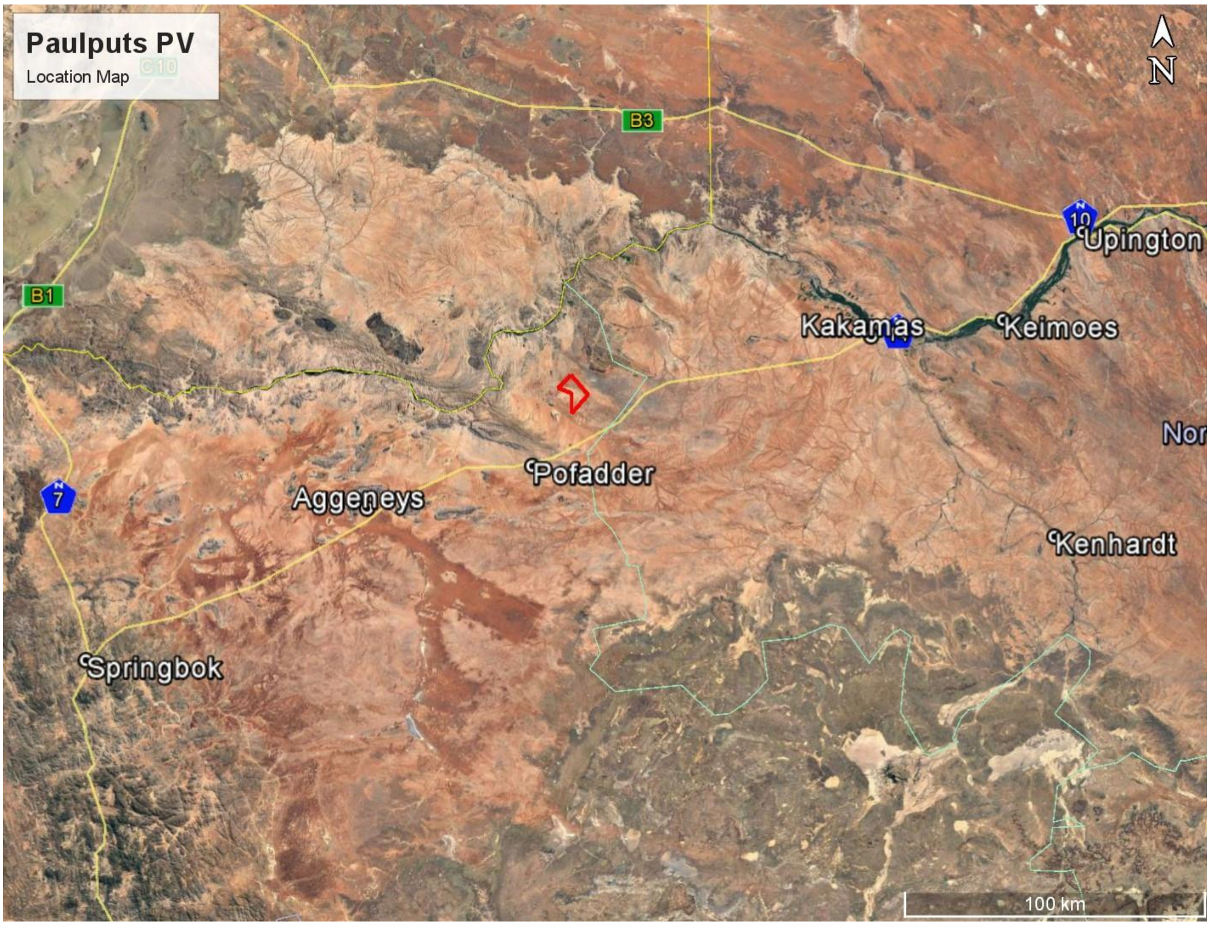


Figure 1. Location of the proposed Paulputs Solar PV Facility, north east of Pofadder in the Northern Cape, with all impacted farm portions outlined in red.

- **<u>Terms of Reference</u>**

The following terms of reference apply to this study:

The report fulfils the terms of reference for an agricultural study as set out in the National Department of Agriculture's document, *Regulations for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011, with an appropriate level of detail for the agricultural suitability, soil variation and level of impact of the proposed development (less than the standardised level of detail stipulated in the above regulations is justified by the extremely low agricultural potential of the proposed site). DEA's requirements for an agricultural study are taken directly from this document but use an older version of the document and not the most recent version, which was updated in 2011.

The report also fulfils the requirements of Appendix 6, GN R326 EIA Regulations of 7 April 2017. The above requirements may be summarised as:

- Identify and assess all potential impacts (direct, indirect and cumulative) of the proposed development on soils and agricultural potential.
- Describe and map soil types (soil forms) and characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers).
- Describe the topography of the site.
- Describe climate as it pertains to agricultural potential
- Summarise available water sources for agriculture
- Describe historical and current land use, agricultural infrastructure, as well as possible alternative land use options.
- Determine and map, if there is variation, the agricultural potential across the site.
- Determine and map the agricultural sensitivity to development across the site, including any agricultural no-go areas.
- Provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified impacts.

1.4. APPROACH AND METHODOLOGY

- **<u>Approach and Methodology</u>**

The area in which the development is proposed is of extremely low land capability and severely limited by climatic moisture availability. A field investigation was not therefore considered necessary. The assessment was based on a desktop analysis of existing soil and agricultural potential data for the site, as well as satellite imagery of the site available on Google Earth. This level of assessment is considered entirely adequate for a thorough assessment of all the agricultural impacts of the proposed development. It is my opinion that the level of soil mapping detail in the above DAFF requirements (see Terms of reference) is appropriate for arable land only. It is not appropriate for this site. Detailed soil mapping has little relevance to an assessment of agricultural potential in this environment, where the agricultural limitations are overwhelmingly climatic and cultivation potential is non-existent. In such an environment, even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity constraints. Conducting a soil assessment at the stipulated level of detail would be very time consuming and would add no value to the assessment. The soil data contained in the land type data set is entirely adequate for the purposes of this assessment.

The potential impacts identified in this specialist study were assessed based on the criteria and methodology outlined in Appendix A. The ratings of impacts were based on the specialist's knowledge and experience of the field conditions of the environment in which the proposed development is located, and of the impact of disturbances on that agricultural environment.

- **Assumptions and Limitations**

The following assumptions were used in this specialist study:

- The study assumes that water for irrigation is not available across the site. This is based on the assumption that a long history of farming experience in an area will result in the exploitation of viable water sources if they exist, and none have been exploited in this area.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 30 km radius.

The following limitation was identified in this study:

- The assessment rating of impacts is not an absolute measure. It is based on the subjective considerations and experience of the specialist but is done with due regard and as accurately as possible within these constraints.

There are no other specific limitations or knowledge gaps relevant to this study.

- **Source of Information**

The following sources of information were used:

- Soil data was sourced from the land type data set, of the Department of Agriculture, Forestry and Fisheries. This data set originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.
- Land capability data was sourced from the 2017 National land capability evaluation raster data layer produced by the Department of Agriculture, Forestry and Fisheries, Pretoria.
- Rainfall and temperature data was sourced from The World Bank Climate Change Knowledge Portal, dated 2015[1].
- Satellite imagery of the site and surrounds was sourced from Google Earth.

1.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

This section is organised in sub headings based on the requirements of an agricultural study as detailed in section 4.2 of this report. The description of the affected environment is identical for all three phases of the solar PV development. The development layout of the three phases is shown in Figure 3. It is noted that an archeological site was identified within the PV3 preferred layout, including a series of low granite bedrock outcrops with several ground patches and a light artefact scatter located in a deflated area (site KK2018/001). In order to prevent impacts to this site, a development envelope was created for the PV3 project which includes an alternative layout for the PV3 project. The development envelope includes sufficient area to develop the PV field and associated infrastructure and avoid the

[1]The World Bank Climate Change Knowledge Portal. 2015. Available at http://sdwebx.worldbank.org/climateportal/

site KK2018/001. The consideration of a development envelope for the PV3 project and alternative layout does not present additional impacts or issues in terms of Agriculture and Soil aspects and does not influence the impact assessment conducted during the Agriculture and Soil Impact Assessment.

- **Climate and water availability**

The site has an extremely low average rainfall of 106 mm per annum. The average monthly rainfall distribution is shown in Figure 2. The low rainfall is a very significant agricultural constraint that seriously limits the level of agricultural production (including grazing) which is possible. Water availability, even for stock watering purposes, is severely constrained.

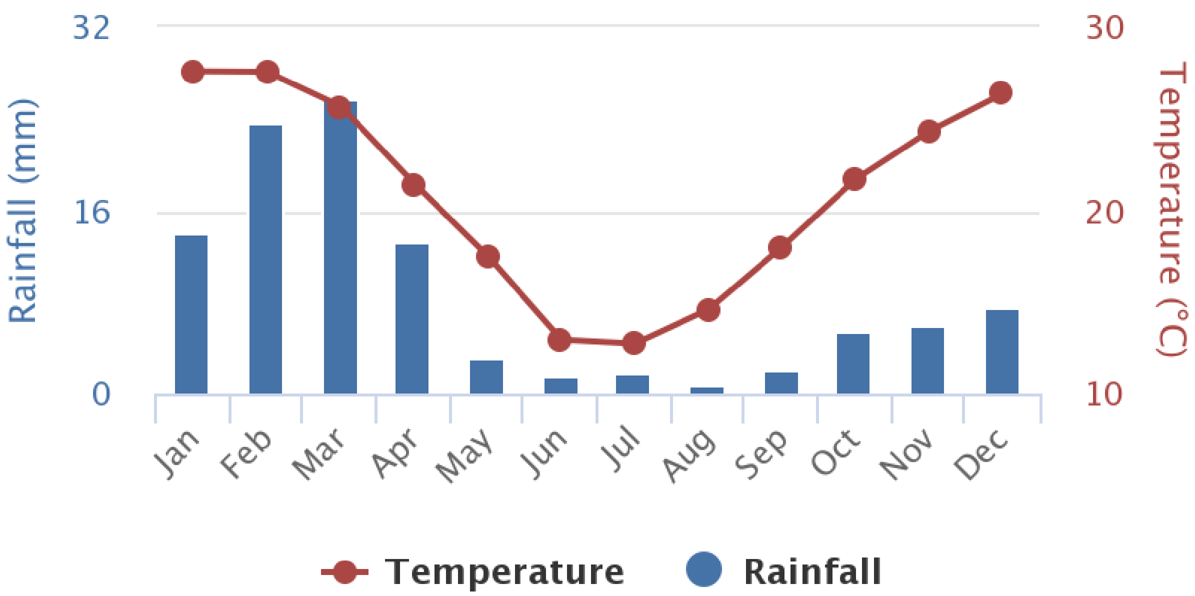


Figure 2. Average monthly temperature and rainfall for location (-28.92, 19.54) from 1991 – 2015[1]. This location is approximately in the centre of the proposed solar development.

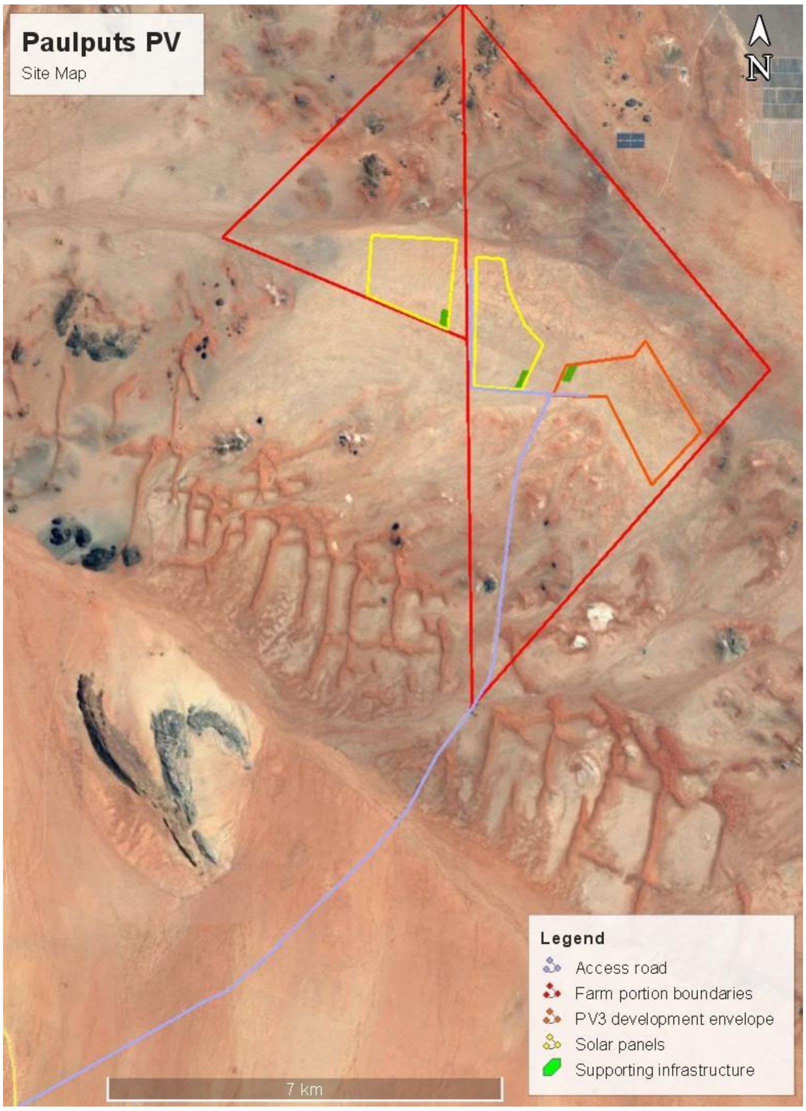


Figure 3. Satellite image map of the development layout of the three phases.

- **<u>Terrain, topography and drainage</u>**

The proposed development is located on a level plain at an altitude of around 800 metres above sea level. The slope across the area is approximately 2%.

The underlying geology of the area is Gneissic granite and other ultrametamorphic rocks of the Namaqualand Metamorphic Complex.

- **<u>Soils</u>**

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. There is a single land type across the entire proposed site of the development, namely land type Ag37. This land type is dominated (57% of the surface area) by shallow, red, sandy soils , predominantly of the Hutton soil form, on underlying rock or hardpan. Twenty percent of the land type surface area is covered by rock outcrop. The rest (23%) comprises deeper soils, but still with limited depth, on underlying rock or hardpan. A summary detailing soil data for the land type is provided in Table 1.

Table 1. Soil data for the land type on which the proposed development is located.

Land type	Land capability class	Soil series (forms)	Depth (mm)			Clay % A horizon			Clay % B horizon			Depth limiting layer	% of land type
Ag37	7	Hutton	200	-	300	3	-	8	3	-	8	R,ka,db	48
		Rock outcrop											20
		Dundee / Oakleaf	500	-	1000	0	-	6				R,ka	15
		Mispah	100	-	200	0	-	6				R	9
		Hutton	500	-	1000	0	-	6	0	-	6	ka,ca	8

The land capability classification used here is the old one associated with the land type data. Class 7 is non-arable, low potential grazing land. Depth limiting layers: R = hard rock; ca = soft carbonate; ka = hardpan carbonate; db = dorbank hardpan.

The environment does not pose a high water erosion risk. Mitigating factors are the low slope, low rainfall, rock outcrops, and high permeability of the sandy soils. Because the soils have a sandy texture, they are however susceptible to wind erosion. Surface disturbance always increases and therefore poses an erosion risk.

- **Agricultural capability**

Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rainfed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land. The higher land capability classes are suitable as arable land for the production of cultivated crops, while the lower suitability classes are only suitable as non-arable grazing land, or at the lowest extreme, not even suitable for grazing. In 2017 DAFF released updated and refined land capability mapping across the whole of South Africa. This has greatly improved the accuracy of the land capability rating for any particular piece of land anywhere in the country. The new land capability mapping divides land capability into 15 different categories with 1 being the lowest and 15 being the highest. Detail of this land capability scale is shown in Table 2.

Table 2. Details of the 2017 Land Capability classification for South Africa.

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

The proposed development footprint is classified with a predominant land capability evaluation value of 4. The raster data includes some pixels of value 5 and 6. Agricultural limitations that result in the low land capability classification of the proposed development location are predominantly due to the extremely limited climatic moisture availability. This renders the site totally unsuitable for any kind of cultivation and limits it to low density grazing only.

The long term grazing capacity of the site is low at 45 hectares per large stock unit[2].

- **Land use and development on and surrounding the site**

The area is a sheep farming area. The climate does not support any cultivation and low intensity natural grazing is the only current and viable agricultural activity. The only agricultural infrastructure in the area are wind pumps, stock watering points and fencing surrounding grazing camps. The only farmstead within the study area exists on the plains to the north east of the proposed PV development, on the neighbouring farm portion.

There are a number of renewable energy developments in close proximity to the site (see section on assessment of cumulative impacts, below).

Access to site from the N14 via the R358 (southern access) is approximately 28 km, of which 11 km are travelled on the R358 and the balance on OG73. Access to site from the N14 via the MR759 (northern access) is approximately 31 km, of which 22 km are travelled on the MR759 and the balance on OG73.

An internal site road network will be developed to provide access to the solar field and associated infrastructure for maintenance, inspections and panel cleaning. These service gravel roads will have a width of approximately 4 m. Existing farm roads will be used and upgraded where required.

- **Possible land use options for the site**

The extremely low climatic moisture availability means that low density grazing is the only possible agricultural land use for the site.

- **Agricultural sensitivity**

Agricultural sensitivity is a direct function of the capability of the land for agricultural production. This is because a negative impact on land of higher agricultural capability is more detrimental to agriculture than the same impact on land of low agricultural capability. A general assessment of agricultural sensitivity, in terms of loss of agricultural land in South Africa, considers arable land that can support viable production of cultivated crops, to have high sensitivity. This is because there is a scarcity of such land in South Africa, in terms of how much is required for food security. However, there is not a scarcity in the country of land that is only suitable as low intensity grazing land and such land is therefore not considered to have high agricultural sensitivity.

The entire study area has extremely low agricultural potential and therefore very low agricultural sensitivity to development and consequent loss of agricultural land use. Agricultural potential and conditions are also very uniform across the site, and the choice of placement of facility infrastructure, including access roads and transmission lines therefore has negligible influence on the significance of

[2] Department of Agriculture Forestry and Fisheries. 2018. Long-term grazing capacity map for South Africa developed in line with the provisions of Regulation 10 of the Conservation of Agricultural Resources Act, Act no 43 of 1983 (CARA).

agricultural impacts. From an agricultural point of view, no parts of the site need to be avoided by the proposed development and no buffers are required.

1.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

According to the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA), an application for the development should be approved by the Department of Agriculture, Forestry and Fisheries (DAFF). DAFF reviews and approves this application according to their Guidelines for the evaluation and review of applications pertaining to renewable energy on agricultural land, dated September 2011

Rehabilitation after disturbance to agricultural land is managed by the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). No application is required in terms of CARA. The Environmental Authorisation process covers the required aspects of this.

1.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS

The identification and assessment of impacts is identical for all three phases of the solar PV development.

- **Description of project aspects relevant to agricultural impacts**

The components of the project that can impact on soils, agricultural resources and productivity are:

- Occupation of the land by the total physical footprint of the proposed project including all PV panels, roads and electrical infrastructure.
- Construction activities that may disturb the soil profile and vegetation, for example for levelling, excavations, etc.

Each proposed solar PV facility that is assessed in this report will consist of the following:

- 100 MW Solar PV array, inverters and mini-subs covering an area of approximately ≤200ha;
- An onsite substation complex covering an area of approximately 2 ha including:
  - a 22/132 kV or 33/132 kV onsite collector substation;
  - a switching substation
  - control rooms and grid control yards for both Eskom and the Independent Power Producer.
  - a telecommunication tower up to 50m high (lattice or monopole type).
- Main access road of a maximum width of 13,5 m, including stormwater channels or drainage structures;
- Internal roads of a maximum width of 6m;
- Operations and Maintenance (O&M) buildings covering an area of approximately ≤1ha
- Battery storage facility covering an area of approximately ≤1 ha;
- Temporary infrastructure covering an area of approximately ≤4 ha including:
  - concrete batching facility,
  - temporary offices,
  - construction yard and
  - laydown area; and
- Other infrastructure such as perimeter fencing, septic tanks, and water storage tanks.

- **Overview of Impacts resulting from the proposed development**

Three potential agricultural impacts have been identified. Two of these are direct, negative impacts and apply to all three phases of the development (construction, operational and decommissioning). These are:

1. Loss of agricultural land use. Agricultural grazing land directly occupied by all of the development infrastructure will become unavailable for agricultural use.
2. Soil degradation resulting from erosion and topsoil loss. Erosion may be by wind or water. It can occur as a result of the alteration of the land surface run-off characteristics, which can be caused by construction related land surface disturbance, vegetation removal, and the establishment of hard surface areas including PV panels and roads. Loss of topsoil can result from poor topsoil management during construction related soil profile disturbance.

The third impact is a positive, indirect impact and only applies to the operational phase:

3. Alternative / additional land use income will be generated by the farming enterprise through the lease of the land to the energy facility. This will provide the farming enterprise with increased cash flow and rural livelihood, and thereby improve its financial sustainability.

The significance of all agricultural impacts is low because of the extremely limited agricultural potential of the proposed development site. The assessment of these impacts, according to the prescribed methodology in Appendix A, is presented in the impact assessment summary tables below.

Management actions to avoid or reduce negative impacts or to enhance positive benefits as well as monitoring recommendations for each of the management actions are presented in section 11, below.

1.8. ASSESSMENT OF CUMULATIVE IMPACTS

The cumulative impact of a development is the impact that development will have when its impact is considered together with the incremental impacts of other past, present or reasonably foreseeable future activities that will affect the same environment. The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

The potential cumulative agricultural impact of importance is a regional loss or degradation of agricultural land. The defining question for assessing the cumulative agricultural impact is this: What level of loss of agricultural land use is acceptable in the area, and will the loss associated with the Paulputs PV development, cause that level in the area to be exceeded?

The formal assessment of cumulative impacts as required by the NEMA regulations has some limitations. Firstly, it restricts the cumulative impacts to similar developments, so in this case to renewable energy developments. In order to accurately answer the defining question above, all developments, regardless of their type and similarity, should be taken into account, because all will contribute to exceeding the acceptable level of change.

The second problem with the regulation requirement, is that it restricts surrounding developments to those within an absolutely defined distance, in this case 30km. Again, this does not allow for accurately answering the defining question. To do so, the distance used for cumulative impact assessment should be discipline dependent. A different distance is likely to apply for agricultural impact than for economic impact or botanical impact. And a different distance should be used in different environments, for example in high potential agricultural environments versus very low potential agricultural environments.

Given the above, this assessment focuses on effectively addressing the defining question above by considering the cumulative impacts more broadly than is required in terms of the regulations. It does this by considering a wider area than the 30 km radius, and by considering the likelihood of pressure from other types of developments as well.

The formal assessment of the cumulative impact of the Paulputs Solar PV considered two distinct scenarios:

- The construction and operation of 1 x 100MW solar Paulputs PV facility and associated infrastructure, as well as all other renewable energy projects approved or under environmental assessment process within 30km of the proposed site.
- The construction and operation of 3 x 100MW solar Paulputs PV facilities and associated infrastructure, as well as all other renewable energy projects approved or under environmental assessment process within 30km of the proposed site.

The approved renewable energy projects, with their associated transmission lines, within 30km of the proposed site (and therefore required in terms of the regulations), constitute the solar energy node, which covers the area around the Paulputs Substation and includes:

- Kaxu Solar One 100 MW CSP facility[3] which was awarded Preferred Bidder status in Bid Window 1 of South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), in operation on the Scuilt-Klip Farm No.92 Portion 4;
- Konkoonsies I 10 MW PV facility[4],[5] which was awarded Preferred Bidder status in Bid Window 1 of REIPPPP, in operation on the Koonkonsies Farm No. 91 Portion 6;
- Xina Solar One 100 MW CSP facility which was awarded Preferred Bidder status in Bid Window 3 of the REIPPPP, under construction on the Scuilt-Klip Farm No.92 Portion 4;
- Konkoonsies II 133 MW PV facility which was awarded Preferred Bidder status in Bid Window 4 of the REIPPPP[6], under construction on the Koonkonsies Farm No. 91 Portion 6; and
- Paulputs CSP Project facility which was authorized in 2016, on the Scuilt-Klip Farm No.92 Portion 4.

The area of land taken out of agricultural grazing as a result of all of the projects above will amount to a total of approximately 2,500 hectares. As a proportion of the area within a 30km radius (approximately 283,000 ha), this amounts to only 0.88% of the surface area. That is well within an acceptable limit in terms of loss of very low potential agricultural land, of which there is no scarcity. This is particularly so when considered within the context of the following two points:

- In order for South Africa to achieve its renewable energy generation goals, agriculturally zoned land will need to be used for renewable energy generation. It is far more preferable to incur a cumulative loss of agricultural land in a region such as the one being assessed, which

[3] http://www.abengoasolar.com/web/en/plantas_solares/plantas_propias/sudafrica/
[4] https://www.apsolutions.co.za/portfolio-item/konkoonsies-i/
[5] http://www.biothermenergy.com/blog/konkoonsies-solar-pv
[6] https://www.apsolutions.co.za/portfolio-item/konkoonsies-ii/

has no cultivation potential, and low grazing capacity, than to lose agricultural land that has a higher potential, and that is much scarcer, to renewable energy development elsewhere in the country. The limits of acceptable agricultural land loss are therefore far higher in this region than in regions with higher agricultural potential.

- It is also preferable, from an impact point of view as well as from practical considerations, to rather have a concentrated node of renewable energy development within one area, than to spread out the same number of developments over a larger area. Therefore, if the cumulative impact is considered only for the node, it leads to a false impression of the magnitude of that impact because of the concentrated development within the node, and the absence of development surrounding it. When averaged over a greater area, the magnitude becomes much less.

It should also be noted that there are few land uses, other than renewable energy, that are competing for agricultural land use in this area. The cumulative impact from developments, other than renewable energy, is therefore low.

Due to all of the considerations discussed above, the cumulative impact of loss of agricultural land use is assessed as having low significance, for both of the scenarios presented above. In terms of cumulative impact, therefore, the development can be authorised.

There is a relatively low risk of significant erosion resulting from renewable energy developments in the vicinity of the study area. This is because erosion risk of the environment is relatively low (see section 6.3), the kind of activities associated with renewable energy developments, do not pose a high erosion risk, and erosion is fairly easy to manage within such a development. Erosion is therefore not considered a significant cumulative impact.

1.9. IMPACT ASSESSMENT SUMMARY

Table 3. Impact assessment summary table for the Construction Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Construction of the project infrastructure on the land	Loss of agricultural land use	Negative	Site	Short term	Very low	Very likely	Moderate	Low	None	Low	Low
Land disturbance	Soil degradation	Negative	Site	Long term	Very low	Not likely	Moderate	Low	Erosion control	Very low	Very low

Table 4. Impact assessment summary table for the Operational Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Long term	Very low	Very likely	Moderate	Low	None	Low	Low
Land disturbance	Soil degradation	Negative	Site	Long term	Very low	Not likely	Moderate	Low	Erosion control	Very low	Very low
Project land rental	Additional land use income	Positive	Site	Long term	Low	Very Likely	Low	Low	None	Low	Low

Table 5. Impact assessment summary table for the Decommissioning Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Removal of the project infrastructure on the land	Loss of agricultural land use	Negative	Site	Short term	Very low	Very likely	Moderate	Low	None	Low	Low
Land disturbance	Soil degradation	Negative	Site	Long term	Very low	Not likely	Moderate	Low	Erosion control	Very low	Very low

1.10. MITIGATION MEASURES AND MANAGEMENT ACTIONS

The following mitigation measures are proposed for inclusion in the EMPr:

- Implement an effective system of storm water run-off control using bunds and ditches, where it is required - that is at points where water accumulation might occur. The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion.
- Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against wind erosion.
- If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface.

The following monitoring requirements are proposed for inclusion in the EMPr:

- Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. This inspection should be done once per month during the construction phase and once every six months during the operational phase. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.
- Photograph all disturbed areas prior to disturbance and periodically thereafter to record the state of vegetation cover.
- Establish an effective record keeping system for each area where soil is disturbed for construction and decommissioning purposes. The following things should be recorded: location, date of topsoil stripping, date of topsoil return, photograph prior to disturbance, photograph after topsoil return.

1.11. CONCLUSIONS AND RECOMMENDATIONS

All agricultural impacts of the proposed development are assessed as being of low significance. This is predominantly because of the extremely limited agricultural potential of the proposed development site. The study area has low agricultural sensitivity because of its low potential and no parts of the site need to be avoided by the proposed development. No buffers are required.

There are no recommended alterations to the proposed layout. There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation.

Due to the extremely low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which preclude authorisation of the proposed development and therefore, from an agricultural impact point of view, the development should be authorised.

1.12. APPENDIX A: SPECIALIST IMPACT ASSESSMENT CRITERIA

The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of the predicted environmental impacts and risks is described in Part 5 - Section 4 of the EIA report.

1.13. APPENDIX B: SPECIALIST DECLARATION

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

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

Signature of the specialist: 

Name of Specialist: Johann Lanz

Date: 15 November 2018

1.14. APPENDIX C: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017

Requirements of Appendix 6 – GN R326 of NEMA EIA Regulations as amended (7 April 2017)	**Addressed in this report**
A specialist report prepared in terms of these Regulations must contain- details of- the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Title page Appendix E
a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix C
an indication of the scope of, and the purpose for which, the report was prepared; an indication of the quality and age of base data used for the specialist report; a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4 Section 5.3 Sections 6.5; 8.3; 9
the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5
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 6.7
an identification of any areas to be avoided, including buffers;	Section 6.7
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;	Figure 3
a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5.2
a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 8
any mitigation measures for inclusion in the EMPr;	Section 11
any conditions for inclusion in the environmental authorisation;	Section 12
any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11
a reasoned opinion- whether the proposed activity, activities or portions thereof should be authorised; regarding the acceptability of the proposed activity or activities; and if the opinion is that the proposed activity 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 12 Section 12 Section 11
a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
any other information requested by the competent authority.	N/A
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.	N/A

1.15. APPENDIX D: SPECIALIST CURRICULUM VITAE

Education

M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1999
B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

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

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

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

Soil specialist study inputs to EIA's, SEA's and EMPR's. These have focused on impact assessments and rehabilitation on agricultural land, rehabilitation and re-vegetation of mining and industrially disturbed and contaminated soils, as well as more general aspects of soil resource management. Recent clients include: Aurecon; CSIR; SiVEST; SRK Consulting; Juwi Renewable Energies; Mainstream Renewable Power; Subsolar; Tiptrans; Planscape; Afrimat; Savannah Environmental; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Haw & Inglis.

Soil resource evaluations and mapping for agricultural land use planning and management. Recent clients include: Cederberg Wines; Unit for Technical Assistance - Western Cape Department of Agriculture; Vogelfontein Citrus; De Grendel Estate; Zewenwacht Wine Estate; Goedgedacht Olives;, Lourensford Fruit Company; Kaarsten Boerdery; Wedderwill Estate; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.

I have conducted several research projects focused on conservation farming, soil health and carbon sequestration.

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

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

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

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

Publications

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

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

2. FAUNA AND FLORA SPECIALIST IMPACT ASSESSMENT REPORT

2.1. EXECUTIVE SUMMARY

juwi Renewable Energies, is proposing to develop a 300 MWac solar PV facility near Pofadder in the Northern Cape Province. The development would consist of three 100 MWac solar PV phases. A 132kV transmission power line approximately 10km long will be constructed to connect the development to the Eskom 220/132kV Paulputs MTS Substation. The development is currently in the EIA Phase and Gaea has appointed 3Foxes Biodiversity Solutions to provide a specialist terrestrial ecology EIA study of the development site as part of the EIA process.

This ecological specialist study details the ecological characteristics of the site and provides an assessment of the likely ecological impacts associated with the development of the Paulputs Solar and Grid Connection development. Impacts are assessed for the construction, operation, and decommissioning phases of the development and a variety of mitigation and avoidance measures are recommended to reduce the impact of the development on the receiving environment. Several site visits and desktop review of the available ecological information for the area was conducted in order to identify and characterise the ecological features of the site and inform an ecological sensitivity map for the site, which has been used to guide development at the site.

The three PV footprint areas are located on the open plains of the site within the Bushmanland Arid Grassland vegetation type. The national vegetation map is however very coarse in the study area and there are numerous other vegetation communities and habitats present in the area. In order to address this shortcoming a detailed habitat map for the site was developed and indicates that the PV footprint areas are located within low sensitivity areas of the site, with a low abundance of species of conservation concern. There are however several protected species present within the site including Aloidendron dichotomum, Hoodia gordonii and Boscia foetida. The abundance of these species within the development footprint is however low and the loss of affected individuals from the development footprint would not compromise the local populations of these species.

The abundance of listed fauna in the area is very low and there are no habitats within the PV footprint areas that are considered to be of high faunal value. Impacts on fauna are likely to be restricted largely to habitat loss for resident species. Important habitats present in the wider area include the drainage lines of the area as well as some small pans and rocky outcrops, which are not within the PV footprint areas and would not be affected by the PV development. There are some rocky areas and drainage features within the grid connection corridors and while impacts on these features can likely be avoided, Grid Connection Alternative 1 is identified as preferred alternative as this route has the least extent of sensitive features along the route. During the operational phase, impacts on fauna are likely to be low and restricted to some habitat disruption as a result of the presence and habitat loss associated with the development.

The site is located within a tier 2 CBA, indicating that the area has been identified as an important area for biodiversity maintenance. Based on the results of the field assessment, the affected areas are not considered to be very sensitive in terms of the biodiversity features that are within the development footprint. However, as a primary purpose of CBAs is to try and secure the broad-scale ecological functioning and resilience of landscapes, the impact that the development may have on broad-scale ecological processes must be considered. However due to the extent and location of the development footprint, it is not likely that it would have a significant impact on broad scale processes as important landscape features such as rocky outcrops and drainage systems are not within the development footprint and would not be affected by the development.

There are no impacts associated with the development that cannot be reduced to a low level. Although there are numerous sensitive features in the broader landscape, the PV footprint areas are located in areas that are considered to be low sensitivity for fauna and flora. This is seen to be a key determinant of the low post-mitigation impacts associated with the development. There are numerous existing and planned developments in the Paulputs area and it is clear that a node of development around the Paulputs substation is starting to develop. Although this may have some local impact on landscape connectivity, the broader landscape and especially the broad-scale movement corridors that are likely to be operating the region remain relatively free from development and significant cumulative impact on these processes is not likely to occur as a result of the current development.

Impact Statement – PV Development

The footprint of the three Paulputs PV phases are located within typical, low sensitivity habitat with a low abundance of species of conservation concern. The post-mitigation impacts associated with the development would be of low significance. The contribution of the Paulputs solar development to cumulative impact in the area would be low and is considered acceptable. Overall, there are no specific long-term impacts likely to be associated with the development of the Paulputs solar development that cannot be reduced to a low significance. As such, there are no fatal flaws associated with the development and no terrestrial ecological considerations that should prevent it from proceeding.

Impact Statement – Grid Connection

The three Paulputs grid connection alternatives are acceptable and would generate very low post-mitigation impacts on fauna and flora. Grid Connection Alternative 1 is identified as the preferred alternative and would generate the lowest overall impacts on fauna and flora. There are no specific long-term impacts likely to be associated with the development of the Paulputs Solar Grid Connection that cannot be reduced to a low significance. The contribution of the power line and substation development to cumulative impact in the area would be low and is considered acceptable. As such, there are no fatal flaws associated with the development and no terrestrial ecological considerations that should prevent it from proceeding.

2.1. LIST OF ABBREVIATIONS

CBA	Critical Biodiversity Area
ESA	Ecological Support Area
IUCN	International Union for Conservation of Nature
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National protected area expansion strategy
SANBI	South African National Biodiversity Institute
SCC	Species of conservation concern

2.2. INTRODUCTION

- **Scope and Objectives**

juwi Renewable Energies, is proposing to develop a 300 MWac solar PV facility near Pofadder in the Northern Cape Province. The development would consist of three 100 MWac solar PV phases and will require separate full scoping and environmental impact assessment processes. A 132kV transmission power line approximately 10km long, will be constructed to connect the development to the Eskom 220/132kV Paulputs MTS Substation and will require a basic assessment process. Juwi Renewable Energies (Pty) Ltd has appointed Gaea Enviro (Pty) Ltd to undertake the required application for environmental authorisation process for the above development. The development is currently in the EIA Phase and Gaea has appointed 3Foxes Biodiversity Solutions to conduct a specialist terrestrial ecology impact assessment of the development site as part of the EA applications.

The purpose of the Paulputs Solar Terrestrial Ecology Impact Assessment Report is to describe and detail the ecological features of the proposed PV project site, provide an assessment of the ecological sensitivity of the site and identify the likely impacts associated with the development of the site as a solar PV facility and grid connection. Several site visits as well as a desktop review of the available ecological information for the area were conducted in order to identify and characterise the ecological features of the site. This information is used to derive an ecological sensitivity map which has been used to inform the layout of the development. Impacts are assessed separately for the facility and the grid connection, for the preconstruction, construction, operation, and decommissioning phases of the development. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which should be included in the EMPr for the development. The full scope of study is detailed below.

- **Terms of Reference**

The scope of the study includes the following activities:

- a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project
- a description and evaluation of environmental issues and potential impacts (incl. using direct, indirect and cumulative impacts) that have been identified
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
- an indication of the methodology used in determining the significance of potential environmental impacts
- an assessment of the significance of direct indirect and cumulative impacts in terms of the following criteria:
    - the nature of the impact, which shall include a description of what causes the effect, what will be affected, and how it will be affected
    - the extent of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international
    - the duration of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0-5 years), medium-term (5- 15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity), or permanent
    - the probability of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood) probable (distinct possibility), highly probable (most likely), or definite (Impact will occur regardless of any preventable measures)
    - the severity/beneficial scale indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit with no real alternative to achieving this benefit), severe/beneficial (long-term impact that could be mitigated/long-term benefit), moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), slight, or have no effect

- the significance which shall be determined through a synthesis of the characteristics described above and can be assessed as low medium or high
    - the status which will be described as either positive, negative or neutral
    - the degree to which the impact can be reversed
    - the degree to which the impact may cause irreplaceable loss of resources
    - the degree to which the impact can be mitigated
- a description and comparative assessment of all alternatives
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr)
- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures
- a description of any assumption, uncertainties and gaps in knowledge
- an environmental impact statement which contains:
    - a summary of the key findings of the environmental impact assessment;
    - an assessment of the positive and negative implications of the proposed activity;
    - a comparative assessment of the positive and negative implications of identified alternatives.

General Considerations:

- Disclose any gaps in information or assumptions made.
- Identify recommendations for mitigatory measures to minimise impacts.
- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the Environmental Management Plan (EMP) for faunal related issues.

A description of the potential impacts of the development and recommended mitigation measures are to be provided, which will be separated into the following project phases:

- Preconstruction
- Construction
- Operational Phase

- **<u>Relevant Aspects of the Development</u>**

The development will consist of the following:

- 3 x 100 MWac Solar PV array, inverters and mini-subs with ≤200ha footprint;
- onsite substation complex including a 22/132 kV or 33/132 kV onsite collector substation, a switching station, control rooms and grid control yards for both Eskom and the Independent Power Producer over an area of ≤2ha.;
- 132kV transmission power line;
- Temporary infrastructure including concrete batching facility, temporary offices, construction yard and laydown area with a combined maximum size of 4 ha;
- Main access road with a maximum width of 13.5 m including stormwater channels or drainage structures;
- Internal service roads with a maximum width of 6m;
- Operations and Maintenance (O&M) buildings including parking, reception area, offices and ablutions facilities for operational staff, security and visitors; workshops, storage areas for materials and spare parts over an area of ≤1ha;

- Telecommunication tower up to 50m high (lattice or monopole type) to be established in the onsite substation complex;
- Battery storage System: A ≤100MWh battery storage facility for grid storage (stacked containers or multi-storey building) and associated operational, safety and control infrastructure, over an area of ≤1ha with ≤8m building height and
- Other infrastructure such as; perimeter fencing, septic tanks, and water storage tanks.

The proposed site for the solar PV development consists of 2 land portions: Konkoonsies 91/2 and Konkoonsies 91/5. The overhead 132 kV power line connection will cross 4 land portions: Konkoonsies 91/2, Konkoonsies 91/5, Konkoonsies 91/6 and Scuit-Klip 92/4.

2.3. APPROACH AND METHODOLOGY

- **Assessment Philosophy & Rationale**

This assessment is conducted according to the 2017 EIA Regulations (Government Notice Regulation 326) in terms of the National Environmental Management Act (Act 107 of 1998) as amended (NEMA), as well as best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005). This includes adherence to the following broad principles:

1. That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

2. Demonstrate how the proponent intends complying with the principles contained in section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should:

    - In order of priority aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
    - Avoid degradation of the environment;
    - Avoid jeopardising ecosystem integrity;
    - Pursue the best practicable environmental option by means of integrated environmental management;
    - Protect the environment as the people's common heritage;
    - Control and minimise environmental damage; and
    - Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

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

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

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

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

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

Community and ecosystem level

- The main vegetation type, its aerial extent and interaction with neighbouring types, soils or topography
- Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc*)

Species level

- Red Data Book (RDB) species (giving location if possible using GPS)
- The viability of an estimated population size of the RDB species that are present (include the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, Low 0-40% confident)
- The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence)

Fauna

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

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

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

- The key ecological “drivers” of ecosystems on the site and in the vicinity, such as fire.

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

- **Site Visit & Field Assessment**

The main site visit occurred over four days from 14-17 May 2018. During the site visit, the three different PV development areas as well as the proposed power line routes were investigated in the field. Walk-through surveys were conducted across the site and a full plant species list was developed for each PV area. Sensitive habitats were identified and mapped in the field where necessary. Small mammal trapping with Sherman Live Traps was conducted over three nights on the plains and rocky hills of the site. However, despite the relatively large number of trap nights (210), no small mammals were caught, which appears to be the result of the drought conditions which preceded the sampling period and which significantly depressed small mammal populations. Camera trapping for larger mammals was also conducted with 5 camera traps set across the site, at watering points, along roads and also on some partly decomposed sheep carcases that were observed in the veld. Additional information on faunal presence at the site was collected through searching for reptiles within areas likely to harbour reptiles as well as through casual observation of fauna at the site while conducting the other field work.

A second site visit was conducted on the 8th of November 2018. During this follow-up site visit, the location of all *Aloidendron dichotomum* individuals within the development footprint were located and mapped with a GPS in the field. In addition, the number of individuals of other protected species such as *Hoodia gordonii* and *Boscia foetida* subsp. *foetida* within each PV development area were counted in the field, during the walk-through for individuals of *Aloidendron dichotomum*. Aside from the specific site visits for the current project, the adjacent Konkoonsies site which includes a large proportion of the length of the power line alternatives, has also been sampled by the consultant numerous times in the past for several different PV projects and associated power lines and the information from these studies is used to inform the current study where relevant.

- **Assumptions and Limitations**

The current study consisted of a detailed field assessment as well as a desktop study, which serves to significantly reduce the limitations and assumptions required for the study. In addition, the adjacent Konkoonsies site has been previously assessed by the consultant for several different projects, with the result that area is well known and has been sampled at different times of the year over a period of several years. For the current assessment, there had been late summer rains which had broken a long-term period of below average rainfall and which resulted in good growth of the vegetation with a well-developed annual and forb component. Due the preceding drought conditions, vegetation cover at the site was depressed, but due the good recent rainfall the diversity of forbs and annuals was high and the vast majority of species present could be identified. Due to the favourable conditions, there are few limitations with regards to the timing or results of the vegetation assessment. The species list obtained for the site are therefore considered comprehensive and reliable. The number of individuals obtained during the walk-through for Aloidendron dichotomum are considered to be reliable and while it is possible that there are some small plants present that were not observed, the estimate of adult plants is likely to be highly reliable as the site is open and plants taller than 1m are easily visible and not easily overlooked. The number of Hoodia gordonii and Boscia foetida subsp. foetida individuals observed within the footprint areas is considered to represent a reliable estimate but as there may be small plants present that are not easily visible, it is possible that there are more individuals present than has been estimated.

Although vegetation had responded well the rainfall, fauna are less quick to rebound after drought and it was clear from the site visit, that the faunal community at the site had been depressed as a result of the drought, with a particular impact on small mammals. However, the previous work in the area has been used to inform the current study, thereby reducing the limitations associated with the short duration and depressed faunal activity at the time of the current study. Regardless of conditions, fauna is difficult to observe in the field and their potential presence at the site is evaluated based on the literature and available databases. Many remote areas have not been well-sampled with the result that the species lists derived for the area do not always adequately reflect the actual fauna present at the site. In order to reduce this limitation, and ensure a conservative approach, the species lists derived for the site from the literature were obtained from an area significantly larger than the study site and are likely to include a much wider array of species than actually occur at the site. This is a cautious and conservative approach which takes the study limitations into account.

- **Source of Information**

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

Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina & Rutherford 2006 and 2012 Powrie update) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Information on plant species recorded for the broad area around the site was extracted from the SANBI POSA database hosted by SANBI. The species list was derived from a considerably larger area than the study site, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself or the immediate area has not been well sampled in the past.
- The IUCN conservation status of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2018).

Ecosystem

- Critical Biodiversity Areas (CBAs) were extracted from the Northern Cape Critical Biodiversity Areas Map (Oosthuysen & Holness 2016).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment (NFEPA) (Nel et al. 2011).
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and Animal Demography Unit (ADU) Virtual Museum spatial database (http://vmus.adu.org.za/).
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- Apart from the literature sources, additional information on fauna was extracted from the ADU web portal http://vmus.adu.org.za
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of mammals is based on the IUCN Red List Categories (EWT/SANBI 2016), while reptiles are based on the South African Reptile Conservation Assessment (Bates et al. 2013) and amphibians on Minter et al. (2004) as well as the IUCN (2018).

2.4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

- **National Vegetation Types**

The majority of the site lies within the Bushmanland Arid Grassland vegetation type, with a small extent of Bushmanland Sandy Grassland in the south (Figure 1). Other vegetation types that occur in the wider area that would not be affected include Lower Gariep Broken Veld to the north and Eastern Gariep Plains Desert and Eastern Gariep Rocky Desert to the south.

The footprint is restricted to the Bushmanland Arid Grassland vegetation type. This vegetation unit is the second most extensive vegetation type in South Africa and occupies an area of 45478 km2 and extends from around Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact and as a result it is classified as Least Threatened. Mucina & Rutherford (2006) list 6 endemic species for the vegetation type which is relatively few given the extensive nature of the vegetation type. Although Mucina & Rutherford provide a description of this vegetation unit, this is not repeated here as the actual vegetation as observed at the site is described in the next section.

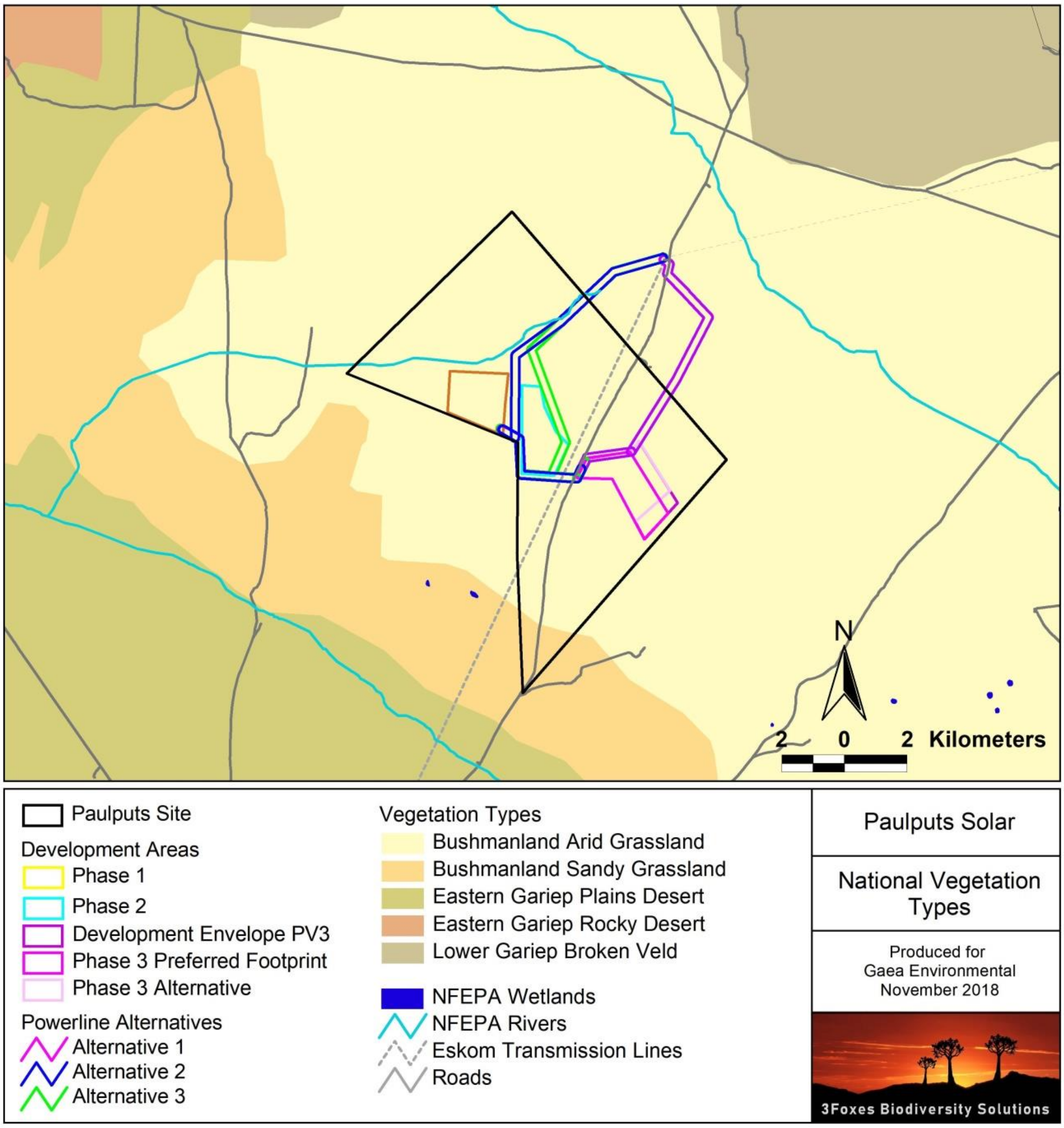


Figure 1. National Vegetation Types (Mucina & Rutherford 2006) for the wider study area, showing that the site falls almost entirely within the Bushmanland Arid Grassland vegetation type.

- **<u>Habitats and Plant Communities</u>**

A habitat map for the site is illustrated below in Figure 2. The PV footprint areas are restricted to the southern plains of the site while there are numerous other habitats present outside of these areas and long the power line corridors. The different habitats are described below, with characteristic species and discussion on their sensitivity.

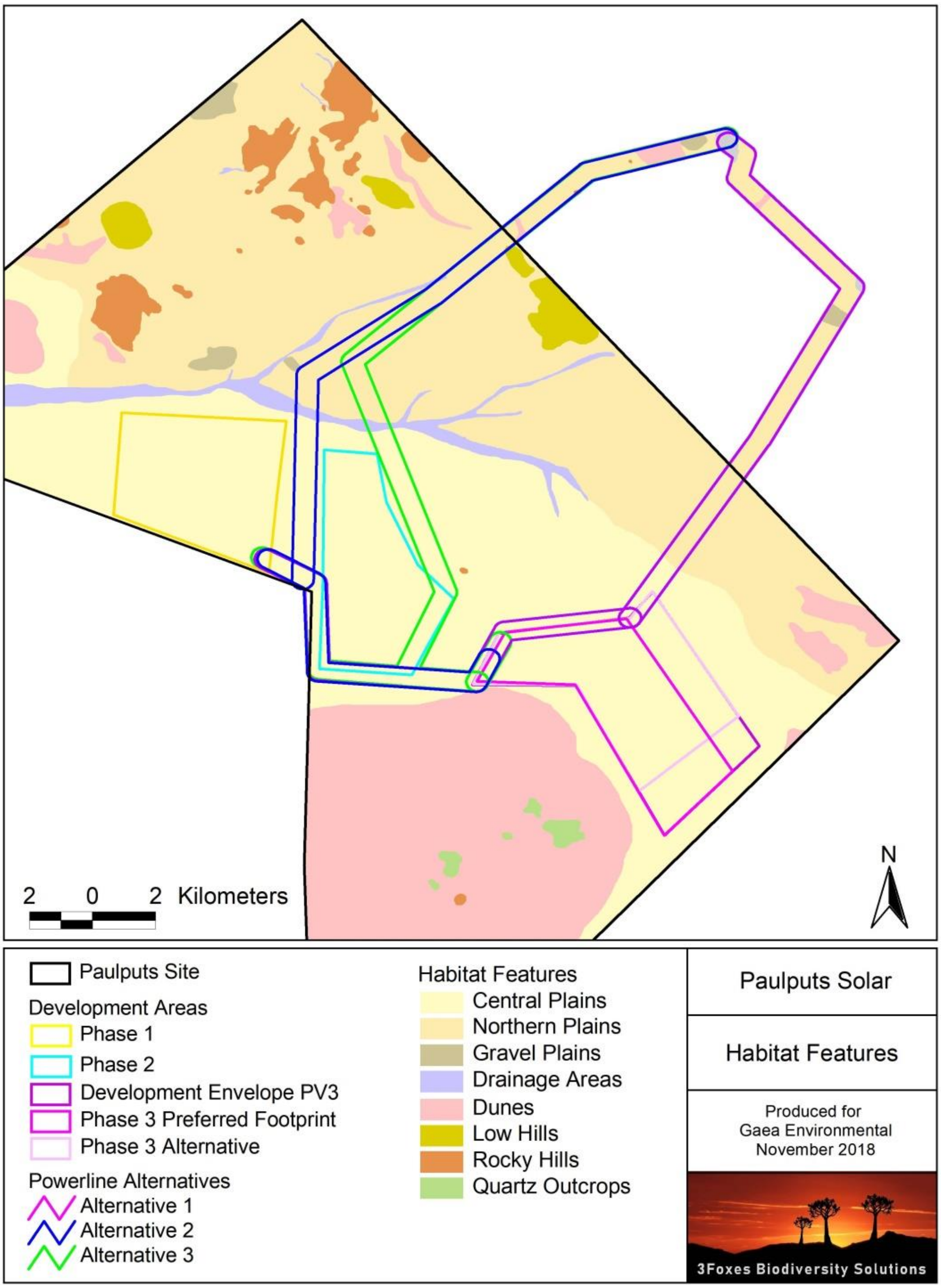


Figure 2. Habitat map for the wider Paulputs site and power line corridors. The different habitats mapped are described below.

Bushmanland Arid Grassland on Open Plains

The majority of the site including the footprint of the PV areas is located on the open plains of the site. These areas are classified as Bushmanland Arid Grassland and are reasonably representative of this vegetation unit. There is some variation in composition of this habitat across the site associated with changes in soil depth and texture, with grasses being dominant on more sandy soils and a larger proportion of shrubs in areas with shallow or gravelly soils. There are also a number of fairly extensive areas where there is clear evidence of degradation as a result of overgrazing. This habitat is considered low sensitivity as the abundance of species of conservation concern is relatively low, although some protected species including Aloidendron dichotomum, Boscia foetida and Hoodia gordonii occur within this habitat at low density. This is the dominant habitat across the majority of the study area as well as along the power line corridors. Characteristic and dominant species include grasses such as Stipagrostis ciliata, Stipagrostis brevifolia, Stipagrostis anomala, Schmidtia kalahariensis and Enneapogon desvauxii; shrubs such as Rhigozum trichotomum, Lycium eenii, Phaeoptilum spinosum, Hermannia spinosa, Hermannia gariepina, Asparagus denudatus, Tetragonia arbuscular, Aptosimum marlothii, Aptosimum spinescens, Indigofera heterotricha and Eriocephalus microphyllus var. pubescens as well as low trees including Boscia foetida subsp. foetida and Parkinsonia africana. Forbs were common at the time of the site visit and include species such as Diascia engleri, Manulea nervosa, Lyperia tristis, Manulea schaeferi, Tribulus cristatus, Tribulus terrestris, Arctotis leiocarpa, Dicoma capensis, Felicia clavipilosa subsp. clavipilosa, Heliotropium curassavicum, Heliophila deserticola, Zygophyllum simplex and Kohautia cynanchica.

Figure 3. Typical vegetation on the open plains within the PV development areas. The vegetation is dominated by Stipagrostis grasses with occasional scattered shrubs and low trees such as Rhigozum trichotomum and Boscia foetida.

Figure 4. Some parts of the site have shallow gravelly soils where the cover is lower but no specific associated species were observed with the result that these areas are not considered more sensitive than the more typical grassy areas.

Figure 5. Areas of deeper sands are usually characterised by the presence of Stipagrostis brevifolia and may also have scattered Aloidendron dichotomum present. The area pictured above is not within the PV footprint but along power line alternative 2 and 3.

Figure 6. Degraded vegetation within the Phase 3 PV area, dominated by Tribulis terrestris, Tribulis pterophorus, Schmidtia kalahariensis and Rhigozum trichotomum.

Rocky Hills

There are numerous rocky hills present in the wider site. These are considered sensitive features, especially for fauna and should be avoided as much as possible. Although there are no rocky hills within the PV areas, the power line alternatives 2 and 3 go through or near several such hills. Species observed on the rocky outcrops include Chascanum garipense, Tricholaena capensis subsp. capensis, Montinia caryophyllacea, Forsskaolea candida, Sericocoma avolans, Microloma incanum, Rogeria longiflora, Coccinia rehmannii, Codon royenii, Cissampelos capensis, Hermannia minutiflora, Enneapogon scaber, Commiphora gracilifrondosa and Aloidendron dichotomum.

Figure 7. Typical rocky outcrop within the wider Paulputs site. These are considered especially important for fauna but also have a suite of associated plant species.

Dunes

There are several low dunes across the wider study area. In some areas such as in the far south of the site, these form small dune fields but in general these form isolated dunes or occur on the slopes of rocky outcrops where wind-blown sand has collected. Due to the vulnerability of these areas to disturbance, they are not considered suitable for development. Species present in the dunes include Stipagrostis brevifolia, Stipagrostis anomala, Rhigozum trichotomum, Citrullus lanatus, Brachiaria glomerata, Cleome foliosa var. lutea, Limeum myosotis, Manulea schaeferi and Lycium bosciifolium. The dunes are also important for fauna and provide a contrasting habitat to the surrounding plains, especially for species associated with loose sandy soils.

Figure 8. Dune vegetation in the foreground is usually dominated by species such as Rhigozum trichotomum, Stipagrostis brevifolia and Brachiaria glomerata.

Drainage Features

There are no well-developed drainage features within the site. The main feature of the site is a wash which runs in a westward direction from near the centre of the site. It is not well differentiated from the surrounding sandy plains but has a higher proportion of larger woody species. Species present in the wash include Stipagrostis brevifolia, Rhigozum trichotomum, Augea capensis, Lycium bosciifolium, Grielum humifusum var. parviflorum, Hypertelis salsoloides var. salsoloides, Parkinsonia africana, Arctotis leiocarpa and Citrullis lanatus. As drainage lines are important from a hydrological perspective as well as faunal movement corridors and important habitat for fauna more generally, they are considered sensitive and should be avoided as much as possible.

Figure 9. The drainage features of the site are not well developed but can be recognised as having a high abundance of tall woody shrubs as well as forbs and annuals.

Bedrock Pans

There are a few bedrock pans present in the wider study area. These are isolated features that occur where large areas of bedrock are exposed and where water may collect in depressions and pockets within the rock. Some of these appear to hold water for extended periods and represent small but important features of the landscape. These pans are used as habitat and breeding sites by temporary water organisms and amphibians but also as water sources by birds, insects, mammals and birds. As these are localised features, they are considered no-go areas. Two such areas were identified in the field study, one in the south of the site west of the PV Phase 1 area and another near to the power line Alternative 2 and 3 corridors. These features are not within the current footprint and can be easily avoided by the development. The pans are generally not well vegetated and are not considered sensitive from a botanical perspective.

Figure 10. The bedrock pans consist of shallow depressions that are occasionally filled with water as well as deeper crevices in the bedrock which hold water for more extended periods.

- **Faunal Communities**

Mammals

The site falls within the known distribution range of 43 terrestrial mammals, indicating that the site has moderate potential mammalian diversity. Species observed at the site include the South African Ground Squirrel, Hairy-footed Gerbil, Aardvark, Aardwolf, African Wild Cat, Cape Hare, Hewitts' Red Rock Rabbit, Yellow Mongoose, Striped Polecat, Cape Fox, Bat-eared Fox, Steenbok and Meerkat. The only listed mammal which may occur at the site is the Black-footed cat Felis nigripes, which is listed as Vulnerable. Although there is a reasonable probability that the black-footed cat occurs in the area as the habitat is broadly favourable for this species, it is widely distributed across the arid and semi-arid areas of South Africa and the habitat loss that would result from the development would be minor in relation to the distribution of this species.

In terms of habitats of significance for fauna, the rocky hills are highlighted as the most important habitat for fauna at the site. These are however outside of the development footprint and would not be affected by the development. The PV development areas are fairly homogenous and do not have a high habitat diversity, with the result that faunal diversity within these areas is likely to be low and restricted to species associated with the open plains habitat characteristic of these areas. The main long-term impact associated with the development would be habitat loss of about 200ha per development phase. As there are no mammalian habitats of high value within the development footprint, the overall significance of this loss would be relatively low.

Reptiles

The site lies in or near the distribution range of at least 46 reptile species (Appendix 2), indicating that the site has potentially quite high reptile diversity and given the range of habitats available at the wider site, a large proportion of these are likely to occur in the area. Based on the distribution records and habitat requirements, the composition of the reptile fauna at the site potentially comprises 1 tortoise, 17 snakes, 19 lizards and skinks, 8 geckos and 1 chameleon. Species confirmed at the site include the Namaqua Sand Lizard Pedioplanis namaquensis, Ground Agama Agama aculeata, Western Rock Skink Mabuya sulcata and Karoo Sand Snake Psammophis notostrictus. The only listed species which may occur at the site is the Black Spitting Cobra, Naja nigricollis woodi, which is likely to occur in the vicinity of the rocky outcrops as well as other areas with sufficient cover. Although this species is a regional endemic, it is common within its range and the extent of habitat loss resulting from the development would be minimal.

The rocky outcrops are the most important habitat in the area for reptiles as they provide cover and structure for a wide variety of lizards, geckos, skinks and snakes. This habitat is however outside of the development footprint and would not be affected by the development. The open plains habitat of the site that would be impacted by the development has relatively low reptile diversity and in addition, many of the species associated with these areas have been observed to continue to use the areas within PV plants where the ground has not been entirely cleared of all vegetation. The overall impact of the development on reptiles is likely to be local in nature and there are no species that would be particularly affected by the development.

Amphibians

The site lies within or near the range of six amphibian species, indicating that amphibian diversity at the site is not likely to be very high. The only areas where some naturally occurring standing water was observed to occur was on some rocky basement areas where there were rock potholes and crevices that contain water after rain. These are the only areas that offer potential breeding sites for those species which require water for their tadpoles such as toads and the marbled rubber frog. These areas aside, the only other areas where amphibians may be present are the dunes and larger drainage lines where burrowing species such as Sand Frogs may be present. Overall abundance and diversity of amphibians at the site is likely to be very low and as a result, long-term impacts on amphibians is also likely to be very low.

- **Critical Biodiversity Areas**

An extract of the Northern Cape Critical Biodiversity Areas map for the study area is depicted below in Figure 11. The entire site as well as the power line corridor lies within an area classified as a CBA 2. Development within CBAs can have negative impacts on biodiversity pattern and process and is generally considered undesirable. As the potential impact of the development on CBAs is seen as being is high potential significance and relevance for the development, a stand-alone spatial assessment of the need and desirability of an offset to mitigate the impacts of the development on ecological patterns and processes has been conducted and this section of the report should be read in conjunction with that study.

The total footprint (ca. 600ha) of the development is fairly large and would result in significant local habitat loss. Based on the results of the field assessment, the affected areas are not considered to be very sensitive in terms of the biodiversity features that are within the development footprint. The most important features in the wider area include the rocky outcrops as well as numerous quartz hills and outcrops that occur in the wider landscape but do not occur within the PV development areas which are restricted to widespread plains habitat. As such, a significant loss of important biodiversity pattern is not likely to result from the development. However, as a primary purpose of CBAs is to try and secure the broad-scale ecological functioning and resilience of landscapes, it is also important to consider the impact that the development may have on broad-scale ecological processes and not just on the species resident within the site. Such broad-scale processes are operating at different scales in the landscape. At a very broad scale, the site lies within the Orange River valley system which is an important corridor for both fauna and flora. At this scale, the development is too small to have a significant impact, especially as it is relatively far from the river itself and does not occur within the vegetation types that are associated with the Orange River valley such as the Orange River Broken Veld. However, at a more local scale, there is likely to be movement of fauna through the area between the rocky habitats in the north and plains and rocky areas south of the site. However, the major movement corridors here are likely to involve species “hopping” between the rocky outcrops of the area as well as species moving along the larger drainage systems of the area. It is not likely that the development would have a significant impact on these processes as the majority of rocky outcrops are located west of the affected area and the only drainage system in close proximity to the site is outside of the development footprint also to the west and is not well developed with the result that is not likely to be of broader significance.

Overall, the development would result in some habitat loss within the CBA which is undesirable, but it is not likely that this would result in significant biodiversity loss within the site itself and impacts on broader scale ecological processes are likely to be relatively minor. Based on the findings of the stand-alone offset study, the post-mitigation impacts of the development are not considered sufficiently high to justify an offset as no long-term moderate or high impacts on biodiversity patterns or processes are likely to result as a consequence the development.

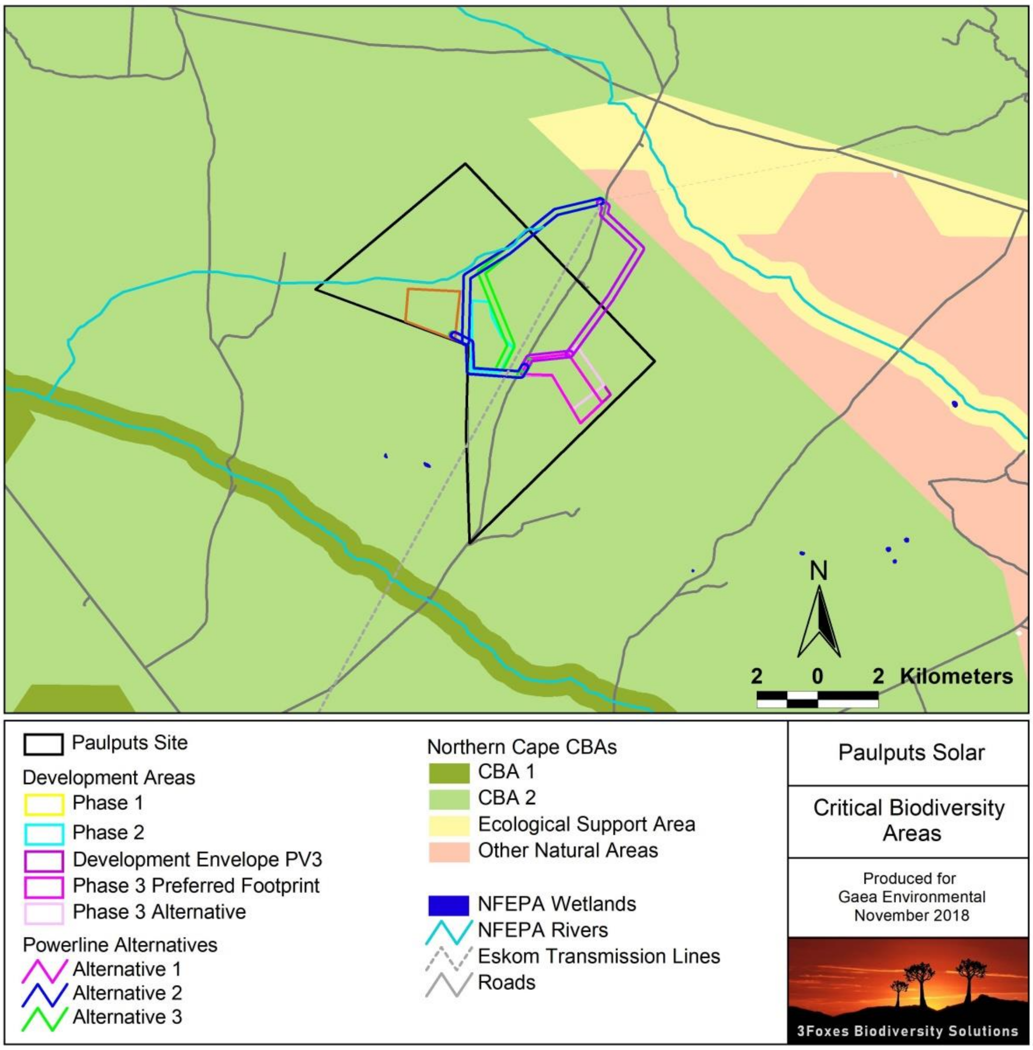


Figure 11. Extract of the Northern Cape Critical Biodiversity Areas map for the wider study area, showing that the site falls within a tier 2 CBA.

- **<u>Current Transformation Baseline & Cumulative Impact</u>**

There are several other existing solar energy developments in close proximity to the current site. This includes the Biotherm 10MW Konkoonsies PV plant north of the site as well as the two CSP plants northeast of the site. As these already existing and operational, they are considered to form part of the transformation baseline for the area. The footprint of these existing plants is approximately 800ha. There is also the larger 75MW PV plant on Konkoonsies that is a preferred bidder and is currently under construction and would have a footprint of approximately 200ha. The total existing footprint of renewable energy in the area is thus approximately 1000ha. Although a node of solar energy development is starting to occur around the Paulputs substation the surrounding landscape is still overwhelmingly intact and has experienced little other transformation to date. Each phase of the current development would contribute approximately 200ha to transformation and habitat loss in the area. While the broader landscape is still little-impacted by transformation (Figure 12), the concentration of development around the substation is a potential concern. However, the location and spatial context of the current sites is seen as being important in moderating the potential cumulative impact of the development. The layout of the plants is seen as being efficient as their close proximity to one another reduces edge effects and their position within the lower sensitivity gravelly and sandy plains of the area minimises their impacts on the more sensitive features of the area, in particular the dune systems, quartz areas and rocky hills. As a result, the cumulative impacts associated with the current development are considered acceptable, even if all three plants were ultimately to be built.

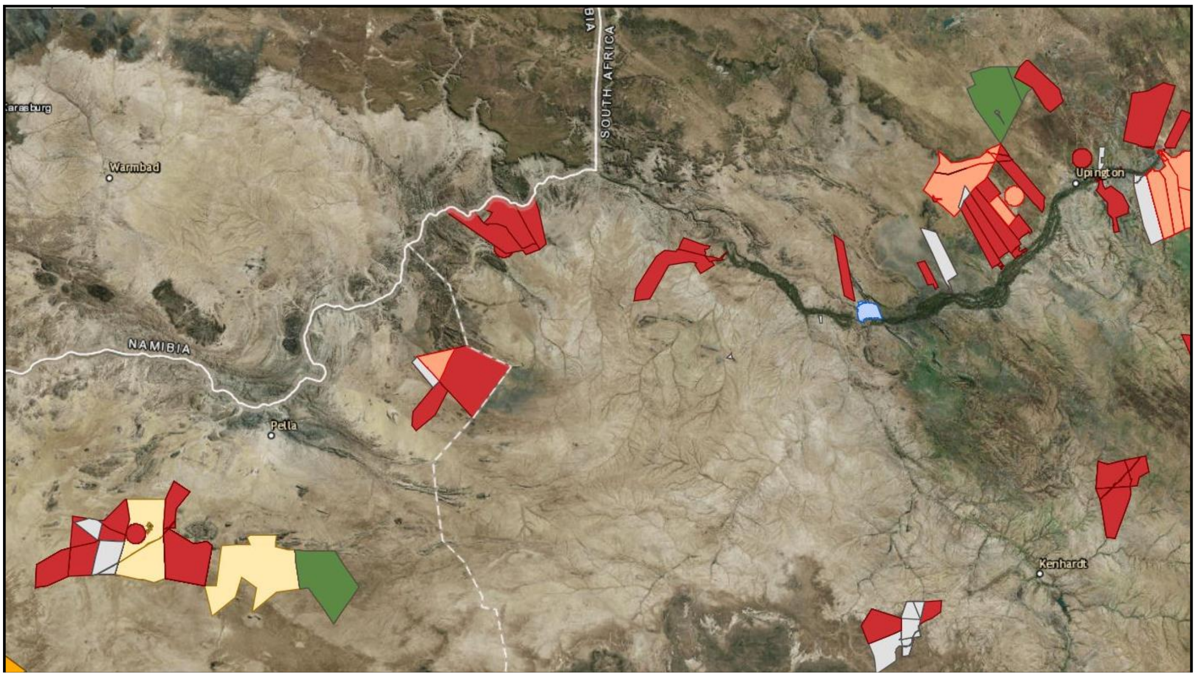


Figure 12. Map of DEA-registered renewable energy projects in the wider area around the Paulputs site, showing that there are several other projects in the immediate vicinity of the site as well as concentrations of projects in the Pofadder region as well as towards Upington.

- **<u>Site Sensitivity Assessment</u>**

The sensitivity map for the site and the power line corridors is illustrated below in Figure 13. The three PV footprint areas are located within an area that is considered to be low sensitivity and there are no significant features within the proposed PV development areas that would need to be avoided. In terms of PV3, the initial footprint area was revised, and an alternative footprint area was included for the EIA. In terms of ecological impacts, there are no significant differences between the two PV3 alternatives and as such the final layout within the proposed development envelope area is not seen as affecting the assessed impact and the final footprint could take more or less any configuration within this area without affecting the impact to any significant degree. Overall, diversity of fauna and flora within the three PV phase footprint areas is relatively low and the affected habitat is not considered to be of broader ecological significance as it is typical of the area and is widely available. There are however some protected plant species within the development footprint, most notably, Hoodia gordonii, Aloidendron dichotomum and Boscia foetida. The abundance of these species within the development footprint areas is however low and their loss from these areas would not compromise the local populations of these species which have healthy populations in the area. Within the power line corridors, there are a variety of sensitive features present including rocky or gravelly hills, dunes and pan features. As these features are concentrated within power line Alternative 2 and Alternative 3, Alternative 1 is identified as the preferred power line option and would generate the lowest overall impacts on fauna and flora. The footprint of the power line is also relatively low and smaller linear features or localised habitats can usually be spanned by the transmission towers and impact to the more sensitive features minimised.

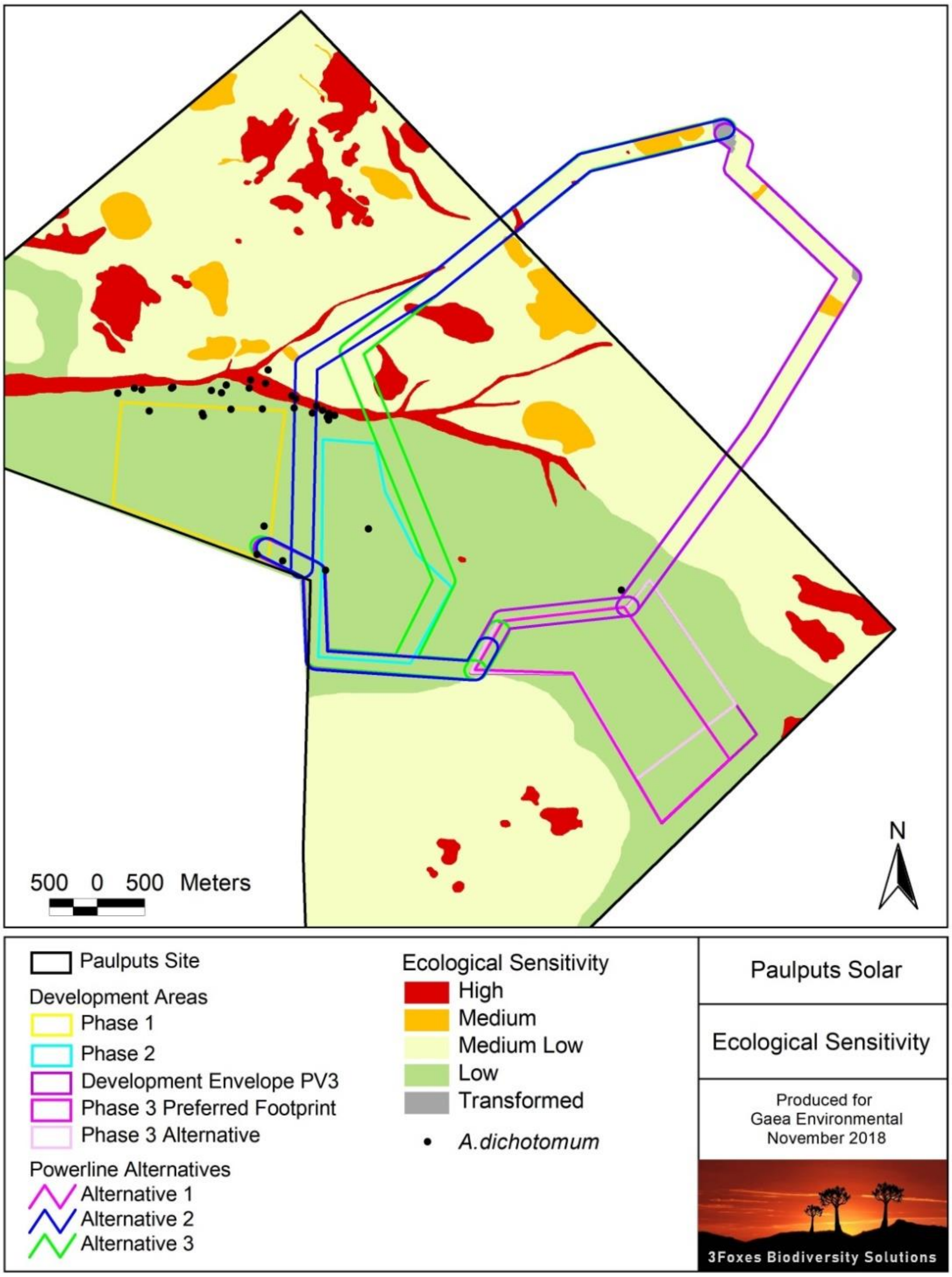


Figure 13. Ecological sensitivity map for the study area, showing that the three PV development areas occur in low sensitivity areas.

2.5. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

A clearing and translocation permit would be required from DENC before construction commences. A preconstruction walk-through would be required to inform the permit application. In addition, if there are any nationally protected trees within the development footprint a destruction permit from DAFF would also be required. Although no nationally protected trees were observed within the development footprint, both *Acacia erioloba* and *Boscia albitrunca* are present in the area and could potentially be affected if the footprint were to change. The provincially protected tree species *Boscia* *foetida subsp. foetida* and *Aloidendron dichotomum* are present within the development footprint and some individuals would be affected as listed below. As the footprint of the power line is more flexible and the exact position of the transmission towers would only be determined at a later stage, it is assumed that the majority of protected species within the power line corridors could be avoided at the preconstruction stage following a walk-through of the final route and micro-siting of the final transmission tower positions. As such, with the appropriate avoidance, a significant impact of the power line on protected species is not likely. In terms of listed and protected species, it is clear that the major area of concern would be associated with the PV footprint areas and not the power line component. Finally, in terms of the numbers of individuals listed below, some additional avoidance of *Aloidendron dichotomum* has been implemented by the developer and the numbers indicated below are the pre-avoidance numbers and not the final number that would be impacted. As the *Aloidendron dichotomum* trees within the footprint are relatively young individuals, there is a high probability that they could be successfully translocated, and this is seen at least to partially reduce the impact on this species as recruitment opportunities and not habitat availability appears to be the limiting factor for this species in the area.

Table 1. Numbers of individuals of protected species observed within the footprint of the different PV footprint areas. Numbers of Aloidendron are actual counts while Boscia and Hoodia are estimates based on counts conducted in the field.

Species	PV 1	PV 2	PV 3
Aloidendron dichotomum	6	2	0
Boscia foetida subsp. foetida	80	30	30
Hoodia gordonii	10	10	5

2.6. IDENTIFICATION AND ASSESSMENT OF IMPACTS

- **Overview of key Impacts resulting from the proposed development**

In this section each of the potential impacts identified as being likely to be associated with the development is explored with reference to the features and characteristics of the site and the likelihood that each impact would occur given the characteristics of the site and the extent and nature of the development.

Impacts on vegetation and protected plant species

Several protected species occur at the site which may be impacted by the development, most notably *Hoodia gordonii*, *Aloidendron dichotomum* and *Boscia foetida*. Vegetation clearing during construction will lead to the loss of currently intact habitat within the development footprint and is an inevitable consequence of the development. As this impact is certain to occur it will be assessed for the construction phase as this is when the impact will occur, although the consequences will persist for a long time after construction.

Direct faunal impacts

Increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. Some impact on fauna is highly likely to occur during construction as well as operation and this impact will therefore be assessed for the construction phase and operational phase.

Reduced ability to meet conservation obligations & targets
The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets. Although the receiving vegetation type in the study area is classified as Least Threatened and is still more than 98% intact, there may be other features of conservation significance in the area that may be targets for conservation. This impact is therefore assessed in light of the current development as well as any other developments in the surrounding area which would also contribute to cumulative impacts.

Impact on broad-scale ecological processes
Transformation of intact habitat on a cumulative basis would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. Due to the presence of a number of other renewable energy developments in the area, this is a potential cumulative impact of the development that is assessed.

- **<u>Overview of key Environmental Management Actions and limits of acceptable changes to the Environment due to the proposed development</u>**

The key action that ensures that the current development has relatively low impact is the planning phase avoidance that has been implemented to ensure that the development footprint of the PV areas is within the lowest sensitivity areas of the receiving landscape. A number of high sensitivity areas were identified in the area and these should be considered to represent no-go areas from a development perspective. Impact to these areas would constitute a potential fatal flaw associated with the development. However, under the layout provided for the assessment, there would not be any impact to these areas. Development within and impact to the medium sensitivity areas is considered potentially acceptable, but context specific. Access roads and power lines are considered acceptable features within these areas as their impacts can be managed, but these areas are not considered suitable for PV development.

A variety of additional mitigation and avoidance measures that should be implemented during the construction and operational phases of the development are highlighted below.

- **<u>Assessment of Impacts – Solar PV component</u>**

The assessment below is for each of the three phases of the solar PV development. In terms of the three phases these are not considered significantly different and the assessed impacts are for a single phase and are considered equally applicable to each PV phase. While there are some minor differences between the environment and species abundances within each phase, these are not considered significantly different so as to generate different significance levels for a particular impact among the PV phases.

> ***Construction Phase Impact 1. Impacts on vegetation and plant species of conservation concern***
> Several protected species occur at the site which may be impacted by the development, most notably *Hoodia gordonii*, *Aloidendron dichotomum* and *Boscia foetida*. The abundance of these species in the development footprint is however relatively low and the loss of these individuals from the local population is not significant and would not compromise the viability of the local populations of these species, especially with the additional avoidance implanted within PV 1 to reduce the impact of the development on *Aloidendron dichotomum*. Apart from the impact on protected species, there would be a more general loss of intact vegetation within the development footprint. Although it may be possible to retain a ground layer of vegetation within

the facilities, taller woody species are generally removed from PV plants and the remaining vegetation tends towards weedy and disturbance-tolerant species. Although this is important in reducing the ecological impacts of the development, it is not considered an effective mitigation with regards to reducing the extent of vegetation loss associated with the development. Although the development would have some local impact on the availability of the affected habitat type, the Bushmanland Arid Grassland is a very extensive vegetation type and the loss of the vegetation within the development footprint is not considered to have broader significance.

Without mitigation this impact would be of **Moderate** potential significance.

Essential mitigation measures include:

- No development of PV footprint areas, roads of other infrastructure within identified High sensitivity areas.
- Pre-construction walk-through of the development footprint to locate and identify protected species within the development footprint. All relevant clearing or translocation permits must be obtained before construction starts.
- Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc.
- Environmental Control Officer (ECO) to provide supervision and oversight of vegetation clearing activities.
- All cleared areas that are not under hard infrastructure will need to be rehabilitated with locally occurring species.
- All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area.
- Temporary lay-down areas should be located within previously transformed areas or areas that have been identified as being of low sensitivity. These areas should be rehabilitated after use.

With the implementation of the suggested mitigation the impact on vegetation and protected species can likely be reduced to a **Low** significance.

Construction Phase Impact 2. Direct and indirect faunal impacts
The construction of the development will result in significant habitat loss, noise and disturbance on site. This will lead to direct and indirect disturbance of resident fauna. Some slow-moving or retiring species such as many reptiles would likely not be able to escape the construction machinery and would be killed. There are also several species present at the site which are vulnerable to poaching and there is a risk that these species may be targeted. This impact would be caused by the presence and operation of construction machinery and personnel on the site. This impact would however be transient and restricted to the construction phase, with significantly lower levels of disturbance during the operational phase.

Without mitigation this impact is likely to be of **Moderate** significance.

Essential mitigation measures would include:

- Avoidance of identified areas of high fauna importance such as rocky outcrops, drainage lines and dunes. All activity should be excluded from these areas.

- Search and rescue for reptiles and other vulnerable species during construction, before areas are cleared.
- Any fauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer.
- All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- If trenches need to be dug for electrical cabling or other purpose, these should not be left open for extended periods of time as fauna may fall in and become trapped in them. Trenches which are standing open should have places where there are soil ramps allowing fauna to escape the trench.
- Limit access to the site and ensure that construction staff and machinery remain within the demarcated construction areas during the construction phase.
- Environmental induction for all staff and contractors on-site.

With the implementation of the suggested mitigation the construction phase impact on fauna can likely be reduced to a **Low Significance**.

Operational Phase Impact 1. Operational Impacts on Fauna

The presence and operation of the development may impact on fauna within or nearby the facility. Electric fencing around the PV plants may cause mortality of fauna and would also prevent fauna from moving through the facilities. In addition, fauna may become trapped within the PV plant areas or persecuted, harassed or killed when passing through a PV plant. Night lighting may also impact nocturnal species. Without mitigation this impact would likely be of **Moderate Significance**.

Essential mitigation measures would include:

- Any potentially dangerous fauna such as snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location.
- If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- All vehicles accessing the site should adhere to a low speed limit (30km/h max) to avoid collisions with susceptible species such as snakes and tortoises.
- If the facility is to be fenced, then no electrified strands should be placed within 30cm of the ground as some species such as tortoises are susceptible to electrocution from electric fences because they do not move away when electrocuted but rather adopt defensive behaviour and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of the fence and not the outside as is the case on the majority of already constructed PV plants. In addition, there should not be a large gap between the inner and outer fence and a single fence with mesh or plain wire strands on the outside and electrified strands on the inside is recommended.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Low Significance**.

Operational Phase Impact 2. Impacts on Critical Biodiversity Areas

The development is located within an area that is a recognised area of biodiversity significance and has been classified as a Tier 2 CBA. The development will result in direct habitat loss equivalent to about 600 ha within the CBA as well as potentially affect broad-scale ecological processes operating in the area. The impact on the CBA would result from the transformation of currently intact habitat as well as the presence and operation of the facility.

Without mitigation this impact would likely be of **Moderate Significance**.

Essential mitigation measures would include:

- Minimise the development footprint as far as possible, which includes locating temporary-use areas such as construction camps and lay-down areas in previously disturbed areas.
- Ensure that fauna are able to pass through the gaps between the different PV facilities. As such each plant should be individually fenced and the gaps between the PV facilities should be at least 100m wide.

With the effective implementation of the mitigation measures, it is likely that this impact will be reduced to a **Low Significance**. Effective and full mitigation is not likely to be possible because the main impact results from the presence and operation of the facility itself, which cannot be avoided should the development go ahead.

Decommissioning Phase Impact 1. Increased Soil Erosion

Decommissioning will remove the hard infrastructure from the site, generating disturbance and leaving areas that are unvegetated and vulnerable to erosion.

Without mitigation, this impact would potentially be of **Moderate significance**.

Essential mitigation measures would include:

- Revegetation of cleared areas with monitoring and follow-up to ensure that rehabilitation is successful. Success must be measured against a predefined benchmark in terms of cover and species richness. Monitoring and rehabilitation must continue until such time as the benchmark has been attained. It is suggested that 40% of the natural vegetation for the affected habitat type represents a useful goal for rehabilitation. No goal for species richness is required, but the species used must be from the local environment and perennial in nature. These will have to be matched to their respective habitats.
- Using net barriers, geotextiles, active rehabilitation and other measures during and after decommissioning to minimise erosion at the site.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to an acceptable, **low significance**.

Decommissioning Phase Impact 2. Increased Alien Plant Invasion

There are already several alien species present on the site such as *Prosopis* spp. and disturbance created during decommissioning would leave the site vulnerable to further alien plant invasion.

Without mitigation this impact would likely be of **Moderate Significance**.

Essential mitigation measures would include:

- Alien management plan to be implemented during the decommissioning phase of the development, which makes provision for regular alien clearing and monitoring for up 5 years after decommissioning.
- Rehabilitation of disturbed areas that have been generated by decommissioning. Rehabilitation should restore ecological function to the affected areas, especially with regards to the return of vegetation cover to a predefined benchmark which is suggested as 40% of the natural vegetation cover for the habitat under consideration.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Low Significance**.

- **Assessment of Impacts – Grid Connection**

The assessment below is for the Paulputs EGI including the three grid connection alternatives and associated infrastructure.

Construction Phase Impact 1. Impacts on vegetation and plant species of conservation concern
Several protected species occur at the site which may be impacted by the power line development, most notably *Hoodia gordonii*, *Aloidendron dichotomum* and *Boscia foetida*. There are also occasional *Boscia albitrunca* and *Acacia erioloba* trees present along the routes to the Paulputs substation, which can likely be avoided, but could be impacted if no avoidance was to be implemented. The abundance of protected species in the development footprint is however low and any unavoidable loss of individuals along the power line corridor would certainly not compromise the viability of the local populations of these species. Apart from the impact on protected species, there would be a more general loss of intact vegetation within the development footprint. The affected habitat type, the Bushmanland Arid Grassland is a very extensive vegetation type and the loss of a small extent of vegetation within the power line development footprint would not have broader significance.

Without mitigation this impact would be of **Moderate to Low** potential significance.

Essential mitigation measures include:

- Pre-construction walk-through of the power line development footprint to locate and identify protected species within the development footprint, that should be avoided or translocated to safety through a search and rescue operation. All relevant clearing or translocation permits must be obtained before construction starts.
- Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc.
- Environmental Control Officer (ECO) to provide supervision and oversight of vegetation clearing activities.
- All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area.
- Temporary lay-down areas should be located within previously transformed areas or areas that have been identified as being of low sensitivity. These areas should be rehabilitated after use.

With the implementation of the suggested mitigation the impact on vegetation and protected species can be reduced to a **Low Significance**.

Construction Phase Impact 2. Direct and indirect faunal impacts

The construction of the power line will result in some habitat loss, noise and disturbance along the power line route. This will lead to direct and indirect disturbance of resident fauna. Some slow-moving or retiring species such as many reptiles would likely not be able to escape the construction machinery and may be killed. There are also several species present at the site which are vulnerable to poaching and there is a risk that these species may be targeted. This impact would be caused by the presence and operation of construction machinery and personnel on the site. This impact would however be transient and restricted to the construction phase, with significantly lower levels of disturbance during the operational phase.

Without mitigation this impact is likely to be of **Low Significance.**

Essential mitigation measures would include:

- Avoidance of identified areas of high fauna importance such as rocky outcrops, drainage lines and dunes.
- Search and rescue for reptiles and other vulnerable species during construction, before areas are cleared.
- Any fauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer.
- All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- If holes or trenches need to be dug for transmission towers or electrical cabling or other purpose, these should not be left open for extended periods of time as fauna may fall in and become trapped in them. Trenches which are standing open should have places where there are soil ramps allowing fauna to escape the trench.
- Limit access to the site and ensure that construction staff and machinery remain within the demarcated construction areas during the construction phase.
- Environmental induction for all staff and contractors on-site.

With the implementation of the suggested mitigation the construction phase impact on fauna can likely be reduced to a **Low Significance**.

Operational Phase Impact 1. Operational Impacts on Fauna

The presence and operation of the power line would generate very low impacts on fauna. Electric fencing around the substation may cause mortality of fauna while maintenance activities along the power line would generate some disturbance for fauna. Night lighting at the substations may also impact nocturnal species. Without mitigation this impact would likely be of **Low Significance**.

Essential mitigation measures would include:

- Any potentially dangerous fauna such as snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location.
- If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- All vehicles accessing the site should adhere to a low speed limit (30km/h max) to avoid collisions with susceptible species such as snakes and tortoises.
- If the substations are to be fenced, then no electrified strands should be placed within 30cm of the ground as some species such as tortoises are susceptible to electrocution

from electric fences because they do not move away when electrocuted but rather adopt defensive behaviour and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of the fence and not the outside.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Very Low Significance**.

Operational Phase Impact 2. Impacts on Critical Biodiversity Areas
The development is located within an area that is a recognised area of biodiversity significance and has been classified as a Tier 2 CBA. The power line development would result in limited direct habitat loss equivalent to about 10 ha within the CBA. The impact on the CBA would result from the transformation of currently intact habitat as well as the presence and operation of the power line. Due to the limited extent of the footprint, this is not expected to compromise the functioning of the CBA on its own.

Without mitigation this impact would likely be of **Low Significance**.

Essential mitigation measures would include:

- Minimise the development footprint as far as possible, which includes locating temporary-use areas such as construction camps and lay-down areas in previously disturbed areas.
- Ensure that any alien vegetation or erosion along the power line are controlled on a regular basis to reduce the indirect negative impacts of the development on biodiversity.

With the effective implementation of the mitigation measures, it is likely that this impact will be of **Low Significance**.

Decommissioning Phase Impact 1. Increased Soil Erosion
Decommissioning will remove the hard infrastructure from the site, generating some disturbance and leaving areas that are unvegetated and vulnerable to erosion. Given the low footprint of the power line and the limited amount of infrastructure that would need to be removed along the power line, this is likely to be of limited extent and of low overall impact.

Without mitigation, this impact would potentially be of **Low significance**.

Essential mitigation measures would include:

- Revegetation of cleared areas with monitoring and follow-up to ensure that rehabilitation is successful.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to **Very Low Significance**.

Decommissioning Phase Impact 2. Increased Alien Plant Invasion
There are already several alien species present on the site such as *Prosopis* spp. and disturbance created during decommissioning would leave the site vulnerable to further alien plant invasion.

Without mitigation this impact would likely be of **Low Significance**.

Essential mitigation measures would include:

- Alien management plan to be implemented during the decommissioning phase of the development, which makes provision for regular alien clearing and monitoring for up 5 years after decommissioning.

- o Rehabilitation of disturbed areas that have been generated by decommissioning. Rehabilitation should restore ecological function to the affected areas, especially with regards to the return of vegetation cover to a predefined benchmark which is suggested as 40% of the natural of the vegetation cover for the habitat under consideration.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Very Low Significance**.

2.7. ASSESSMENT OF CUMULATIVE IMPACTS

- **<u>Assessment of Cumulative Impacts – Solar PV Component</u>**

Cumulative Impact 1. Cumulative habitat loss and impact on broad-scale ecological processes
There are several other renewable energy developments in the wider area and along with the current development, these would potentially generate significant cumulative impacts on habitat loss and fragmentation and negative impact on broad-scale ecological processes such as dispersal and climate change resilience. The location of the sites within low sensitivity habitat is seen to reduce the significance of their potential contribution to cumulative impact on the area. While there are many proposed renewable energy developments in the wider area (within 100km), those in closer proximity (within 30km) to the site are seen as the most important with regards to generating cumulative impact. The current footprint in the area stands at 1000ha with each phase of the current development contributing approximately 200ha of additional habitat loss to the area. Although a node of development is concentrating around the Paulputs substation, even with the current and other proposed developments, the overall extent of development in the wider area is still low and currently impacts on broad scale ecological processes are likely to remain low as the areas that are likely to be important for the maintenance of broad-scale ecological processes such as dispersal remain free of development.

Without mitigation, this impact is likely to be of **Moderate Significance.**

Essential mitigation measures would include:

- o Avoid impact to restricted and specialised and high biodiversity-value habitats such as quartz patches.
- o Minimise the current development footprint as much as possible and rehabilitate cleared areas after construction.
- o Ensure that management of the facility occurs in a biodiversity-conscious manner in accordance with an open-space management plan for the facility.

With the effective implementation of the mitigation measures, it is likely that this impact will be reduced to a **Low Significance**.

Cumulative Impact 2. Decreased ability to meet conservation targets
Although the affected vegetation type (Bushmanland Arid Grassland) at the site is classified as Least Threatened, this does not provide an adequate measure of the impact of the development on the ability to meet conservation targets. This is firstly because the vegetation map is very coarse and does not map many of the actual features that are on the ground and secondly because impact on conservation targets should generally not be measured at the scale of the whole vegetation type, but rather at a more local level that takes the spatial context and features of the area into account. While the development of renewable energy projects around the Paulputs substation would reduce the conservation value of the area, it has not been identified as an area for conservation expansion under the Northern Cape Protected Area Expansion

Strategy and there are no features present in the immediate area that are not widely available elsewhere.

Without mitigation, this impact is likely to be of **Low Significance**

Essential mitigation measures would include:
- Restricting the development to the low sensitivity open plains habitat as is currently the case.

With the effective implementation of the mitigation measures, it is likely that this impact will remain at **Low Significance**.

- **Assessment of Cumulative Impacts – Grid Connection**

Cumulative Impact 1. Cumulative habitat loss and impact on broad-scale ecological processes
There are several other renewable energy developments and associated power lines in the wider area and along with the current development, these would potentially generate significant cumulative impacts on habitat loss and fragmentation and negative impact on broad-scale ecological processes such as dispersal and climate change resilience. The location of the current PV footprint areas within low sensitivity habitats is seen to reduce the significance of their potential contribution to cumulative impact on the area. The current footprint in the area stands at approximately 600ha with each phase of the current development contributing approximately 200ha of additional habitat loss to the area. The contribution of the power line to cumulative impact is seen as being low and would be less than 10ha. Although a node of development is concentrating around the Paulputs substation, even with the current and other proposed developments, the overall extent of development in the wider area is still low and currently impacts on broad scale ecological processes are likely to remain low as the areas that are likely to be important for the maintenance of broad-scale ecological processes such as dispersal remain free of development.

Without mitigation, this impact is likely to be of **Low Significance.**

Essential mitigation measures would include:
- Avoid impact to restricted and specialised and high biodiversity-value habitats such as quartz patches.
- Minimise the current development footprint as much as possible and rehabilitate cleared areas after construction.
- Ensure that management of the facility occurs in a biodiversity-conscious manner in accordance with an open-space management plan for the facility.

With the effective implementation of the mitigation measures, it is likely that this impact will be reduced to a **Low Significance**.

2.8. COMPARATIVE ASSESSMENT OF ALTERNATIVES

A comparative assessment of the grid alternatives is detailed below and includes the identification of the preferred alternatives in each case.

Alternative	Preference	Reasons (incl. potential issues)
POWER LINES and ASSOCIATED SUBSTATIONS		
Grid Connection Alternative 1	Preferred	This is considered the preferred option as the footprint is located largely within low sensitivity areas and the power line would generate the lowest overall impacts.
Grid Connection Alternative 2	Favourable	This is considered a favourable Option. While there are some higher sensitivity rocky areas and drainage lines along the proposed route, it is likely that significant impact on these features can be avoided.
Grid Connection Alternative 3	Favourable	This is considered a favourable Option. While there are some higher sensitivity rocky areas and drainage lines along the proposed route, it is likely that significant impact on these features can be avoided.

2.9. IMPACT ASSESSMENT SUMMARY

- **<u>Solar PV Component</u>**

Table 1 Impact assessment summary table for the Construction Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence / effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Significance of Impact		Residual Impact after mitigation
									Without Mitigation/ Management	With Mitigation/ Management	
Clearing of vegetation for the PV Footprint areas	Vegetation loss including protected species	Negative	Site	Long-term	Substantial	Certain	Low	Low	Moderate	Low	Low
Disturbance and clearing of currently intact habitat	Faunal impact due to construction activities	Negative	Site	Long-term	Moderate	Certain	Moderate	Low	Moderate	Low	Low

Table 2 Impact assessment summary table for the Operational Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Significance of Impact		Residual Impact after mitigation
									Without Mitigation/ Management	With Mitigation/ Management	
Presence and operation of the facility	Operational impacts on fauna	Negative	Site	Long-term	Moderate	Likely	Moderate	Low	Moderate	Low	Low
Presence of the facility	Impact on CBAs	Negative	Site	Long-term	Moderate	Likely	Moderate	Low	Moderate	Low	Low

Table 3 Impact assessment summary table for the Decommissioning Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence / effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Significance of Impact		Residual Impact after mitigation
									Without Mitigation/ Management	With Mitigation/ Management	
Soil erosion	Decommissioning will leave the site vulnerable to erosion	Negative	Site	Long-term	Moderate	Likely	High	Low	Moderate	Low	Low
Alien plant invasion	Decommissioning will leave the site vulnerable to alien plant invasion	Negative	Site	Long-term	Moderate	Likely	High	Low	Moderate	Low	Low

Table 4 Impact assessment summary table for Cumulative Impacts

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Significance of Impact		Residual Impact after mitigation
									Without Mitigation/ Management	With Mitigation/ Management	
Habitat Loss	Cumulative impacts on broad scale ecological processes	Negative	Site	Long-term	Moderate	Likely	High	Low	Moderate	Low	Low
Habitat loss	Cumulative impacts on ability to meet conservation targets	Negative	Site	Long-term	Moderate	Likely	High	Low	Low	Low	Low

- **Paulputs EGI**

Table 1 Impact assessment summary table for the Construction Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence / effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Significance of Impact		Residual Impact after mitigation
									Without Mitigation/ Management	With Mitigation/ Management	
Clearing of vegetation for the power line and substation footprint areas	Vegetation loss including protected species	Negative	Site	Long-term	Minor	Certain	Moderate	Low	Low	Low	Low
Disturbance and clearing of currently intact habitat	Faunal impact due to construction activities	Negative	Site	Long-term	Minor	Certain	High	Low	Low	Low	Low

Table 2 Impact assessment summary table for the Operational Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Significance of Impact		Residual Impact after mitigation
									Without Mitigation/ Management	With Mitigation/ Management	
Presence and operation of the power line	Operational impacts on fauna	Negative	Site	Long-term	Minor	Likely	Moderate	Low	Low	Very Low	Low
Presence of the facility	Impact on CBAs	Negative	Site	Long-term	Minor	Likely	Moderate	Low	Low	Low	Low

Table 3 Impact assessment summary table for the Decommissioning Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence / effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Significance of Impact		Residual Impact after mitigation
									Without Mitigation/ Management	With Mitigation/ Management	
Soil erosion	Decommissioning will leave the site vulnerable to erosion	Negative	Site	Long-term	Minor	Likely	High	Low	Low	Very Low	Low
Alien plant invasion	Decommissioning will leave the site vulnerable to alien plant invasion	Negative	Site	Long-term	Minor	Likely	High	Low	Low	Very Low	Low

Table 4 Impact assessment summary table for Cumulative Impacts

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Significance of Impact		Residual Impact after mitigation
									Without Mitigation/ Management	With Mitigation/ Management	
Habitat loss	Cumulative impacts due to development pressure in the broader area	Negative	Site	Long-term	Minor	Likely	Moderate	Low	Low	Low	Low

2.10. MITIGATION MEASURES AND MANAGEMENT ACTIONS

- **Solar PV Component**

Construction Phase

- Pre-construction walk-through of the development footprint to locate and identify protected species within the development footprint. All relevant clearing or translocation permits must be obtained before construction starts.
- Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc.
- Search and rescue for reptiles and other vulnerable species during construction, before areas are cleared.
- Environmental Control Officer (ECO) to provide supervision and oversight of vegetation clearing activities.
- Any fauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer.
- All cleared areas that are not under hard infrastructure will need to be rehabilitated with locally occurring species.
- All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area.
- Temporary lay-down areas should be located within previously transformed areas or areas that have been identified as being of low sensitivity. These areas should be rehabilitated after use.
- All construction vehicles should adhere to a low speed (30km/h for trucks and 40km/h for light vehicles) limit to avoid collisions with susceptible species such as snakes and tortoises.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- If trenches need to be dug for electrical cabling or other purpose, these should not be left open for extended periods of time as fauna may fall in and become trapped in them. Trenches which are standing open should have places where there are soil ramps allowing fauna to escape the trench.
- Limit access to the site and ensure that construction staff and machinery remain within the demarcated construction areas during the construction phase.

Operational Phase

- Any potentially dangerous fauna such as snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location.
- If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- All vehicles accessing the site should adhere to a low speed limit (30km/h max) to avoid collisions with susceptible species such as snakes and tortoises.
- The perimeter fence should have no electrified wires within 30cm of the ground as some species such as tortoises are susceptible to electrocution from electric fences because they do not move away when electrocuted but rather adopt defensive behaviour and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of the

fence and not the outside as is the case on the majority of already constructed PV plants. In addition, there should not be a large gap between the inner and outer fence and a single fence with mesh or plain wire strands on the outside and electrified strands on the inside is recommended.

Decommissioning Phase

- Revegetation of cleared areas with monitoring and follow-up to ensure that rehabilitation is successful. Success must be measured against a predefined benchmark in terms of cover and species richness. Monitoring and rehabilitation must continue until such time as the benchmark has been attained. It is suggested that 40% of the natural vegetation for the affected habitat type represents a useful goal for rehabilitation. No goal for species richness is required, but the species used must be from the local environment and perennial in nature. These will have to be matched to their respective habitats.
- Alien management plan to be implemented during the decommissioning phase of the development, which makes provision for regular alien clearing and monitoring for up 5 years after decommissioning.
- Rehabilitation of disturbed areas that have been generated by decommissioning. Rehabilitation should restore ecological function to the affected areas, especially with regards to the return of vegetation cover to a predefined benchmark which is suggested as 40% of the natural vegetation cover for the habitat under consideration.

- **Paulputs EGI**

Construction Phase

- Pre-construction walk-through of the development footprint to locate and identify protected species within the development footprint. All relevant clearing or translocation permits must be obtained before construction starts.
- Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc.
- Search and rescue for reptiles and other vulnerable species during construction, before areas are cleared.
- Environmental Control Officer (ECO) to provide supervision and oversight of vegetation clearing activities.
- Any fauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer.
- All cleared areas that are not under hard infrastructure will need to be rehabilitated with locally occurring species.
- All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area.
- Temporary lay-down areas should be located within previously transformed areas or areas that have been identified as being of low sensitivity. These areas should be rehabilitated after use.
- All construction vehicles should adhere to a low speed (30km/h for trucks and 40km/h for light vehicles) limit to avoid collisions with susceptible species such as snakes and tortoises.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- If trenches need to be dug for electrical cabling or other purpose, these should not be left open for extended periods of time as fauna may fall in and become trapped in them. Trenches which are standing open should have places where there are soil ramps allowing fauna to escape the trench.

- Limit access to the site and ensure that construction staff and machinery remain within the demarcated construction areas during the construction phase.

Operational Phase

- Any potentially dangerous fauna such as snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location.
- If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- All vehicles accessing the site should adhere to a low speed limit (30km/h max) to avoid collisions with susceptible species such as snakes and tortoises.

Decommissioning Phase

- Revegetation of cleared areas with monitoring and follow-up to ensure that rehabilitation is successful. Success must be measured against a predefined benchmark in terms of cover and species richness. Monitoring and rehabilitation must continue until such time as the benchmark has been attained. It is suggested that 40% of the natural vegetation for the affected habitat type represents a useful goal for rehabilitation. No goal for species richness is required, but the species used must be from the local environment and perennial in nature. These will have to be matched to their respective habitats.
- Alien management plan to be implemented during the decommissioning phase of the development, which makes provision for regular alien clearing and monitoring for up 5 years after decommissioning.
- Rehabilitation of disturbed areas that have been generated by decommissioning. Rehabilitation should restore ecological function to the affected areas, especially with regards to the return of vegetation cover to a predefined benchmark which is suggested as 40% of the natural of the vegetation cover for the habitat under consideration.

2.11. CONCLUSIONS AND RECOMMENDATIONS

The three PV footprint areas are located on the open plains of the site within the Bushmanland Arid Grassland vegetation type. The national vegetation map is however very coarse in the study area and there are numerous other vegetation communities and habitats present in the area. In order to address this shortcoming a detailed habitat map for the site was developed and indicates that the PV footprint areas are located within low sensitivity areas of the site, with a low abundance of species of conservation concern. There are however several protected species present within the site including Aloidendron dichotomum, Hoodia gordonii and Boscia foetida. The abundance of these species within the development footprint is however low and the loss of affected individuals from the development footprint would not compromise the local populations of these species. Based on the findings of the ecological study, a revised footprint for the PV 1 area was designed by the applicant in order to implement further avoidance and reduce the impacts of the development on the Aloidendron dichotomum recorded within the northern part of the preferred site. The alternative footprint and development envelope avoid impacts on most of the Aloidendron dichotomum individuals present and also avoids impact on the area in the north of the original footprint which appears to be the most important in terms of habitat for this species (Figure 14).

The abundance of listed fauna in the area is very low and there are no habitats within the PV footprint areas that are considered to be of high faunal value and impacts on fauna are likely to be restricted largely to habitat loss for resident species. Important habitats present in the wider area include the drainage lines of the area as well as some small pans and rocky outcrops, which are not within the PV footprint areas and would not be affected by the PV development. There are some rocky areas and drainage features within the grid connection corridors and while impacts on these features can likely be avoided, Grid Connection Alternative

1 is identified as preferred alternative as this route has the least extent of sensitive features along the route. During the operational phase, impacts on fauna are likely to be low and restricted to some habitat disruption as a result of the presence and habitat loss associated with the development.

The site is located within a tier 2 CBA, indicating that the area has been identified as an important area for biodiversity maintenance. Based on the results of the field assessment, the affected areas are not considered to be very sensitive in terms of the biodiversity features that are within the development footprint. However, as a primary purpose of CBAs is to try and secure the broad-scale ecological functioning and resilience of landscapes, the impact that the development may have on broad-scale ecological processes must be considered. However due to the extent and location of the development footprint, it is not likely that it would have a significant impact on broad scale processes as important landscape features such as rocky outcrops and drainage systems are not within the development footprint and would not be affected by the development.

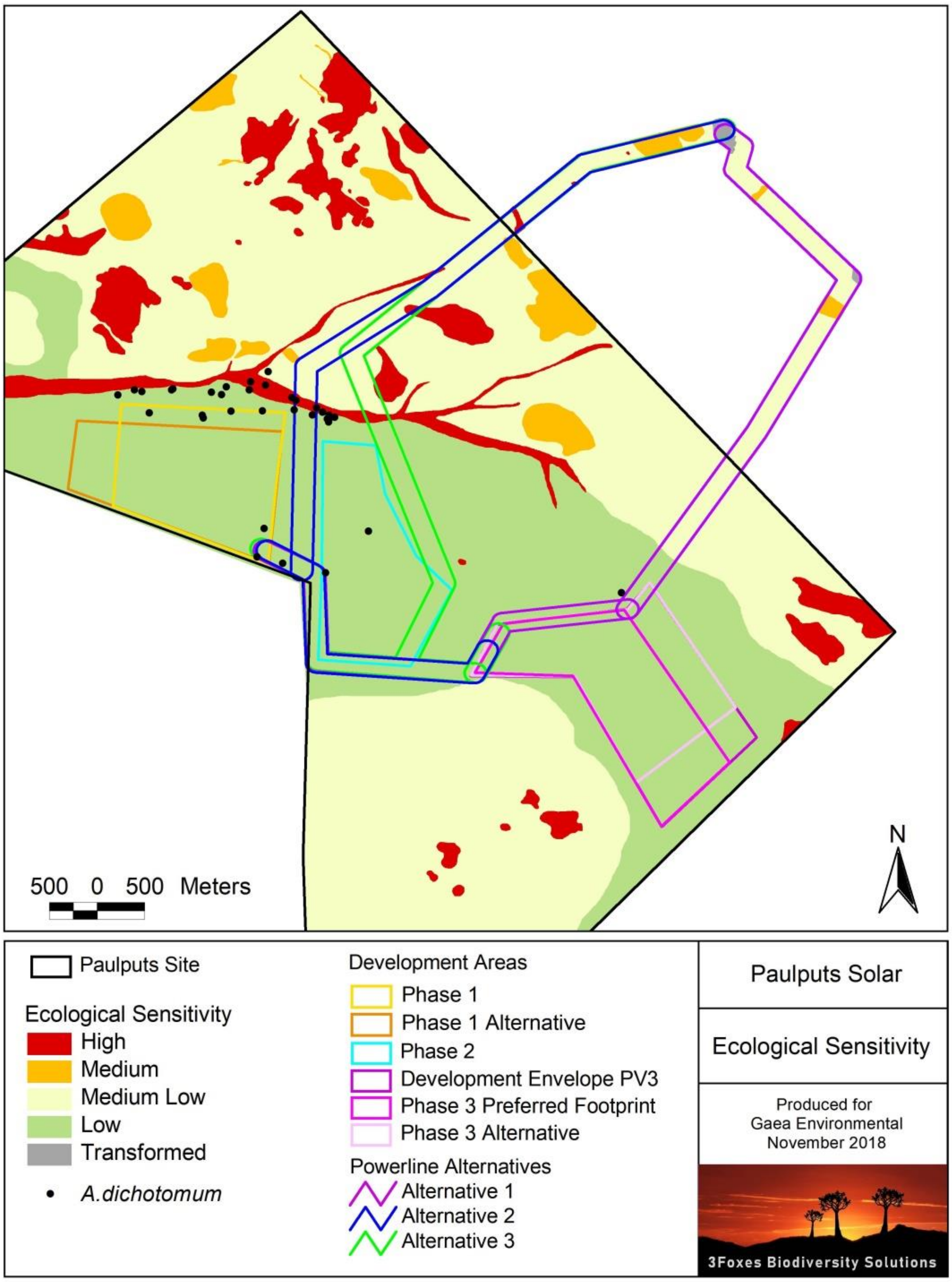


Figure 14. Ecological sensitivity map for the study area, showing revised, mitigated layout alternatives for Phase 1 and Phase 3 of the development.

There are no impacts associated with the development that cannot be reduced to a low level. Although there are numerous sensitive features in the broader landscape, the PV footprint areas are located in areas that are considered to be low sensitivity for fauna and flora. This is seen to be a key determinant of the low post-mitigation impacts associated with the development. There are numerous existing and planned developments in the Paulputs area and it is clear that a node of development around the Paulputs substation is starting to develop. Although this may have some local impact on landscape connectivity, the broader landscape and especially the broad-scale movement corridors that are likely to be operating the region remain relatively free from development and significant cumulative impact on these processes is not likely to occur as a result of the current development.

Impact Statement – PV Development

The footprint of the three Paulputs PV phases are located within typical, low sensitivity habitat with a low abundance of species of conservation concern. The post-mitigation impacts associated with the development would be of low significance. The contribution of the Paulputs solar development to cumulative impact in the area would be low and is considered acceptable. Overall, there are no specific long-term impacts likely to be associated with the development of the Paulputs solar development that cannot be reduced to a low significance. As such, there are no fatal flaws associated with the development and no terrestrial ecological considerations that should prevent it from proceeding.

Impact Statement – Grid Connection

The three Paulputs grid connection alternatives are acceptable and would generate very low post-mitigation impacts on fauna and flora. Grid Connection Alternative 1 is identified as the preferred alternative and would generate the lowest overall impacts on fauna and flora. There are no specific long-term impacts likely to be associated with the development of the Paulputs Solar Grid Connection that cannot be reduced to a low significance. The contribution of the power line and substation development to cumulative impact in the area would be low and is considered acceptable. As such, there are no fatal flaws associated with the development and no terrestrial ecological considerations that should prevent it from proceeding.

2.12. APPENDIX A: SPECIALIST IMPACT ASSESSMENT CRITERIA

The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of the predicted environmental impacts and risks is described in Part 5 - Section 4 of the EIA report.

2.13. APPENDIX B: SPECIALIST DECLARATION

I, Simon Todd., as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

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

Signature of the specialist: ______ Sim Todd. ___

Name of Specialist: _____Simon Todd________________________________

Date: _____08 December 2018____

2.14. APPENDIX C: SPECIALIST CURRICULUM VITAE

3Foxes Biodiversity Solutions
ECOLOGICAL SPECIALIST SERVICES
Assessment/Management/Research

Simon Todd Pr.Sci.Nat
Director & Principle Scientist
C: 082 3326502
O: 021 782 0377
Simon.Todd@3foxes.co.za

60 Forrest Way
Glencairn
7975

Ecological Solutions for People & the Environment

Simon Todd is Director and principal scientist at 3Foxes Biodiversity Solutions and has over 20 years of experience in biodiversity measurement, management and assessment. He has provided specialist ecological input on more than 200 different developments distributed widely across the country. This includes input on the Wind and Solar SEA (REDZ) as well as the Eskom Grid Infrastructure (EGI) SEA and Karoo Shale Gas SEA. He is on the National Vegetation Map Committee as representative of the Nama and Succulent Karoo Biomes. Simon Todd is a recognised ecological expert and is a past chairman of the Arid-Zone Ecology Forum. He is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

A selection of recent work is as follows:

- Strategic Environmental Assessments
- Co-Author. Chapter 7 - Biodiversity & Ecosystems - Shale Gas SEA. CSIR 2016.
- Co-Author. Chapter 1 Scenarios and Activities – Shale Gas SEA. CSIR 2016.
- Co-Author – Ecological Chapter – Wind and Solar SEA. CSIR 2014.
- Co-Author – Ecological Chapter – Eskom Grid Infrastructure SEA. CSIR 2015.

Recent Specialist Ecological Studies in the Vicinity of the Current Site:

- Proposed PV Facility on Konkoonsies – Fauna and Flora Specialist Assessment. EScience Associates 2012.
- Biotherm Energy – Konkoonsies II Solar Facility: Fauna and Flora Preconstruction Walk-Through Study. Savannah Environmental 2015.
- Proposed Konkoonsies II Solar On-Site Substation and Konkoonsies II to Paulputs MTS Power Line: Fauna & Flora Specialist Report For Basic Assessment. Savannah Environmental 2015.
- Specialist Vegetation Assessment, Konkoonsies. Limarco 77 (PTY) LTD. 2012.
- Proposed Southern Cross Solar Energy Facility: Southern Farm 425. Fauna & Flora Specialist Report. Savannah Environmental 2012.
- Proposed Tutwa Solar Energy Facility: Portion 4 of Narries 7. Fauna & Flora Specialist Report. Savannah Environmental 2012.
- Proposed Khoi-Sun Solar Facility - Fauna & Flora Specialist Report For Impact Assessment, Cape Eaprac 2012.

2.15. APPENDIX D: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017

Requirements of Appendix 6 – GN R326 of NEMA EIA Regulations as amended (7 April 2017)	Please indicate where it is addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- details of- the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Pg 6
a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 19
an indication of the scope of, and the purpose for which, the report was prepared; (ca) an indication of the quality and age of base data used for the specialist report; (cb) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6 Section 7 Section 8
the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 7.2
a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 7
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 8
an identification of any areas to be avoided, including buffers;	Section 8.6
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 8.6
a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.3
a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 11/12
any mitigation measures for inclusion in the EMPr;	Section 11/12
any conditions for inclusion in the environmental authorisation;	Section 14
any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11/12
a reasoned opinion- whether the proposed activity, activities or portions thereof should be authorised; (ia) regarding the acceptability of the proposed activity or activities; and if the opinion is that the proposed activity 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 14
a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
any other information requested by the competent authority.	N/A

(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.	N/A

2.16. APPENDIX E: LIST OF PLANT SPECIES

List of plant species known from the area with those observed at the site in bold.

Family	Species	Family	Species
ACANTHACEAE	***Acanthopsis disperma***	**ACANTHACEAE**	***Acanthopsis hoffmannseggiana***
ACANTHACEAE	*Barleria lancifolia subsp. lancifolia*	**ACANTHACEAE**	***Barleria lichtensteiniana***
ACANTHACEAE	***Barleria rigida***	**ACANTHACEAE**	***Blepharis mitrata***
ACANTHACEAE	*Blepharis pruinosa*	**ACANTHACEAE**	***Monechma divaricatum***
ACANTHACEAE	*Monechma incanum*	**ACANTHACEAE**	***Monechma spartioides***
ACANTHACEAE	*Petalidium lucens*	**AIZOACEAE**	***Aizoon canariense***
AIZOACEAE	*Galenia africana*	**AIZOACEAE**	***Galenia fruticosa***
AIZOACEAE	***Galenia sarcophylla***	AIZOACEAE	*Galenia secunda*
AIZOACEAE	***Tetragonia arbuscula***	AIZOACEAE	*Tetragonia reduplicata*
AIZOACEAE	***Trianthema parvifolia var. parvifolia***	AIZOACEAE	*Trianthema parvifolia var. rubens*
AMARANTHACEAE	*Amaranthus praetermissus*	**AMARANTHACEAE**	***Sericocoma avolans***
ANACARDIACEAE	*Rhus burchellii*	ANACARDIACEAE	*Searsia burchellii*
ANACARDIACEAE	*Searsia populifolia*	APOCYNACEAE	*Fockea sinuata*
APOCYNACEAE	***Hoodia gordonii***	**APOCYNACEAE**	***Microloma incanum***
APOCYNACEAE	*Microloma sagittatum*	APOCYNACEAE	*Pergularia daemia var. leiocarpa*
APOCYNACEAE	*Pergularia daemia subsp. garipensis*	**ASPARAGACEAE**	***Asparagus denudatus***
ASPARAGACEAE	***Asparagus exuvialis forma exuvialis***	ASPARAGACEAE	*Asparagus pearsonii*
ASPHODELACEAE	*Aloe claviflora*	ASPHODELACEAE	*Aloe dichotoma var. dichotoma*
ASTERACEAE	***Amellus tridactylus subsp. arenarius***	**ASTERACEAE**	***Arctotis leiocarpa***
ASTERACEAE	*Berkheya spinosissima subsp. namaensis var. namaensis*	ASTERACEAE	*Berkheya spinosissima subsp. spinosissima*
ASTERACEAE	***Dicoma capensis***	ASTERACEAE	*Didelta carnosa var. carnosa*
ASTERACEAE	*Dimorphotheca polyptera*	ASTERACEAE	*Dimorphotheca sinuata*
ASTERACEAE	*Eriocephalus ericoides subsp. ericoides*	**ASTERACEAE**	***Eriocephalus microphyllus var. pubescens***
ASTERACEAE	*Eriocephalus pauperrimus*	ASTERACEAE	*Eriocephalus spinescens*
ASTERACEAE	*Euryops dregeanus*	**ASTERACEAE**	***Felicia clavipilosa subsp. clavipilosa***
ASTERACEAE	*Foveolina dichotoma*	**ASTERACEAE**	***Gazania lichtensteinii***
ASTERACEAE	*Geigeria filifolia*	ASTERACEAE	*Geigeria vigintisquamea*
ASTERACEAE	***Gorteria corymbosa***	ASTERACEAE	*Helichrysum argyrosphaerum*
ASTERACEAE	*Helichrysum herniarioides*	ASTERACEAE	*Ifloga molluginoides*
ASTERACEAE	*Kleinia longiflora*	ASTERACEAE	*Myxopappus acutilobus*
ASTERACEAE	*Osteospermum pinnatum var. breve*	ASTERACEAE	*Osteospermum rigidum var. rigidum*
ASTERACEAE	*Pentzia pinnatisecta*	ASTERACEAE	*Pseudognaphalium luteo-album*
ASTERACEAE	***Pteronia leucoclada***	ASTERACEAE	*Pulicaria scabra*
ASTERACEAE	***Senecio niveus***	ASTERACEAE	*Senecio sisymbriifolius*
ASTERACEAE	***Tripteris microcarpa subsp. microcarpa***	**ASTERACEAE**	***Ursinia nana subsp. nana***

BIGNONIACEAE	***Rhigozum trichotomum***	**BORAGINACEAE**	***Codon royenii***
BORAGINACEAE	*Ehretia rigida subsp. rigida*	**BORAGINACEAE**	***Heliotropium curassavicum***
BORAGINACEAE	***Trichodesma africanum***	**BRASSICACEAE**	***Heliophila deserticola***
BRASSICACEAE	*Heliophila deserticola var. deserticola*	BRASSICACEAE	*Heliophila deserticola var. micrantha*
BRASSICACEAE	*Heliophila trifurca*	**BURSERACEAE**	***Commiphora gracilifrondosa***
BURSERACEAE	*Commiphora namaensis*	CAMPANULACEAE	*Wahlenbergia psammophila*
CAPPARACEAE	*Boscia albitrunca*	**CAPPARACEAE**	***Boscia foetida subsp. foetida***
CAPPARACEAE	*Cadaba aphylla*	**CAPPARACEAE**	***Cleome angustifolia subsp. diandra***
CAPPARACEAE	***Cleome foliosa var. lutea***	CAPPARACEAE	*Cleome oxyphylla var. oxyphylla*
CAPPARACEAE	*Maerua gilgii*	CHENOPODIACEAE	*Salsola armata*
CHENOPODIACEAE	*Salsola barbata*	CHENOPODIACEAE	*Salsola columnaris*
CHENOPODIACEAE	*Salsola glabrescens*	CHENOPODIACEAE	*Salsola kali*
CHENOPODIACEAE	*Salsola namibica*	CHENOPODIACEAE	*Salsola rabieana*
CHENOPODIACEAE	*Salsola zeyheri*	**COLCHICACEAE**	***Ornithoglossum viride***
COLCHICACEAE	*Ornithoglossum vulgare*	CONVOLVULACEAE	*Ipomoea cairica var. cairica*
CUCURBITACEAE	***Coccinia rehmannii***	**CUCURBITACEAE**	***Cucumis africanus***
CUCURBITACEAE	*Cucumis sagittatus*	CUCURBITACEAE	*Kedrostis africana*
CYPERACEAE	*Cyperus marginatus*	EBENACEAE	*Diospyros acocksii*
EUPHORBIACEAE	*Euphorbia gariepina subsp. balsamea*	**EUPHORBIACEAE**	***Euphorbia gariepina subsp. gariepina***
EUPHORBIACEAE	*Euphorbia glanduligera*	EUPHORBIACEAE	*Euphorbia inaequilatera var. inaequilatera*
EUPHORBIACEAE	***Euphorbia multiceps***	EUPHORBIACEAE	*Euphorbia rudis*
EUPHORBIACEAE	***Euphorbia spinea***	EUPHORBIACEAE	*Euphorbia virosa*
FABACEAE	***Acacia erioloba***	**FABACEAE**	***Acacia mellifera subsp. detinens***
FABACEAE	*Adenolobus garipensis*	FABACEAE	*Caesalpinia bracteata*
FABACEAE	*Cyamopsis serrata*	FABACEAE	*Hoffmannseggia lactea*
FABACEAE	***Indigastrum argyraeum***	FABACEAE	*Indigastrum argyroides*
FABACEAE	***Indigofera alternans var. alternans***	**FABACEAE**	***Indigofera heterotricha***
FABACEAE	*Indigofera hololeuca*	FABACEAE	*Indigofera pechuelii*
FABACEAE	*Indigofera sessilifolia*	FABACEAE	*Lebeckia spinescens*
FABACEAE	*Leobordea platycarpa*	FABACEAE	*Lessertia annularis*
FABACEAE	***Lessertia pauciflora var. pauciflora***	FABACEAE	*Lotononis rabenaviana*
FABACEAE	*Melilotus albus*	FABACEAE	*Melolobium candicans*
FABACEAE	***Parkinsonia africana***	FABACEAE	*Pomaria lactea*
FABACEAE	*Prosopis glandulosa var. glandulosa*	FABACEAE	*Prosopis velutina*
FABACEAE	***Ptycholobium biflorum subsp. biflorum***	FABACEAE	*Sutherlandia microphylla*
FABACEAE	*Tephrosia dregeana var. dregeana*	FABACEAE	*Trigonella hamosa*
FRANKENIACEAE	*Frankenia pulverulenta*	GERANIACEAE	*Monsonia parvifolia*
GERANIACEAE	***Monsonia umbellata***	**GISEKIACEAE**	***Gisekia africana var. africana***
GISEKIACEAE	***Gisekia pharnacioides var. pharnacioides***	HYACINTHACEAE	*Albuca acuminata*
HYACINTHACEAE	***Albuca setosa***	**HYACINTHACEAE**	***Dipcadi glaucum***
HYACINTHACEAE	***Dipcadi gracillimum***	IRIDACEAE	*Moraea venenata*
LAMIACEAE	*Stachys burchelliana*	**LOASACEAE**	***Kissenia capensis***
LOPHIOCARPACEAE	***Lophiocarpus polystachyus***	LORANTHACEAE	*Tapinanthus oleifolius*

MALVACEAE	***Hermannia gariepina***	MALVACEAE	*Hermannia grandiflora*
MALVACEAE	*Hermannia marginata*	**MALVACEAE**	***Hermannia minutiflora***
MALVACEAE	*Hermannia modesta*	**MALVACEAE**	***Hermannia spinosa***
MALVACEAE	*Hermannia stricta*	MALVACEAE	*Hibiscus elliottiae*
MALVACEAE	***Radyera urens***	MELIACEAE	*Nymania capensis*
MENISPERMACEAE	***Cissampelos capensis***	**MESEMBRYANTHEMACEAE**	***Aridaria noctiflora subsp. straminea***
MESEMBRYANTHEMACEAE	*Mesembryanthemum coriarium*	**MESEMBRYANTHEMACEAE**	***Mesembryanthemum crystallinum***
MESEMBRYANTHEMACEAE	*Mesembryanthemum inachabense*	MESEMBRYANTHEMACEAE	*Phyllobolus lignescens*
MESEMBRYANTHEMACEAE	*Prenia tetragona*	MESEMBRYANTHEMACEAE	*Psilocaulon articulatum*
MESEMBRYANTHEMACEAE	*Psilocaulon coriarium*	MESEMBRYANTHEMACEAE	*Psilocaulon subnodosum*
MESEMBRYANTHEMACEAE	*Ruschia ferox*	**MOLLUGINACEAE**	***Hypertelis salsoloides var. salsoloides***
MOLLUGINACEAE	***Limeum aethiopicum var. aethiopicum***	MOLLUGINACEAE	*Limeum aethiopicum var. lanceolatum*
MOLLUGINACEAE	*Limeum aethiopicum subsp. aethiopicum var. aethiopicum*	MOLLUGINACEAE	*Limeum argute-carinatum var. kwebense*
MOLLUGINACEAE	***Limeum myosotis var. confusum***	MOLLUGINACEAE	*Limeum sulcatum var. gracile*
MOLLUGINACEAE	***Limeum sulcatum var. robustum***	**MOLLUGINACEAE**	***Mollugo cerviana var. cerviana***
MOLLUGINACEAE	*Pharnaceum brevicaule*	MOLLUGINACEAE	*Suessenguthiella scleranthoides*
MONTINIACEAE	***Montinia caryophyllacea***	**NEURADACEAE**	***Grielum humifusum var. parviflorum***
NEURADACEAE	*Grielum sinuatum*	**NYCTAGINACEAE**	***Phaeoptilum spinosum***
OXALIDACEAE	***Oxalis beneprotecta***	PASSIFLORACEAE	*Adenia repanda*
PEDALIACEAE	***Rogeria longiflora***	**PEDALIACEAE**	***Sesamum capense***
PLUMBAGINACEAE	***Dyerophytum africanum***	**POACEAE**	***Aristida adscensionis***
POACEAE	***Aristida congesta subsp. barbicollis***	POACEAE	*Cenchrus ciliaris*
POACEAE	*Cynodon dactylon*	POACEAE	*Enneapogon cenchroides*
POACEAE	***Enneapogon desvauxii***	**POACEAE**	***Enneapogon scaber***
POACEAE	*Eragrostis annulata*	POACEAE	*Eragrostis biflora*
POACEAE	*Eragrostis brizantha*	POACEAE	*Eragrostis nindensis*
POACEAE	*Eragrostis porosa*	POACEAE	*Leucophrys mesocoma*
POACEAE	*Odyssea paucinervis*	POACEAE	*Phragmites australis*
POACEAE	*Polypogon monspeliensis*	**POACEAE**	***Schmidtia kalahariensis***
POACEAE	*Setaria verticillata*	POACEAE	*Sporobolus nervosus*
POACEAE	***Stipagrostis anomala***	**POACEAE**	***Stipagrostis brevifolia***
POACEAE	***Stipagrostis ciliata var. capensis***	POACEAE	*Stipagrostis hochstetteriana var. hochstetteriana*
POACEAE	*Stipagrostis hochstetteriana var. secalina*	POACEAE	*Stipagrostis namaquensis*
POACEAE	***Stipagrostis obtusa***	POACEAE	*Stipagrostis uniplumis var. neesii*
POACEAE	***Stipagrostis uniplumis var. uniplumis***	POACEAE	*Tragus berteronianus*
POACEAE	*Tragus racemosus*	**POACEAE**	***Tricholaena capensis subsp. capensis***
POLYGALACEAE	*Polygala leptophylla var. leptophylla*	POLYGALACEAE	*Polygala seminuda*
POLYGONACEAE	*Persicaria decipiens*	PORTULACACEAE	*Anacampseros filamentosa subsp. tomentosa*
PORTULACACEAE	***Avonia albissima***	PORTULACACEAE	*Talinum arnotii*
POTTIACEAE	*Tortula atrovirens*	**RHAMNACEAE**	***Ziziphus mucronata subsp. mucronata***

RICCIACEAE	*Riccia cavernosa*	RUBIACEAE	*Kohautia caespitosa subsp. brachyloba*
RUBIACEAE	***Kohautia cynanchica***	SANTALACEAE	*Thesium lineatum*
SAPINDACEAE	*Pappea capensis*	SCROPHULARIACEAE	*Aptosimum elongatum*
SCROPHULARIACEAE	*Aptosimum junceum*	**SCROPHULARIACEAE**	***Aptosimum marlothii***
SCROPHULARIACEAE	***Aptosimum procumbens***	**SCROPHULARIACEAE**	***Aptosimum spinescens***
SCROPHULARIACEAE	***Diascia engleri***	**SCROPHULARIACEAE**	***Jamesbrittenia aridicola***
SCROPHULARIACEAE	***Jamesbrittenia ramosissima***	**SCROPHULARIACEAE**	***Lyperia tristis***
SCROPHULARIACEAE	***Manulea nervosa***	**SCROPHULARIACEAE**	***Manulea schaeferi***
SCROPHULARIACEAE	***Peliostomum leucorrhizum***	SCROPHULARIACEAE	*Selago albida*
SCROPHULARIACEAE	*Selago articulata*	SCROPHULARIACEAE	*Selago dinteri subsp. pseudodinteri*
SCROPHULARIACEAE	***Selago divaricata***	SCROPHULARIACEAE	*Veronica anagallis-aquatica*
SOLANACEAE	*Datura stramonium*	**SOLANACEAE**	***Lycium bosciifolium***
SOLANACEAE	***Lycium cinereum***	**SOLANACEAE**	***Lycium eenii***
SOLANACEAE	*Lycium oxycarpum*	**SOLANACEAE**	***Lycium pumilum***
SOLANACEAE	*Nicotiana glauca*	SOLANACEAE	*Nicotiana longiflora*
SOLANACEAE	*Solanum capense*	TAMARICACEAE	*Tamarix usneoides*
TECOPHILAEACEAE	*Cyanella lutea*	**URTICACEAE**	***Forsskaolea candida***
VERBENACEAE	***Chascanum garipense***	VISCACEAE	*Viscum capense*
VISCACEAE	*Viscum rotundifolium*	**ZYGOPHYLLACEAE**	***Augea capensis***
ZYGOPHYLLACEAE	***Sisyndite spartea***	**ZYGOPHYLLACEAE**	***Tribulus cristatus***
ZYGOPHYLLACEAE	*Tribulus pterophorus*	**ZYGOPHYLLACEAE**	***Tribulus terrestris***
ZYGOPHYLLACEAE	***Zygophyllum dregeanum***	ZYGOPHYLLACEAE	*Zygophyllum foetidum*
ZYGOPHYLLACEAE	*Zygophyllum microcarpum*	ZYGOPHYLLACEAE	*Zygophyllum prismatocarpum*
ZYGOPHYLLACEAE	*Zygophyllum retrofractum*	ZYGOPHYLLACEAE	*Zygophyllum rigidum*
ZYGOPHYLLACEAE	***Zygophyllum simplex***	ZYGOPHYLLACEAE	*Zygophyllum suffruticosum*

2.17. APPENDIX F: LIST OF MAMMALS

List of mammals which are likely to occur in the broad vicinity of the study area. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2014 and Friedmann & Daly (2004).

Scientific Name	Common Name	Status	Habitat	Likelihood
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	High
Elephantulus rupestris	Western Rock Elephant Shrew	LC	Rocky koppies, rocky outcrops or piles of boulders where	High

			these offer sufficient holes and crannies for refuge.	
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Definite
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Definite
Lagomorpha (Hares and Rabbits):				
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	High
Lepus saxatilis	Scrub Hare	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	Low
Pronologus saunsersiae	Hewitt's Red Rock Rabbit	LC	Closely confined to rocky koppies, rocky kloofs and gorges.	Definite
Rodentia (Rodents):				
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Definite
Petromus typicus	Dassie Rat	LC	Mountainous regions and inselbergs, where they are confined to rocky outcrops and live in crevices or piles of boulders	High
Pedetes capensis	Springhare	LC	Occur widely on open sandy ground or sandy scrub, on overgrazed grassland, on the fringes of vleis and dry river beds.	High

Xerus inauris	South African Ground Squirrel	LC	Open terrain with a sparse bush cover and a hard substrate	Definite
Graphiurus ocularis	Spectacled Dormouse	LC	Associated with sandstones of Cape Fold mountains, which have many vertical and horizontal crevices.	Low
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	High
Thallomys paedulcus	Acacia Tree Rat	LC	Associated with stands of Acacia woodland	Low
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	Definite
Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	High
Parotomys littledalei	Littledale’s Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	High
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub	High

			or light woodland cover	
Gerbillurus tytonis	Dune Hairy-footed Gerbil	LC	Hot dry areas on shifting red sand dunes	High
Gerbilliscus leucogaster	Bushveld Gerbil	LC	Predominantly associated with light sandy soils or sandy alluvium	Low
Gerbilliscus brantsii	Higheld Gerbil	LC	Sandy soils or sandy alluvium with some cover of grass, scrub or open woodland	Medium
Saccostomus campestris	Pouched Mouse	LC	Catholic habitat requirements, commoner in areas where there is a sandy substrate.	Medium
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Petromyscus collinus	Pygmy Rock Mouse	LC	Arid areas on rocky outcrops or koppies with a high rock cover	High
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	High
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	Low
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo,	High

			Succulent Karoo Grassland and Savanna biomes	
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	High
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	Definite
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Definite
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	High
Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	High
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	Definite
Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Rumanantia (Antelope):				
Oryx gazella	Gemsbok	LC	Open arid country	Low
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	High
Antidorcas marsupialis	Springbok	LC	Arid regions and open grassland.	Low
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Definite

Oreotragus oreotragus	Klipspringer	LC	Closely confined to rocky habitat.	Medium

2.18. APPENDIX G: LIST OF REPTILES

List of reptiles which are likely to occur in the vicinity of the Konkoonsies II study area, based on records from the SARCA database, conservation status is from Bates et al. 2013.

Scientific Name	Common Name	Distribution	Status	Habitat	Likelihod
Tortoises and Terrapins:					
Psammobates tentorius verroxii	Bushmanland Tent Tortoise	Endemic	Data Deficient	Varied: usually arid karroid areas or rocky sandveld	High
Snakes:					
Rhinotyphlops schinzi	Schinz's Beaked Blind Snake	Endemic	Data Deficient	Semi-deseet and arid savanna	High
Leptotyphlops occidentalis	Western Thread Snake	Endemic	Data Deficient	Nambib Desert and Karoo scrub	High
Lamprophis capensis	Brown House Snake	Widespread	Data Deficient	Common in highveld grassland & arid karroid regions, but found everywhere & tolerant of urban sprawl	High
Pseudaspis cana	Mole Snake	Widespread	Data Deficient	Sandy scrubland in SW Cape, highveld grassland & mountainous & desert regions	High
Prosymna bivittata	Two-striped Shovel-snout			Acacia sanannah entering sandveld	Low
Dipsina multimaculata	Dwarf Beaked Snake	Endemic	Data Deficient	Rocky, sandy areas. Cape karroid areas.	High
Psammophis notostictus	Karoo Sand or Whip Snake	Widespread	Data Deficient	Arid scrubland & karroid regions	High
Psammophis leightoni	Cape Whip Snake	Endemic	Data Deficient	Coastal fynbos, desert and semi-desert	High
Dasypeltis scabra	Common/Rhombic Egg Eater	Widespread	LC	Absent only from true desert & closed-canopy forest	High
Telescopus beetzii	Namib Tiger Snake	Endemic	Data Deficient	Rocky, arid regions	High
Telescopus semiannulatus	Eastern Tiger Snake	Widespread	Data Deficient	Desert to Karoo, savanna and forest	Low
Aspidelaps lubricus	Coral Shield Cobra	Widespread	Data Deficient	Karroid & sandveld regions, entering dry valley plains in S and E Cape	High
Naja nivea	Cape Cobra	Widespread	Data Deficient	Arid karroid regions, particularly along river courses, entering well drained open areas	High

				along the southern coast	
Naja nigricollis woodi	Black Spitting Cobra	Endemic	SARDB Rare	Namibia to Citrusdal in karroid scrub	High
Bitis arietans	Puff Adder	Widespread	Data Deficient	Absent only from desert & mnt tops	High
Bitis xeropaga	Desert Mountain Adder	Endemic	Data Deficient	Mountain slopes and sparsely vegetated rocky hillsides	Low
Bitis caudalis	Horned Adder	Widespread	Data Deficient	Sandy regions, throughout Karoo	High
Worm Lizards					
Monopeltis infuscata	Dusky Spade-snouted Worm Lizard	Widespread		Dry and moist savannah	Low
Lizard and Skinks:					
Acontias lineatus	Striped Legless Skink	Endemic	Data Deficient	Sandy, arid soils	High
Mabuya capensis	Cape Skink	Widespread	Data Deficient	Very varied: arid karroid veld, moist coastal bush, montane grassland, etc	High
Mabuya occidentalis	Western Three-Striped Skink	Widespread	Data Deficient	Arid Savanna karroid veld and desert	High
Mabuya spilogaster	Kalahari Tree Skink	Widespread		Arid Savannah	High
Mabuya sulcata	Western Rock Skink	Widespread	Data Deficient	Karroid areas	High
Mabuya striata	Striped Skink	Widespread	Data Deficient	Varied, except desert areas, succulent karoo and fynbos	Low
Mabuya variegata	Variegated Skink	Widespread	Data Deficient	Extremely varied; desert, karroid veld, montane grassland, savanna, coastal bush & valley bushveld	High
Meroles suborbitalis	Spotted Desert Lizard	Endemic	Data Deficient	Varied, arid savanna to desert	High
Nucras tessellata tessellata	Striped Sandveld Lizard	Widespread	Data Deficient	Open arid savannah & karroid veld	High
Pedioplanis laticeps	Cape Sand Lizard	Endemic	LC	Coastal dunes and succulent karroid veld	Low
Pedioplanis lineoocellata	Spotted Sand Lizard	Endemic	Data Deficient	Very varied: karroid veld, valley bushveld & arid & mesic savannah	High
Pedioplanis namaquensis	Namaqua Sand Lizard	Widespread	Data Deficient	Karroid veld	High
Pedioplanis undata	Western Sand Lizard	Widespread	Data Deficient	Prefers arid, sparsely vegetated desert	High
Cordylus polyzonus	Karoo Girdled Lizard	Endemic	Data Deficient	Karroid regions, coastal renosterveld and succulent karoo	High

Platysaurus broadleyi	Broadley's Flat Lizard	Narrow Endemic	Data Deficient	Rocky, arid sanannah, between augrabies and Pella	Low
Agama aculeata	Ground Agama	Widespread	Data Deficient	Semi desert and savanna	High
Agama anchietae	Anchieta's Agama	Widespread	Data Deficient	Semi desert and arid savanna	High
Agama atra	Southern Rock Agama	Endemic	Data Deficient	Semi-desert to fynbos, from sea level to mountain tops	Low
Chameleons:			Data Deficient		
Chamaeleo namaquensis	Namaqua Chameleon	Widespread	LC	Sandy regions (incl coastal dunes) with scrub vegetation	High
Geckos:			Data Deficient		
Chondrodactylus angulifer	Giant Ground Gecko	Endemic	LC	Gravel plains, interdune spaces & sandy flats	High
Lygodactylus bradfieldi	Bradfield's Dwarf Gecko	Widespread	Data Deficient	Arid savannah and succulent desert	High
Chondrodactylus bibronii	Bibron's Tubercled Gecko	Endemic	Data Deficient	Rocky outcrops, cliffs and large trees	High
Pachydactylus turneri	Turner's Thick-toed Gecko	Widespread	Data Deficient	Semi-desert and arid savannah	Low
Pachydactyus haackei	Haacke's Thick-toed Gecko	Endemic	Data Deficient	Large rock outcrops	Low
Pachydactylus rugosus	Rough Thick-toed Gecko	Endemic	Data Deficient	Semi-desert and succulent karroid veld	High
Pachydactylus serval	Western Spotted Gecko	Endemic	Data Deficient	Semi desert and succulent karroid veld	High
Ptenopus garrulus	Common Barking Gecko	Endemic	Data Deficient	Desert and semi-desert on various soil types, preferring flat stable sandy soils with sparse vegetation cover	High

2.19. APPENDIX H: LIST OF AMPHIBIANS

List of amphibians which are likely to occur in in the vicinity of the Konkoonsies II site according to the Frog Atlas of South Africa. Conservation status is from the Minter et al. 2004.

Scientific Name	**Common Name**	**Status**	**Habitat**	**Distribution**	Konkoonsies
Vandijkophrynus gariepensis	Karoo Toad	Not Threatened	Karoo Scrub	Widespread	Low
Vandijkophrynus robinsoni	Paradise Toad	Not Threatened	Natural springs and waterholes in the arid areas of the Richtersveld	Endemic	Low
Phrynomantis annectens	Marbled Rubber Frog	Not Threatened	Arid environments, closely associated with inselbergs and rocky areas	Widespread	High

Xenopus laevis	Common Platanna	Not Threatened	Any more or less permanent water	Widespread	Low
Cacosternum boettgeri	Common Caco	Not Threatened	Marshy areas, vleis and shallow pans	Widespread	Low
Tomopterna tandyi	Tandy's Sand Frog	Not Threatened	Nama karoo grassland and savanna	Widespread	Low

3. AVIFAUNA SPECIALIST IMPACT ASSESSMENT REPORT

3.1. EXECUTIVE SUMMARY

This report evaluates the likely impact on birds of a proposed solar photovoltaic energy facility near Pofadder in the Northern Cape. The facility is named Paulputs Solar PV Energy Facility and consists of a 300 MWac solar array and associated infrastructure.

This arid area is home to several large terrestrial bird and raptor species, the most important of which are Ludwig's Bustard *Neotis ludwigii*, Kori Bustard *Ardeotis kori*, Secretarybird *Sagittarius serpentarius*, Karoo Korhaan *Eupodotis vigorsii,* Verreaux's Eagle *Aquila verreauxii* and Martial Eagle *Polemaetus bellicosus*. In addition to being classified as threatened regionally and in some cases globally, most of these species are facing significant threats to their survival from existing impacts in the arid parts of South Africa. In addition, this area is home to an assemblage of arid zone adapted smaller bird species including larks, sparrow-larks, chats and others. Most important of these from a conservation perspective are Red Lark *Calendulauda burra* and Sclater's Lark *Spizocorys sclateri*, both of which are listed as regionally threatened species (Vulnerable and Near-threatened respectively), have very restricted ranges and have been recorded in the broader area within which the study area is situated. Stark's Lark *Spizocorys starki* is also an important endemic present in the area, and Burchell's Courser *Cursorius rufus* (Vulnerable) is a nomadic species which occurs in the broader area.

For the purposes of this study we conducted a specialist site visit and four seasons of on-site bird monitoring, in accordance with the best practice guidelines (Jenkins *et al,* 2017). We made the following findings with respect to avifauna:

- Our surveys on site took place in a slightly below average rainfall year, but good rain did fall just prior to our final site visit. We consider the data from this site visit to have sampled optimal conditions on site.
- The proposed site falls within the Mattheus-Gat Conservation Area Important Bird & Biodiversity Area.
- A total of 15 bird species were recorded by walked transects on site across the four seasons, with a peak in species richness in autumn (post rainfall) of 13 species, followed by summer (4), winter (4) and spring (3). Karoo Korhaan was the only regionally Red Listed species recorded by this method. The most abundant species was Stark's Lark *Spizocorys starki* (near-endemic), followed by Black-eared Sparrowlark *Eremopterix australis* (a near-endemic to South Africa); and Grey-backed Sparrowlark *Eremopterix verticali*. These three species were recorded only in autumn (post good rainfall). Our autumn site visit recorded a significant influx of smaller bird species onto the site based on better plant growth and food availability after the rain. Red Lark*,* Sclater's Lark, and Burchell's Courser *Cursorius rufus* (all regionally Red Listed and in the case of the larks endemics) were not recorded on site by this method (or any other).
- A total of 4 species were recorded by driven transects on site, 3 species in summer, 2 species in spring and 1 in winter and autumn. Two of the 4 species are regionally Red Listed: Karoo Korhaan is Near-threatened and Ludwig's Bustard is Endangered. Interestingly the larger bird species did not show a similar increase (such as that of the small passerines) in abundance on site after the rainfall.
- Our work on site recorded a total of 42 species on site: 21 on the initial site visit; 19 in winter; 22 in spring; 16 in summer; and 21 in autumn. Six of the species recorded on site are regionally Red Listed (Taylor *et al*, 2015): Ludwig's Bustard and Martial Eagle (Endangered); Lanner Falcon and Verreaux's Eagle (Vulnerable); and Karoo Korhaan and Kori Bustard (Near-threatened). Four of the recorded species are near-endemic to South Africa: Black-eared Sparrowlark; Jackal Buzzard *Buteo rufofuscus*; Large-billed Lark *Galerida magnirostris*; and Sickle-winged Chat *Cercomela sinuata*.

- A Martial Eagle nest was found on the existing Aggeneis-Paulputs 220kV power line on site. This pair of eagles bred successfully in 2016 but did not breed in 2017, possibly as a result of one adult being killed through collision with an existing 33kV power line on site. In 2018 our own monitoring indicated that the eagles had not started breeding by May 2018, and we were able to confirm via a third party that as at 5 September 2018 breeding had still not commenced nor was the nest occupied. We conclude that the eagles have not bred in 2018, making it two consecutive seasons without breeding.

Our assessment of the significance of the impacts on avifauna on site is as follows:

- Habitat destruction during the construction phase will be of Medium significance, both pre and post-mitigation.
- Disturbance of birds during the construction phase will be of High significance and can be mitigated to Low significance.
- Disturbance of birds during the operational phase will be of Medium significance, mitigated to Low significance.
- Bird fatalities at the facility during the operational phase (mostly through collision with infrastructure) will be of Low significance pre and post mitigation.
- Nesting of birds on the facility infrastructure during the operational phase will be of Low significance.
- Altered surface water runoff on site during the operational phase will be of Medium significance and can be mitigated to Low significance.
- Chemical pollution due to panel cleaning during the operational phase will be of Low significance, reduced to Very low by mitigation.
- Disturbance of birds during the decommissioning phase will be of Medium significance mitigated to Low.

Mitigation for inclusion in the EMPr
The following mitigation measures are recommended:

- The sensitive areas identified on site should be avoided by infrastructure.
- All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted. No extra wide turning of vehicles off the existing and purpose built facility roads should be permitted.
- Care should be taken not to introduce or propagate alien plant species/weeds during construction.
- The No-go buffer area around the Martial Eagle nest should be adhered to with respect to the construction of new infrastructure. This buffer area is also relevant to vehicular traffic accessing the site. At this stage, since the eagle nest is not active, either the north or south access road can be used. However the status of breeding at the nest must be determined in the last breeding season prior to construction and if breeding is active the southern access road must be used during breeding season (approximately May to November).
- No construction staff should be allowed to visit the eagle nest site for any reason.
- A site specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to construction, so as to ensure that no additional sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.

- Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.
- If the Martial Eagle nest is active during construction, monitoring of the eagles response to construction activities will need to be conducted by an avifaunal specialist during the eagles breeding season.
- It is particularly important that any on site water storage be done in closed tanks, not open ponds. Any evaporation ponds should be covered.
- Very little is known about the direct fatality impacts on birds of solar PV facilities in South Africa. For this reason post construction monitoring programme is recommended for this site, as prescribed by the latest relevant guidelines in order to document any impacts and provide the basis for an adaptive management approach to any impacts.
- Mitigation is complex at electrical structures since there are many ways in which birds could get electrocuted as the hardware is complex and provides many different potential perches for birds. It is therefore recommended that mitigation be applied reactively once the facility is operational, only if a significant problem is detected. Monitoring of this infrastructure for bird fatalities should be built into the operational environmental management plan for the facility.
- The most important mitigation measure for bird collision and electrocution on the overhead grid connection power line is to select the optimal route for the new power line. We recommend that Power line Alternative 1 be selected.
- All on site power line connecting panels to the on-site substation must be buried. No overhead power line should be allowed except for the grid connection line. It is acceptable to lay cables on ground surface if necessary from a technical perspective, but they may not be raised off the ground as this then poses a collision risk to birds in flight and attracts birds to perch thereby posing an electrocution risk.
- The grid connection power line should be fitted with the best available (at the time of construction) anti bird collision line marking devices in order to make the overhead cables more visible to birds. More specifically:
    - Devices should be fitted on the entire length of the power line as collision risk is high all along the alignment for nomadic species such as Ludwig's Bustard.
    - Devices should be fitted on the earth wire/s.
    - On each span, the full span should be fitted with marking devices (i.e. not only the middle 60% as done previously by Eskom). Research has shown that collisions occur even close to transmission towers (Shaw, 2013).
    - Light and dark colour devices should be alternated so as to provide contrast against both dark and light backgrounds.
    - These devices should be fitted as soon as the earth wires are strung as collision risk begins immediately, not only once the line is commissioned and live.
    - The power line owner will be responsible for ensuring that the marking devices remain in place and effective on the power line for its' full lifespan. Any device failures must be rectified immediately by replacement with new devices.
- The power line should be monitored through patrolling its full length at least 4 times per year to measure the impacts on birds and the durability of line marking devices. This can be done as part of the post construction bird monitoring for the full facility, described elsewhere in this report.
- The proposed tower/transmission tower structure for the grid connection power line has not been decided in detail. It is critically important that Eskom approved bird friendly structures be used, and that the Eskom Bird Perch be installed on all pole tops to provide safe perching space for large eagles well above the live hardware. In our opinion only large eagles (such as Martial) are at risk of electrocution in this study area, and these species tend to sit on the highest perch on transmission

towers, i.e. the Bird Perch on pole top, thereby being safely above the hardware. We suggest that the phase-phase and phase-earth clearances should be in the range of 1500 – 1800mm.

- For the impact of the birds nesting on the power line/substation, we recommend nest management on a case by case basis under the supervision of an avifaunal specialist, and in conformance with all relevant national and provincial legislation.
- We recommend that the operational phase EMP include provision for application to the provincial authority for permits for any necessary nest management should the need arise during the operational phase.
- There is a need for the development of a carefully considered surface water/drainage management plan for the site. This plan should stipulate the use of environmentally friendly and acceptable cleaning products.
- DEA should ensure that all new facilities in this broader area monitor their impacts on birds once operational, in accordance with BirdLife SA guidance (Jenkins *et al,* 2017).

Environmental impact statement

The Paulputs Solar PV Energy Facility site is important habitat for an assemblage of arid zone bird species, several of which are endemic. The transformation of natural habitat for the proposed facility will therefore be of Medium significance. Fortunately, the facility will transform a small area relative to the remaining habitat, which is fairly uniform in the broader area. Further, we believe it wise to consolidate such facilities in a node such as that surrounding Paulputs Substation. The impact of habitat destruction can be mitigated to moderate significance by ensuring that the more sensitive micro habitats are designated as no go areas. All other impacts are of moderate or low significance. We recommend that the facility be authorised, provided that the recommendations of this report are implemented.

Cumulative impact statement

In our view, the primary impact which will be residual after mitigation measures at all the above described facilities is habitat destruction. While the more sensitive habitats can be avoided spatially, and the total amount of habitat transformation can be kept to a minimum, it is unavoidable that a certain amount of habitat will be destroyed. It is not possible to mitigate this impact beyond a certain point. Our assessment of the Paulputs facility is that this impact remains at Medium significance post mitigation, and we believe it likely that the same significance will apply to other projects within this area. The impact of bird collision with overhead power lines in the area is also of concern in terms of residual impacts, since the line marking devices typically installed onto power lines to make them more visible to birds do not 100% eliminate bird collisions. Our assessment at Paulputs PV is that this mitigation in combination with optimal power line route selection (and location of facility close to Paulputs Substation) is sufficient to reduce significance to Low. However, if the overall length of power line in the broader area is increased significantly by multiple projects, the cumulative impact would probably increase to Medium. This is one of the main reasons for our support for placing the new proposed Paulputs facility in its current location close to the Paulputs Substation as it reduces the length of grid connection power line required.

The overall cumulative impact of renewable energy facilities on avifauna in the IBBA is Low, since such a small proportion of the IBBA is affected. The proposed Paulputs Solar PV Energy Facilities make a Moderate contribution to the overall amount of land developed in the IBBA. The primary residual impact after mitigation is that of habitat destruction. We recommend that to mitigate this further, the DEA ensure that all projects authorised in this area monitor their impacts on birds during the operational phase, in accordance with the BirdLife SA guidance (Jenkins *et al,* 2017). This will ensure that standardised data is collected which can be analysed collectively in order to measure cumulative impacts and determine any further research or mitigation required. This monitoring should include any new overhead power line.

It is our opinion that it is advantageous for developments to be consolidated into this one area rather than dotted around the landscape. Consolidation of facilities close to Paulputs substation also means that less overhead power line is required with less bird collision risk.

3.1. LIST OF ABBREVIATIONS

DEA	Department of Environmental Affairs
BLSA	BirdLife South Africa
TOPS	Threatened or Protected Species List (NEMA)
IUCN	International Union for Conservation of Nature
NEMA	National Environmental Management Act
IBBA	Important Bird & Biodiversity Area
EBA	Endemic Bird Area

3.2. INTRODUCTION

Scope and Objectives

juwi Renewable Energies Pty Ltd ("juwi") plans to develop a new solar photovoltaic energy facility close to the Paulputs Substation in the Northern Cape. Juwi approached WildSkies Ecological Services (Pty) Ltd (WildSkies) for initial advice on the risk to avifauna at this site early in 2017. The initial findings were reported in May 2017 (Smallie, 2017). Juwi then appointed WildSkies to conduct pre-construction bird monitoring on site. Four seasons of pre-construction bird monitoring were conducted on site (in accordance with best practice guidance – Jenkins *et al*, 2017). The scoping and EIA process has now commenced under the management of Gaea Enviro (Pty) Ltd (Gaea Enviro).

This report presents an avifaunal impact assessment for the proposed facility, using the data collected on site through pre-construction bird monitoring.

Terms of Reference

The terms of reference for this study were as follows:

- Provide status of bird habitats and identification of all ecologically sensitive areas
- Identification of endangered species and their locations
- Identify conservation worthy areas and how the proposed development can avoid them;
- Identify potential impacts and mitigation measures of the proposed infrastructure on the avifauna
- Classification of each impact according to methods as outlined by the client (see Appendix A)
- Recommendation of the best management measures to mitigate any risk.
- Identification of any monitoring required during operational phase.

Project description

The proposed activities associated with the construction phase, operational phase, and decommissioning phase of the proposed project are described in the EIA report

The proposed facility will consist of the following components:

- The full 300 MWac Paulputs solar PV facility including all components below will cover an area of 600ha.
- PV Panels of approximately 5m above the ground
- Inverter stations where power is sent from each string of PV panels
- Medium voltage transformers which will transform power from low to medium voltage (22kV)
- It is planned that 100 MW of alternating current (MWac) is generated by the solar field
- Medium voltage underground cables (22 or 33 kV)

- An on-site substation complex including a 22/132 kV or 33/132 kV onsite collector substation, a switching station, control rooms and grid control yards for both Eskom and the Independent Power Producer (housing unit to control switch gears in the form of a small concrete single story building) covering approximately 1 ha and 30m height.
- A 132 kV overhead transmission line approximately 10km long, will be constructed to connect the development to the Eskom 220/132kV Paulputs MTS Substation (currently proposed for upgrade to 400/132kV).
- A 50 m high telecommunications tower (lattice or monopole type) to be constructed within the on-site substation complex for communication during the construction and operation phases of the development.
- Operations & Maintenance (O&M) building infrastructure including (totaling approximately 1ha): workshops; storage areas; offices, receptions and ablutions; septic tanks and sewer lines; water storage tanks or lined ponds; water pipelines; waste collection and storage area; parking area.
- The water storage tanks will have a capacity sufficient to supply approximately 160kl per day during first 3 months of the construction phase; approximately 90kl per day during rest of the construction phase; and approximately 20kl per day during the operation phase.
- A 24 hour security service to guard the solar PV facility during the construction and operation phases, including a guardhouse with ablution facilities to be constructed at the site entrance.
- Perimeter fencing and internal security fencing (approximately 3 m high) and gates will be installed as required.
- A battery storage system of approximately 100 MWh for storage of the electricity generated from solar energy resources in the grid, in stacked containers or multi-story building, with a maximum height of 8m and covering an area of approximately one hectare.
- Temporary structures within the proposed development area, including a concrete batching facility, temporary offices, a construction yard and laydown area (maximum 4ha). The concrete batching facility and construction yard will have a combined maximum size of 2 hectares. The laydown area will have a maximum size of 2 hectares and will only be used mainly for storage of material and equipment during the construction phase.
- Access to site from the N14 via the R358 (southern access) is approximately 28 km, of which 11 km are travelled on the R358 and the balance on OG73.
- Access to site from the N14 via the MR759 (northern access) is approximately 31 km, of which 22 km are travelled on the MR759 and the balance on OG73.
- The main access gravel road will be upgraded with a width of approximately 13.5 m, including stormwater channels or drainage structures. Internal service roads with a width of approximately 6m will be constructed to provide access to the solar field and associated infrastructure for maintenance, inspections and panel cleaning.
- The roads will be fitted with traffic control systems and stormwater controls as required.

Figures 1 and 2 show the location and layout of the proposed project.

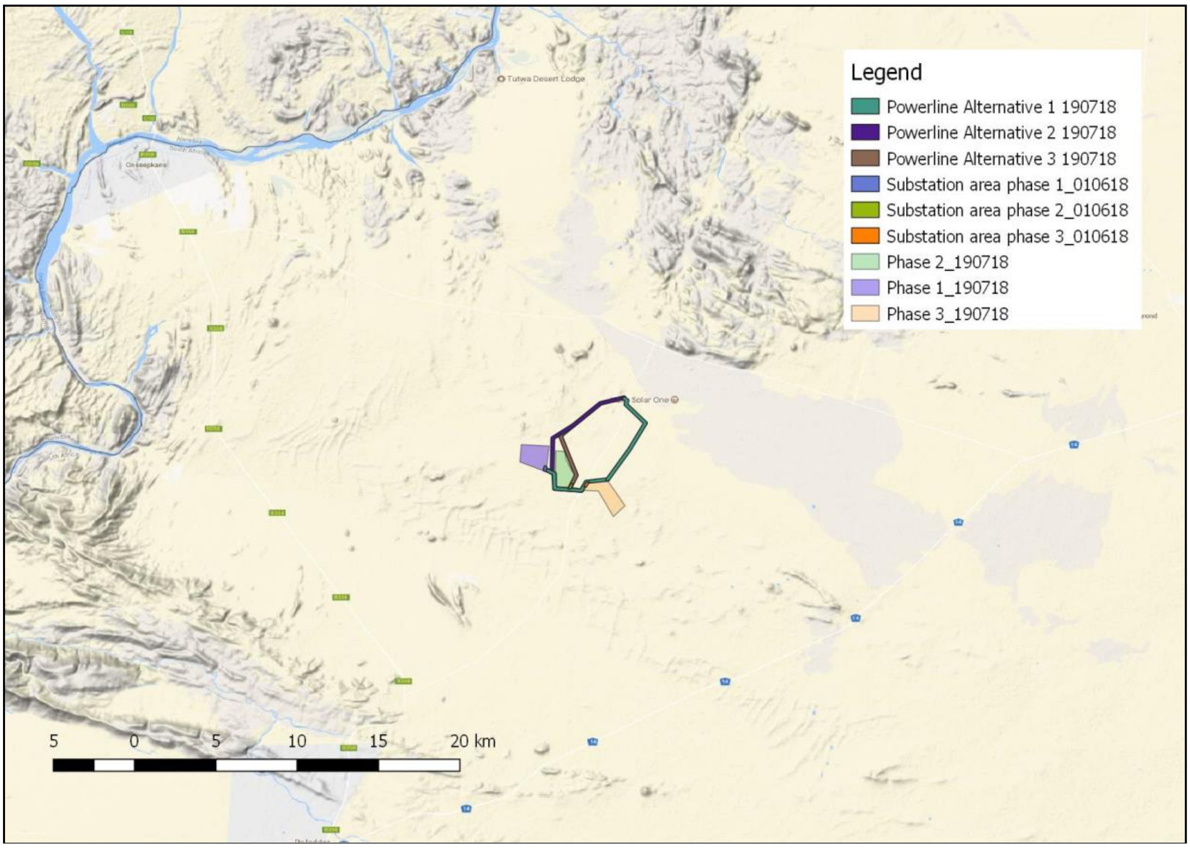


Figure 1. The location of the proposed Paulputs Solar PV Energy Facility.

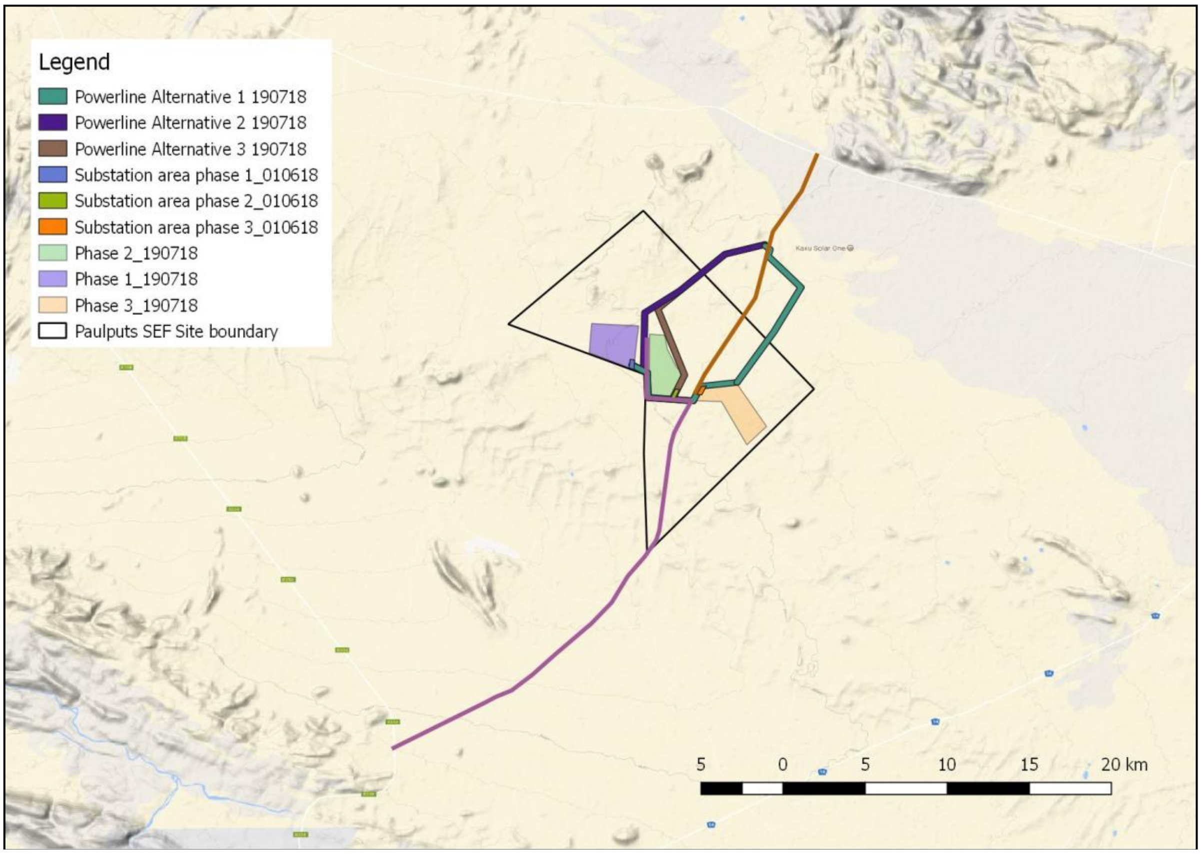


Figure 2. The layout of the proposed Paulputs Solar PV Energy Facility.

3.3. APPROACH AND METHODOLOGY

Approach and Methodology
The methods employed for this assessment were as follows:

An initial assessment of the site was conducted in May 2017 and included the following:

- All relevant and available avifaunal data sources were consulted to identify any avifaunal sensitivity on or near site.
- The site was visited for two days to assess the avifauna present and habitats available. More specifically:
    - Using a combination of driving and walking the site was covered as thoroughly as possible, in order to see all available habitats and maximise the likelihood of detecting all bird species present.
    - All birds seen and heard were recorded using Birdlasser, 10x32 binoculars, a 20-60x spotting scope, and Garmin GPS.
    - Representative photographs of bird micro habitats were taken.
    - The locations of any sensitive features were annotated on a map.
    - A wider area than the site itself was considered as far as possible in order to address the larger bird species which have large territories, such as Martial Eagle.
    - All available nesting substrate was surveyed for large raptor nests, which could require a buffer for mitigation.
- Any no go areas on the site were identified.
- Consideration was given to the cumulative impacts of multiple facilities in the vicinity.
- No avifaunal fatal flaws were identified for the development. Recommendations were made for the development of this site, which included changes to the layout and a proposed methodology for the required pre-construction monitoring.

Pre-construction bird monitoring was then initiated on site according to the following regime:

- As per the BirdLife best practice guidelines (Jenkins *et al,* 2017) the Paulputs Solar PV Energy Facility site qualifies as “Regime 3”, due to its size being greater than 150 hectares and it being in an Important Bird & Biodiversity Area (IBBA). Pre-construction bird monitoring consisted of four site visits spread over approximately 12 months: August 2017 (winter); November 2017 (spring); February 2018 (summer); May 2018 (Autumn) and each lasting four days.
- During each seasonal site visit the following data collection activities were conducted:
    - Walked transects to sample small passerine species (11 x approximately 1km transects were established and conducted on each site visit – see Figure 3). Small terrestrial birds are an important component of this programme. Given the large spatial scale of PV facilities, these smaller species may be particularly vulnerable to displacement and habitat level effects. Several regionally Red Listed or endemic small passerine species exist in the Bushmanland area. Sampling these smaller species is aimed at establishing indices of abundance for small terrestrial birds in the study area. These counts should be done when conditions are optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings. Counting is done by walking slowly along the transect centre line and recording all birds seen or heard within 200m either side of the centre line. For more details see Jenkins *et al* (2017).

- Driven transects (5 transects were established on site – see Figure 3). This is a very similar data collection technique to that above, the aim being to establish indices of abundance for large terrestrial species and raptors. These species are relatively easily detected from a vehicle, hence vehicle based (VT) transects are conducted in order to determine the number of birds of relevant species in the study area. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day. These transects were each counted twice on each site visit. Counting was done by driving slowly along the road (<40km/hr) and scanning to detect any large birds within 2km either side of the transect. The vehicle is also stopped periodically and observer scans with binoculars from a standing position. For more detail on exact methods of conducting Vehicle transects see Jenkins *et al* (2017).
- Focal sites:
    - The Martial Eagle *Polemaetus bellicosus* nest was identified as a Focal Site (FS1) and visited on each site visit to determine breeding status.
    - The section of 220kV power line was monitored as FS2 (Figure 3). On each site visit the section of power line on site was driven to look for bird fatalities and nests.
- All relevant Incidental observations of priority bird species during time on site were recorded.

The layout of the pre-construction bird monitoring activities on site is shown in Figure 3.

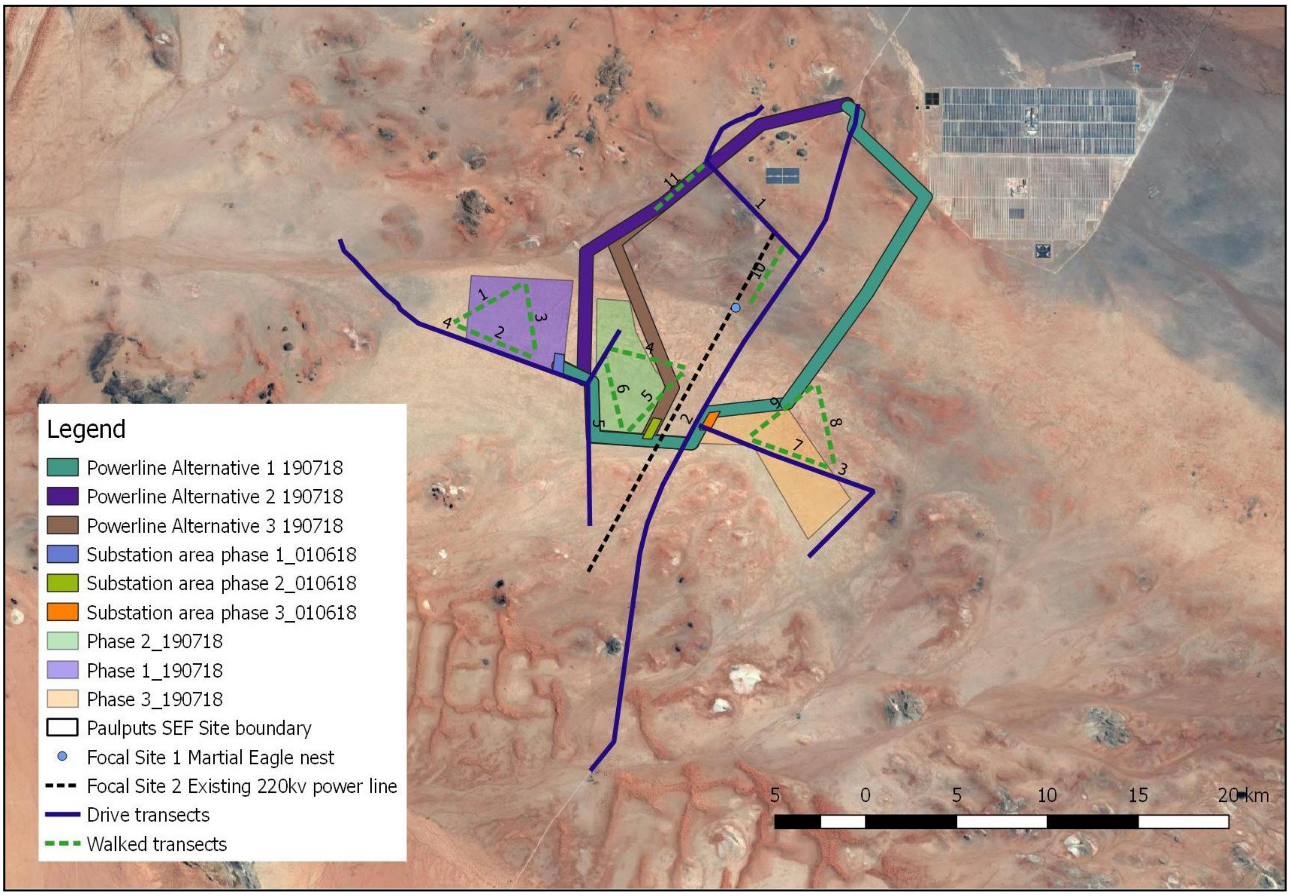


Figure 3.The layout of the bird monitoring activities on the Paulputs Solar PV Energy Facility site.

Based on the data collected on site, the possible impacts of the proposed project on avifauna were assessed according to the methodology supplied by Gaea Enviro (Appendix A).

Assumptions & Limitations

For the purposes of this study we need to assume that conditions on site during our surveys were representative of general conditions on site, and those conditions likely to exist during the construction and operational phase of the proposed project. Given that our surveys have spanned a period of 12 months and the operational lifespan of the proposed facility is likely to be at least 20 years, accurate representation is a challenge. We have chosen to examine rainfall data to shed more light on this aspect, since we believe rainfall to be the major driver of ecological and avifaunal conditions on site. We obtained annual rainfall data from the South African Weather Service for the Pofadder area. This is displayed in Figure 4. The annual rainfall from 1977 to 2017 is presented. In 2017 a total of 89.4mm was recorded. The mean rainfall over this 40 year period was 114.1mm. The 2017 rainfall was therefore slightly below average for the area. This gave us some cause to be wary of our findings during the pre-construction monitoring programme. However, in late March 2018 approximately 80-100mm of rain fell on site (not reflected in Figure 4). Our final monitoring site visit took place three weeks after this rain, and in our view represents a likely highest possible bird diversity and abundance situation.

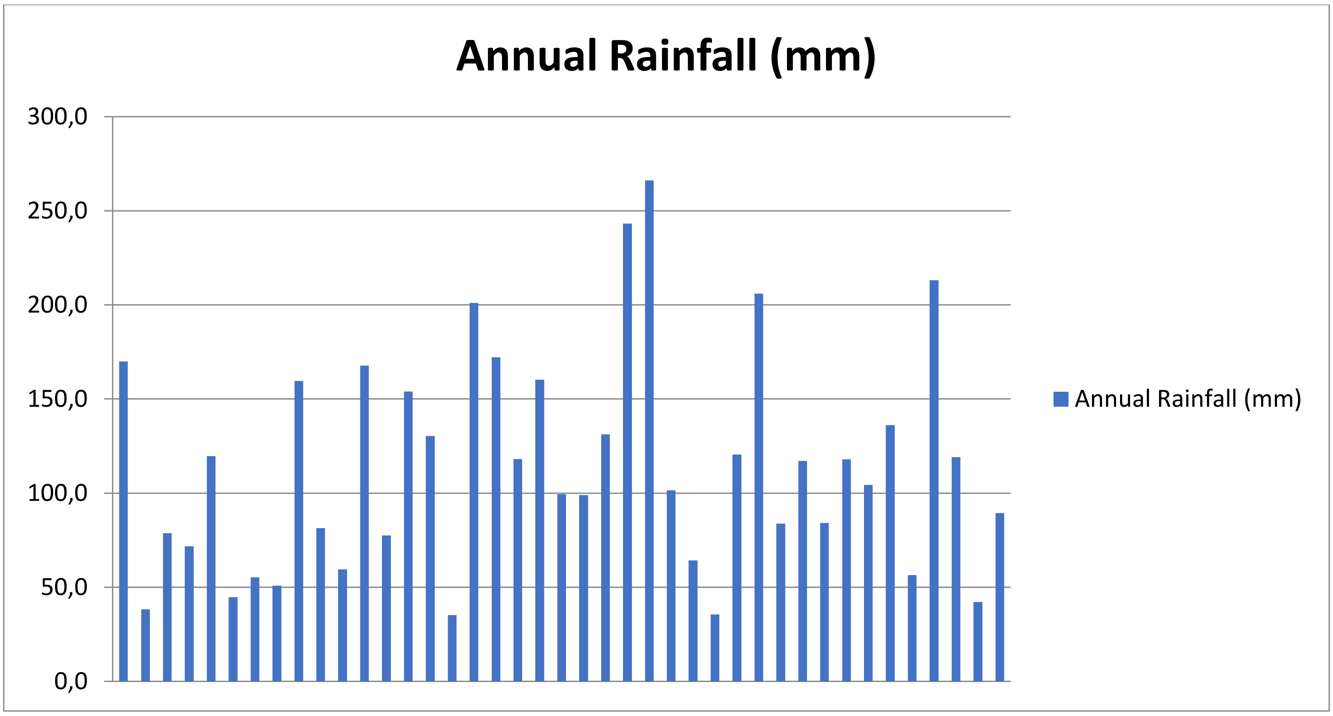


Figure 4. Annual rainfall at Pofadder from 1977 to 2017 (South African Weather Service).

Source of Information

The following information sources were consulted for this study:

- Bird distribution data from the South African Bird Atlas Projects 1 and 2 were obtained to ascertain which bird species occur in the study area (Harrison *et al.* 1997; www.sabap2.adu.org.za; www.mybirdpatch.adu.org.za).
- The regional conservation status of all bird species occurring in the study area was determined using The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor, Peacock & Wanless, 2015) and the global status was determined from the IUCN 2017 Red List.
- The BirdLife South Africa checklist 2017 was consulted to determine species endemism.
- A description of the vegetation types occurring in the study area was obtained from The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford 2006).
- The Coordinated Avifaunal Road count project was consulted (Young *et al*. 2003), but no routes exist close to this study area.

- The Important Bird & Biodiversity Areas (IBBA) programme of BirdLife South Africa was consulted (Marnewick, Retief, Theron, Wright, & Anderson, 2015). The proposed facility falls within an IBBA, and this is discussed later in this report.
- Data from the specialist site visit in May 2017 was used.
- Data collected by the four pre-construction bird monitoring site visits was used for the purposes of this study.
- The recent "Best Practice Guidelines: Birds and Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. (Jenkins, Ralston-Paton & Smit-Robinson, 2017) was consulted for guidance on relevant aspects and for pre-construction bird monitoring requirements for the site.

BirdLife South Africa (BLSA) was contacted several times by juwi for input on the project in order to ensure that they were comfortable with the approach to monitoring and avifaunal risk at the site. Most importantly a meeting was held with BLSA on 28 February 2018 at which the following most important points were made: none of the three most sensitive lark species (Red Lark *Calendulauda burra*, Sclater's Lark *Spizocorys sclateri* & Stark's Lark *Spizocorys starki*) had been recorded on site to date, although it was recognized that the site had been dry during the monitoring programme up to that point; it was agreed that if good rains fell on site a monitoring site visit should be conducted approximately 3 weeks after rainfall to determine the effects of such rainfall; it was agreed that Robin Colyn's (BLSA) habitat modelling for these three species had shown that the Paulputs Solar PV Energy Facility site does not fall in a high risk area. This means that the likelihood of the site being of high importance for these species is low; It was agreed that the proposed site does not appear to be highly sensitive based on data collected up to that point. We followed up in October 2018 to obtain published findings of Colyn's above work but were unsuccessful.

3.4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

- **<u>Vegetation description</u>**

According to Mucina and Rutherford (2006), the vegetation on site is mostly "Bushmanland Arid Grassland", with some "Bushmanland Sandy Grassland" in the far south and the southernmost road access passing through some "Eastern Gariep Plains Desert". These are all short, sparse vegetation types, well suited to small passerine and large terrestrial bird species.

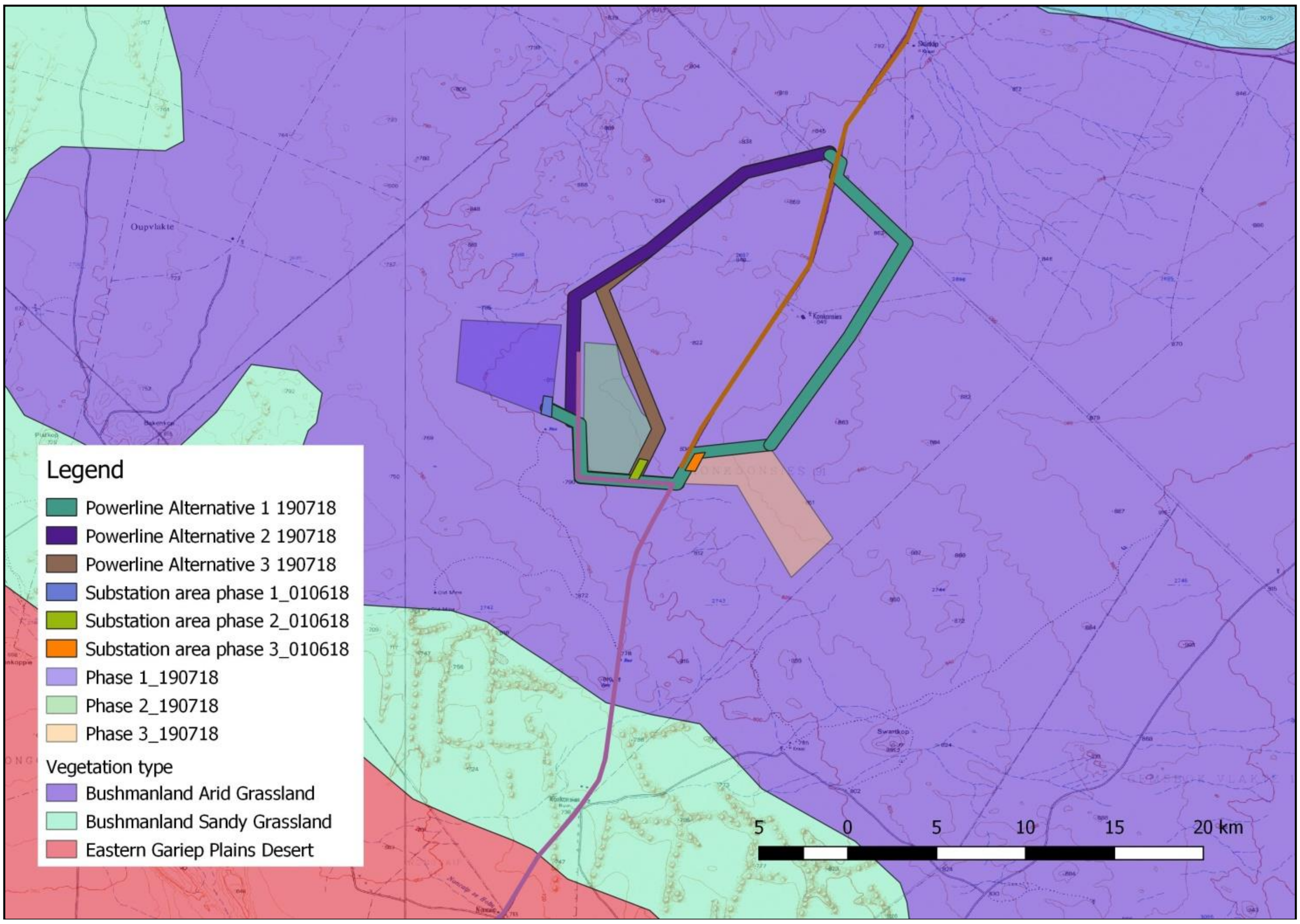


Figure 5. Vegetation classification at the proposed Paulputs site.

Within this vegetation type, four micro habitats exist for birds: grassy plains, drainage lines, rocky outcrops and red dunes. These are pictured below in Figure 6.

Figure 6. Photographs of micro habitats available to avifauna on site.

Existing anthropogenic features
Although the proposed site is relatively remote, there are several significant existing infrastructures in the area. Existing infrastructure includes the existing Eskom Paulputs Substation, the 33kV Paulputs Onseepkans power line, the 220kV Aggeneis - Paulputs line, the operational Konkoensies 1 Solar PV facility, the operational KaXu CSP facility, and the operational Xina CSP facility. As a result of these various activities, disturbance levels are relatively high on site for such a remote area, and the landscape is already relatively impacted on. This is discussed in more detail in the cumulative impact assessment section.

- **Avifaunal community on site**

Southern African Bird Atlas Project data
The first and second Southern African Bird Atlas Projects (Harrison *et al,* 1997; & www.sabap2.adu.org.za) recorded a combined total of approximately 195 bird species in the broader area (30-40km radius) within which the Paulputs Solar PV Energy Facility falls (see Appendix E). These are the species which could occur on the Paulputs site if suitable habitat and conditions occur on site. They have not however all been confirmed on the site itself. Twelve of these 195 species are considered regional Red List species (Taylor *et al,* 2015): Ludwig's Bustard *Neotis ludwigii*, Martial Eagle, and Black Harrier *Circus maurus* are 'Endangered'; Burchell's Courser *Cursorius rufus*, Verreaux's Eagle *Aquila verreauxii*, Lanner Falcon *Falco biarmicus*, Red Lark, Secretarybird *Sagittarius serpentarius*, and Black Stork *Ciconia nigra* are 'Vulnerable'; and Kori Bustard *Ardeotis kori*, Karoo Korhaan *Eupodotis vigorsi*i, and Sclater's Lark are 'Near-threatened. These are the species that were considered the most important for this assessment at a desktop level. Our own monitoring on site then confirmed which of these species occur there.

Important Bird & Biodiversity Area data
Important Bird & Biodiversity Areas are classified on the basis of the following criteria (Marnewick *et al*, 2015):

- The site regularly holds significant numbers of a globally threatened species;
- The site is thought to hold a significant component of a group of species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area; and
- The site is known or thought to hold a significant component of a group of species whose distributions are largely or wholly confined to one biome.

One IBBA is relevant to this study: the Mattheus-Gat Conservation Area IBBA which encompasses the Paulputs Solar PV Energy Facility area. This IBBA is considered important for globally threatened species such as Red Lark, Sclater's Lark, Kori and Ludwig's Bustards, and Black Harrier (Marnewick *et al,* 2015). Karoo Korhaan is regionally threatened and occurs here. Additional species present in this IBBA include: Martial Eagle; Secretarybird; Verreaux's Eagle; Booted Eagle *Hieraaetus pennatus*; Black-chested Snake Eagle *Circaetus pectoralis*; Cape Eagle Owl *Bubo capensis*; and Spotted Eagle-Owl *Bubo africanus*. Nama Karoo biome specialist species which occur here include: Stark's Lark *Spizocorys starki*; Karoo Long-billed Lark *Certhilauda subcoronata*; Black-eared Sparrow-lark *Eremopterix australis*; Tractrac Chat *Cercomela tractrac*; Sickle-winged Chat *Cercomela sinuate*; Karoo Chat *Cercomela schlegelii*; Layard's Tit-Babbler *Sylvia layardi*; Karoo Eremomela *Eremomela gregalis*; Cinnamon-breasted Warbler *Euryptila subcinnamomea*; Namaqua Warbler *Phragmacia substriata*; Sociable Weaver *Philetairus socius*; Pale-winged Starling *Onychognathus nabouroup* and Black-headed Canary *Serinus alario*.

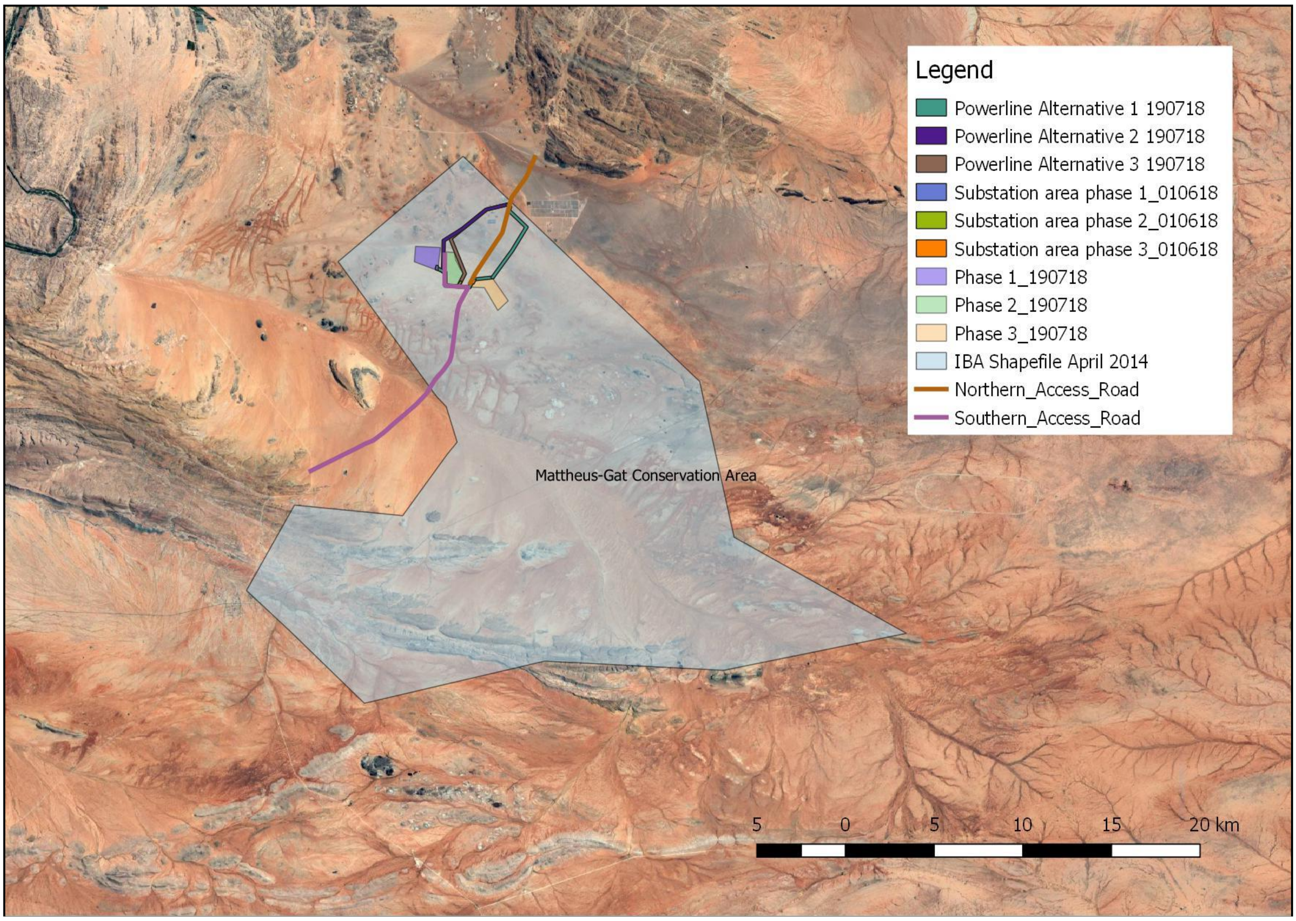


Figure 7. The position of the Mattheus-Gat Conservation Area IBBA relative to the proposed Paulputs Solar PV Energy Facility.

Renewable energy developments (some of which are already operational) are the newest threat to the habitat in this IBBA. New power lines are also listed a threat to the birds in this IBBA (Marnewick *et al,* 2015).

- **Specialist site visit data**

Our own initial field work recorded a total of 21 bird species on site over the two days (see Appendix E). This low number of species relative to the data from the SABAP project is due to the relatively short time on site, and the fact that not all habitats available to birds in the broader area are available on the Paulputs Solar PV Energy Facility site itself. Three of the species we recorded are regionally Red Listed: Martial Eagle (present at a nest on the 220kV Aggeneis - Paulputs power line - S28 54 33.74/E19 32 54.27 – see Figures 9, 10 & 11); Lanner Falcon (recorded several times on site); and Verreaux's Eagle (recorded once flying immediately south-west of site).

Figure 8. The Martial Eagle nest with adult and juvenile, photographed in August 2016.

Figure 9. The Martial Eagle nest with one adult in attendance (May 2017).

- **<u>Pre-construction bird monitoring data</u>**

In accordance with the BirdLife SA Best Practice Guidelines (Jenkins *et al*, 2017), pre-construction bird monitoring was conducted over 4 site visits in a 12 month period (August 2017 to May 2018). The final site visit was brought forward to mid-May 2018 to respond to heavy rainfall that had fallen on site approximately 3 weeks prior. At this stage of the programme rainfall had not yet fallen and we decided it was important to obtain data post a rainfall event to investigate the role that such an event would play in determining bird diversity and abundance on site.

Each site visit consisted of 4 days on site by an ornithologist. The methods conducted on these 4 days have been described in Section 3.3.

Small passerine bird data

Table 1 presents the small passerine bird data collected by walked transects on site across the four seasons. Since bird abundance and diversity on site was very low overall, even larger bird species which were recorded whilst on walked transects are included in the data (e.g. Karoo Korhaan). A total of 15 different bird species were recorded by this method across the four seasons, with a peak in species richness in autumn (post rainfall) of 13 species, followed by summer (4), winter (4) and spring (3). Karoo Korhaan was the only regionally Red Listed species recorded by this method. The most abundant species was Stark's Lark Spizocorys starki (near-endemic), followed by Black-eared Sparrowlark Eremopterix australis (a near-endemic to South Africa); and Grey-backed Sparrowlark Eremopterix verticali. These three species were recorded only in autumn (post good rainfall). Our autumn site visit recorded a significant influx of smaller bird species onto the site based on better plant growth and food availability after the rain. Red Lark, Sclater's Lark, and Burchell's Courser Cursorius rufus (all regionally Red Listed and in the case of the larks endemics) were not recorded on site by this method (or any other).

Large terrestrial and raptor data

Table 2 presents a summary of the data collected by this method. A total of 4 species were recorded by this method, 3 species in summer, 2 species in spring and 1 in winter and autumn. Two of the 4 species are regionally Red Listed: Karoo Korhaan is Near-threatened and Ludwig's Bustard is Endangered. Interestingly the larger bird species did not show a similar increase (such as that of the small passerines) in abundance on site after the rainfall.

Incidental observations of priority species

Table 3 presents summary incidental observation data. Seven priority species were recorded by this method. Four of these are regionally Red Listed (Taylor et al, 2015): Martial Eagle (Endangered); Karoo Korhaan (Near-threatened); Lanner Falcon (Vulnerable); and Kori Bustard (Near-threatened).

Table 1. Summary small passerine bird species data collected by walked transects across four seasons.

		Full year			**Winter**			**Spring**			**Summer**			**Autumn**		
transect length		**56.104**			**14.026**			**14.026**			**14.026**			**14.026**		
# species		**15**			**4**			**3**			**4**			**13**		
	South African endemism	**Birds**	**Rec**	**Birds/km**	**Birds**	**Rec**	**Birds/km**	**Birds**	**Rec**	**Birds/km**	**Birds**	**Rec**	**Birds/km**	**Birds**	**Rec**	**Birds/km**
Stark's Lark	Near-endemic	129	34	2.30										129	34	9.20
Black-eared Sparrowlark	Near-endemic	127	19	2.26										127	19	9.05
Grey-Backed Sparrowlark		84	15	1.50										84	15	5.99
Lark-like Bunting		69	18	1.23							2	1	0.14	67	17	4.78
Sociable Weaver		51	5	0.91	10	2	0.71							41	3	2.92
Spike-Heeled Lark		22	14	0.39	7	4	0.50	5	3	0.36	6	4	0.43	4	3	0.29
Ant-eating Chat		6	5	0.11	3	3	0.21				3	2	0.21			
Pied Crow		5	4	0.09	1	1	0.07	2	1	0.14				2	2	0.14
Chat Flycatcher		4	2	0.07							2	1	0.14	2	1	0.14
Capped Wheatear		2	2	0.04										2	2	0.14
Karoo Korhaan	Near-threatened	2	1	0.04				2	1	0.14						
Pale Chanting Goshawk		2	1	0.04										2	1	0.14
Speckled Pigeon		2	1	0.04										2	1	0.14
Common Quail		1	1	0.02										1	1	0.07
Yellow Canary		1	1	0.02										1	1	0.07

Birds = number of individual birds recorded. Rec = number of records (a record may include multiple individual birds. Birds/km = number of birds recorded per kilometre of transect walked.

Table 2. Summary large terrestrial and raptor species data collected by driven transects across all four seasons.

		Full year			Winter			Spring			Summer			Autumn		
Transect length		**223.2**			**55.8**			**55.8**			**55.8**			**55.8**		
# species	**Conservation status (regional, global)**	**4**			**1**			**2**			**3**			**1**		
		Birds	**Rec**	**Birds/ km**	**Birds**	**Rec**	**Birds/ km**	**Birds**	**Rec**	**Birds/ km**	**Birds**	**Rec**	**Birds/ km**	**Birds**	**Rec**	**Birds/ km**
Karoo Korhaan	NT,LC	7	4	0.03	3	2	0.05				2	1	0.04	2	1	0.04
Ludwig's Bustard	EN,EN	2	1	0.01							2	1	0.04			
Pale Chanting Goshawk		2	2	0.01				1	1	0.02	1	1	0.02			
Greater Kestrel		2	1	0.01				2	1	0.04						

NT = Near-threatened; EN = Endangered; LC = Least concern. Birds = number of individual birds recorded. Rec = number of records (a record may include multiple individual birds. Birds/km = number of birds recorded per kilometre of transect driven.

Table 3. Summary data for Incidental Observations of priority species across four seasons.

		Full year		Winter		Spring		Summer		Autumn	
# species		**7**		**2**		**4**		**2**		**2**	
	Conservation status (regional, global)	**Birds**	**Rec**	**Birds**	**Rec**	**Birds**	**Rec**	**Birds**	**Rec**	**Birds**	**Rec**
Pale Chanting Goshawk		4	3			1	1			3	2
Martial Eagle	EN, LC	3	3	1	1			1	1	1	1
Karoo Korhaan	NT, LC	2	1			2	1				
Jackal Buzzard		1	1					1	1		
Greater Kestrel		1	1	1	1						
Lanner Falcon	VU, LC	1	1			1	1				
Kori Bustard	NT, NT	1	1			1	1				

NT = Near-threatened; EN = Endangered; LC = Least concern. Birds = number of individual birds recorded. Rec = number of records (a record may include multiple individual birds

Existing power line surveys

The existing distribution and transmission power lines were surveyed as far as possible whilst on site each season. We recorded one Martial Eagle collision fatality under the existing Paulputs-Onseepkans 33kV line during late August 2017. We estimate this fatality had occurred in July or August 2017. We presume this to be one of the adults from the breeding pair on site.

Breeding site surveys

During all seasons the Martial Eagle nest (Figure 11) was checked multiple times over the 4 days on site. During winter 2017 an adult and juvenile were seen close to the nest site. Thereafter the juvenile was recorded in the general area on its' own two additional times in winter. During the remaining seasons adult eagles were not seen either as a pair or in close attendance at the nest. We conclude that this pair of eagles did not breed in winter 2017. In 2018 our own monitoring indicated that the eagles had not started breeding by May 2018, and we were able to confirm via a third party that as at 5 September 2018 breeding had still not commenced nor was the nest occupied. We conclude that the eagles have not bred in 2018, making it two consecutive seasons without breeding.

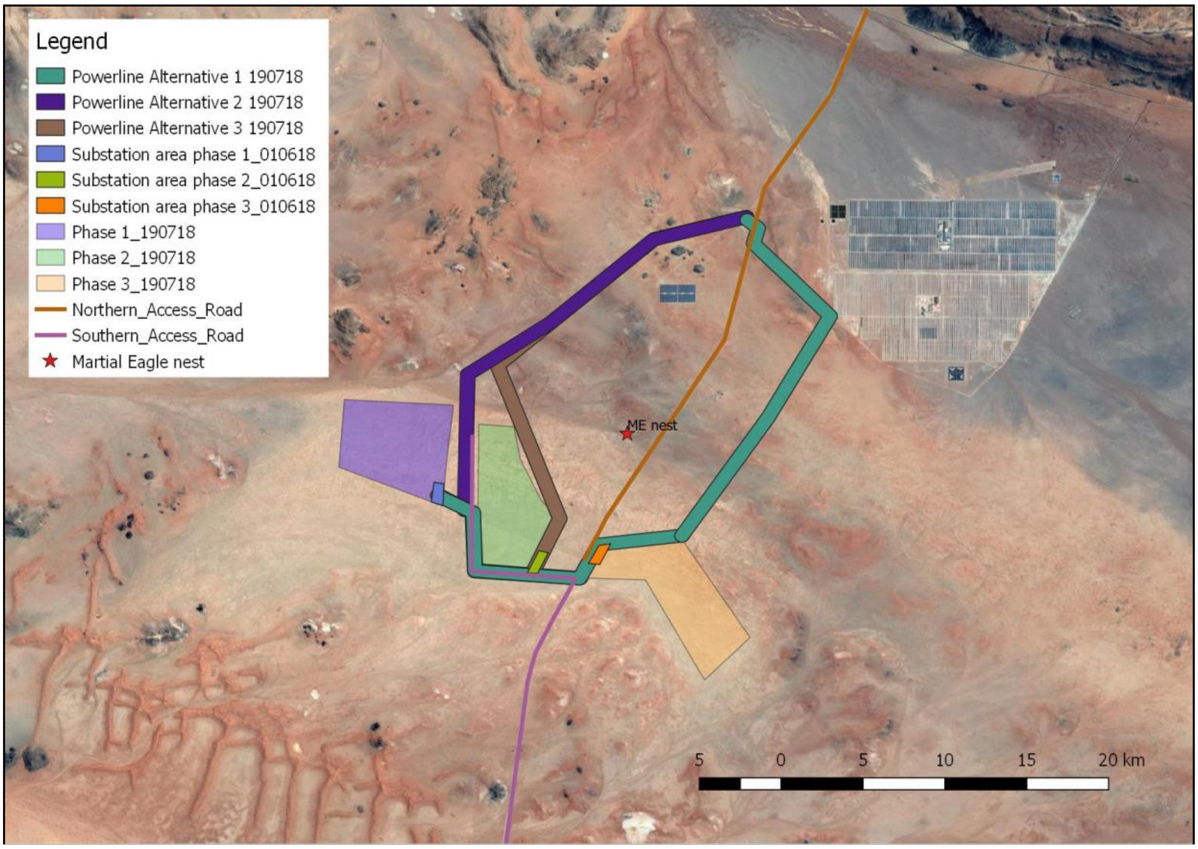


Figure 10. The Martial Eagle nest site location at the Paulputs Solar PV Energy Facility site.

Overall species list

Our work on site compiled a comprehensive list of bird species recorded by all methods and incidentally. A total of 42 species were recorded on site: 21 on the initial site visit; 19 in winter; 22 in spring; 16 in summer; and 21 in autumn (Appendix E). Six of the species recorded on site are regionally Red Listed (Taylor *et al*, 2015): Ludwig's Bustard and Martial Eagle (Endangered); Lanner Falcon and Verreaux's Eagle (Vulnerable); and Karoo Korhaan and Kori Bustard (Near-threatened). Four of the recorded species are near-endemic to South Africa: Black-eared Sparrowlark; Jackal Buzzard *Buteo rufofuscus*; Large-billed Lark *Galerida magnirostris*; and Sickle-winged Chat *Cercomela sinuata*.

- **Priority bird species for this site**

Considering the above data collected on site by our own pre-construction bird monitoring programme, and the data collected in a wider area over a longer period by the bird atlas projects, we discuss the risk to the priority bird species at this site:

Large terrestrial species

These physically large species are likely to be affected to some extent by disturbance and habitat destruction. They are also vulnerable to collision with overhead power lines.

Ludwig's Bustard

Ludwig's Bustard is a wide-ranging bird endemic to the south-western region of Africa (Hockey *et al.* 2005). This species was listed as globally Endangered in 2010 because of potentially unsustainable power line collision mortality, exacerbated by the rapidly expanding power grid (Jenkins *et al.* 2011). Ludwig's Bustards are both partially nomadic and migratory (Allan 1994, Shaw 2013), with a large proportion of the population moving west in the winter months to the Succulent Karoo. In the arid and semi-arid Karoo environment, bustards are also thought to move in response to rainfall, so the presence and abundance of bustards in any one area are not predictable. Therefore, power line collisions are also largely unpredictable, and vary greatly between seasons and years (Shaw 2013). While there is no evidence yet of population-level declines resulting from collision mortality, detailed range-wide power line surveys estimate that tens of thousands of bustards (from a total South African population of approximately 114,000 birds) die annually on the existing power grid in this country, which is of grave concern given that they are likely to be long-lived and slow to reproduce. It seems likely that there will be a threshold power line load at which population declines will become apparent, but it is not possible to accurately predict what this will be, and such effects will probably only be noticed when it is too late to do anything about it (Shaw 2013). Caution is therefore necessary in the planning of any new power lines in the range of this species. We found remains of a Ludwig's Bustard collision under the 220kV Aggeneis - Paulputs power line (at S28" 54.914'/E19" 32.714', or between transmission towers 208 & 209) during our field assessment, confirming the risk in this area. *In our view, Ludwig's Bustard could be an occasional visitor to the site (we <u>recorded the species once on site in summer)</u>, sometimes in groups of birds if conditions are favourable. The impacts of habitat destruction and disturbance caused by the facility on this species will be of low significance (since the species ranges so widely and the site has no particularly unique habitat). The risk of collision of this species with the overhead power lines is high but can be mitigated.*

Kori Bustard

Kori Bustards are classified as regionally Near-threatened (Taylor *et al* 2015), with an estimated population of 2,000 – 5,000 birds in South Africa (Hockey *et al.* 2005). There are also worries for the population consequences of power line mortality for this species, given that some 14% of the population is estimated to die annually on Karoo transmission lines alone (Shaw 2013). Kori Bustards in the arid areas are thought to be locally nomadic (Hockey *et al.* 2005) and thus likely suffer greater collision rates than more sedentary populations in other areas (e.g. the Kalahari; Senyatso 2011). *Kori Bustard could visit the site occasionally, singly or in pairs – we have <u>recorded a single bird once on site in spring</u>. The impacts of habitat destruction and disturbance caused by the facility on this species will be of low significance. The risk of collision of this species with overhead power lines is high but can be mitigated.*

Secretary bird

This species is classified as regionally Vulnerable (Taylor *et al* 2015) and has recently been up-listed to globally Vulnerable on the basis of population declines. While there is no current population estimate in South Africa, there has been a reduction of sightings in the areas it previously occupied (SABAP 2 c.f. SABAP 1 data). This is probably mainly due to habitat loss, but power line collisions may also be a significant factor. The physical attributes of Secretary birds mean that they are highly vulnerable to collision, and data from Karoo transmission lines (Shaw 2013) and the Central Incident Register (Eskom-EWT) indicate that these birds do indeed collide across their range. However, as the population is sparsely distributed it is probably underrepresented in available collision data, and further research would be necessary to better understand potential population impacts of this source of unnatural mortality. *Secretary bird could utilise the site and may breed in the wider area, although we did not find any nests (there are suitable trees for nests) <u>and have not recorded it on site</u>. At this stage we believe the main risk to this species will be collision with overhead power lines. Fortunately, this can be mitigated.*

Black Stork

Black Stork is classified as Vulnerable and has experienced a population decline (Taylor *et al,* 2015). This species will be mostly confined to larger river valleys and gorges (such as those mountains to the north-west of site), and we do not expect it to be a regular visitor to the current study area. We do not anticipate this species to utilise the site, and risk to the species will consequently be low.

Karoo Korhaan

Karoo Korhaan has recently been upgraded to Near-threatened (Taylor *et al* 2015). As a sedentary species, they seem to be less susceptible to collision than the larger, more mobile bustards, but they are still frequently recorded as collision victims in the Karoo, which is their stronghold (Shaw 2013). There is some evidence that Karoo Korhaans are not as abundant as previously thought (Shaw 2013), so additional mortality caused by the proposed grid connection power line is of concern. *In our opinion this species is likely to utilise the site frequently in one or more pairs of birds. The species has been recorded several times on site in all four seasons. Destruction of habitat will therefore have some effect on these pairs, although the habitat on site is not particularly unique or scarce for this species. Once again, the main risk to this species is that of collision with overhead power lines, and this can be mitigated. We judge the significance of habitat destruction to be low and that of collision with power lines to be medium mitigated to low.*

Raptors

Raptors are potentially susceptible to disturbance whilst breeding and to electrocution on the overhead power lines if the correct pole top design is not used. Habitat destruction will also affect these species but becomes less significant as bird species territory size increases.

Martial Eagle

The Martial Eagle is classified as globally Near-threatened, and regionally Endangered (Taylor *et al* 2015). This species is well known to have adapted to using Eskom transmission line towers for perching, roosting and nesting. A Martial Eagle nest was found in this study area, on the existing 220kV Aggeneis - Paulputs power line. The following timeline summarises our findings with respect to this nest:

I. August 2016: Nest was found (during field work for a different project), with a juvenile bird on the nest.
II. May 2017: An adult and a juvenile were seen in attendance at the nest.
III. August 2017: One adult and juvenile seen at nest. One adult found dead (through collision with an existing 33kV power line on site).
IV. November 2017: No eagles seen at nest. Single adult seen once 1km from nest. Breeding did not take place in the 2017 breeding season.
V. February 2018: No eagles seen at nest. One adult seen once 4km from nest.
VI. May 2018: No eagles recorded in attendance at the nest site.
VII. August 2018: No eagles recorded in attendance at nest or any evidence of nest building or intent to breed.
VIII. September 2018: No eagles recorded in attendance at nest or any evidence of nest building or intent to breed. Breeding did not take place in the 2018 season.

In our view, the impact of habitat destruction on this species will be of low significance, on account of its large range relative to the size of the proposed development (approximately 6.4km² will be developed by the Paulputs facility c.f. approximately 108km² Martial Eagle home range – Van Eeden, 2017), and that habitat of this type is not limited in this area. Collision and electrocution on the overhead power lines are risks to the adult birds, and more so the juveniles (if breeding takes place again on site sometime in the future). Far more important though is the risk of disturbance of breeding, particularly during construction of the proposed facility. Disturbance could have one or more of the following effects on the breeding: loss of breeding productivity (fewer chicks produced); failed breeding (adults abandon eggs or chicks);

temporary abandonment of nest site by adults [We are aware of one instance where a Martial Eagle nest was abandoned during construction of a PV facility but then re-occupied once the facility was operational (Perold pers comm)]; and permanent abandonment of nest site. All of these could have a significant impact on this endangered species' survival. We recommend that this risk be managed through spatial protection for the eagle nest site. We have identified a no go circular buffer of 1.5km radius around the nest. No new infrastructure can be built within this buffer area. Disturbance of the eagles during breeding season by traffic on existing roads is also a concern. At this stage since the nest does not seem active either the north or south access roads may be used. However breeding status at this nest must be determined in the last breeding season prior to construction and if the nest is active the southern road access must be used for the duration of breeding season (approximately May to November). A monitoring plan has been put in place involving staff from the nearby operational Konkoonsies facility who will visit (not approaching closer than the existing public gravel road) the eagle nest monthly in breeding season in order to determine breeding status. In addition, an ornithologist will visit the nest during the site specific EMP avifaunal walk through prior to construction.

Black Harrier
The conservation status of the endemic Black Harrier *Circus maurus* has recently been upgraded to Endangered in both South Africa (Taylor *et al* 2015) and Namibia (Simmons *et al* 2015). Fynbos destruction and fragmentation are known to be the main causes of decline (Curtis *et al* 2004) but limited genetic variation (Fuchs *et al* 2014) now add to the concern over this species. Additional mortality factors due to operational wind farms in its tiny breeding range in South Africa mean that this species is now more threatened than ever. The current study area is probably relatively marginal in this species range, but the risk that the proposed facility poses in terms of collision, and habitat destruction still needs careful assessment. *Black Harrier could be an occasional visitor to the site (<u>not recorded on site by our monitoring</u>), but in our view is not at risk from the proposed activities.*

Verreaux's Eagle
Verreaux's Eagle is classified as regionally Vulnerable. It occurs in the broader area, and we recorded it off site to the south-west of the site. This is a species that typically uses mountainous areas or at least rocky areas on account of its need for cliffs to breed on, and the habitat of its' primary prey species Rock Hyrax. The proposed site does not provide such habitat. This species has however also learnt to nest on Eskom transmission towers (which opens up new areas of the country for use by the species, away from mountains), so this cannot be ruled out in this broader area. However we have surveyed existing power lines up to approximately 5km from the Paulputs site and are confident that no nests exist within this area currently. We anticipate that this species could occasionally forage over the site. However the closest cliff substrate is approximately 7-8 km to the north-east or south-west of site. Even these hills do not provide optimal habitat and it is conceivable that the bird recorded near site came from further afield, perhaps from the mountains associated with the Orange River. *Based on current information we do not believe this species is at risk on the proposed site.*

Lanner Falcon
The Lanner Falcon is classed as Vulnerable and the species does seem to be in decline (Taylor *et al,* 2015). This species is susceptible to collision with overhead cables such as power lines, and also has a tendency to nest on power line structures, which could bring it into close proximity of the proposed power line. This species was recorded in the study area several times (a pair of birds). *We conclude that a pair (or possibly two) of these birds is probably resident in the broader area surrounding the Paulputs site. Habitat destruction will affect these birds to*

some extent when the facility is constructed. Since we have not located any active nests on (or near) site, disturbance of the birds whilst breeding is considered to be of low risk.

Small terrestrial species

These species are particularly susceptible to displacement from site and habitat destruction, as most of them have smaller territories (than the large terrestrial or raptors). This risk is somewhat lessened with the species discussed below as they are mostly nomadic, moving around within the region in response to conditions.

Burchell's Courser

Burchell's Courser is classified as Vulnerable by Taylor *et al* (2015). It is a nomadic species with an estimated regional population of <10 000 birds. It has undergone a significant reduction in population size in recent decades. Habitat loss is a key threat for this species, although its nomadic nature means that it would most likely move to better habitat elsewhere if disturbed or displaced from a particular site. *We did not record this species on site but conclude that it could use the site at times when conditions are right. This species will be susceptible to habitat loss as a result of construction of the facility. However, it cannot be argued that this will be of high significance since it is a nomadic species, and the habitat on site is not unique or scarce. If the species breeds on site, then it would be at risk of disturbance.*

Red Lark

Bushmanland is renowned for its high diversity and abundance of larks, many of which are endemic to southern Africa (Hockey *et al.* 2005). Up to 14 lark species can be seen in this area. Red Lark is listed as regionally Vulnerable (Taylor *et al*, 2015), and has been recorded in the broader area by the SABAP project. It is a habitat specialist, utilising the red sand dunes and adjacent plains.

We specifically surveyed all areas of red dunes and surrounds on or close to the site for Red Lark (during the initial site visit and subsequent monitoring seasons) but did not record the species. At a meeting with BLSA in February 2018, Mr Robin Colyn presented the results of a habitat suitability modelling exercise he had conducted for Red, Sclater's and Stark's Larks. The model output showed that the proposed Paulputs site was not in an area identified as being likely to have good habitat for these species. This gives us cause to believe that the Paulputs site is certainly not in prime habitat for Red Lark. *It is possible that the birds will use these dunes and associated habitat close to site at some point when conditions are favourable, but this is not a species known to move significantly at this stage. We conclude that this species will not be at risk.*

Sclater's Lark

Sclater's Lark is an endemic species classified as Near-threatened by Taylor *et al* (2015). It is mostly found on stony arid plains, often associated with quartz gravel. This is a nomadic species, which moves around in response to rainfall and food availability. It has been recorded in this broader area by the SABAP project previously. We did not record it on site but expect that it could utilise the site at times when conditions are right. Once again, the model by Colyn (pers comm) did not identify the Paulputs site as highly suitable habitat for the species. *We conclude that this species could occur on site at times although we have not recorded it on site. Destruction of habitat and disturbance will be of low significance for this species as it moves around in any event and can move to a more suitable area if disturbed or displaced.*

Stark's Lark

This is a near-endemic species which is found in arid areas and is nomadic, moving in large numbers to areas where rain has fallen recently. We experienced such an influx on the Paulputs site, where the species was abundant in our autumn site visit post good rainfall. The species is not Red listed regionally. *We consider this species to be Moderate risk at the Paulputs site, although this is likely to be erratic due to the birds' nomadic nature and the relatively infrequent rainfall events on site.*

- **Avifaunal sensitivity mapping**

Two spatial features are considered to be sensitive for avifauna on and near site (see Figure 11). The red dunes have been digitised off Google Earth as accurately as possible and should be avoided as far as possible with infrastructure. The current layout avoids these areas, except for along power line corridor alternatives 2 and 3. A 1.5km no go buffer around the Martial Eagle nest has been delineated. The current planned layout respects this buffer.

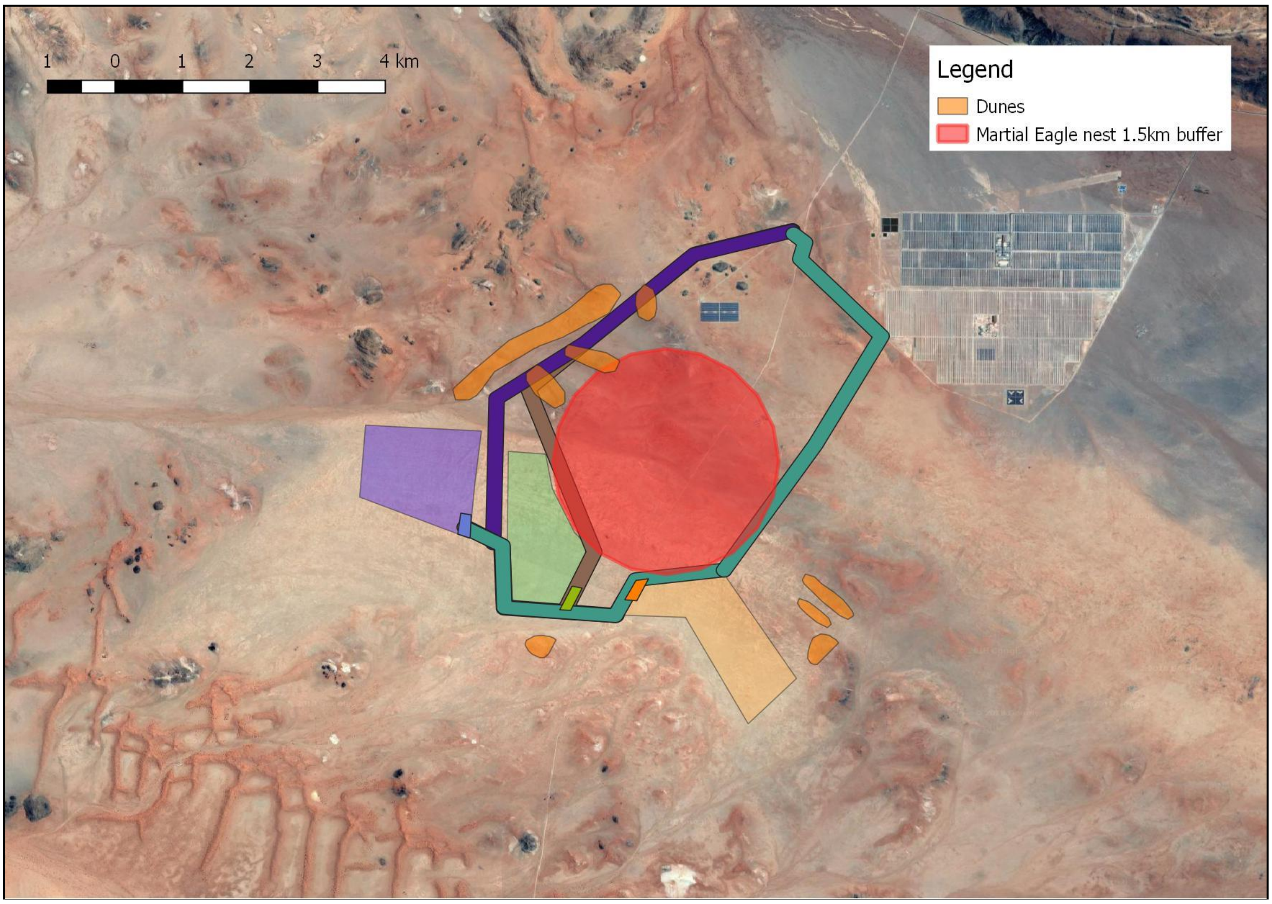


Figure 10. Avifaunal sensitivity map for the proposed Paulputs Solar PV Energy Facility.

3.5. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Various sets of legislation and policy frameworks are relevant to this specialist study and development, including the following:

- The Convention on Biological Diversity is dedicated to promoting sustainable development. The Convention recognises that biological diversity is about more than plants, animals and micro-organisms and their ecosystems. It is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live. It is an international convention signed by 150 leaders at the Rio 1992 Earth Summit, and South Africa is a signatory.
- An important principle encompassed by the CBD is the precautionary principle, which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used as a reason for delaying management of these risks. The burden of proof that the impact will not occur lies with the proponent of the activity posing the threat.
- The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe and Oceania. South Africa is a signatory.
- The African-Eurasian Waterbird Agreement: the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is the largest of its kind developed so far under the CMS. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguins. The agreement covers 119 countries from Europe, parts of Asia and Canada, the Middle East and Africa.
- National Environmental Management – Biodiversity Act - Threatened or Protected Species list (TOPS): the following species relevant to this study are on the list: Kori Bustard, Ludwig's Bustard, Black Stork, Martial Eagle (all Vulnerable).
- The Northern Cape Nature Conservation Act 9 of 2009 is relevant, and provides protection for most bird species, including Sociable Weaver.

3.6. IDENTIFICATION AND ASSESSMENT OF IMPACTS

- <u>**Key Issues Identified During the Scoping Phase - Background to bird interactions with solar photovoltaic facilities**</u>

Photovoltaic (PV) technology uses cells to convert sunlight into electric current. Commercial scale facilities typically consist of the following components: PV modules; Inverters and power electronics; structural and wiring hardware; roads; fences; substations; and office buildings.

The impacts of such facilities on avifauna can be amongst the most significant of all environmental impacts (Rudman *et al,* 2017).

We have identified the following possible impacts:

- <u>**Habitat destruction**</u>

Due primarily to the surface area required for the PV modules or panels (typically approximately 2-5hectares per MW – Ong *et al*, 2013; Hernandez *et al,* 2014 or 1.4 to 6.2 ha/MW according to US Department of Energy 2012) and the associated roads, substations, offices etc, solar PV facilities occupy a relatively large amount of land and therefore represent a large human land use in the environment (Walston *et al,* 2015). Lovich and Ennen (2011) and DeVault *et al* (2014) state that in 'many' cases vegetation removal is complete at PV facilities. Our own observations of operational PV facilities in South Africa to date confirm that vegetation removal is complete in all cases. Vegetation removal translates into habitat removal or destruction for bird species. Habitat removal is a consequence of almost any new form of development and is not particularly unique to solar PV energy. The significance of the habitat removal depends on factors such as: the amount of habitat affected; the uniqueness of the habitat; and the sensitivity and conservation status of the bird species utilizing that habitat.

- **Disturbance of birds & displacement effects**

Construction of a facility of this nature requires a significant amount of machinery and labour to be present on site for a period of time (approximately 12 -18 months). For the more shy and sensitive bird species this could disturb them and displace them from the area at least for the duration of construction and possibly longer. In addition, species commuting around the area may avoid the site once operational and fly longer distances than usual as a result. For some species this may have critical energy implications. Disturbance of breeding birds is of particular concern since this could result in lower breeding productivity, total breeding failure, and/or temporary or permanent abandonment of the breeding site. All of these can have significant consequences for threatened bird species.

- **Bird fatality at PV facilities**

Until recently very little information on bird fatality at PV facilities around the world was available. As a result there was relatively low concern for this impact amongst ornithologists, certainly when compared to wind energy facilities for example. However, in the last 3-4 years some data has emerged which points towards the direct fatality impacts at PV facilities possibly being far greater than previously understood (Kagan *et al,* 2014; Walston *et al*, 2015). Bird fatalities have been recorded in high numbers at at-least one site in the USA (Kagan *et al*, 2014; Walston *et al*, 2015; Walston *et al*, 2016).

Walston *et al* (2016) reviewed bird fatality information at solar energy facilities across the USA (although finding that most information was available for a smaller area in California). They found that 3 facilities had systematically collected data on avian mortalities, one of which was a PV facility, the California Valley Solar Ranch project of 250MW. At this facility, a total mortality rate of 10.7 birds/MW/year was recorded, consisting of 0.5birds/MW/year from known fatality causes (attributable to the facility) and 0.2birds/MW/year of unknown causes.

It is important to understand that bird abundance and flight activity levels differ according to habitat availability, and other natural features. Therefore the impact on birds through direct fatality is very site specific. The risk can be greatly reduced if the location of the project takes the following features relating to bird habitat into account: migratory flyways; wetlands; riparian vegetation; and availability of habitat amongst the arrays. Avoiding siting the solar project infrastructure in these sensitive areas can greatly reduce the impact on birds (Walston *et al*, 2015).

In addition to the above information, much has been written about the potential to attract certain bird guilds to a solar energy facility (Kagan *et al*, 2014). Such attractants could include evaporative cooling ponds (if present) that provide artificial habitat to birds and their prey. Glare and polarized light could attract insects and in turn foraging bird species (Horváth *et al,* 2009). The so called "lake effect" created by the reflective surfaces of the PV panels have been hypothesized to attract migrating waterfowl that then collide with the panels when they attempt to land (Kagan *et al*, 2014). To date no empirical research has been conducted on this "lake effect" (Walston *et al,* 2015) and it remains unproven.

Birds can also be killed through electrocution and collision on electrical infrastructure such as substations and switching gear on site, and through entanglement in or collision with fences. Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The larger bird species are most affected since they are most capable of bridging critical clearances on electrical hardware. Species likely to frequent these areas are typically the less sensitive, non-threatened species such as crows.

- **Nesting & other utilization of facility by birds**

Various bird species are quick to seize a new opportunity for perching, roosting or nesting, including on man- made structures (van Rooyen & Ledger 1999, de Goede & Jenkins 2001). In this landscape this is particularly relevant as it is relatively devoid of tall trees. It is likely then that birds will use certain parts of the proposed facility once commissioned. A prime example in the Pofadder area is the Sociable Weaver *Philetairus socius* which is quick to nest on any vertical infrastructure in this area. Whilst this nesting could be viewed as a positive impact for birds, it typically creates operational problems for the facility, which require management actions such as nest management in order to ensure that the nests don’t interfere with operations or increase fire risk. Most bird species in the Northern Cape are protected by the provincial ordinance (including Sociable Weaver), and any nest relocation or removal should be done under permit from the provincial authority.

It is also likely that some small species will use the PV panels for shade and this will create a new microhabitat on the site. This should not adversely affect the operation of the equipment however and should also not lead to direct mortalities by these small species.

- **Altered water availability and water runoff patterns**

It is likely that altering the nature of the sites surface from natural vegetation to infrastructure, roads, gravel, and possible paving – will alter the way in which water moves on the site after rainfall and cleaning of infrastructure. If this is not carefully managed this could cause soil erosion and thereby alter more bird habitat than necessary by affecting off site areas. Increased runoff could also create moister conditions on or near the site thereby attracting more birds to the area and increasing the likelihood of other interactions with the facility.

In addition water needs to be stored on site during the operational phase. This will be either in the form of tanks or ponds. We recommend the use of tanks so that this water does not attract birds for drinking, bathing, feeding and roosting. If ponds are used we recommend the use of some sort of cover over the ponds in order to render the water unavailable to birds.

- **Chemical pollution associated with PV panel cleaning**

It has been suggested (Jenkins *et al*, 2017) that pollution could occur if hazardous chemicals are used to clean PV panels once operational. This could have secondary effects on vegetation, invertebrate populations and in turn food availability and habitat for birds. However cleaning is done with automated tracking mechanisms with very little water use and often dry cleaning products. We anticipate this impact to be insignificant.

- **Findings from operational solar energy plants in South Africa**

We were able to find two available reports from operational phase monitoring at South African facilities.

Visser (2016) monitored the operational 96MW (180ha) Jasper PV facility near Postmasburg for three months and made the following findings:

- The density and diversity of bird species did not differ significantly between within the PV facility, along the boundary and outside the facility. There was however a shift from a bird community preferring woodland to one preferring open country and grassland, and those species associated with man-made structures. Some species seemed to benefit from the construction of the facility (mostly open country, grassland species) whilst others (mostly woodland species) did not.
- Vegetation regrowth between the arrays allowed for plant, invertebrate and small reptiles to be present thereby providing food for the relevant bird species.
- Some bird species were seen to use shade under panels, and nests of some common species were found under panels.
- 12 bird fatalities of 6 species were found, although in most cases only feather remains were found and cause of death could not be confirmed. There was some evidence of trapment of birds between inner and outer fences.
- When searcher efficiency and scavenger removal were accounted for the fatality estimate for the Jasper PV facility was 435 fatalities/year (95% CI 133-805) over 323 920 solar panels or 180ha.

Van Rooyen, Froneman & Laubscher (2015) monitored the 50MW Globeleq De Aar solar energy facility approximately 5km north of De Aar during the course of 2013 and 2015. The facility consists of approximately 170 000 photovoltaic panels on 100ha of land. Key findings include:

- Bird species diversity recorded by drive transects was significantly lower post construction than pre-construction. Since this data collection method typically records larger bird species we conclude that fewer large bird species were present post construction.
- Bird species diversity recorded by walked transects showed no significant difference pre and post construction. Since this method records small bird species typically, we conclude that small bird species diversity was unchanged. On an individual species level, about half of the species showed an increase in abundance whilst half showed a decrease. This result was not entirely attributable to the presence of the solar facility, since changes also occurred at the control site.
- It appears no fatality searches were conducted.

- **<u>Contextualising solar energy avifaunal impacts</u>**

Walston *et al* (2015) stated that it is important to compare solar energy bird fatalities with bird fatalities from other anthropogenic sources. Several authors have done this already including (Erickson *et al.* 2005, 2014; Loss *et al.* 2013; Smallwood 2013; Sovacool 2013). Whilst such contextualization is important, care needs to be taken when using this approach as not all bird species are equally exposed to all of the sources of fatality, and not all comparisons are valid. Drawing comparisons between for example common passerines colliding in high numbers with high rise buildings in cities, and rare Red List bird species colliding with a PV facility in a rural landscape is not reasonable. Small numbers of fatalities of threatened species can far outweigh (in conservation importance) far greater numbers of fatalities of common bird species. Comparisons with other 'rurally' located developments such as wind energy may be far more valid. Importantly, any mortality associated with a new proposed development such as the Paulputs Solar PV Energy Facility is added to the existing mortality from all other sources for the species, they do not replace any of the other sources of mortality. For certain bird species, especially Red Listed species it is of critical importance than any new sources of anthropogenic impacts are avoided as far as possible, precisely because the existing other impacts are so difficult to mitigate reactively. Impacts of other forms of development on bird species should be used for context but cannot be used as justification for creating new impacts on those species in our opinion.

- **Background to bird interactions with overhead power lines**

Because of its size and prominence, electrical infrastructure constitutes an important interface between wildlife and man. Wildlife interactions with power lines are almost all negative, with the two main problems caused by electrocution of birds (and other animals) and birds colliding with power lines (Ledger & Annegarn 1981, APLIC 1994, Bevanger 1998, Kruger 1999, van Rooyen & Ledger 1999, Lehman *et al.* 2007, Jenkins *et al.* 2010, Shaw *et al*. 2010, Prinsen *et al.* 2011, APLIC 2012, Shaw 2013). Other issues are nesting of birds on infrastructure and electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure (van Rooyen & Ledger 1999) (not relevant on distribution lines such as those proposed), and disturbance and habitat destruction during construction and maintenance activities (e.g. Silva *et al.* 2010, Raab *et al.* 2011a).

- **Bird electrocutions**

Electrocution of birds on overhead lines is an important cause of unnatural mortality of raptors and storks and has been a focus of much attention in Europe, USA and South Africa (APLIC 1994, Alonso & Alonso 1999, van Rooyen & Ledger 1999, Lehman 2001, Lehman *et al.* 2007). Electrocution can occur when a bird is perched or attempts to perch on an electrical structure and causes a short circuit by physically bridging the air gap between live components and/or live and earthed components. Electrocution of birds is possible on 132kV power lines such as those proposed, depending on the transmission tower structure to be used. The Red Listed species that could occur in this area and be susceptible to this impact are probably the Martial Eagle and Verreaux's Eagle. Various large non Red Listed species could however also be susceptible.

- **Bird collisions**

Collision with power lines is a well-known conservation problem for many birds and for some species can be a significant source of mortality (Bevanger 1998, Erickson *et al.* 2005, Drewitt & Langston 2008, Shaw *et al.* 2010, Jenkins *et al.* 2011). The reasons for collisions are complex, with each case involving a variety of biological, topographical, meteorological and technical factors (Bevanger 1994). Although all birds have the potential to be affected by collisions, those most heavily impacted are generally large, flocking species which fly often, with waterfowl, gamebirds, cranes, bustards and storks usually among the most frequently reported casualties (Bevanger 1998, Janss 2000, Jenkins *et al.* 2010). The large body size of such species mean that they have limited manoeuvrability in the air and are less able to take necessary evasive action to avoid colliding with power lines (Bevanger 1998).

In South Africa, incidentally discovered mortality incidents reported by Eskom staff, conservationists and the general public are collated in the Central Incident Register, which is maintained by the Eskom-Endangered Wildlife Trust Strategic Partnership. These data, together with those from more systematic power line surveys near De Aar (Anderson 2002), in the Overberg (Shaw *et al.* 2010) and across the Karoo (Jenkins *et al.* 2011, Shaw 2013) highlight the high levels of large terrestrial bird mortality caused by existing power lines in this country. Particularly affected are Red-listed birds including cranes, bustards, storks, Secretarybirds, flamingos and vultures, which are generally long-lived and slow to reproduce (Shaw 2013). These species have not evolved to cope with high adult mortality, with the result that consistent mortality in this age group over an extended period could seriously affect a population's ability to sustain itself in the long or even medium term. The cumulative effects of collisions together with other anthropogenic threats to these species (e.g. habitat destruction, disturbance) are unknown over the long term.

Mitigating bird collisions with power lines typically involves the installation of line marking devices on the cables in order to make them more visible to approaching birds. Worldwide, a variety of marking devices are used, but very few have been adequately field-tested (Jenkins *et al.* 2010). Great uncertainty remains about which are best, as they vary enormously in effectiveness between species and in different conditions (van Rooyen & Ledger 1999, Anderson 2002). Generally though, marking seems to be fairly effective, with a recent meta-analysis showing a 78% decrease in mortality rates on marked lines (Barrientos *et al.* 2011).

- **<u>Overview of key Environmental Management Actions and limits of acceptable changes to the Environment due to the proposed development</u>**

Destruction of bird habitat during construction of the proposed facility is a key issue for birds. Unfortunately, since a certain amount of habitat must be transformed for the facility it is difficult to reduce the significance of this impact. Key management actions are to avoid sensitive areas identified by this study and to ensure that no unnecessary alteration of habitat takes place. We consider the amount of habitat destruction required for his facility to be acceptable, but no additional habitat destruction (for example through poor management of staff and vehicles during construction) should be allowed.

Disturbance of breeding Martial Eagles is a key issue, which can be managed through the mitigation discussed in Section 3.9. An acceptable limit of change is that the eagles do not abandon breeding or breed unsuccessfully during construction or operation of the facility. It is important to note that this change could occur as the result of factors other than the proposed facility and it will be important not to unfairly attribute change to the facility itself. For example, an adult eagle was previously killed through collision with an existing power line which may have resulted in the abandonment of this site for breeding.

Bird fatalities as a result of collision with overhead power lines or electrocution on power lines is a key issue requiring management as described in Section 3.9. In the case of electrocution, there is no reason to accept any bird fatalities as it is possible to design the power line 100% bird friendly. In the case of collision, the mitigation measures recommended are not 100% effective. An acceptable limit of change would be that collision of regionally Red Listed bird species do not occur.

The following impacts are anticipated to occur if the Paulputs Solar PV Energy Facility is constructed:

- **<u>Construction phase impacts</u>**

Destruction of bird habitat
During the construction and maintenance phases of this proposed facility, a certain amount of habitat destruction and alteration will take place. We have judged the significance of this impact to be Medium both pre and post mitigation. Unfortunately, since a certain amount of habitat destruction is inevitable it is difficult to mitigate fully.

<u>Mitigation</u>

- The sensitive areas should be avoided by infrastructure.

- All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted. No extra wide turning of vehicles off the existing and purpose built facility roads should be permitted.
- Care should be taken not to introduce or propagate alien plant species/weeds during construction.

The residual impact after mitigation remains at Medium significance. In terms of the NEMA National Biodiversity Offset Policy, impacts with residual significance of Medium or higher trigger a requirement for a biodiversity offset. However, we recommend that an offset is not required in this instance for the following reasons:

- The habitat on site is not unique or limited in the broader area.
- The key regionally Red Listed lark species for which there is concern in this broader area and IBBA are not well represented on site, and habitat modelling has not identified the site as holding high value.
- A relatively small amount of habitat is affected i.e. 600ha (from a total of 67 000ha in the IBBA for example).
- We cannot envisage in this case how an appropriate offset could be implemented or what it would achieve. The vast majority of this habitat type is not transformed nor does it face any threat of transformation in the broader area in any event. A fundamental challenge with an offset approach in this environment is that most of the key bird species are nomadic in response to environmental conditions (particularly rainfall) and cannot be guaranteed to even use and offset designated area.
- Given that the impact assessment methodology is categorical, we believe that such a motivation is acceptable in light of the fact that not all 'Medium' significance impacts are equal, and this particular one is towards the lower end of the Medium category.

Disturbance of breeding birds
Disturbance of avifauna during the construction of the facility could occur. Disturbance of breeding birds is typically of greatest concern. In this regard the Martial Eagle nest on site is the most important aspect to manage. We conclude the significance of this impact to be High pre-mitigation and Low post mitigation.

<u>Mitigation</u>

- The No-go buffer area around the Martial Eagle nest should be adhered to with respect to the construction of new infrastructure. This buffer area is also relevant to vehicular traffic accessing the site. At this stage, since the eagle nest is not active, either the north or south access road can be used. However the status of breeding at the nest must be determined in the last breeding season prior to construction and if breeding is active the southern access road must be used during breeding season (approximately May to November). A monitoring plan has been put in place involving staff from the nearby operational Konkoonsies facility who will visit (not approaching closer than the existing public gravel road) the eagle nest monthly in breeding season in order to determine breeding status. In addition, an ornithologist will visit the nest during the site specific EMP avifaunal walk through prior to construction.
- No construction staff should be allowed to visit the nest site for any reason.
- A site specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to construction, so as to ensure that no additional sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.

- Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.
- If the Martial Eagle nest is active during construction, monitoring of the eagles response to construction activities will need to be conducted by an avifaunal specialist.

- **<u>Operational phase impacts</u>**

Disturbance of breeding birds

Disturbance of avifauna during the operation of the facility could occur. Disturbance of breeding birds is typically of greatest concern. In this regard the Martial Eagle nest on site is the most important aspect to manage. We conclude the significance of this impact to be High pre-mitigation and Low post mitigation.

<u>Mitigation</u>

- No operational staff should be allowed to visit the nest site for any reason.
- Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.
- If the Martial Eagle nest is active during operations, monitoring of the eagles response to operational activities will need to be conducted by an avifaunal specialist.

Bird fatalities through interaction with facility infrastructure

Bird fatalities are possible at the facility through a number of mechanisms, as discussed elsewhere in this report. Based on our data collected on bird species on site, we conclude that this impact will be of Low significance both pre and post mitigation. Overall the abundance of birds on site is low and there seems little in the way of landscape or habitat features to concentrate birds into particular areas where impacts could occur.

<u>Mitigation</u>

- The more sensitive habitat areas of the site should be avoided. A buffer area should ideally apply to all livestock watering points as far as possible, and drainage lines/water courses/wetlands. This is to provide separation between the facility and water associated birds. Secondly no additional surface water sources (dams, ponds, reservoirs, treatment works etc) should be developed on or close to the PV panels in order to limit the attractiveness of the area to birds. It is particularly important that any on site water storage be done in closed tanks, not open ponds.
- The PV panels should spend as little time as possible time in a vertical position since this presents a greater collision hazard. It is not clear at this stage whether the panels will be at a fixed tilt or utilise single axis tracking.
- Very little is known about this impact in South Africa. For this reason post construction monitoring programme is recommended for this site, as prescribed by the latest relevant guidelines in order to document any impacts and provide the basis for an adaptive management approach to any impacts.
- Mitigation is complex at electrical structures since there are many ways in which birds could get electrocuted as the hardware is complex and provides many different potential perches for birds. It is therefore recommended that mitigation be applied reactively once the facility is operational, only if a significant problem is detected. Monitoring of this infrastructure for bird fatalities should be built into the operational environmental management plan for the facility.

Bird collision and electrocution on overhead power line
We judge the significance of bird collisions to be High. This can be mitigated to Low significance as described below. The impact of bird electrocution on the power line will be particularly relevant to large eagles, such as Martial Eagle, which we know to be present in the broader area. The significance of this impact is High pre-mitigation but this can be easily mitigated to Low significance as described below. Within the on-site substation bird electrocution is also possible. However it is typically the common species which frequent substation yards and there are many places on the hardware which pose an electrocution risk. We prefer to manage this on a case specific basis if and when problems arise once the facility is operational.

Mitigation

- The most important mitigation measure is to select the optimal route for the new power line. We recommend that Power line Alternative 1 be selected.
- All on site power line connecting panels to the on-site substation must be buried as far as possible. No overhead power line should be allowed except for the grid connection line. Where power line cannot be buried it may be laid on top of the ground surface but should not be raised above the ground as it will pose a collision and electrocution risk.
- The grid connection power line should be fitted with the best available (at the time of construction) anti bird collision line marking devices in order to make the overhead cables more visible to birds. More specifically:
  - Devices should be fitted on the entire length of the power line as collision risk is high all along the alignment for nomadic species such as Ludwig’s Bustard.
  - Devices should be fitted on the earth wire/s.
  - On each span, the full span should be fitted with marking devices (i.e. not only the middle 60% as done previously by Eskom). Research has shown that collisions occur even close to transmission towers (Shaw, 2013).
  - Light and dark colour devices should be alternated so as to provide contrast against both dark and light backgrounds.
  - These devices should be fitted as soon as the earth wires are strung as collision risk begins immediately, not only once the line is commissioned and live.
  - The power line owner will be responsible for ensuring that the marking devices remain in place and effective on the power line for its’ full lifespan. Any device failures must be rectified immediately by replacement with new devices.
- The power line should be monitored through patrolling its full length at least 4 times per year (for the first 2 years of operation) to measure the impacts on birds and the durability of line marking devices. This can be done as part of the post construction bird monitoring for the full facility, described elsewhere in this report. If ownership of the power line is passed to Eskom once constructed the monitoring must still be done and reported on by the solar facility.
- All on site power line connecting panels to the on-site substation must be buried. No overhead power line should be allowed except for the grid connection line.
- The proposed tower/transmission tower structure for the grid connection power line has not been decided in detail. It is critically important that Eskom approved bird friendly structures be used, and that the Eskom Bird Perch be installed on all pole tops to provide safe perching space for large eagles well above the live hardware. In our opinion only large eagles (such as Martial) are at risk of electrocution in this study area, and these species tend to sit on the highest perch on transmission towers, i.e. the Bird Perch on pole top, thereby being safely above the hardware. We suggest that the phase-phase and phase-earth clearances should be in the range of 1500 – 1800mm.

Nesting of birds on facility infrastructure
Certain species, in particular Sociable Weaver, crows, and possibly medium sized raptors such as Greater Kestrel *Falco rupicoloides* and Lanner Falcon are likely to use some of the power line/substation infrastructure for nesting. At face value this is a positive impact for birds and has been rated as Low significance. However, nesting typically brings birds into conflict with infrastructure management as they may make maintenance difficult for staff, and also poses a fire risk since nests present abundant fuel for fires. This will require management on site, preferably through the operational Environmental Management Plan (EMP). As with electrocutions in substation yards, the exact location of this impact is very difficult to predict at this stage and should be managed as and when it occurs, in consultation with a bird specialist and in compliance with all relevant legislation. Most bird species are protected by the Northern Cape conservation ordinance (including Sociable Weaver) so any nest management will require permits.

Mitigation

- For the impact of the birds nesting on the power line/substation, we recommend nest management on a case by case basis under the supervision of an avifaunal specialist, and in conformance with all relevant national and provincial legislation.
- We recommend that the operational phase EMP include provision for application to the provincial authority for permits for any necessary nest management should the need arise during the operational phase.

Altered water availability and water runoff patterns from facility
It is likely that water used to wash the panels and rainfall will fall to the bare ground and then need to runoff somewhere. If not managed correctly this could either result in water standing for long periods, which would attract birds and their prey thereby placing them at risk of collision with infrastructure, or it could result in soil erosion. This could also extend the impact of habitat destruction beyond the immediate footprint and increase the impact if not managed correctly. It is also necessary to store water on site during operations. If this is in the form of open ponds this may attract birds to the site and place them at risk of being impacted on. These impacts have been rated as Medium significance pre-mitigation and can be mitigated to Low significance.

Mitigation

- This will need to be managed through the development of a carefully considered surface water/drainage management plan for the site.
- It is preferred that water storage on site is done in tanks not ponds. If ponds are used, some form of cover will need to be installed to ensure that the water does not attract birds.

Chemical pollution from facility
There is a risk that if hazardous chemicals are used to clean panels and fall to the ground and enter the environment this could have secondary effects. This has been rated as Low significance pre and Very low post -mitigation.

Mitigation

- The surface water management plan should stipulate the use of environmentally friendly and acceptable cleaning products.

- **Decommissioning phase impacts**

Disturbance of breeding birds
Disturbance of avifauna during the decommissioning of the facility could occur. Disturbance of breeding birds is typically of greatest concern. In this regard the Martial Eagle nest on site is the most important aspect to manage. We conclude the significance of this impact to be High pre-mitigation and Low post mitigation.

<u>Mitigation</u>

- If the Martial Eagle nest is active at decommissioning time, the No-go buffer area around the Martial Eagle nest should be adhered to with respect to the decommissioning of infrastructure. This buffer area is also relevant to vehicular traffic accessing the site.
- No staff should be allowed to visit the nest site for any reason.
- A site specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to decommissioning, so as to ensure that no additional sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.
- If the Martial Eagle nest is active during decommissioning, monitoring of the eagles response to activities will need to be conducted by an avifaunal specialist.

3.7. ASSESSMENT OF CUMULATIVE IMPACTS

A cumulative impact, in relation to an activity, means the past, current and reasonable foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonable foreseeable impacts eventuating from similar or diverse activities (as defined by NEMA EIA Reg 1).

The cumulative impacts have been assessed below, according to the guidance offered by the DEA (DEAT (2004) Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7, Department of Environmental Affairs and Tourism (DEAT), Pretoria) and IFC guidelines (Good Practice Handbook - Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets" (International Finance Corporation) on this matter.

Specifically, the steps undertaken in the cumulative impact assessment section of the study were as follows:

- Define and assess the impacts of the Paulputs Solar PV Energy Facility project.
- Identify and obtain details for all operational and authorised overhead power lines and solar energy facilities (within 100km radius of the Paulputs Solar PV Energy Facility). See Appendix B. Those projects closer to the Paulputs site are described below.
- Identify impacts of the proposed Paulputs Solar PV Energy Facility which are also likely or already exist at the other projects. All of the impacts described in Section 3.6 will occur on the other projects.
- Where possible obtain reports and data for other projects. This has been done as far as possible. Only one comprehensive avifaunal impact assessment report was obtained, for the Paulputs CSP project.
- As far as possible quantify the effect of all projects on key bird species local populations (defined and estimated). This has been illustrated in Figure 14.
- Express the likely impacts associated with the Paulputs Solar PV Energy Facility as a proportion of the overall impacts on key species. This analysis is presented below.

- A reasoned overall opinion must be expressed on the suitability of the proposed development against the above background. This will include a cumulative impact assessment statement. This has been presented below.
- The decision making process with respect to the above will be clearly documented in the report.
- Identified cumulative impacts must be clearly defined and where possible the size of the identified impact quantified and indicated. See below.
- Detailed process flow and proof must be provided to indicate how the specialists' recommendations, mitigation measures and conclusions from the various similar developments in the area were taken into consideration in the assessment of cumulative impacts and when the conclusion and mitigation measures were drafted for this project.
- The cumulative impacts significance rating must also inform the need and desirability of the proposed development. This has been addressed with the Cumulative Impacts Statement.
- A cumulative impact environmental statement on whether the proposed development must proceed. See below.

We are aware of three operational renewable energy facilities in the Paulputs area: the KaXu CSP; Xina CSP; and Konkoonsies I PV. In addition the DEA database of renewable applications shows a large area under application (Figure 16) and we are aware that Konkoonsies II is a preferred bidder site just north of the Paulputs site. Other infrastructure in the area includes the existing Paulputs Substation, and two overhead power lines: a 33kV line and the 220kV Aggeneis - Paulputs line. We are also aware of a new proposed 400kV Aggeneis Paulputs line, which will most likely run adjacent to the existing 220kV line.

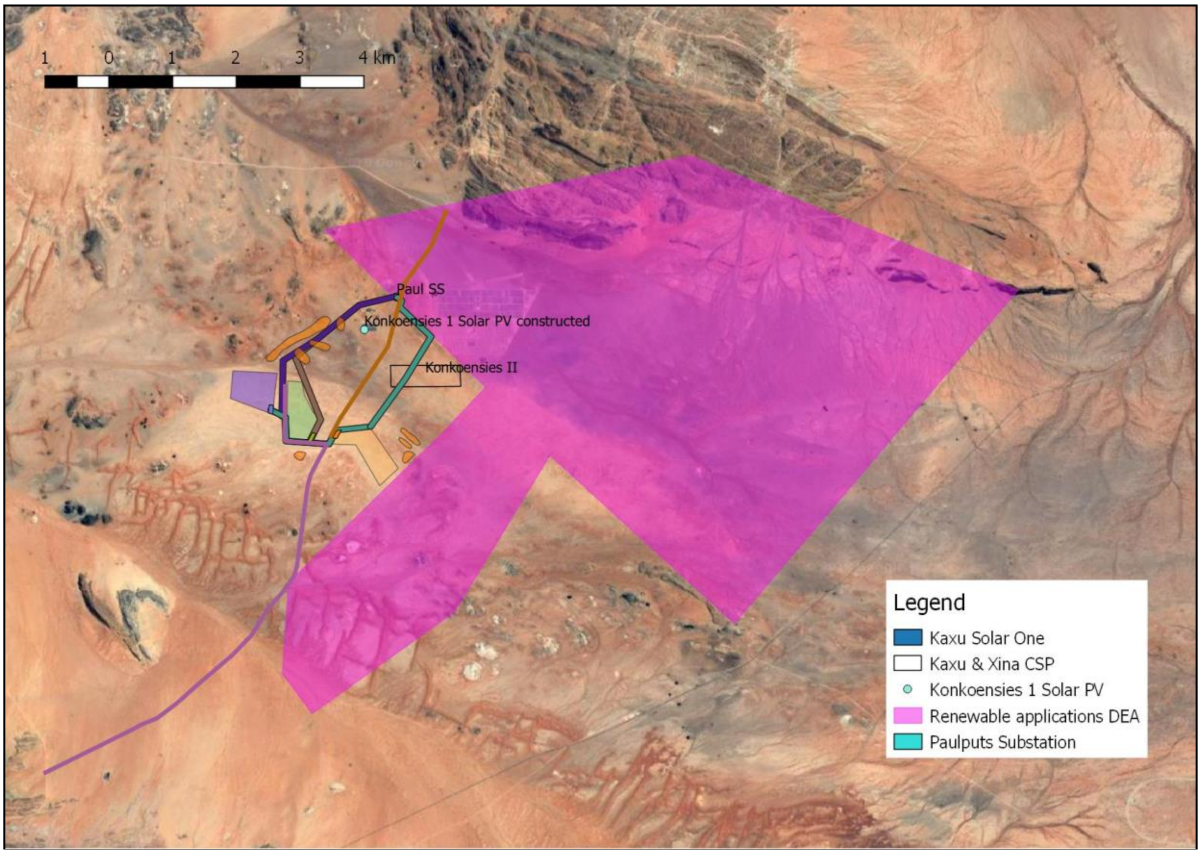


Figure 11. Existing & planned infrastructure in the vicinity of the proposed Paulputs Solar PV Energy Facility site.

The most appropriate management unit for avifaunal cumulative assessment is the Important Bird & Biodiversity Area (IBBA) within which the proposed Paulputs facility is located. This IBBA takes up an area of approximately 77 700 hectares (Figure 17). Three of the proposed facilities shown in Appendix B are within the IBBA, including the Paulputs PV facility. A 133MW facility is approved just north of the Paulputs PV site, which we estimate will affect approximately 266 ha (based on an index of 2ha/MW). A second approved facility of approximately 10MW is located immediately south-east of the Paulputs site, which will affect approximately 20 ha. The Paulputs facility itself will affect 600ha. In total then 886ha are currently proposed to be affected by renewable facilities within the IBBA, or 1.14% of the land area of the IBBA. The proposed Paulputs facility represents the largest portion of this.

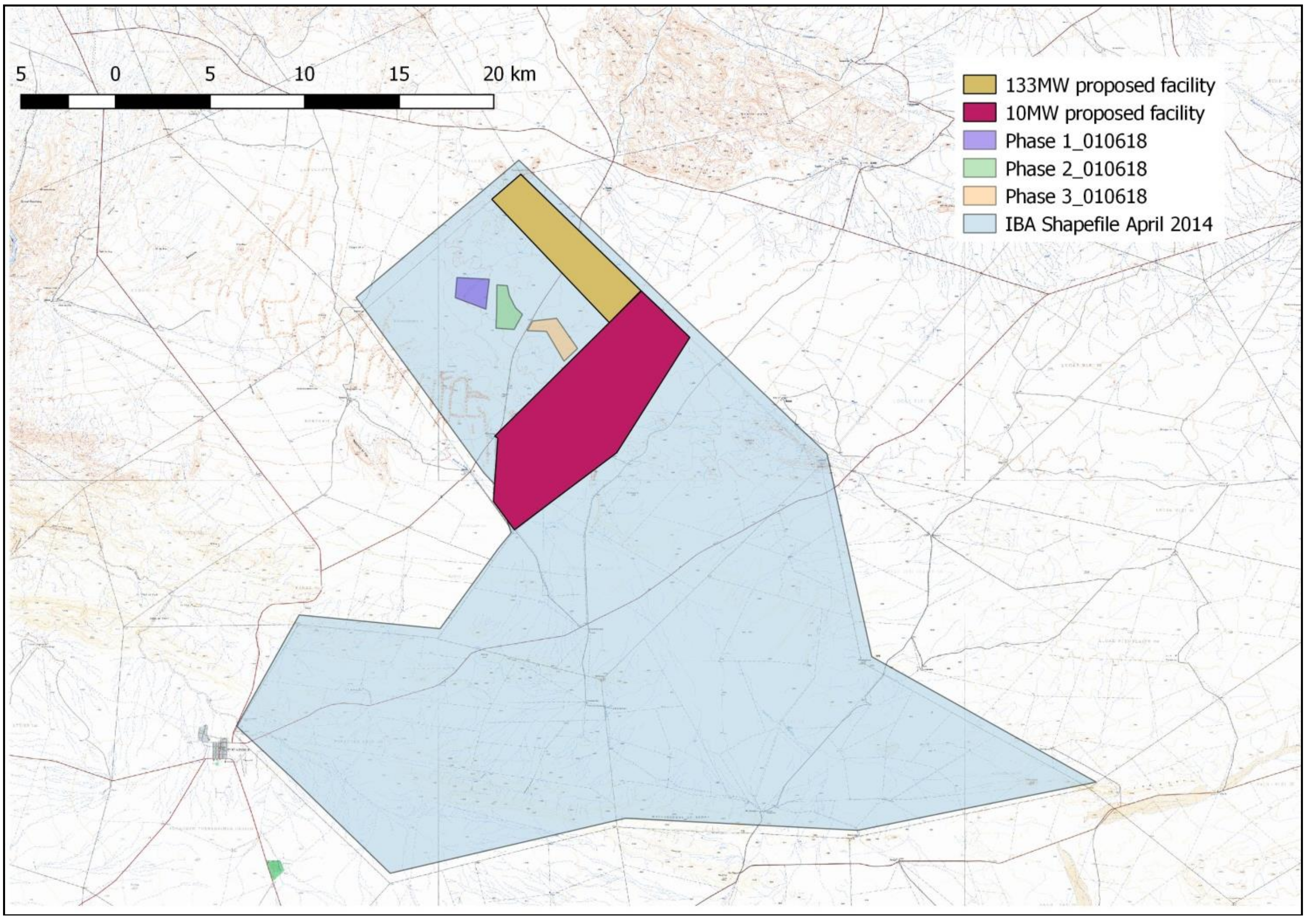


Figure 12. Planned renewable facilities within the Important Bird & Biodiversity Area.

Cumulative Impact Statement

In our view, the primary impact which will be residual after mitigation measures at all the above described facilities is habitat destruction. While the more sensitive habitats can be avoided spatially, and the total amount of habitat transformation can be kept to a minimum, it is unavoidable that a certain amount of habitat will be destroyed. It is not possible to mitigate this impact beyond a certain point. Our assessment of the Paulputs facility is that this impact remains at Medium significance post mitigation, and we believe it likely that the same significance will apply to other projects within this area. The impact of bird collision with overhead power lines in the area is also of concern in terms of residual impacts, since the line marking devices typically installed onto power lines to make them more visible to birds do not 100% eliminate bird collisions. Our assessment at Paulputs PV is that this mitigation in combination with optimal power line route selection (and location of facility close to

Paulputs Substation) is sufficient to reduce significance to Low. However, if the overall length of power line in the broader area is increased significantly by multiple projects, the cumulative impact would probably increase to Medium. This is one of the main reasons for our support for placing the new proposed Paulputs facility in its current location close to the Paulputs Substation as it reduces the length of grid connection power line required.

The overall cumulative impact of renewable energy facilities on avifauna in the IBBA is Low, since such a small proportion of the IBBA is affected. The proposed Paulputs Solar PV Energy Facilities make a Moderate contribution to the overall amount of land developed in the IBBA. The primary residual impact after mitigation is that of habitat destruction. We recommend that to mitigate this further, the DEA ensure that all projects authorised in this area monitor their impacts on birds during the operational phase, in accordance with the BirdLife SA guidance (Jenkins et al, 2017). This will ensure that standardised data is collected which can be analysed collectively in order to measure cumulative impacts and determine any further research or mitigation required. This monitoring should include any new overhead power line.

It is our opinion that it is advantageous for developments to be consolidated into this one area rather than dotted around the landscape. Consolidation of facilities close to Paulputs substation also means that less overhead power line is required with less bird collision risk.

3.8. IMPACT ASSESSMENT SUMMARY

Table 1 Impact assessment summary table for the Construction Phase

Impact source/ cause	Description of Impact	Nature of Impact	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Vegetation clearing	Destruction of bird habitat	Negative	Site	Long-term	Low	Most likely	Moderate	Moderate	Avoid sensitive areas – see sensitivity map	Medium	Medium	Some destruction of habitat is inevitable for construction
Construction activities, earth moving, machinery, vehicles	Disturbance of breeding sensitive species	Negative	Site	Short term	Moderate	Most likely	High	Low	Construction of new infrastructure should avoid No-go buffer area around Martial Eagle nest – see sensitivity map. At this stage since the nest is not active either the north or south access road may be used. However, the breeding status at the nest must be determined before construction and if the nest is active the southern access road must be used for the duration of breeding season (approximately May to November).	High	Low	Some noise and vibration disturbance are still unavoidable

Table 2 Impact assessment summary table for the Operational Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Operational activities, staff, vehicles	Disturbance of breeding sensitive species	Negative	Site	Long term	Moderate	Likely	High	Low	Construction of new infrastructure should avoid No-go buffer area around Martial Eagle nest – see sensitivity map	Moderate	Low	Some noise and vibration disturbance is still unavoidable
Operation of facility & associated infrastructure	Bird fatalities through collision/entanglement with infrastructure	Negative	Site	Long term	Moderate	Unlikely	High	Low	Avoid any open water storage ponds on site. See Section 9 for detailed mitigation	Low	Low	Some fatalities are probably inevitable but mitigation reduces fatalities to acceptable level
Operation of grid connection overhead power line	Bird fatalities through collision with or electrocution on power line	Negative	Site	Long term	Moderate	Most likely	High	Low	See Section 9 for detailed mitigation	High	Low	For collision, mitigation is approximately 60% effective, collisions can still occur
Operation of facility & associated infrastructure	Nesting of birds on infrastructure	Positive for birds but management of nests can be negative if not correct	Site	Long term	Low	Not likely	High	Low	Nest management only in accordance with EMP and applicable legislation	Low	Low	Nesting may still occur and require reactive management
Operation of facility & associated infrastructure	Water runoff patterns altered resulting in erosion or secondary effects on habitat	Negative	Site and surrounds	Long term	Low	Likely	High	Low	Thorough storm water management plan to form part of EMP	Medium	Low	Unlikely to be any residual impacts
Operation of facility & associated infrastructure	Secondary pollution of environment through chemical cleaning of PV panels	Negative	Site and surrounds	Long term	Low	Not likely	High	Low	EMP to include requirement to use only environmentally friendly cleaning agents	Low	Very Low	Unlikely to be any residual impacts

Table 3 Impact assessment summary table for the Decommissioning Phase

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Decommissioning activities, earth moving, machinery, vehicles	Disturbance of breeding sensitive species	Negative	Site	Short term	Moderate	Likely	High	Low	Construction of new infrastructure should avoid No-go buffer area around Martial Eagle nest – see sensitivity map. At this stage since the nest is not active either the north or south access road may be used. However, the breeding status at the nest must be determined before construction and if the nest is active the southern access road must be used for the duration of breeding season (approximately May to November)	Medium	Low	Some disturbance will still occur despite best efforts to mitigate

3.9. MITIGATION MEASURES AND MANAGEMENT ACTIONS

We have identified the following mitigation measures as being required if the project is to proceed:

- The sensitive areas identified on site should be avoided by infrastructure.
- All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted. No extra wide turning of vehicles off the existing and purpose built facility roads should be permitted.
- Care should be taken not to introduce or propagate alien plant species/weeds during construction.
- The No-go buffer area around the Martial Eagle nest should be adhered to with respect to the construction of new infrastructure. This buffer area is also relevant to vehicular traffic accessing the site. At this stage, since the eagle nest is not active, either the north or south access road can be used. However the status of breeding at the nest must be determined in the last breeding season prior to construction and if breeding is active the southern access road must be used during breeding season (approximately May to November).
- No construction staff should be allowed to visit the nest site for any reason.
- A site specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to construction, so as to ensure that no additional sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.
- Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.
- If the Martial Eagle nest is active during construction, monitoring of the eagles response to construction activities will need to be conducted by an avifaunal specialist.
- It is recommended that any on site water storage be done in closed tanks, not open ponds. If ponds are used they must be covered to ensure that birds are not attracted.
- The PV panels should spend as little time as possible in a vertical position since this presents a greater collision hazard due to the angle of typical bird flight being perpendicular to the reflective surface and reflections therefore causing the most confusion or errors by birds.
- Very little is known about the direct fatality impacts on birds of solar PV facilities in South Africa. For this reason post construction monitoring programme is recommended for this site, as prescribed by the latest relevant guidelines in order to document any impacts and provide the basis for an adaptive management approach to any impacts.
- Mitigation is complex at electrical structures since there are many ways in which birds could get electrocuted as the hardware is complex and provides many different potential perches for birds. It is therefore recommended that mitigation be applied reactively once the facility is operational, only if a significant problem is detected. Monitoring of this infrastructure for bird fatalities should be built into the operational environmental management plan for the facility.
- The most important mitigation measure for bird collision and electrocution on the overhead grid connection power line is to select the optimal route for the new power line. We recommend that Power line Alternative 1 be selected.
- All on site power line connecting panels to the on-site substation must be buried, as far as possible. No overhead power line should be allowed except for the grid connection line. It is

acceptable for cables to be laid on ground surface and covered with protective sheeting if geology does not allow it to be buried.

- The grid connection power line should be fitted with the best available (at the time of construction) anti bird collision line marking devices in order to make the overhead cables more visible to birds. More specifically:
  - Devices should be fitted on the entire length of the power line as collision risk is high all along the alignment for nomadic species such as Ludwig's Bustard.
  - Devices should be fitted on the earth wire/s.
  - On each span, the full span should be fitted with marking devices (i.e. not only the middle 60% as done previously by Eskom). Research has shown that collisions occur even close to transmission towers (Shaw, 2013).
  - Light and dark colour devices should be alternated so as to provide contrast against both dark and light backgrounds.
  - These devices should be fitted as soon as the earth wires are strung as collision risk begins immediately, not only once the line is commissioned and live.
  - The power line owner will be responsible for ensuring that the marking devices remain in place and effective on the power line for its' full lifespan. Any device failures must be rectified immediately by replacement with new devices.
- The power line should be monitored through patrolling its full length at least 4 times per year, during post construction monitoring period of 2 years to measure the impacts on birds and the durability of line marking devices. This can be done as part of the post construction bird monitoring for the full facility, described elsewhere in this report.
- The proposed tower/transmission tower structure for the grid connection power line has not been decided in detail. It is critically important that Eskom approved bird friendly structures be used, and that the Eskom Bird Perch be installed on all pole tops to provide safe perching space for large eagles well above the live hardware. In our opinion only large eagles (such as Martial) are at risk of electrocution in this study area, and these species tend to sit on the highest perch on transmission towers, i.e. the Bird Perch on pole top, thereby being safely above the hardware. We suggest that the phase-phase and phase-earth clearances should be in the range of 1500 – 1800mm.
- For the impact of the birds nesting on the power line/substation, we recommend nest management on a case by case basis under the supervision of an avifaunal specialist, and in conformance with all relevant national and provincial legislation.
- We recommend that the operational phase EMP include provision for application to the provincial authority for permits for any necessary nest management should the need arise during the operational phase.
- The surface water management plan should stipulate the use of environmentally friendly and acceptable cleaning products.
- DEA should ensure that all new facilities in this broader area monitor their impacts on birds once operational, in accordance with BirdLife SA guidance (Jenkins *et al,* 2017).

The most important mitigation measure for this site is the no-go buffer of 1.5km around the Martial Eagle nest. In compiling this mitigation recommendation for the Martial Eagle nest we have assumed that breeding continues at this site in future. However we must note that we have little data on the longevity of this nest to date. The nest was first recorded (to our knowledge) in late August 2016, and we have evidence of only one successful breeding season since then. Furthermore, we note that this nest is not in a pristine situation. The nest itself is on an artificial structure (power line). Within these birds' home range several power lines, extensive public gravel road and several solar facilities exist. A new 400kV Aggeneis - Paulputs power line will also be constructed through this area in future. The recent fatality is testimony to the risk that these power lines pose to the eagles. The availability of multiple identical Eskom transmission towers along the power line presents an opportunity for the eagles to nest on different transmission towers in future seasons, which could complicate matters. We expect nest fidelity to be reasonably high with Martial Eagle but a change in nest location is not inconceivable.

Large eagles such as the Martial Eagle present at the Paulputs SEF site are typically protected against the impacts of new developments through the use of spatial buffers. The aim of these buffer areas is to restrict the construction of infrastructure within a certain distance of the nest site. It is believed that such restrictions should reduce the construction phase disturbance risk to the birds (since noise, light and other forms of disturbance would be further away), protect habitat for the birds, reduce the operational phase displacement effects on the birds (since the buffer portion of the birds' territory remains unaltered), and reduce the risk of collision of birds with infrastructure (if that is a risk). Of these four impacts, the impact of disturbance is probably the most straight forward to mitigate for using a buffer approach. Without fully understanding the intricacies of the effects of disturbance on breeding eagles, it makes sense that the further the source of disturbance is from the eagles, the less the effect should be. In the case of displacement and collision it is more important to understand the eagles' behaviour within their territories, since the importance of parts of their territory may not automatically diminish with distance from the nest. For example, a prime foraging area could exist several kilometres from the nest, whilst the area immediately around the nest holds less prey. Prey populations are also well known to be subject to local population fluctuations, so these resource areas may vary in time.

Our view is that adequate mitigation for disturbance, displacement and habitat destruction can be provided with a buffer that includes a portion of the birds' home range. It is only when collision risk is very high that the full home range may need to be protected since birds in flight anywhere in their range could be at risk (such as at wind farms). At Paulputs Solar PV Energy Facility the collision risk is from the new grid connection power line, which we believe can be mitigated through correct routing and the installation of line marking devices in earth wires to make them more visible. We do not consider collision with solar infrastructure to be a risk at Paulputs SEF. Raptors (and more so eagles) seem poorly represented in PV facility fatality data collected at operational facilities (Kagan *et al,* 2014).

Experience at a wind farm in the Eastern Cape revealed that a buffer of 1km from the nest was sufficient to provide protection against breeding disturbance risks during construction (birds bred during construction and for at least one season post construction – pers obs). The topography at that site is however such that the nest is not as exposed to construction activities as at Paulputs Solar PV Energy Facility (it being in a small gorge). We therefore recommend a larger buffer of 1.5km at Paulputs. Factors affecting our decision on this buffer size include: that this is a nest on an artificial or man-made structure and hence cannot be considered as important as one on natural substrate (in which case the eagles would also serve as a flagship species for conservation of the natural habitat in which the nest is located); that one adult bird presumed from the breeding pair has recently been killed, and (perhaps as a result) no breeding took place in 2017 or 2018; that the nest site is already in an area of multiple forms of existing infrastructure; we don't consider collision with the facility to be a risk to this species; and that a larger buffer would render the proposed development unfeasible at this site, and we believe strongly that these developments should be consolidated in this area as close to Paulputs MTS Substation as possible and not scattered widely through the landscape (as may happen if this site is not available for development).

For clarity we have summarised in Table 4 the goals of imposing a protective buffer around the eagle nest at Paulputs SEF and the contribution this buffer size will make relative to the birds' home range. In our view, the adherence to a 1.5km no new infrastructure zone would provide sufficient protection against disturbance of breeding, if the eagles breed in the relevant season, which at this stage does not appear a given. This buffer zone will also provide sufficient protection during the operational phase in our view. In addition, the proposed facility will take up only approximately 6% of the home range of 108km². We believe this is a small enough proportion to be an acceptable risk. The same reasoning applies for the destruction of eagle habitat when the facility is constructed. Mitigation of eagle electrocution and collision risk on the necessary new grid connection power line will be achieved through a combination of the 1.5km no go zone and mitigation on the power line infrastructure itself (line marking devices for collision and bird friendly transmission tower design for electrocution). This buffer area is also relevant to vehicular traffic accessing the site. At this stage, since the eagle nest is not active, either the north or south access road can be used. However the status of breeding at the nest must be determined in the last breeding season prior to construction and if breeding is active the southern access road must be used during breeding season (approximately May to November).

Table 4. Summary of risk management/mitigation approach to the Martial Eagle nest close to the Paulputs site.

Risk	Goal	Project phase	Buffer	Effect
Disturbance of eagle breeding	Minimise impact on breeding productivity	Construction	No construction activities or project related traffic within 1.5km of nest. At this stage, since the eagle nest is not active, either the north or south access road can be used. However the status of breeding at the nest must be determined in the last breeding season prior to construction and if breeding is active the southern access road must be used during breeding season (approximately May to November).	Breeding will continue unaffected if birds choose to breed in that season.
		Operational	No operational activities within 1.5km.	No disturbance of eagles during operational life span of facility.
Displacement of eagles	Minimise displacement effects	Operational	No operational activities within 1.5km.	7.1% of theoretical home range will be protected by the buffer.

Destruction of habitat	Minimise impact on foraging range	Construction	No operational activities within 1.5km.	Facility uses 6.4km² (6%) of 108km² theoretical home range, none of which is within the portion closest to nest.
Collision with or electrocution on power lines	Eliminate risk of electrocution Minimise risk of collision	Operational	Route new power line outside of 1.5km buffer. Mitigate by using bird friendly structures (electrocution) and installing line marking devices on earth wires (collision).	New power lines will be bird friendly and pose no risk.

- **Monitoring requirements**

It is recommended that an avifaunal walk-through be conducted on site just prior to construction. Amongst other tasks this walk through must determine whether the Martial Eagle nest is active in the last breeding season prior to construction. If it is active it will be necessary to monitor the breeding status at the nest during construction and if possible the eagles reaction to construction activities. This should be done through three site visits during the breeding season (May to November), by a suitably qualified avifaunal specialist during construction period.

Post-construction bird monitoring should be started as soon as possible after the facility becomes operational and continue for a minimum of two years. This should ensure that the immediate effects of the facility on resident and passing birds are recorded, while avoiding the confusing, short-term effects of the construction process. The below framework is that recommended by Jenkins *et al* (2017).

Post-construction bird data collection or monitoring is critical to:

- Determine the actual impacts of the facility.
- Determine if additional mitigation is required (adaptive management).
- Provide an indication of likely impacts from scaling-up (similar developments in same general area);
- Improve future assessments.

Post-construction monitoring can be divided into three categories: habitat classification; quantifying bird abundance (replicating baseline data collection); and quantifying bird mortalities.

Habitat classification
The exact 'as built' effects of the facility on the natural habitat should be delineated, classified and quantified once construction is complete. This should take into account any secondary effects such as erosion, alien plant invasion, and incomplete rehabilitation of areas used temporarily.

Bird abundance
As a rule of thumb survey protocols used in baseline data collection should be repeated during the first two years of operation (12 months/4 seasons in year 1, and 12 months/4 seasons in year 2 for Regime 3 sites), and should be combined with monitoring of fatalities over the full two-year period. This should be subject to review at the end of this time and in the event that significant impacts are

measured it may be necessary to extend data collection for longer. It may also be necessary to repeat post-construction monitoring protocols periodically (perhaps every 3-5 years) over the lifetime of the project, should it be deemed necessary at the time.

Quantifying bird mortalities/fatality estimates
This should be done by a dedicated full time team of staff searching the facility regularly (recommended weekly) with a formal and measureable searching method. Any bird carcasses found should be kept on site in a freezer until all necessary information has been recorded. It will also be necessary to conduct searcher efficiency and carcass persistence trials on site to obtain estimates of these factors for use in the statistical analysis, to account for those birds not found or removed by scavengers.

Reporting
Quarterly reports, summarising interim findings should be complied and submitted to BirdLife South Africa and the Department of Environmental Affairs. At the end of each year of monitoring, a more detailed post-construction monitoring report analysing the results should be completed and submitted to relevant stakeholders (as identified by the DEA).

We recommend that the grid connection power line be monitored as part of the post construction monitoring of the proposed PV facility as follows:

- The full power line should be driven or walked at least 4 times per year, during the 2 year post-construction monitoring period.
- An area extending out to 50m either side of the power line centre line should be scanned for any bird carcasses. Experience conducting similar surveys has indicated that bird collision victims may fall up to 50m from the power line as a result of their momentum. Any such carcasses should be carefully documented and kept frozen on site.
- All transmission tower/tower tops should be scanned for bird nests. Where nests are found they should be observed to determine which species are breeding. Priority species nests should be photographed and breeding status recorded.
- If any significant findings are made these should be reported on.

3.10. CONCLUSIONS AND RECOMMENDATIONS

We made the following findings with respect to avifauna:

- Our surveys on site took place in a slightly below average rainfall year, but good rain did fall just prior to our final site visit. We consider the data from this site visit to have sampled optimal conditions on site.
- The proposed site falls within the Mattheus-Gat Conservation Area Important Bird & Biodiversity Area.
- A total of 15 bird species were recorded by walked transects on site across the four seasons, with a peak in species richness in autumn (post rainfall) of 13 species, followed by summer (4), winter (4) and spring (3). Karoo Korhaan was the only regionally Red Listed species recorded by this method. The most abundant species was Stark's Lark Spizocorys starki (near-endemic), followed by Black-eared Sparrowlark Eremopterix australis (a near-endemic to South Africa); and Grey-backed Sparrowlark Eremopterix verticali. These three species were recorded only in autumn (post good rainfall). Our autumn site visit recorded a significant influx of smaller bird species onto the site based on better plant growth and food availability after the rain. Red Lark, Sclater's Lark, and Burchell's Courser Cursorius rufus (all regionally Red Listed and in the case of the larks endemics) were not recorded on site by this method (or any other).

- A total of 4 species were recorded by driven transects on site, 3 species in summer, 2 species in spring and 1 in winter and autumn. Two of the 4 species are regionally Red Listed: Karoo Korhaan is Near-threatened and Ludwig's Bustard is Endangered. Interestingly the larger bird species did not show a similar increase (such as that of the small passerines) in abundance on site after the rainfall.
- Our work on site recorded a total of 42 species on site: 21 on the initial site visit; 19 in winter; 22 in spring; 16 in summer; and 21 in autumn. Six of the species recorded on site are regionally Red Listed (Taylor et al, 2015): Ludwig's Bustard and Martial Eagle (Endangered); Lanner Falcon and Verreaux's Eagle (Vulnerable); and Karoo Korhaan and Kori Bustard (Near-threatened). Four of the recorded species are near-endemic to South Africa: Black-eared Sparrowlark; Jackal Buzzard Buteo rufofuscus; Large-billed Lark Galerida magnirostris; and Sickle-winged Chat Cercomela sinuata.
- A Martial Eagle nest was found on the existing Aggeneis Paulputs 220kV power line on site. This pair of eagles bred successfully in 2016 but did not breed in 2017 or in 2018. Previous observations indicated that the absence of breeding possibly results from one adult being killed through collision with an existing 33kV power line.

Our assessment of the significance of the impacts on avifauna on site is as follows:

- Habitat destruction during the construction phase will be of Medium significance, both pre and post-mitigation.
- Disturbance of birds during the construction phase will be of High significance and can be mitigated to Low significance.
- Disturbance of birds during the operational phase will be of Medium significance, mitigated to Low significance.
- Bird fatalities at the facility during the operational phase (mostly through collision with infrastructure) will be of Low significance pre and post mitigation.
- Nesting of birds on the facility infrastructure during the operational phase will be of Low significance.
- Altered surface water runoff on site during the operational phase will be of Medium significance and can be mitigated to Low significance.
- Chemical pollution due to panel cleaning during the operational phase will be of Low significance reduced to Very low by mitigation.
- Disturbance of birds during the decommissioning phase will be of Medium significance mitigated to Low.

Mitigation for inclusion in the EMPr

The following mitigation measures are recommended:

- The sensitive areas identified on site should be avoided by infrastructure.
- All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted. No extra wide turning of vehicles off the existing and purpose built facility roads should be permitted.
- Care should be taken not to introduce or propagate alien plant species/weeds during construction.
- The No-go buffer area around the Martial Eagle nest should be adhered to with respect to the construction of new infrastructure. This buffer area is also relevant to vehicular traffic accessing the site. At this stage, since the eagle nest is not active, either the north or south access road can be used. However the status of breeding at the nest must be determined in

the last breeding season prior to construction and if breeding is active the southern access road must be used during breeding season (approximately May to November).

- No construction staff should be allowed to visit the nest site for any reason.
- A site specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to construction, so as to ensure that no additional sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.
- Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.
- If the Martial Eagle nest is active during construction, monitoring of the eagles response to construction activities will need to be conducted by an avifaunal specialist.
- It is important that any on site water storage be done in closed tanks, not open ponds. If ponds are used they must be covered to ensure that birds are not attracted.
- The PV panels should spend as little time as possible time in a vertical position since this presents a greater collision hazard due to the angle of typical bird flight being perpendicular to the reflective surface and reflections therefore causing the most confusion or errors by birds.
- Very little is known about the direct fatality impacts on birds of solar PV facilities in South Africa. For this reason post construction monitoring programme is recommended for this site, as prescribed by the latest relevant guidelines in order to document any impacts and provide the basis for an adaptive management approach to any impacts.
- Mitigation is complex at electrical structures since there are many ways in which birds could get electrocuted as the hardware is complex and provides many different potential perches for birds. It is therefore recommended that mitigation be applied reactively once the facility is operational, only if a significant problem is detected. Monitoring of this infrastructure for bird fatalities should be built into the operational environmental management plan for the facility.
- The most important mitigation measure for bird collision and electrocution on the overhead grid connection power line is to select the optimal route for the new power line. We recommend that Power line Alternative 1 be selected.
- All on site power line connecting panels to the on-site substation must be buried. No overhead power line should be allowed except for the grid connection line. It is acceptable to lay cables on ground surface if necessary from a technical perspective, but they may not be raised off the ground as this then poses a collision risk to birds in flight and attracts birds to perch thereby posing an electrocution risk.
- The grid connection power line should be fitted with the best available (at the time of construction) anti bird collision line marking devices in order to make the overhead cables more visible to birds. More specifically:
- Devices should be fitted on the entire length of the power line as collision risk is high all along the alignment for nomadic species such as Ludwig's Bustard.
- Devices should be fitted on the earth wire/s.
- On each span, the full span should be fitted with marking devices (i.e. not only the middle 60% as done previously by Eskom). Research has shown that collisions occur even close to transmission towers (Shaw, 2013).
- Light and dark colour devices should be alternated so as to provide contrast against both dark and light backgrounds.
- These devices should be fitted as soon as the earth wires are strung as collision risk begins immediately, not only once the line is commissioned and live.
- The power line owner will be responsible for ensuring that the marking devices remain in place and effective on the power line for its' full lifespan. Any device failures must be rectified immediately by replacement with new devices.

- The power line should be monitored through patrolling its full length at least 4 times per year during the 2 year operational monitoring programme to measure the impacts on birds and the durability of line marking devices. This can be done as part of the post construction bird monitoring for the full facility, described elsewhere in this report.
- The proposed tower/transmission tower structure for the grid connection power line has not been decided in detail. It is critically important that Eskom approved bird friendly structures be used, and that the Eskom Bird Perch be installed on all pole tops to provide safe perching space for large eagles well above the live hardware. In our opinion only large eagles (such as Martial) are at risk of electrocution in this study area, and these species tend to sit on the highest perch on transmission towers, i.e. the Bird Perch on pole top, thereby being safely above the hardware. We suggest that the phase-phase and phase-earth clearances should be in the range of 1500 – 1800mm.
- For the impact of the birds nesting on the power line/substation, we recommend nest management on a case by case basis under the supervision of an avifaunal specialist, and in conformance with all relevant national and provincial legislation.
- We recommend that the operational phase EMP include provision for application to the provincial authority for permits for any necessary nest management should the need arise during the operational phase.
- There is a need for the development of a carefully considered surface water/drainage management plan for the site. This plan should stipulate the use of environmentally friendly and acceptable cleaning products.
- DEA should ensure that all new facilities in this broader area monitor their impacts on birds once operational, in accordance with BirdLife SA guidance (Jenkins et al, 2017).

Environmental impact statement

The proposed site is important habitat for an assemblage of arid zone bird species, several of which are endemic. The transformation of natural habitat for the proposed facility will therefore be of Medium significance. Fortunately the facility will transform a small area relative to the remaining habitat, which is fairly uniform in the broader area. Further, we strongly believe it wise to consolidate such facilities in a node such as that surrounding Paulputs Substation. The impact of habitat destruction can be mitigated to moderate significance by ensuring that the more sensitive micro habitats are designated as no go areas. All other impacts are of moderate or low significance. We recommend that the facility be authorised, provided that the recommendations of this report are implemented.

Cumulative impact statement

In our view, the primary impact which will be residual after mitigation measures at all the above described facilities is habitat destruction. While the more sensitive habitats can be avoided spatially, and the total amount of habitat transformation can be kept to a minimum, it is unavoidable that a certain amount of habitat will be destroyed. It is not possible to mitigate this impact beyond a certain point. Our assessment of the Paulputs facility is that this impact remains at Medium significance post mitigation, and we believe it likely that the same significance will apply to other projects within this area. The impact of bird collision with overhead power lines in the area is also of concern in terms of residual impacts, since the line marking devices typically installed onto power lines to make them more visible to birds do not 100% eliminate bird collisions. Our assessment at Paulputs PV is that this mitigation in combination with optimal power line route selection (and location of facility close to Paulputs Substation) is sufficient to reduce significance to Low. However if the overall length of power line in the broader area is increased significantly by multiple projects, the cumulative impact would probably increase to Medium. This is one of the main reasons for our support for placing the new proposed Paulputs facility in its current location close to the Paulputs Substation as it reduces the length of grid connection power line required.

The overall cumulative impact of renewable energy facilities on avifauna in the IBBA is Low, since such a small proportion of the IBBA is affected. The proposed Paulputs Solar PV Energy Facilities make a Moderate contribution to the overall amount of land developed in the IBBA. The primary residual impact after mitigation is that of habitat destruction. We recommend that to mitigate this further, the DEA ensure that all projects authorised in this area monitor their impacts on birds during the operational phase, in accordance with the BirdLife SA guidance (Jenkins et al, 2017). This will ensure that standardised data is collected which can be analysed collectively in order to measure cumulative impacts and determine any further research or mitigation required. This monitoring should include any new overhead power line.

It is our opinion that it is advantageous for developments to be consolidated into this one area rather than dotted around the landscape. Consolidation of facilities close to Paulputs substation also means that less overhead power line is required with less bird collision risk.

3.11. APPENDIX A: REFERENCES

Allan, D.G. 1994. The abundance and movements of Ludwig's Bustard Neotis ludwigii. Ostrich 65: 95-105.

Alonso, J.A. and Alonso, J.C. 1999. Collision of birds with overhead transmission lines in Spain. In: Ferrer, M. and

Anderson, M.D. 2002. Karoo large terrestrial bird powerline project: Report No 1. Eskom, Johannesburg.

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating bird collisions with power lines: the state of the art in 1994. Edison Electrical Institute, Washington D.C.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing avian collisions with power lines: the state of the art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Boshoff A. Density, breeding performance and stability of Martial Eagles Polemaetus bellicosus breeding on electricity transmission towers in the Nama-Karoo, South Africa. Annales-Musee Royal de l'Afrique Centrale Sciences Zoologiques (Belgium). 1993.

Curtis, O.E., Simmons, R.E., Jenkins, A.R., 2007. Black Harrier Circus maurus of the Fynbos biome, South Africa, a threatened specialist or an adaptable survivor. Bird Conservation International. 14: 233-245.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. and Brown, C.J. (Eds.) 1997. The Atlas of Southern African Birds. BirdLife South Africa, Johannesburg.

Hockey, P.A.R., Dean, W.R.J. and Ryan, P.G. (Eds.) 2005. Roberts Birds of Southern Africa, 7th edn. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Janss, G.F.E. 2000. Avian mortality from power lines: a morphological approach of a species-specific mortality. Biological Conservation 95: 353–359.

Janss, G.F.E. (Eds.) Birds and Power Lines. Collision, Electrocution and Breeding: pages 57-82. Servicios Informativos Ambientales/Quercus, Madrid.

Janss, G.F.E. and Ferrer, M. 1998. Rate of bird collision with power lines: effects of conductor-marking and static wire-marking. Journal of Field Ornithology 69: 8-17.

Jenkins, A.R., Smallie, J.J. and Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 20: 263-278.

Jenkins, A.R., Shaw, J.M., Smallie, J.J., Gibbons, B., Visagie, R. and Ryan, P.G. 2011. Estimating the impacts of power line collisions on Ludwig's Bustards Neotis ludwigii. Bird Conservation International 21: 303 – 310.

Jenkins, A.R., Ralston-Paton, S., & Smit-Robinson, H. 2017. Best Practice Guidelines: Birds and Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa.

Kagan, R.A., T.C. Viner, P.W. Trail, and E.O. Espinoza. 2014. Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis. National Fish and Wildlife Forensics Laboratory.
Marnewick MD, Retief EF, Theron NT, Wright DR, Anderson TA. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.
Mucina, L., & Rutherford, C. 2006. The Vegetation of South Africa, Lesotho and Swaziland, South African National Biodiversity Institute, Pretoria.
Raab, R., Spakovszky, P., Julius, E., Schütz, C. and Schulze, C.H. 2011a. Effects of power lines on flight behaviour of the West-Pannonian Great Bustard Otis tarda population. Bird Conservation International 21:142-155.
Raab, R., Schütz, C., Spakovszky, P., Julius, E. and Schulze, C.H. 2011b. Underground cabling and marking of power lines: conservation measures rapidly reduced mortality of West-Pannonian Great Bustards Otis tarda. Bird Conservation International 22: 299-306.
Rudman, J., Gauche, P., & Esler, K. 2017. Direct environmental impacts of solar power in two arid biomes: an initial investigation. South African Journal of Science, 2017: 113
Senyatso, K.J. 2011. Conserving widely distributed wildlife species in an African savannah: parks, cattle-grazing and community-managed areas. PhD thesis, University of East Anglia, Norwich.
Senyatso, K.J., Collar, N.J. and Dolman, P.M. 2012. Assessing range-wide conservation status change in an unmonitored widespread African bird species. Diversity and Distributions 19: 106-119.
Shaw, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. PhD Thesis, University of Cape Town, Cape Town.
Shaw, J.M., Jenkins, A.R., Smallie, J.J. and Ryan, P.G. 2010. Modelling power-line collision risk for the Blue Crane Anthropoides paradiseus in South Africa. Ibis 152: 590-599.
Shaw, J.M., van der Merwe, R., van der Merwe, E. and Ryan, P.G. In prep. Camera traps reveal high winter scavenging rates under power lines in the Karoo.
Simmons, R.E., Brown, C.J., & Kemper, J. 2015. Birds to watch in Namibia: red, rare and endemic species. Ministry of Environment and Tourism and Namibia Nature Foundation, Windhoek
Smallie, J. 2017. Paulputs Solar Energy Facility – Initial Avifaunal Assessment. Unpublished report submitted to juwi.
Taylor, M. R, Peacock, F., & Wanless, R. 2015. The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho & Swaziland.
Van Eeden, R., Whitfield, P., Botha, A. & Amar, A. 2017. Ranging behaviour and habitat preferences of the Martial Eagle: Implications for the decline of a declining apex predator. PLoS ONE 12(3): e0173956. https://doi.org/10.1371/journal.pone.0173956
Van Rooyen, C., Froneman, A. & LaubsCher, N. 2015. Avifaunal pre- and post-construction monitoring at the Globeleq De Aar Solar Energy Facility. Unpublished report.
Visser, E. 2016. The impact of South Africa's largest photovoltaic solar energy facility on birds in the Northern Cape, South Africa. Minor Dissertation presented in partial fulfilment of the requirements for the degree of Masters of Science in Conservation Biology. Percy FitzPatrick Institute of African Ornithology, University of Cape Town, Rondebosch, 7701, South Africa.
Young, D.J., Harrison, J.A., Navarro, R.A., Anderson, M.D., & Colahan, B.D. (eds) 2003. Big Birds on Farms: Mazda CAR Report 1993-2001. Avian Demography Unit. Cape Town.

Websites:
www.sabap2.adu.org.za Southern African Bird Atlas Project 2
www.mybirdpatch.org.za
www.cwac.adu.org.za
www.car.adu.org.za

3.12. APPENDIX B: SPECIALIST IMPACT ASSESSMENT CRITERIA

The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of the predicted environmental impacts and risks is described in Part 5 - Section 4 of the EIA report.

3.13. APPENDIX C: SPECIALIST DECLARATION

APPENDIX C:

Specialist Declaration

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

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

Signature of the specialist: ______________________

Name of Specialist: __Jon Smallie – WildSkies Ecological Services (Pty) Ltd______________

Date: _22 June 2018______________________

3.14. APPENDIX D: SPECIALIST CURRICULUM VITAE

JONATHAN JAMES SMALLIE
WildSkies Ecological Services (2011/131435/07)
Curriculum Vitae

BACKGROUND
Date of birth: 20 October 1975
Qualifications: BSC – Agriculture (Hons) (completed 1998)
University of Natal – Pietermaritzburg
MSC – Environmental Science (completed 2011)
University of Witwaterstrand
Occupation: Specialist avifaunal consultant
Profession registration: South African Council for Natural Scientific Professions

CONTACT DETAILS
Cell number: 082 444 8919
Fax: 086 615 5654
Email: jon@wildskies.co.za
Postal: 36 Utrecht Avenue, Bonnie Doon, East London, 5210

PROFESSIONAL EXPERIENCE
Consulting Projects:

Post construction bird monitoring for wind energy facilities:
Dassieklip (Caledon) –initiated in April 2014; Dorper Wind Farm (Molteno) – initiated in July 2014; Jeffreys Bay Wind Farm – initiated in August 2014; Kouga Wind Farm – started Feb 2015; Cookhouse West Wind Farm – started March 2015; Grassridge Wind Farm – initiated in April 2015; Chaba Wind Farm – initiated December 2015; Amakhala Emoyeni 01 Wind Farm initiated August 2016; Gibson Bay Wind Farm – initiated March 2017; Nojoli Wind Farm initiated March 2017.

Pre-construction bird monitoring & EIA for wind energy facilities:
Golden Valley; Middleton; Dorper; Qumbu; Ncora; Nqamakhwe; Ndakana; Thomas River; Peddie; Mossel Bay; Hluhluwe; Richards Bay; Garob; Outeniqua; Castle; Wolf; Inyanda-Roodeplaat; Dassiesridge; Great Kei; Bayview; Grahamstown; Bakenskop; Umsobomvu; Stormberg; Zingesele; Oasis; Gunstfontein; Naumanii; Golden Valley Phase 2; Ngxwabangu; Hlobo; Woodstock; and Impofu wind energy facilities.

Other Electricity Generation projects:
Port of Nqura Power Barge EIA; Bonnievale Solar Energy Facility; Dealesville Solar Energy Facility; Rooipunt Solar Energy Facility; De Aar Solar Energy Facility; Noupoort Solar Energy Facility, Aggeneys Solar Energy Facility; Tugela Hydro-Electric Scheme; Eskom Concentrated Solar Power Plant; Bronkhorstspruit Solar Photovoltaic Plant; De Aar Solar Energy Facility; Paulputs Solar Energy Facility; Kenhardt Solar Energy Facility.

Overhead transmission power lines (>132 000 kilovolts):
Oranjemund Gromis 220kv; Perseus Gamma 765kv; Aries Kronos 765kv; Aries Helios 765kv; Perseus Kronos 765kv; Helios Juno 765kv; Borutho Nzelele 400kv; Foskor Merensky 275kv; Kimberley Strengthening; Mercury Perseus 400kV; Eros Neptune Grassridge 400kV; Kudu Juno 400kV; Garona Aries 400kV; Perseus Hydra 765Kv; Tabor Witkop 275kV; Tabor Spencer 400kV; Moropule Orapa 220kV (Botswana); Coega Electrification; Majuba Venus 765kV; Gamma Grassridge 765kV; Gourikwa Proteus

400KV; Koeberg Strengthening 400kV; Ariadne Eros 400kV; Hydra Gamma 765kV; Zizabona transmission - Botswana

Overhead distribution power lines (<132 000 kilovolts):
Kanoneiland 22KV; Hydra Gamma 765kV; Komani Manzana 132kV; Rockdale Middelburg 132kV; Irenedale 132 kV; Zandfontein 132kV; Venulu Makonde 132 kV; Spencer Makonde 132 kV; Dalkeith Jackal Creek 132Kv; Glen Austin 88kV; Bulgerivier 132kV; Ottawa Tongaat 132kV; Disselfontein 132kV; Voorspoed Mine 132kV; Wonderfontein 132kV; Kabokweni Hlau Hlau 132kV; Hazyview Kiepersol 132kV; Mayfern Delta 132kV; VAAL Vresap 88kV; Arthursview Modderkuil 88kV; Orapa, AK6, Lethakane substations and 66kV lines (Botswana); Dagbreek Hermon 66kV; Uitkoms Majuba 88kV; Pilanesberg Spitskop 132kV; Qumbu PG Bison 132kV; Louis Trichardt Venetia 132kV; Rockdale Middelburg Ferrochrome 132kV; New Continental Cement 132KV; Hillside 88kV; Marathon Delta 132kV; Malelane Boulder 132kV; Nondela Strengthening 132kV; Spitskop Northern Plats 132kV; West Acres Mataffin 132kV; Westgate Tarlton Kromdraai 132kV; Sappi Elliot Ugie 132kV; Melkhout Thyspunt 132kV; St Francis Bay 66kv

Risk Assessments on existing power lines:
Hydra-Droerivier 1,2 & 3 400kV; Hydra-Poseidon 1,2 400kV; Butterworth Ncora 66kV; Nieu-Bethesda 22kV; Maclear 22kV (Joelshoek Valley Project); Wodehouse 22kV (Dordrecht district); Burgersdorp Aliwal North Jamestown 22kV; Cradock 22kV; Colesberg area 22kV; Loxton self-build 11kV; Kanoneiland 22kV; Stutterheim Municipality 22kV; Majuba-Venus 400kV; Chivelston-Mersey 400kV; Marathon-Prairie 275kV; Delphi-Neptune 400kV; Ingagane – Bloukrans 275kV; Ingagane – Danskraal 275kV; Danskraal – Bloukrans 275kV

Avifaunal "walk through" (EMP's):
Kappa Omega 765kv; Rockdale Marble Hall 400kv; Beta Delphi 400kV; Mercury Perseus 765kV; Perseus 765kV Substation; Beta Turn 765kV in lines; Spencer Tabor 400kV line; Kabokweni Hlau Hlau 132kV; Mayfern Delta 132Kv; Eros Mtata 400kV; Cennergi Grid connect 132kV; Melkhout Thyspunt 132kv.

Strategic Environmental Assessments for Master Electrification Plans:
Northern Johannesburg area; Southern KZN and Northern Eastern Cape; Northern Pretoria; Western Cape Peninsula

Other specialist studies:
Bird Impact Assessment for Lizzard Point Golf Estate – Vaaldam; Bird Impact Assessment for Lever Creek Estates housing development; Investigation into rotating Bird Flapper saga – Aberdeen 22Kv; Investigation of in excess of 80 separate incidents of bird mortalities on power line networks from August 1999 to present; Investigation of bird mortalities at 3 substations; Special investigation into faulting on Ariadne-Eros 132kV; Special investigation into Bald Ibis faulting on Tutuka Pegasus 275kV; Special investigation into bird related faulting on 22kV Geluk Hendrina line; Special investigation into bird related faulting on Camden Chivelston 400kV line

Specialist risk assessments for wildlife airport hazards:
Kigali International Airport – Rwanda; Port Elizabeth Airport – specialist study as part of the EIA for the proposed Madiba Bay Leisure Park; Manzini International Airport (Swaziland); Polokwane International Airport; Mafekeng International Airport; Lanseria Airport

Positions held to date:
August 1999 to May 2004: Eastern Cape field officer for the South African Crane Working Group of the Endangered Wildlife Trust

May 2004 to November 2007: National Field officer for Eskom-EWT Strategic Partnership and Airports Company SA – EWT Strategic Partnership (both programmes of Endangered Wildlife Trust)
November 2007 to August 2011: Programme Manager – Wildlife & Energy Programme – Endangered Wildlife Trust
August 2011 to present: Independent avifaunal specialist – Director at WildSkies Ecological Sevices (Pty) Ltd

Relevant achievements:
Recipient of BirdLife South Africa's Giant Eagle Owl in 2011 for outstanding contribution to bird conservation in SA
Founded and chaired for first two years – the Birds and Wind Energy Specialist Group (BAWESG) of the Endangered Wildlife Trust & BirdLife South Africa.

Conferences attended and presented at:
May 2011. Conference of Wind Energy and Wildlife, Trondheim, Norway.
March 2011. Chair and facilitator at Endangered Wildlife Trust – Wildlife & Energy Programme – "2011 Wildlife & Energy Symposium", Howick, SA
September 2010 – Raptor Research Foundation conference, Fort Collins, Colorado. Presented on the use of camera traps to investigate Cape Vulture roosting behaviour on transmission lines
May 2010 - Wind Power Africa 2010. Presented on wind energy and birds
October 2008. Session chair at Pan-African Ornithological Conference, Cape Town, South Africa
March 27 – 30 2006: International Conference on Overhead Lines, Design, Construction, Inspection & Maintenance, Fort Collins Colorado USA. Presented a paper entitled "Assessing the power line network in the Kwa-Zulu Natal Province of South Africa from a vulture interaction perspective".
June 2005: IASTED Conference at Benalmadena, Spain – presented a paper entitled "Impact of bird streamers on quality of supply on transmission lines: a case study"
May 2005: International Bird Strike Committee 27th meeting – Athens, Greece. Presented a paper entitled Bird Strike Data analysis at SA airports 1999 to 2004.
2003: Presented a talk on "Birds & Power lines" at the 2003 AGM of the Amalgamated Municipal Electrical Unions – in Stutterheim - Eastern Cape
September 2000: 5th World Conference on Birds of Prey in Seville, Spain.

Papers & publications:
Prinsen, H.A.M., J.J. Smallie, G.C. Boere, & N. Pires. (compilers), 2011. Guidelines on how to avoid or mitigate impacts of electricity power grids on migratory birds in the African-Eurasian Region. CMS Technical Series Number XX. Bonn, Germany.
Prinsen, H.A.M., J.J. Smallie, G.C. Boere, & N. Pires. (compilers), 2011. Review of the conflict between migratory birds and electricity power grids in the African-Eurasian region. CMS Technical Series Number XX, Bonn, Germany.
Jenkins, A.R., van Rooyen, C.S, Smallie, J.J, Harrison, J.A., Diamond, M.D., Smit-Robinson, H.A & Ralston, S. 2014. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa
Jenkins, A.R., Shaw, J.M., Smallie, J.J., Gibbons, B., Visagie, R. & Ryan, P.G. 2011. Estimating the impacts of power line collisions on Ludwig's Bustards Neotis ludwigii. Bird Conservation International.
Jordan, M., & Smallie, J. 2010. A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds. Endangered Wildlife Trust , Unpublished report
Smallie, J., & Virani, M.Z. 2010. A preliminary assessment of the potential risks from electrical infrastructure to large birds in Kenya. Scopus 30: p32-39
Shaw, J.M., Jenkins, A.R., Ryan, P.G., & Smallie, J.J. 2010. A preliminary survey of avian mortality on power lines in the Overberg, South Africa. Ostrich 2010. 81 (2) p109-113

Jenkins, A.R., Smallie, J.J., & Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 2010. 20: 263-278.
Shaw, J.M., Jenkins, A.R., Ryan, P.G., & Smallie, J.J. 2010. Modelling power line collision risk for the Blue Crane *Anthropoides paradiseus* in South Africa. Ibis 2010 (152) p590-599.
Jenkins, A.R., Allan, D.G., & Smallie, J.J. 2009. Does electrification of the Lesotho Highlands pose a threat to that countries unique montane raptor fauna? Dubious evidence from surveys of three existing power lines. Gabar 20 (2).
Smallie, J.J., Diamond, M., & Jenkins, A.R. 2008. Lighting up the African continent – what does this mean for our birds? Pp 38-43. In Harebottle, D.M., Craig, A.J.F.K., Anderson, M.D., Rakotomanana, H., & Muchai. (eds). Proceedings of the 12th Pan-african Ornithological Congress. 2008. Cape Town. Animal Demography Unit. ISBN (978-0-7992-2361-3)
Van Rooyen, C., & Smallie, J.J. 2006. The Eskom –EWT Strategic Partnership in South Africa: a brief summary. Nature & Faunae Vol 21: Issue 2, p25
Smallie, J. & Froneman, A. 2005. Bird Strike data analysis at South African Airports 1999 to 2004. Proceedings of the 27th Conference of the International Bird Strike Committee, Athens Greece.
Smallie, J. & Van Rooyen, C. 2005. Impact of bird streamers on quality of supply on transmission lines: a case study. Proceedings of the Fifth IASTED International Conference on Power and Energy Systems, Benalmadena, Spain.
Smallie, J. & Van Rooyen, C. 2003. Risk assessment of bird interaction on the Hydra-Droërivier 1 and 2 400kV. Unpublished report to Eskom Transmission Group. Endangered Wildlife Trust. Johannesburg. South Africa
Van Rooyen, C. Jenkins, A. De Goede, J. & Smallie J. 2003. Environmentally acceptable ways to minimise the incidence of power outages associated with large raptor nests on Eskom transmission towers in the Karoo: Lessons learnt to date. Project number 9RE-00005 / R1127 Technology Services International. Johannesburg. South Africa
Smallie, J. J. & O'connor, T. G. (2000) Elephant utilization of *Colophospermum mopane*: possible benefits of hedging. African Journal of Ecology 38 (4), 352-359.

Courses & training:
Successfully completed a 5 day course in High Voltage Regulations (modules 1 to 10) conducted by Eskom – Southern Region
Successfully completed training on, and obtained authorization for, live line installation of Bird Flappers

3.15. APPENDIX E: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017

Requirements of Appendix 6 – GN R326 of NEMA EIA Regulations as amended (7 April 2017)	**Please indicate where it is addressed in the Specialist Reports:**
1. (1) A specialist report prepared in terms of these Regulations must contain- details of- the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix F
a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix C
an indication of the scope of, and the purpose for which, the report was prepared;	Section 4

(ca) an indication of the quality and age of base data used for the specialist report; (cb) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5.3 Section 9
the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 5
a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5
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 9
an identification of any areas to be avoided, including buffers;	Section 6
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 6
a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5.2
a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 12
any mitigation measures for inclusion in the EMPr;	Section 12
any conditions for inclusion in the environmental authorisation;	Section 12
any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 12
a reasoned opinion- whether the proposed activity, activities or portions thereof should be authorised; (ia) regarding the acceptability of the proposed activity or activities; and if the opinion is that the proposed activity 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 13
a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 5.3
a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 5.3
any other information requested by the competent authority.	n/a
(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.	n/a

3.1. APPENDIX F: BIRD DATA FOR THE PAULPUTS SITE

‘1’ denotes presence, not abundance
E – South African endemic status: (*) = near-endemic; * = endemic; SLS = endemic to South Africa, Lesotho & Swaziland
EN – Endangered; VU – Vulnerable; NT – Near-threatened; LC – Least concern
Regional Red List – Taylor et al, 2015
Global Red List - IUCN
SABAP1 – recorded by this project
SABAP2 – recorded by this project
Initial site visit – recorded on initial specialist site visit
Winter, Spring, Summer, Autumn – recorded in these seasons

Common name	*Scientific name*	SABAP1	SABAP2	Conservation status (regional, global)	TOPS	E	Initial site visit	Winter	Spring	Summer	Autumn
Bustard, Ludwig's	*Neotis ludwigii*	1	1	EN, EN	VU					1	
Eagle, Martial	*Polemaetus bellicosus*	1	1	EN, VU	VU		1	1	1	1	1
Korhaan, Karoo	*Eupodotis vigorsii*	1	1	NT, LC			1	1	1	1	1
Bustard, Kori	*Ardeotis kori*	1	1	NT, NT	VU				1		
Falcon, Lanner	*Falco biarmicus*	1	1	VU, LC			1		1		
Eagle, Verreaux's	*Aquila verreauxii*	1		VU, LC			1				
Sparrowlark, Black-eared	*Eremopterix australis*	1	1			(*)					1
Buzzard, Jackal	*Buteo rufofuscus*	1	1			(*)				1	
Lark, Large-billed	*Galerida magnirostris*	1	1			(*)			1		
Chat, Sickle-winged	*Cercomela sinuata*	1	1			(*)	1				
Chat, Anteating	*Myrmecocichla formicivora*	1	1				1	1	1	1	1
Crow, Pied	*Corvus albus*	1	1				1	1	1	1	1
Flycatcher, Chat	*Bradornis infuscatus*	1	1				1	1	1	1	1
Lark, Spike-heeled	*Chersomanes albofasciata*	1	1				1	1	1	1	1
Pigeon, Speckled	*Columba guinea*	1	1				1	1	1	1	1
Weaver, Sociable	*Philetairus socius*	1	1				1	1	1	1	1
Lark, Karoo Long-billed	*Certhilauda subcoronata*	1	1				1	1	1	1	
Canary, Yellow	*Crithagra flaviventris*	1	1					1	1		1
Goshawk, Pale Chanting	*Melierax canorus*	1	1						1	1	1
Kestrel, Rock	*Falco rupicolus*	1	1					1	1	1	
Sandgrouse, Namaqua	*Pterocles namaqua*	1	1					1		1	1
Bunting, Lark-like	*Emberiza impetuani*	1	1				1			1	1
Chat, Karoo	*Cercomela schlegelii*	1	1				1	1	1		

Chat, Tractrac	*Cercomela tractrac*	1	1				1		1		1
Kestrel, Greater	*Falco rupicoloides*	1	1				1	1	1		
Sparrow, Cape	*Passer melanurus*	1	1				1	1	1		
Warbler, Rufous-eared	*Malcorus pectoralis*	1	1				1	1	1		
Sparrow-weaver, White-browed	*Plocepasser mahali*	1	1					1	1		
Sparrowlark, Grey-backed	*Eremopterix verticalis*	1	1							1	1
Bokmakierie	*Telophorus zeylonus*	1	1					1			
Dove, Laughing	*Streptopelia senegalensis*	1	1							1	
Dove, Namaqua	*Oena capensis*	1	1								1
Falcon, Pygmy	*Polihierax semitorquatus*	1	1								1
Lark, Stark's	*Spizocorys starki*	1	1								1
Penduline-tit, Cape	*Anthoscopus minutus*	1						1			
Quail, Common	*Coturnix coturnix*	1									1
Turtle-dove, Cape	*Streptopelia capicola*	1	1								1
Wheatear, Capped	*Oenanthe pileata*	1	1								1
Wheatear, Mountain	*Oenanthe monticola*	1	1						1		
Chat, Familiar	*Cercomela familiaris*	1	1				1				
Eremomela, Yellow-bellied	*Eremomela icteropygialis*	1	1				1				
Fiscal, Common (Southern)	*Lanius collaris*	1	1				1				
Avocet, Pied	*Recurvirostra avosetta*	1									
Barbet, Acacia Pied	*Tricholaema leucomelas*	1	1								
Batis, Pririt	*Batis pririt*	1	1								
Bee-eater, European	*Merops apiaster*	1	1								
Bee-eater, Swallow-tailed	*Merops hirundineus*	1	1								
Bishop, Southern Red	*Euplectes orix*	1									
Brubru	*Nilaus afer*	1									

Bulbul, African Red-eyed	*Pycnonotus nigricans*	1	1								
Bunting, Cape	*Emberiza capensis*	1	1								
Canary, Black-headed	*Serinus alario*	1	1			(*)					
Canary, Black-throated	*Crithagra atrogularis*	1	1								
Canary, White-throated	*Crithagra albogularis*	1	1								
Cisticola, Grey-backed	*Cisticola subruficapilla*	1	1								
Cisticola, Zitting	*Cisticola juncidis*	1									
Coot, Red-knobbed	*Fulica cristata*	1									
Cormorant, Reed	*Phalacrocorax africanus*	1									
Cormorant, White-breasted	*Phalacrocorax carbo*	1									
Courser, Burchell's	*Cursorius rufus*	1	1								
Courser, Double-banded	*Rhinoptilus africanus*	1									
Crombec, Long-billed	*Sylvietta rufescens*	1	1								
Crow, Cape	*Corvus capensis*	1	1								
Cuckoo, Diderick	*Chrysococcyx caprius*	1	1								
Darter, African	*Anhinga rufa*	1									
Dove, Red-eyed	*Streptopelia semitorquata*	1	1								
Dove, Rock	*Columba livia*	1	1								
Drongo, Fork-tailed	*Dicrurus adsimilis*	1									
Duck, African Black	*Anas sparsa*	1									
Duck, Yellow-billed	*Anas undulata*	1									
Eagle, Booted	*Aquila pennatus*	1	1								
Eagle-owl, Spotted	*Bubo africanus*	1	1								
Egret, Cattle	*Bubulcus ibis*	1									
Egret, Little	*Egretta garzetta*	1									
Egret, Yellow-billed	*Egretta intermedia*	1									
Eremomela, Karoo	*Eremomela gregalis*	1	1			(*)					

Finch, Red-headed	*Amadina erythrocephala*	1									
Finch, Scaly-feathered	*Sporopipes squamifrons*	1	1								
Firefinch, Red-billed	*Lagonosticta senegala*	1									
Fish-eagle, African	*Haliaeetus vocifer*	1									
Flycatcher, Fairy	*Stenostira scita*	1	1								
Flycatcher, Fiscal	*Sigelus silens*		1			(*)					
Flycatcher, Spotted	*Muscicapa striata*	1	1								
Goose, Egyptian	*Alopochen aegyptiacus*	1	1								
Goose, Spur-winged	*Plectropterus gambensis*	1									
Grebe, Little	*Tachybaptus ruficollis*	1	1								
Greenshank, Common	*Tringa nebularia*	1									
Guineafowl, Helmeted	*Numida meleagris*	1									
Hamerkop, Hamerkop	*Scopus umbretta*	1									
Harrier, Black	*Circus maurus*	1									
Heron, Black-headed	*Ardea melanocephala*	1									
Heron, Goliath	*Ardea goliath*	1									
Heron, Grey	*Ardea cinerea*	1									
Heron, Purple	*Ardea purpurea*	1									
Hoopoe, African	*Upupa africana*	1	1								
Ibis, Hadeda	*Bostrychia hagedash*		1								
Kingfisher, Giant	*Megaceryle maximus*	1									
Kingfisher, Malachite	*Alcedo cristata*	1									
Kingfisher, Pied	*Ceryle rudis*	1									
Kite, Black-shouldered	*Elanus caeruleus*	1									
Korhaan, Northern Black	*Afrotis afraoides*		1								
Lapwing, Blacksmith	*Vanellus armatus*	1	1								
Lapwing, Crowned	*Vanellus coronatus*	1	1								

Lark, Cape Clapper	*Mirafra apiata*	1				(*)					
Lark, Clapper	*Mirafra apiata*	1									
Lark, Eastern Clapper	*Mirafra fasciolata*	1									
Lark, Fawn-coloured	*Calendulauda africanoides*	1	1								
Lark, Pink-billed	*Spizocorys conirostris*	1									
Lark, Red	*Calendulauda burra*	1		VU, VU		*					
Lark, Red-capped	*Calandrella cinerea*	1	1								
Lark, Sabota	*Calendulauda sabota*	1	1								
Lark, Sclater's	*Spizocorys sclateri*	1	1	NT, NT		(*)					
Lovebird, Rosy-faced	*Agapornis roseicollis*	1	1								
Martin, Brown-throated	*Riparia paludicola*	1	1								
Martin, Rock	*Hirundo fuligula*	1	1								
Masked-weaver, Southern	*Ploceus velatus*	1	1								
Moorhen, Common	*Gallinula chloropus*	1									
Mousebird, Red-faced	*Urocolius indicus*	1	1								
Mousebird, White-backed	*Colius colius*	1	1								
Nightjar, Freckled	*Caprimulgus tristigma*	1									
Nightjar, Rufous-cheeked	*Caprimulgus rufigena*	1	1								
Ostrich, Common	*Struthio camelus*	1	1								
Palm-swift, African	*Cypsiurus parvus*		1								
Pipit, African	*Anthus cinnamomeus*	1	1								
Pipit, Long-billed	*Anthus similis*	1									
Plover, Common Ringed	*Charadrius hiaticula*	1									
Plover, Kittlitz's	*Charadrius pecuarius*	1									
Plover, Three-banded	*Charadrius tricollaris*	1	1								
Pochard, Southern	*Netta erythrophthalma*	1									
Prinia, Black-chested	*Prinia flavicans*	1	1								

Prinia, Drakensberg	*Prinia hypoxantha*	1				SLS					
Prinia, Karoo	*Prinia maculosa*	1	1			(*)					
Prinia, Spotted	*Prinia hypoxantha*	1									
Quelea, Red-billed	*Quelea quelea*	1	1								
Rail, African	*Rallus caerulescens*	1									
Reed-warbler, African	*Acrocephalus baeticatus*	1	1								
Robin-chat, Cape	*Cossypha caffra*	1	1								
Rock-thrush, Short-toed	*Monticola brevipes*		1								
Sandgrouse, Double-banded	*Pterocles bicinctus*	1									
Sandpiper, Common	*Actitis hypoleucos*	1	1								
Sandpiper, Curlew	*Calidris ferruginea*	1									
Sandpiper, Wood	*Tringa glareola*	1	1								
Scimitarbill, Common	*Rhinopomastus cyanomelas*	1									
Scrub-robin, Kalahari	Cercotrichas paena	1	1								
Scrub-robin, Karoo	Cercotrichas coryphoeus	1	1								
Secretarybird	Sagittarius serpentarius	1	1	VU, VU							
Shelduck, South African	Tadorna cana	1	1								
Shoveler, Cape	Anas smithii	1									
Shrike, Lesser Grey	*Lanius minor*	1									
Shrike, Red-backed	*Lanius collurio*	1									
Snake-eagle, Black-chested	*Circaetus pectoralis*	1	1								
Sparrow, Grey-headed	*Passer diffusus*	1									
Sparrow, House	*Passer domesticus*	1	1								
Sparrow, Northern Grey-headed	*Passer griseus*	1									
Sparrow, Southern Grey-headed	*Passer diffusus*	1	1								

Sparrowlark, Chestnut-backed	*Eremopterix leucotis*		1								
Spurfowl, Cape	*Pternistis capensis*	1									
Spurfowl, Red-necked	*Pternistis afer*	1									
Starling, Cape Glossy	*Lamprotornis nitens*	1	1								
Starling, Pale-winged	*Onychognathus nabouroup*	1	1								
Starling, Wattled	*Creatophora cinerea*	1									
Stilt, Black-winged	*Himantopus himantopus*	1	1								
Stint, Little	*Calidris minuta*	1									
Stork, Black	*Ciconia nigra*	1		VU, LC	VU						
Stork, White	*Ciconia ciconia*	1									
Sunbird, Dusky	*Cinnyris fuscus*	1	1								
Sunbird, Malachite	*Nectarinia famosa*	1									
Sunbird, Southern Double-collared	*Cinnyris chalybeus*	1				(*)					
Swallow, Barn	*Hirundo rustica*	1	1								
Swallow, Greater Striped	*Hirundo cucullata*	1	1								
Swallow, White-throated	*Hirundo albigularis*	1									
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*	1									
Swift, Alpine	*Tachymarptis melba*	1	1								
Swift, Bradfield's	*Apus bradfieldi*	1	1								
Swift, Common	*Apus apus*	1	1								
Swift, Little	*Apus affinis*	1	1								
Swift, White-rumped	*Apus caffer*	1	1								
Teal, Cape	*Anas capensis*	1	1								
Teal, Red-billed	*Anas erythrorhyncha*	1									
Thick-knee, Spotted	*Burhinus capensis*	1	1								

Thrush, Karoo	*Turdus smithi*	1	1			(*)					
Thrush, Olive	*Turdus olivaceus*	1									
Tit, Ashy	*Parus cinerascens*	1	1								
Tit, Grey	*Parus afer*		1								
Tit-babbler, Chestnut-vented	*Parisoma subcaeruleum*	1	1								
Tit-babbler, Layard's	*Parisoma layardi*	1	1			(*)					
Wagtail, African Pied	*Motacilla aguimp*	1									
Wagtail, Cape	*Motacilla capensis*	1	1								
Warbler, Cinnamon-breasted	*Euryptila subcinnamomea*	1	1			(*)					
Warbler, Garden	*Sylvia borin*	1									
Warbler, Namaqua	*Phragmacia substriata*	1				(*)					
Warbler, Willow	*Phylloscopus trochilus*	1									
Waxbill, Common	*Estrilda astrild*	1	1								
White-eye, Cape	*Zosterops virens*	1									
White-eye, Orange River	*Zosterops pallidus*	1	1								

4. INLAND AQUATIC ECOSYSTEMS' SPECIALIST IMPACT ASSESSMENT REPORT

4.1. EXECUTIVE SUMMARY

The Freshwater Consulting Group (FCG) was commissioned by Gaea Enviro to provide a specialist report on the inland aquatic ecosystems that may be affected by the proposed 132 kV powerline for the 300 MW Paulputs solar photovoltaic (PV) plant on the Farm Konkoonsies, near Pofadder, Northern Cape. The proposed PV plant is located within the Northern Corridor of the Strategic Transmission Corridors, as identified in Notice No 113 (18 Feb 2018 – Government Gazette No 41445). The overall project comprises three phases each of 100MW on two farms, namely Konkoonsies Remainder of 91/2 and Konkoonsies 91/5. The 132kV transmission line will cross two additional land portions namely Konkoonsies 91/6 and Scuit-Klip 92/4. Layouts for the three phases (PV arrays, substations, access and internal roads and battery storage system) and three alternative corridors for the routing of the overhead transmission lines have been proposed, based on exclusion areas specified by the landowner, sensitivity mapping from specialists' assessments and a set of initial environmental constraints.

The Paulputs site lies completely within the Lower Orange Water Management Area (WMA14), in quaternary catchments D81E and D81F. The site is located within the Nama Karoo Level 1 ecoregion (Kleynhans et al., 2005), which incorporates a number of northward flowing rivers, with the main system into which these rivers flow being the perennial Orange River. The location and rough extent of all inland aquatic ecosystems (wetlands and watercourses) were identified on the site, and within a 500m radius of the site, and mapped. This was followed by a site visit (15 – 16 May 2018) during which the location of identified watercourses was field-verified. The site visit took place during the relatively dry autumn season, and although there had been good rainfall three weeks prior to the site visit (28.5 mm in March 2018), the watercourses were dry.

The Paulputs site is located on very shallow, loamy sand on the very gentle slopes between two ephemeral, relatively pristine tributaries of the Orange River – the Kaboep River to the south and an unnamed tributary to the north of the site. An ephemeral tributary of the Kaboep River traverses the sites earmarked for PV1 and PV2, with a network of smaller watercourses feeding into this tributary and scattered throughout the site. These systems are ephemeral, with surface water remaining on the surface for a very short period, especially if there has been a sustained dry period before the rainfall. Two waterholes were recorded on the broader Paulputs site (not within the PV footprints) during the field trip, and these were filled with rainwater at the time of the site visit.

The vegetation on the Paulputs site is Bushmanland Arid Grassland, which is Least Concern in terms of conservation status. The geology comprises mudstones and shales of the Ecca Group and Dwyka tillites. According to the Northern Cape Critical Biodiversity Areas (CBA) Map, the Paulputs site lies completely within a CBA 2 site. In this case, the reason for this designation is the categorization of the site as a CBA 2 category site by the Namakwa District Biodiversity Sector Plan (a previous conservation plan that predates the Northern Cape CBA Map). The Kaboep River has been identified as a CBA1 on the Northern Cape CBA Map, as all FEPA watercourses were identified as such, including a 500m riverine buffer on either side of the centreline.

The mainstem rivers on the Paulputs site were assessed as being Category B (largely unmodified) for Present Ecological State. The rivers are slightly impacted by abstraction of water in small dams and weirs located within the channels. There are a few gravel road crossings and existing powerline crossings that also have a minimal impact on the watercourses. The smaller tributaries flowing into these mainstem rivers were mostly assessed as being Category A, with very few flow obstructions on these smaller rivers. The three tributaries located in the north of the Paulputs site, close to the existing

Eskom substation, were assessed to be Category C, due to diversion of these streams into channels and culverts around the substation.

In terms of EIS, the watercourses were all assessed as being of high importance and sensitivity, including the watercourses to the north at the Eskom substation. Despite their condition, all of these ephemeral watercourses are extremely sensitive to changes in hydrology, as their structure and function are driven by the prevailing hydrological and sediment transport regime. The watercourses are all important corridors for the movement of flora and fauna, and as nesting, breeding and feeding habitat. Thus, combining both current condition and EIS, the Kaboep and its main tributaries were assessed as being of high sensitivity, and the smaller tributaries of very high sensitivity. The watercourse to the north at the Eskom substation is of medium sensitivity. These sensitivities were mapped for the site as a whole and were used to determine recommended ecological buffers around the watercourses. The buffers range from 15m (medium sensitivity) to 55m (very high sensitivity).

The current location and layout of the Phase 2 footprint does not encroach into any areas of aquatic sensitivity, and the site slopes away from the Kaboep River. The Phase 2 footprint is located more than 100 m from any of the ecological buffers recommended for the watercourses on the site, and so falls outside the regulated area with regards to Section 21 (c) and (i) water use authorisation, and is unlikely to have a severe impact on the condition and functioning of any of the inland aquatic ecosystems on the site. The access road to the site will make use of an existing gravel road so no new road crossings are proposed.

Most of the impacts identified and assessed for the EIA are associated with the construction phase and, to a lesser extent, the decommissioning phase. The most significant of these impacts is the threat of introduction of invasive alien plants, especially Prosopis sp., which is a problem species in the watercourses of the Northern Cape. This species is currently not on the site, so it is important that it not be introduced in fill or through disturbance of soils.

The construction and decommissioning phase impacts can all be reduced to, at worst, low significance with the implementation of the mitigation measures and management actions proposed in this report. The operational and layout impacts of concern are the loss of open space for construction of the PV array and associated operations and maintenance buildings, clearing of vegetation and increase in water use. Areas that have been cleared of indigenous vegetation are subject to a significantly greater alien plant invasion risk, and also the risk of changes in soil structure. For instance, soils in cleared areas can form a crust, as a result of rainfall displacing finer particles and causing compaction. Crusted soils are less permeable, and lead to an increase in runoff. Clearing also leads to significant changes in surface hydrology as vegetation intercepts rainfall and influences the way runoff behaves on the surface, which consequently has an effect on erosion and sedimentation. Levelling and grading of areas to remove steep slopes and undulations in the landscape is often associated with the placement of the PV arrays, and this topographic alteration could alter the natural surface hydrology. Furthermore, extensive hardening of surfaces associated with solar PV facilities would result in significant increases in stormwater runoff and concentration of surface flow patterns. Infrastructural development such as cables and roads across watercourse would lead to the interruption of flows.

These impacts can be reduced in significance to low or low to negligible, through implementation of the proposed mitigation measures and management actions. Overall, the proposed Phase 2 facility at Paulputs is considered to be acceptable, from an inland aquatic ecosystem perspective. No biodiversity offset is required due to the overall low significance of the negative impacts of the proposed facility.

An assessment of the cumulative impacts of the proposed facility, in light of the other two phases at Paulputs, and a number of similar facilities within 30 km of the site, found that the impacts of most concern in this area are the loss of open space, fragmentation of inland aquatic ecosystems as a result of road crossings, changes in flow input and patterns (and the consequent changes in sediment input) from stormwater discharge off the site, and the introduction and spread of alien invasive (especially Prosopis sp.). The increased demand for and use of water resources is also of concern.

Implementation of the mitigation measures recommended in this report, and location of the infrastructure in low sensitivity habitat, with specific reference to the watercourses and wetlands of the area, will decrease the significance of the cumulative impacts to low significance.

4.2. LIST OF ABBREVIATIONS AND GLOSSARY

Acronym	Description
BA	Basic Assessment
CBA	Critical Biodiversity Area
CESA	Critical Ecological Support Area
CR	Critically Endangered (threat status)
DRDLR	South African Department of Rural Development and Land Reform
DWS	South African Department of Water and Sanitation
EA	Environmental authorisation
EGI	Electricity grid infrastructure
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
EN	Endangered (threat status)
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
GIS	Geographical Information Systems
ha	Hectare
LT	Least Threatened (threat status)
MW	Megawatt
NFEPA	National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2011)
NGI	National Geo-Spatial Information
NT	Near Threatened (threat status)
NWA	South African National Water Act (1998)
OESA	Other Ecological Support Area
PES	Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting change from its reference condition.
PV	Photovoltaic
SANBI	South African National Biodiversity Institute
SKEP	Succulent Karoo Ecosystem Programme
VU	Vulnerable (threat status)
WfWet	Working for Wetlands

Term	Definition
Alternative	In relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to the— (a) property on which or location where the activity is proposed to be undertaken; (b) type of activity to be undertaken; (c) design or layout of the activity; (d) technology to be used in the activity; or (e) operational aspects of the activity; and includes the option of not implementing the activity;
Borehole	A well, excavation or any artificially constructed or improved underground cavity which can be used for the purpose of - Intercepting, collecting or storing water in or removing water from an aquifer; Observing and collecting data and information on water in an aquifer; or Recharging an aquifer.
Catchment	In relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points.
Extent of a watercourse	The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; and Wetlands and pans: the delineated boundary (outer temporary zone) of any wetland or pan.
Inland aquatic ecosystems	This term is used collectively for wetlands, pans and watercourses
Pan	Any depression collecting water or that is inward draining (i.e. endorheic) or a flow-through system with flow contributions from surface water, groundwater or interflow or combinations thereof. NOTE: pans are wetlands (see below).
Regulated area of a watercourse for NWA Section 21 (c) and/or (i) water uses	The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; and In the absence of a determined 1 in 100 year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); A 500 m radius from the delineated boundary (extent) of any wetland or pan.
Rehabilitation	The process of reinstating natural ecological driving forces within part or the whole of a degraded watercourse to recover former or desired ecosystem structure, function, biotic composition and associated ecosystem services.
Riparian habitat (or zone)	Includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a

Term	Definition
	composition and physical structure distinct from those of adjacent land areas.
River management plan	Any river management plan developed for the purposes of river or storm water management in any municipal/metropolitan area or described river section, river reach, entire river or sub quaternary catchment that considers the river in a catchment context and as approved by the Department of Water and Sanitation
Watercourse	A river or spring; A natural channel in which water flows regularly or intermittently; A wetland, lake or dam into which, or from which, water flows; and 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
Water resource	Includes a watercourse, surface water, estuary, or aquifer.
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. NOTE: in this report, pans (depressions) are considered to fall within this definition.

4.3. INTRODUCTION

- **Scope and Objectives**

The Freshwater Consulting Group (FCG) was commissioned by Gaea Enviro to provide a specialist report on the inland aquatic ecosystems that may be affected by the development of a proposed solar photovoltaic (PV) plant and associated infrastructure on the Farm Konkoonsies, near Pofadder, Northern Cape. The specialist report will form part of the environmental authorisation application for the project.

The proposed development is located within the Northern Corridor of the Strategic Transmission Corridors, as identified in Notice No 113 (18 Feb 2018 – Government Gazette No 41445). The overall project comprises three phases each of 100MW on two farms, namely Konkoonsies Remainder of 91/2 and Konkoonsies 91/5. The 132kV transmission line will cross two additional land portions namely Konkoonsies 91/6 and Scuit-Klip 92/4. A layout for the three phases (PV arrays, substations, access and internal roads and battery storage system) and three alternative corridors for the routing of the overhead transmission lines have been proposed, based on specified exclusion areas, sensitivity mapping from specialists' assessments and a set of initial environmental constraints.

This report comprises the detailed scoping and environmental impact assessment (EIA) specialist input for the Phase 2 PV array, access and internal roads and substation. Phases 1 and 3 are dealt with in separate specialist reports, and a basic assessment (BA) of the three transmission corridor alternatives (one for each of the PV phases) for the electricity grid infrastructure (EGI) also forms a separate report.

- **Terms of Reference**

The specific terms of reference for the inland aquatic ecosystem specialist input to the scoping and EIA of the Paulputs Phase 2 PV facility on Konkoonsies 91/Remainder of Portion 2 were to:

- Identify and map the inland aquatic ecosystems on the proposed Paulputs Phase 2 PV site;
- Describe and assess the nature, consequence, extent, duration, probability and significance of potential impacts on the identified inland aquatic ecosystems, which would result from the construction, operation, and closure phases of the proposed Phase 2 PV facility;
- Assess the cumulative impacts associated with the Phase 2 PV facility, in association with the overall Paulputs PV project (all three phases and infrastructure) and other similar projects within a 30 km radius;
- Assess the degree to which the impacts (a) can be reversed; (b) may cause irreplaceable loss of resources, and (c) can be avoided, managed or mitigated;
- Identify the most ideal location for the activity within the overall site, based on the lowest level of environmental sensitivity identified during the specialist impact assessment;
- Identify suitable measures to avoid, mitigate and manage identified impacts following the mitigation hierarchy, as well as residual risks that need to be managed and monitored to inform an Environmental Management Programme (EMPr) for the proposed facility.

- **Use of this Report**

This report reflects the professional opinions of its author. It is the policy of FCG that the full and unedited contents of this report should be presented to the client, and that any summary of the findings should only be produced in consultation with the author.

- **Declaration of Independence**

This is to confirm that **Kate Snaddon**, the specialist consultant who is responsible for undertaking this study and preparing this report, is independent, and has no vested interests, financial or otherwise, in the development under consideration. Please see Appendix A for specialist declaration.

- **Specialist Details**

The author of this report is an independent specialist consultant, with 22 years of experience in the field of freshwater ecology, registered with the South African Council for Natural Scientific Professions (registration number 400225/06, Ecological Science).

4.4. APPROACH AND METHODOLOGY

- **Mapping of inland aquatic ecosystems**

The location and rough extent of all inland aquatic ecosystems (wetlands and watercourses) were identified on the site, and within a 500m radius of the site. The latter represents the regulated area of a watercourse for National Water Act (NWA) Section 21 (c) and/or (i) water uses.

The inland aquatic ecosystems – only watercourses, as no wetlands were encountered on the site - were firstly mapped using desktop information, and the 50cm colour imagery for South Africa (2008 – 2012) (imagery obtained from the National Geo-Spatial Information (NGI) branch of the Department of Rural Development and Land Reform (DRDLR)). This was followed by a site visit (15 – 16 May 2018) during which the location of identified watercourses was field-verified. The approximate extent of the riparian zone of the watercourses was mapped using a hand-held GPS, and using the indicators recommended in DWS's wetland and riparian area delineation manual (DWAF, 2005).

The site visit took place during the relatively dry autumn season, and although there had been good rainfall three weeks prior to the site visit (28.5 mm in March 2018), the watercourses were dry. These systems are ephemeral, with surface water remaining on the surface for a very short period, especially if there has been a sustained dry period before the rainfall. The waterholes described in this report were inundated, however, and could easily be detected.

- **<u>Assessment of Present Ecological State and Ecological Importance and Sensitivity</u>**

An assessment of the conservation importance of an inland aquatic ecosystem requires the assessment of both the present ecological state (PES) of the ecosystem and its perceived ecological importance and sensitivity (EIS). The ecological state, condition or integrity of an ecosystem is defined as its ability to support and maintain a balanced, integrated composition of physico-chemical and habitat characteristics, as well as biotic components on temporal and spatial scales that are comparable to the natural characteristics of ecosystems of the region. The integrity of a system is directly influenced by its current state, and how much the system has been altered from the reference or unimpacted condition. The ecological importance of a freshwater ecosystem is an expression of its importance to the maintenance of ecological diversity (i.e. both species and habitat diversity) and functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Resh et al., 1988; Milner, 1994). Both abiotic and biotic components of the system are taken into consideration in an assessment of ecological importance and sensitivity. It is strongly biased towards the potential importance and sensitivity of a particular section of a stream or river, as it would be expected under unimpaired conditions.

- **<u>Present Ecological State</u>**

The Department of Water and Sanitation's (DWS) Resource Directed Measures (RDM) approach provides methods for the assessment of ecological integrity and ecological importance and sensitivity for rivers, in the context of the determination of the ecological management class as part of the Reserve Determination procedure (DWAF, 1999). This procedure can be followed at different levels of detail – desktop, rapid, intermediate and comprehensive. The desktop approach was followed for the ephemeral watercourses located on the site due to these being dry at the time of the site visit, despite the recent rainfall. In addition, a national desktop assessment of the PES and EIS of river reaches was recently completed by DWS (DWS, 2014), and this information is presented here for comparison purposes.

The PES assessment of DWS is based on the assessment of existing impacts on two components of the watercourse - the riparian zone and the instream habitat. Assessments are made separately for both components, but data for the riparian zone are interpreted primarily in terms of their potential impact on the instream component. Criteria within each component (see Table 1) are pre-weighted according to the importance of each, and each criterion is scored between 0 and 25, with six descriptive categories ranging from 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact). The scores for the instream and riparian zone components were used to place the site in a habitat integrity category (A – E/F) for both components (see Table 2). A full description of the method can be found in DWAF's RDM document (DWAF, 1999).

The Field Guide to Present Ecological State Scores (Southern Waters, 2001) was used to complete the assessment of PES.

Table 1: Criteria used in the assessment of Present Ecological Status (from Kleynhans, 1996).

CRITERION	RELEVANCE
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments.
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river. Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochthonous7 organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

[7] Organic matter that originates from outside the river.

Table 2: Present Ecological State categories for watercourses (adapted from Kleynhans, 1996).

Category	SCORE (% OF TOTAL)	Description
A	90-100	Unmodified, natural.
B	80-90	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	60-79	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.
D	40-59	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E	20-39	The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	0	Modifications have reached a critical level and the lotic 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.

- **Ecological Importance and Sensitivity**

The DWS-recommended method for the determination of the Ecological Importance and Sensitivity of a river reach considers the following ecological aspects:

- Rare and endangered instream and riparian biota;
- Unique instream and riparian biota;
- Intolerant instream and riparian biota;
- Species richness, both riparian and instream;
- Diversity of habitat types or features;
- Refuge value of habitat types;
- Sensitivity of habitat to flow changes;
- Sensitivity to flow related water quality changes;
- Sensitivity to water quality changes in terms of alkalinity;
- Sensitivity to water quality changes in terms of hardness;
- Migration route/corridor for instream and riparian biota, and
- Presence of Protected Areas and conservation areas.

Each criterion is scored between 1 and 5, and the medians of these scores are calculated to derive the EIS category (Table 4.3).

Table 3: Ecological importance and sensitivity categories for watercourses.

Ecological Importance and Sensitivity Categories	General Description
Very high (score >3 and ≤4)	Reaches or watercourses that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These watercourses (in terms of biota and habitat) are usually very sensitive to channel / bed modifications and have no or only a small capacity for use.

High (score >2 and ≤3)	Reaches or watercourses that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These watercourses (in terms of biota and habitat) may be sensitive to channel / bed modifications but in some cases, may have a substantial capacity for use.
Moderate (score >1 and ≤2)	Reaches or watercourses that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These watercourses (in terms of biota and habitat) are usually not very sensitive to channel / bed modifications and often have a substantial capacity for use.
Low/marginal (score >0 and ≤1)	Reaches or watercourses that are not unique at any scale. These watercourses (in terms of biota and habitat) are generally not very sensitive to channel / bed modifications and usually have a substantial capacity for use.

- **<u>Determining buffer widths</u>**

The buffer width tool developed by MacFarlane et al. (2014) was used to determine appropriate buffers for the watercourses on the site, for both the construction and operational phases of the project. The assessment is based on the PES and EIS of each aquatic ecosystem, and the quality of the buffer during both phases of the project. It was assumed that the current vegetation would be representative of the buffers for both phases, unless the actual removal of vegetation and soils is expected. The density of vegetation plays a major role in determining the effectiveness of a buffer – a well-vegetated buffer, with a high basal cover (such as grass or sedges) is the most effective buffer, due to the ability of the plants and their roots to trap sediments, toxins and other pollutants before they reach the wetland or watercourse.

- **<u>Sensitivity mapping</u>**

The PES and EIS assessments were combined into a sensitivity score. Buffers were established around each watercourse, and the result included in a sensitivity map for the Phase 2 site. The preferred location of the Phase 2 layout is indicated on the map.

- **<u>Impact assessment</u>**

    - **<u>Criteria</u>**

The impacts associated with the construction, operation and decommissioning of the Phase 2 PV facility were described and assessed according to the EIA regulations, taking into account cumulative impacts of all three phases of the project and other similar projects in the vicinity. The criteria and applicable scoring for the assessment were as supplied by Gaea Enviro. See methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of the predicted environmental impacts and risks in Part 5 - Section 4 of the EIA report.

    - **<u>Scoring</u>**

The criteria described above were integrated to a certain extent through assigning scores to each category.

Extent was scored as follows:

Extent description	Score
Local (0 - 10 km from site)	2
Regional (10 – 100 km)	3
National (> 100 km, within SA)	4
International/Global (outside SA)	5

Duration was scored as follows:

Duration description	Score
Very short-term (instantaneous)	1
Short term (< 1 year)	2
Medium term (1 to 10 years)	3
Long term (the operational life of the activity)	4
Permanent (beyond decommissioning)	5

Intensity / Consequence was scored as follows:

Potential Intensity description (negative)	Rating	Score
Potential to severely impact Human Health (morbidity/mortality); or to lead to Loss of species[8] (fauna and/or flora)	Very High/Fatal Flaw	16
Potential to reduce faunal/flora population or to lead to severe reduction/alteration of natural process, loss of livelihoods or severe impact on quality of life[9], individual economic loss	High	8
Potential to reduce environmental quality – air, soil, water. Potential loss of habitat, loss of heritage, reduced amenity	Medium	4
Nuisance	Medium-Low	2
Negative change – with no other consequence	Low	1
Potential Intensity description (positive)	Rating	Score
Potential Net improvement in human welfare	High	8
Potential to improve environmental quality – air, soil, water. Improved individual livelihoods	Medium	4
Potential to lead to Economic Development	Medium-Low	2
Potential positive change – with no other consequence	Low	1

Probability was scored as follows:

Probability description	Score
Improbable (0% chance of occurring)	0.0

[8] Note that a loss of species is a global issue and is differentiated from a loss of a population.

[9] Note that a visual impact or air emissions for example could be considered as severely impacting on quality of life should it constitute more than a nuisance but not being life threatening.

Very unlikely (1 – 20% chance)	0.25
Unlikely (21-50% chance)	0.5
Likely (51 – 90% chance)	0.75
Very likely (>90% chance of occurring regardless of prevention measures)	1

The magnitude of the impact was calculated as the sum of the intensity, duration and extent:
Impact magnitude = intensity + duration + extent

Finally, the significance of the impact was calculated as the product of the magnitude and the probability and scored according to
Impact significance = magnitude x probability

Table 4: Scoring of impact significance, calculated as the product of impact magnitude and probability of occurrence.

Scoring	Significance rating	Description
18-26	Fatally flawed	The project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating.
10-17	High	The impacts 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.
5-9	Medium	The 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.
<5	Low	The 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.

All impacts were assessed before and after all the key proposed mitigation measures have been implemented.

- **Mitigation and management actions**

The mitigation measures and management actions required to reduce the severity of the negative impacts and to enhance the positive impacts of the proposed facility, are recommended. These will contribute towards the Environmental Management Programme (EMPr) for the site. In some instances, monitoring of specific indicators has been included as a management action.

- **Source of Information**

The 50 cm colour aerial photography for South Africa, available online through ArcGIS Online (original images are generated by NGI, and cover the period 2008 – 2012), was used as the background imagery for all maps. All in-field mapping was done using a hand-held GPS, and maps produced using ArcMap 9.2.

4.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

- **Overview of the Paulputs site and surrounds**

The Paulputs site lies completely within the Lower Orange Water Management Area (WMA14), and in quaternary catchments D81E and D81F. The site is located within the Nama Karoo Level 1 ecoregion (Kleynhans et al., 2005), which incorporates a number of northward flowing rivers, with the main system into which these rivers flow being the perennial Orange River. The characteristics of the ecoregion are:

- Topography is diverse, but plains with a moderate to high relief and lowlands, hills and mountains with moderate to high relief are dominant. Vegetation consists almost exclusively of Nama Karoo vegetation types;
- Most of the rivers in the region are seasonal to ephemeral, such as the Hartbees and Sak rivers. Perennial rivers that traverse this region are the Riet and Orange;
- Rainfall is moderate to low in the east, decreasing to arid in the west. Coefficient of variation of annual precipitation is moderate to high in the east to very high in the west;
- Drainage density is generally low, but medium to high in some parts;
- Median annual simulated runoff is moderate to low in the east, decreasing to arid in the west, and
- Mean annual temperature is moderate to low in the east, increasing to moderate to high in the west.

Rainfall at the site is less than 100mm per year (97 mm per year in catchment D81E, and 91 mm per year in catchment D81F), and evaporation over 3000mm per year (3001 mm in D81E, and 3751 mm in D81F) (WR2012 dataset). Median annual simulated runoff is 1mm, which is extremely low (WR2012 dataset). The Paulputs site is located on very shallow (< 300 mm) loamy sand (clay content is 7 – 15%) on the very gentle slopes (Figure 1) between two ephemeral, relatively pristine tributaries of the Orange River – the Kaboep River to the south and an unnamed tributary to the north of the site (Figure 2 and Figure 3). An ephemeral tributary of the Kaboep River traverses the sites earmarked for PV1 and PV2, with a network of smaller watercourses feeding into this tributary and scattered throughout the site (Figure 4 and Figure 5).

The vegetation on the Paulputs site is Bushmanland Arid Grassland, which is Least Concern in terms of conservation status (Mucina et al., 2006). The geology comprises mudstones and shales of the Ecca Group and Dwyka tillites. The Nama Karoo is underlain by a 3000 m-thick succession of sedimentary rocks. At depth is the Cape Supergroup, which is of marine origin, and above this lies the Dwyka tillites, deposited 400 – 300 million years ago (mya), and then the Karoo Supergroup, which includes the Ecca and Beaufort Groups, deposited in an inland sea 300 – 180 mya (Mucina et al., 2006). Igneous activity approximately 180 mya led to the intrusion of dolerite sills and dykes into Karoo sediments. The strata of the Nama Karoo remained relatively horizontal, in comparison with the intense folding that occurred further south and that led to the Cape Fold Mountains of the Fynbos and Succulent Karoo biomes. As a result, the Karoo is flat to gently undulating, with boulder outcrops and flat-topped mesas.

Watercourses are numerous across this flat landscape, draining water off slopes, and more slowly across plains or basins. Due to the low gradient of most of the terrain, these drainage lines proliferate, sometimes with a number of lines running more or less in parallel across the plains, creating a wash effect (e.g. MacDonald, 2009). Drainage patterns are also fairly dynamic due to the lack of gradient, as a small obstruction to flow (plant roots, rocks, burrows etc.) can change the way water moves across the flat surface. All of the surface water ecosystems on and around the site are intermittent or ephemeral, being inundated only for brief periods each year, with periods of drought that are unpredictable in duration.

The plant species that tend to occur within the watercourses in this area include:

- Stipagrostis namaquensis
- Cenchrus ciliaris,
- Lycium cinereum
- Melinis repens

The small ephemeral watercourses traversing the site are not always connected to downstream watercourses, and sometimes disappear into sand (see Figure 1). There is insufficient surface water flow to sustain these watercourses, especially on the flat slopes typical of this area.

Figure 1: Gentle slopes of the site, looking north towards the Orange River.

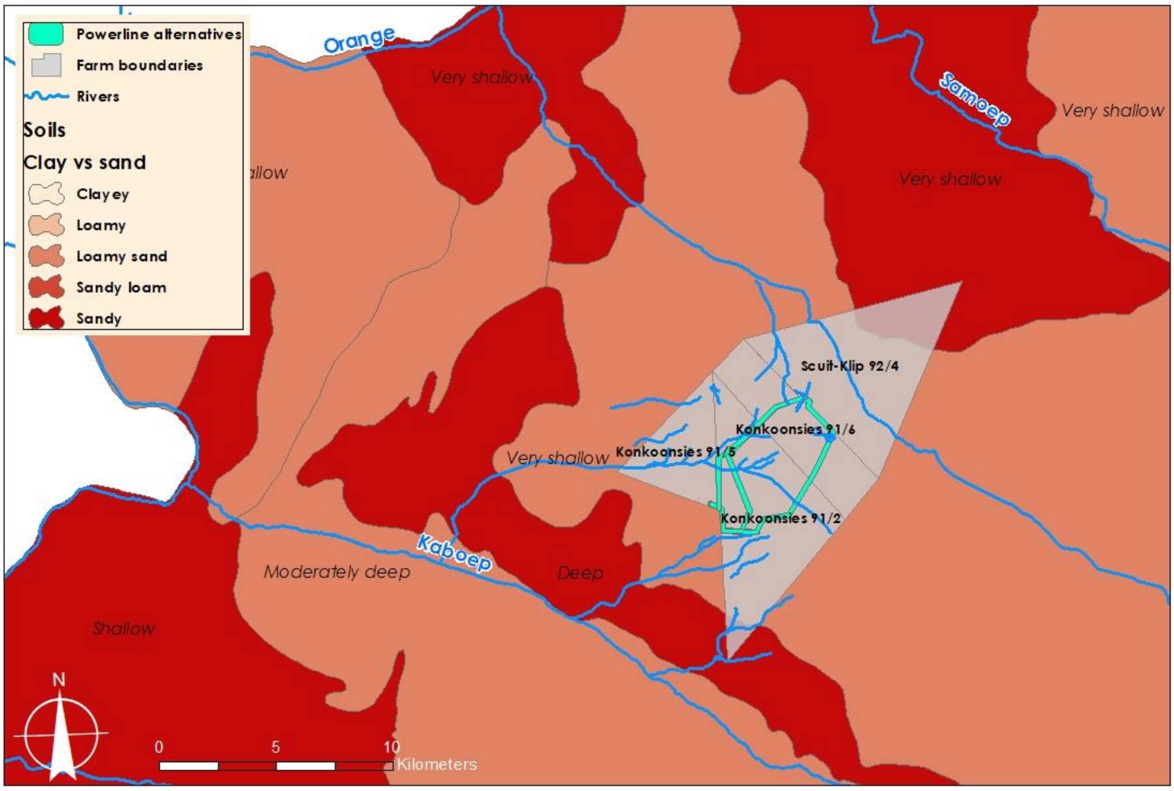


Figure 2: Soils and mainstem rivers on and around the Paulputs site.


Figure 3: Bed of the Kaboep River near the site. The bed comprises loose, medium depth sands.

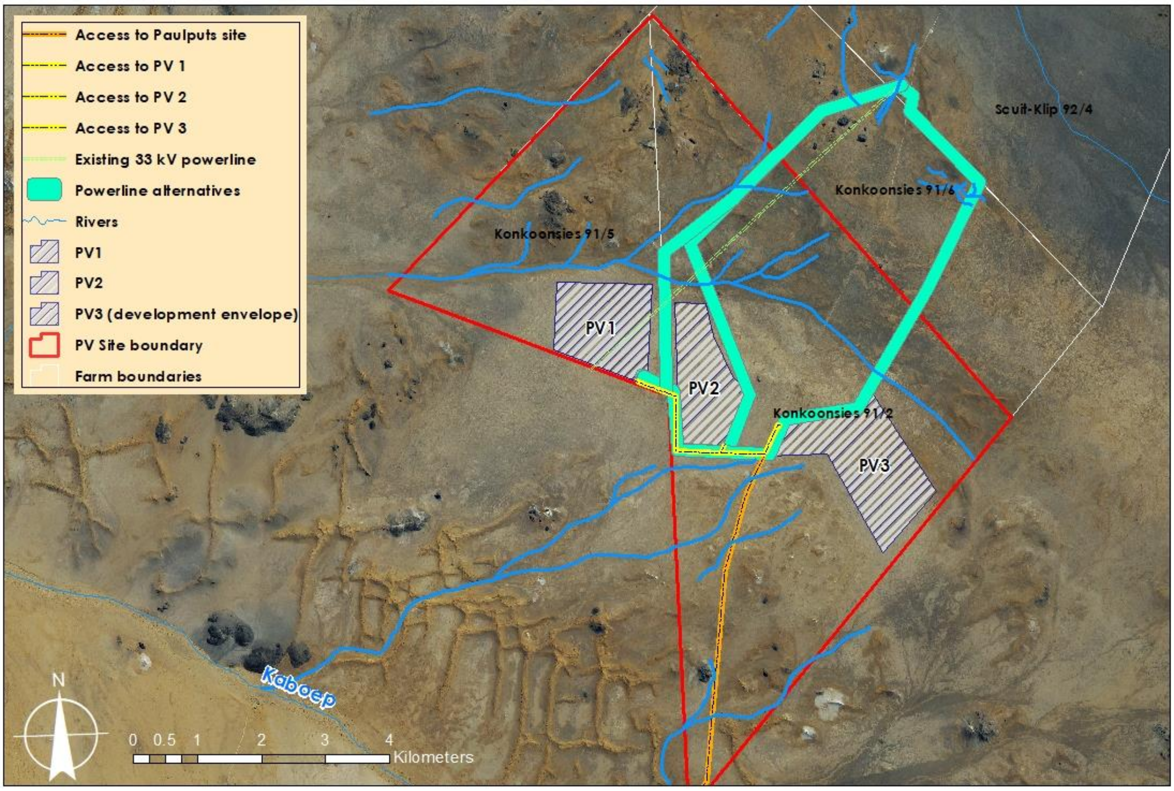


Figure 4: Map of the watercourses that traverse the site. The location of all three PV phases (including the development footprint for PV3) and powerline corridor alternatives are included on the map.

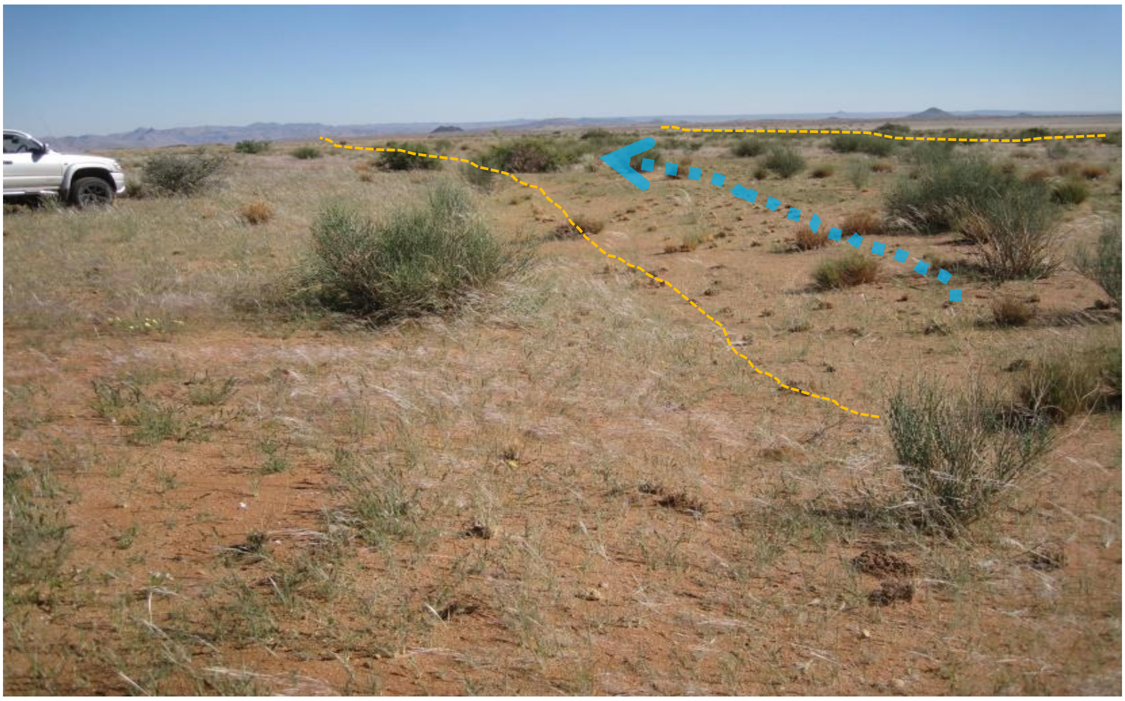


Figure 5: Ephemeral tributary of the Kaboep River, where it traverses the site near the PV site on Konkoonsies Farm 91/5. The orange dashed lines indicate the left and right margins of the river, and the blue arrow shows direction of water flow. The vegetation is greener and of a different community, compared with the surrounding terrestrial landscape.

Figure 6: Typical small ephemeral watercourse on the site. These ecosystems are recognisable by the loose, deeper sands within the watercourse, and usually taller and greener plant communities.

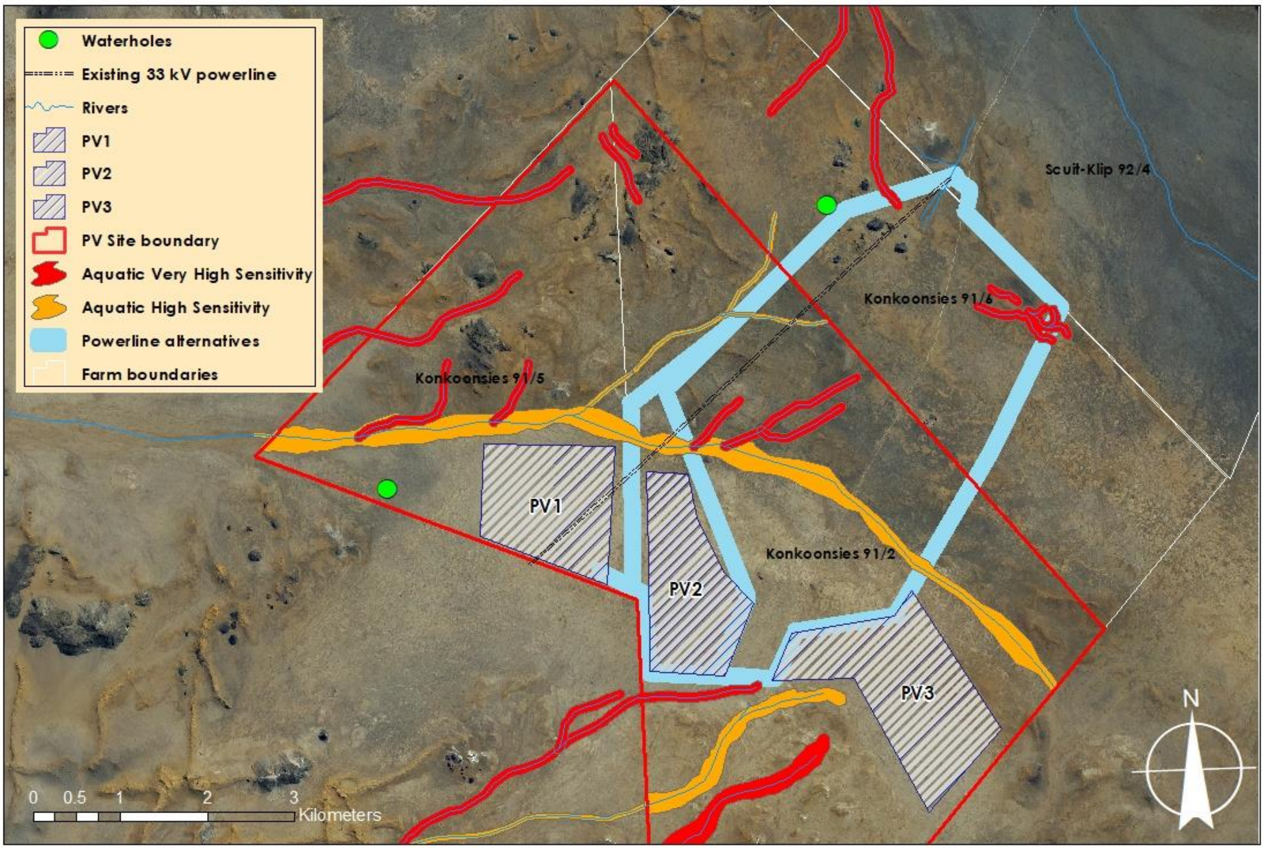


Figure 7: Location of the two waterholes within the Paulputs site, but some distance from the PV footprints.

During the site visit in May 2018, two waterholes were recorded on the site (Figure 8). These are located on outcrops of granite, where potholes have formed that accumulate water and retain it for longer than the surrounding landscape. As a result, these waterholes are important sources of water, and pools for breeding of aquatic invertebrates, in an otherwise very arid landscape. Fairy shrimps (Order Anostraca – see Figure 9), water boatmen (Order Hemiptera, Family Corixidae), birds and wasps were noted in and around these waterholes.

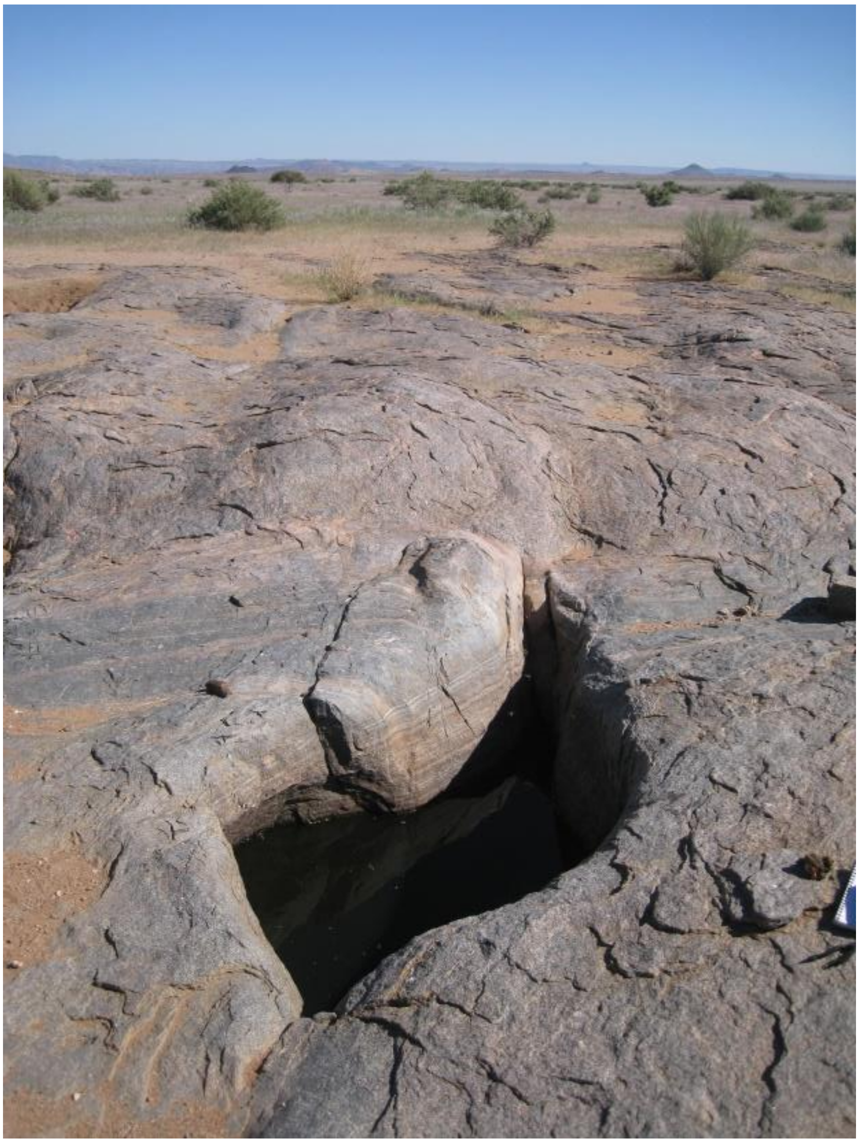


Figure 8: Waterhole on a granite slab.

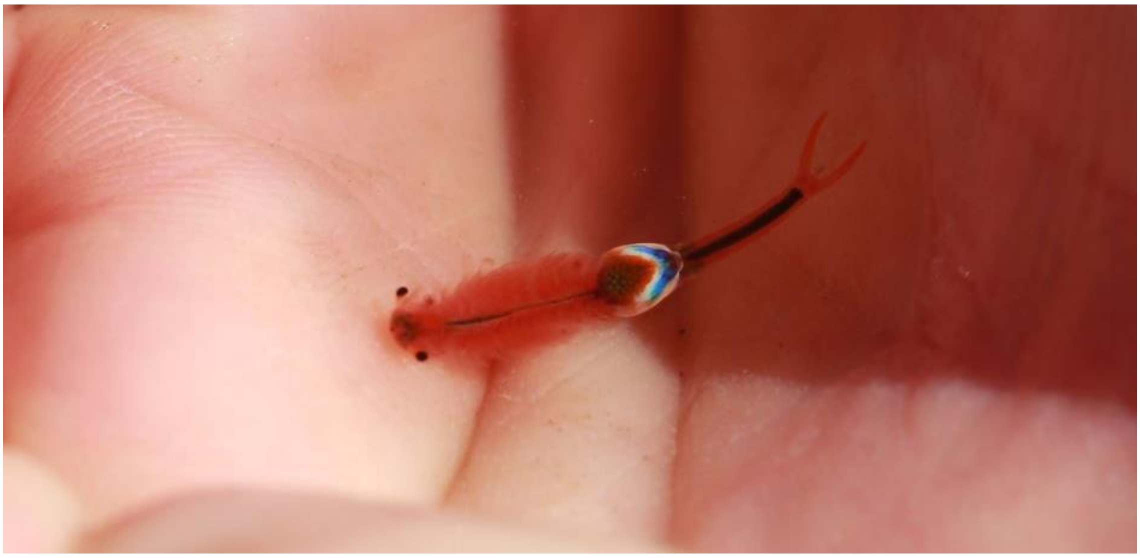


Figure 9: Adult fairy shrimp from one of the waterholes on site.

- **Conservation status of the site**

According to the Northern Cape Critical Biodiversity Areas (CBA) Map, the Paulputs site lies completely within a CBA 2 site. In this case, the reason for this designation is the categorization of the site as a CBA 2 category site by the Namakwa District Biodiversity Sector Plan (a previous conservation plan that predates the Northern Cape CBA Map). These CBA 2 sites were incorporated into the Northern Cape CBA Map with a 60% target (Holness and Oosthuysen, 2016).

The Kaboep River has been identified as a CBA1 on the Northern Cape CBA Map, as all FEPA watercourses were identified as such, including a 500m riverine buffer on either side of the centreline. There are no NFEPA wetlands located within the study area, and none are located within 500m of the Paulputs site boundary.

- **PES and EIS of the watercourses**

The DWS assessed the mainstem of the Kaboep River and the major tributary that traverses the Konkoonsies Farm 91/5 to be in Category AB, i.e. largely natural. This is supported by the in-field assessment done in May 2018, which yielded a Category B (largely unmodified) for both instream and riparian condition for all of the mainstem rivers on the site as a whole.

The rivers are slightly impacted by some abstraction of water in small dams and weirs located within the channel. There are a few gravel road crossings and existing powerline crossings that also have a minimal impact on the watercourses.

The smaller tributaries flowing into these mainstem rivers were mostly assessed as being Category A, largely natural, as there are very few flow obstructions on these smaller rivers. The exception to this is a watercourse (comprising three tributaries) located to the north of the Paulputs site, close to the existing Eskom substation. This watercourse flows through the substation site but has been diverted into channels and culverts so that the substation is not flooded (see Figure 10 and Figure 11). This has influenced the natural hydrology of the watercourse and reduced the overall condition of the ecosystem. The watercourse was thus assessed as Category C – moderately modified.

In terms of EIS, the watercourses were all assessed as being of high importance and sensitivity, including the watercourses to the north at the Eskom substation. Despite their condition, all of these ephemeral watercourses are extremely sensitive to changes in hydrology, as their structure and function are driven by the prevailing hydrological and sediment transport regime. They are less sensitive to changes in water quality, especially salinity and pH. The watercourses are all important corridors for the movement of flora and fauna, and as nesting, breeding and feeding habitat.

Thus, combining both current condition and EIS, the Kaboep and its main tributaries were assessed as being of high sensitivity, and the smaller tributaries of very high sensitivity. The watercourse to the north at the Eskom substation is of medium sensitivity.

Figure 10: View of the ephemeral watercourse flowing around the Eskom substation site, looking upstream at the point that the watercourse meets the gravel road around the site.

Figure 11: Channel carrying surface water around the Eskom substation (yellow arrow).

- **<u>Species information</u>**

The Nama Karoo biome or ecoregion is characterised by a depauperate aquatic fauna, and a southern temperate ichthyofauna (L. Day, Ecoregions of the World, www.feow.org). Most of the species are hardy opportunistic species, that migrate to water as and when it becomes available, breed rapidly and then disperse more widely when condition are favourable. Perennial pools, rivers and wetlands (i.e. systems sustained throughout the year by groundwater) provide refugia for many of these species.

The fauna of these ephemeral systems is not well-known, but the pans have been found to provide aquatic habitat to a diverse array of species that depend on brief periods of inundation for hatching, mating, feeding and refuge (e.g. Hamer and Rayner, 1996; Anderson, 2000; Minter et al., 2004).

Ephemeral watercourses and wetlands also provide habitat for faunal species seeking refuge during dormant or drought-resistant stages. A great number of other organisms are not confined to these temporary systems, but derive crucial benefits from them, like migratory birds and many invertebrates that migrate from permanent to temporary habitats on a regular basis.

The frog atlas data do not record any likely occurrences of amphibians in the quarter degree square in which the site lies (2819DC). The IUCN Red List of Threatened Species notes the likely occurrence of the freshwater gastropod Radix natalensis (IUCN, 2016) to the north of the site, but this species only occurs in permanent waterbodies, so it unlikely to occur in any of the natural watercourses on the site. It might be found in watering holes and reservoirs.

Very little is known of the invertebrate fauna of the watercourses and wetlands of the Karoo region. Given the constant shift from aquatic to dry phases, ephemeral wetlands and watercourses support unique, well-adapted biotic communities with species that show rapid hatching, fast development, high fecundity, and short life spans. For example, the tadpole shrimp, Triops granarius, and the fairy shrimp in Figure 9 are reportedly common where mean inundation is less than one month; these invertebrates reach sexual maturity within days. Many taxa will reproduce asexually several times during the wet season.

Organisms that inhabit temporary wetlands rely on the production of desiccation-resistant or dormant propagules (such as eggs, cysts, seeds, spores) to survive this kind of environment. Propagules allow for the organisms to lie-in-wait during the dry period, and then come back to life when the wetland is inundated. There are several taxa that are completely dependent on ephemeral wetlands to complete their life-cycle. Phyllopod crustaceans are well-known inhabitants of ephemeral wetlands and watercourses; these include the Anostraca (fairy shrimp, e.g. Streptocephalus sp.), Notostraca (tadpole shrimp, e.g. Triops namaquensis), Spinicaudata (clam shrimps, e.g. Eocyzicus gigas), Laevicaudata (clam shrimps), Cladocera (water fleas, e.g. Daphnia gibba), and Ostracoda (seed shrimps) (Lloyd and Le Roux, 2985; and Musa Mlambo, Albany Museum, pers. comm., January 2016).

- **<u>Buffers</u>**

Buffers represent zones in which construction or habitat degradation would risk direct or indirect impacts on aquatic features and local hydrology. The main objective of the establishment and protection of buffers around aquatic features is to ensure that these features are protected from direct and indirect impacts.

The national Preliminary Guideline for the Determination of Buffer Zones for River, Wetlands and Estuaries (MacFarlane et al., 2014) was used to determine a desktop-level buffer width, which was based on the types of impacts associated with construction and operation of power (electrical) infrastructure. The generic buffer for this type of activity is 55m for all aquatic ecosystems located in an area with low rainfall and with low rainfall intensity.

It is recommended that this generic buffer be reduced to the following, based on the sensitivities of the watercourses:

  - Aquatic features of very high sensitivity: 55m buffer
  - Aquatic features of high sensitivity: 30m buffer
  - Aquatic features of medium sensitivity: 15m buffer

- **<u>Sensitivity map</u>**

The ecological buffers were added to the watercourses (the buffer was measured from the edge of the riparian zone, roughly mapped on ArcGIS as “river area”, for the larger watercourses, and from the centreline for the smaller watercourses, where there a riparian zone is difficult to map) and are represented on the sensitivity map (Figure 12).

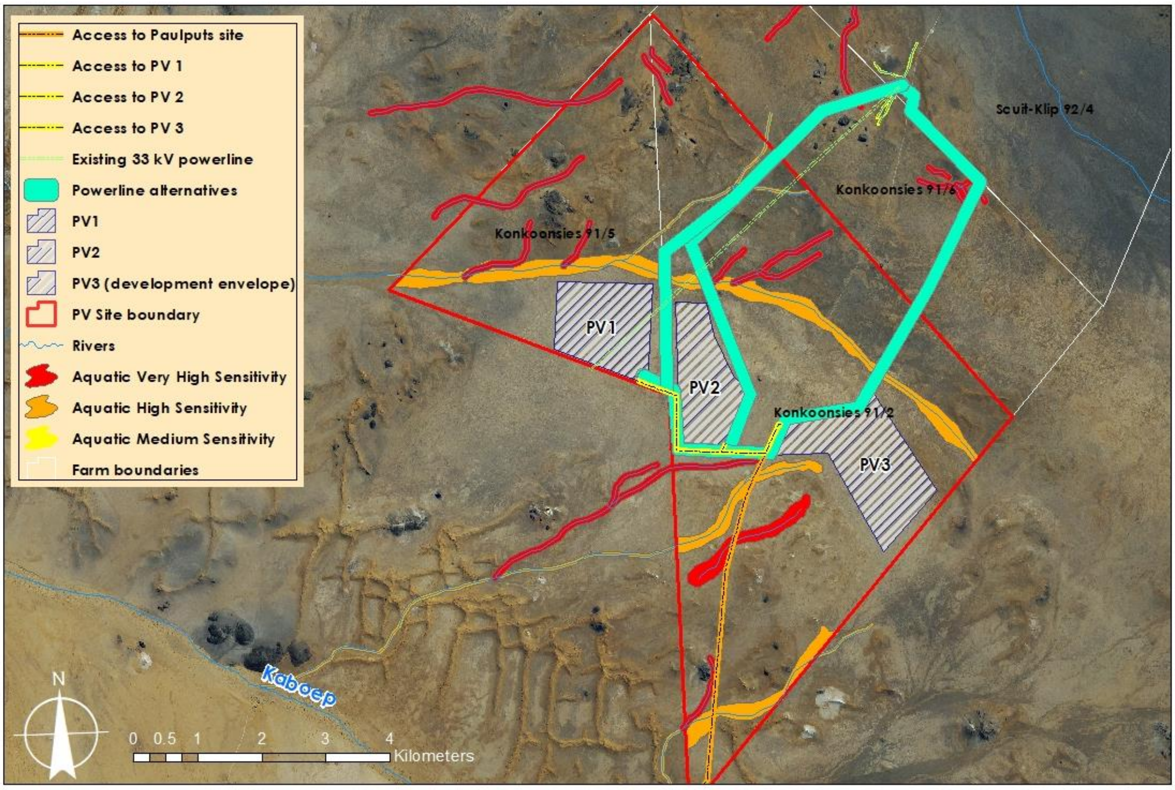


Figure 12: Aquatic sensitivity map for the Paulputs site.

4.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

- **National Environmental Management Act (Act 107 as amended by Act 62 of 2008)**

The National Environmental Management Act of 2008 (NEMA), outlines measures that….”prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.”

Of particular relevance to this assessment is Chapter 1(4r), which states that sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

Section 24 of NEMA requires that the potential impact on the environment, socio-economic conditions and cultural heritage of activities that require authorisation or permission by law, must be considered, investigated and assessed prior to implementation, and reported to the relevant regulatory authority.

- **Environmental Impact Assessment regulations issued in terms of NEMA (originally promulgated as Regulation 385, 2006, with new legislation adopted in December 2014, as amended in 2017)**

These regulations identify activities deemed to have a potentially detrimental effect on natural ecosystems, including aquatic ecosystems, and outline the requirements and timeframe for approval of development applications. Different sorts of activities are listed as environmental triggers that determine different levels of impact assessment and planning required. The regulations detail the procedure to be followed for a basic or full environmental impact assessment.

- **Conservation of Agricultural Resources Act (Act 43 of 1983)**

Key aspects include legislation that allows for:

Section 6: Prescription of control measures relating to the utilisation and protection of vleis, marshes, water sponges and water courses. These measures are described in regulations promulgated in terms of the Act, as follows:

Regulation 7(1): Subject to the Water Act of 1956 (since amended to the Water Act 36 of 1998), no land user shall utilise the vegetation of a vlei, marsh or water sponge or within the flood area of a water course or within 10 m horizontally outside such flood area in a manner that causes or may cause the deterioration or damage to the natural agricultural resources.

Regulation 7(3) and (4): Unless written permission is obtained, no land user may drain or cultivate any vlei, marsh or water sponge or cultivate any land within the flood area or 10 m outside this area (unless already under cultivation).

- **Biodiversity Act**

To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act of 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bio-prospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute.

- **National Water Act (1998)**

The main regulatory requirements with regards to aquatic features relates to the National Water Act No. 36 of 1998 (NWA). The NWA regulates 11 water uses that require authorisation, some of which are likely to be applicable to the PV project. Section 21 of the NWA defines water use as:

  - Taking water from a water resource;
  - Storing water;
  - Impeding or diverting the flow of water in a watercourse;
  - Engaging in a stream flow reduction activity;
  - Engaging in a controlled activity identified and declared as such in terms of the Act;
  - Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
  - Disposing of waste in a manner which may detrimentally impact on a water resource;
  - Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
  - Altering the bed, banks, course or characteristics of a watercourse;
  - 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
  - Using water for recreational purposes.
  - The construction of river crossings over a river can lead to the changes in flow in (Section 21 (c)) or alterations to the bed and banks/characteristics of (Section 21 (i)) the affected river reaches, and so a water use authorisation must be obtained for these specific

activities. Should stormwater be discharged into seeps or streams, this is generally authorised (but requires registration) up to 2000 m3 per day (Section 21 (f)). Volumes higher than this will be subject to a full water use license application.

The construction of river crossings over a river can lead to the changes in flow in (Section 21 (c)) or alterations to the bed and banks/characteristics of (Section 21 (i)) the affected river reaches, and so a water use authorisation must be obtained for these specific activities. Should stormwater be discharged into seeps or streams, this is generally authorised (but requires registration) up to 2000 m3 per day (Section 21 (f)). Volumes higher than this will be subject to a full water use licence application.

The Department of Water and Sanitation (DWS) has issued a number of General Authorisations (GA) in terms of Section 39 of the National Water Act. A water use may be generally authorised if it falls within a specific threshold or area. The GA of the 26th August 2016 provides the limits and conditions of water uses that may be generally authorised and defines the regulated zone outside of which the GA applies.

The regulated area is the area within 500 m of the outer boundary of any wetland, and 100 m from the outer edge of the riparian zone of a watercourse, or the 1:100 year floodline, whichever is greater. If the riparian zone has not been delineated, or is difficult to delineate, then the 100 m is measured from the most clearly identified bank. In the case of the ephemeral watercourses on the Paulputs site, the riparian zone and the banks are difficult to delineate, due to the lack of sufficient surface flow to sustain these features. In this case, the outer edge of the recommended ecological buffer has been used as the boundary from which the 100 m should be measured.

- **Namakwa District Environmental Management Framework**

The Paulputs site lies in the far north-eastern corner of the Namakwa District. The Namakwa District EMF identifies all rivers (watercourses) and wetlands as having an environmental sensitivity rating of D, i.e. medium sensitivity, which includes sensitive ecosystems that are fairly common in the area, where “development must be guided by the constraints offered by the site and must ensure that adequate provision is made for protection of environmental features”.

Water as a resource is seen as limiting in the region. Alien invasive species along watercourses are a priority in terms of ecosystem management. The 1:100 year floodline needs to be depicted on all proposed development maps. No specific recommendation is made with regard to watercourse buffers.

4.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS

- **Description of the development**

A description of the Phase 2 facility is provided in Table 1, with maps in Figure 13 and Figure 14.

Table 1 Description of the Phase 2 PV facility.

Component	Dimensions
Solar facility	≤ 200ha footprint
Battery Storage System: ≤ 100MWh battery storage facility for grid storage (stacked containers or multi-storey building) and associated operational, safety and control infrastructure.	≤ 1ha ≤ 8m building height

Component	Dimensions
Access road: existing gravel access road running from OG73 to main site entrance from the R358, and then a new access road to PV1. Access to site from the N14 via the R358 (southern access) is approximately 28 km, of which 11 km are travelled on the R358 and the balance (approximately 17 km) on OG73. Access to site from the N14 via the MR759 (northern access) is approximately 31 km, of which 22 km are travelled on the MR759 and the balance on OG73.	Maximum width of 13,5 m, including stormwater channels or drainage structures
Internal roads: ≤ 6m wide gravel internal roads linking the access road and various project components and servicing the solar panel arrays. Roads fitted with traffic control systems and stormwater controls as required.	≤ 6m wide gravel roads
Onsite substation complex: ≤ 2ha onsite substation complex including a collector substation to receive, convert and step up electricity from the PV facility to a grid suitable power supply. A 50m telecommunications tower (lattice or monopole type) will be established in the substation area.	≤ 2ha infrastructure up to 30m height 50m telecommunications tower
Operations and Maintenance (O&M) area: ≤1ha hectare O&M laydown area (near / adjacent substation); Parking, reception area, offices and ablutions facilities for operational staff, security and visitors; Workshops, storage areas for materials and spare parts; Water storage tanks or lined ponds (~160kl/day during first 3 months; ~90kl/day during rest of construction period; ~20kl/day during operation; small diameter water supply pipeline connecting existing boreholes or existing pipeline access points to storage.); Septic tanks and sewer lines to service ablution facilities; and Central Waste collection and storage area. Perimeter fencing and internal security fencing and gates as required. Access control gate and guard house on access road;	≤1ha office, ablutions, workshop complex
Temporary infrastructure: ≤ 4 ha area including a concrete batching facility, temporary offices, a construction yard, and a laydown area. Temporary site camp, laydown areas including access road, site offices.	≤ 4ha (Temporary)

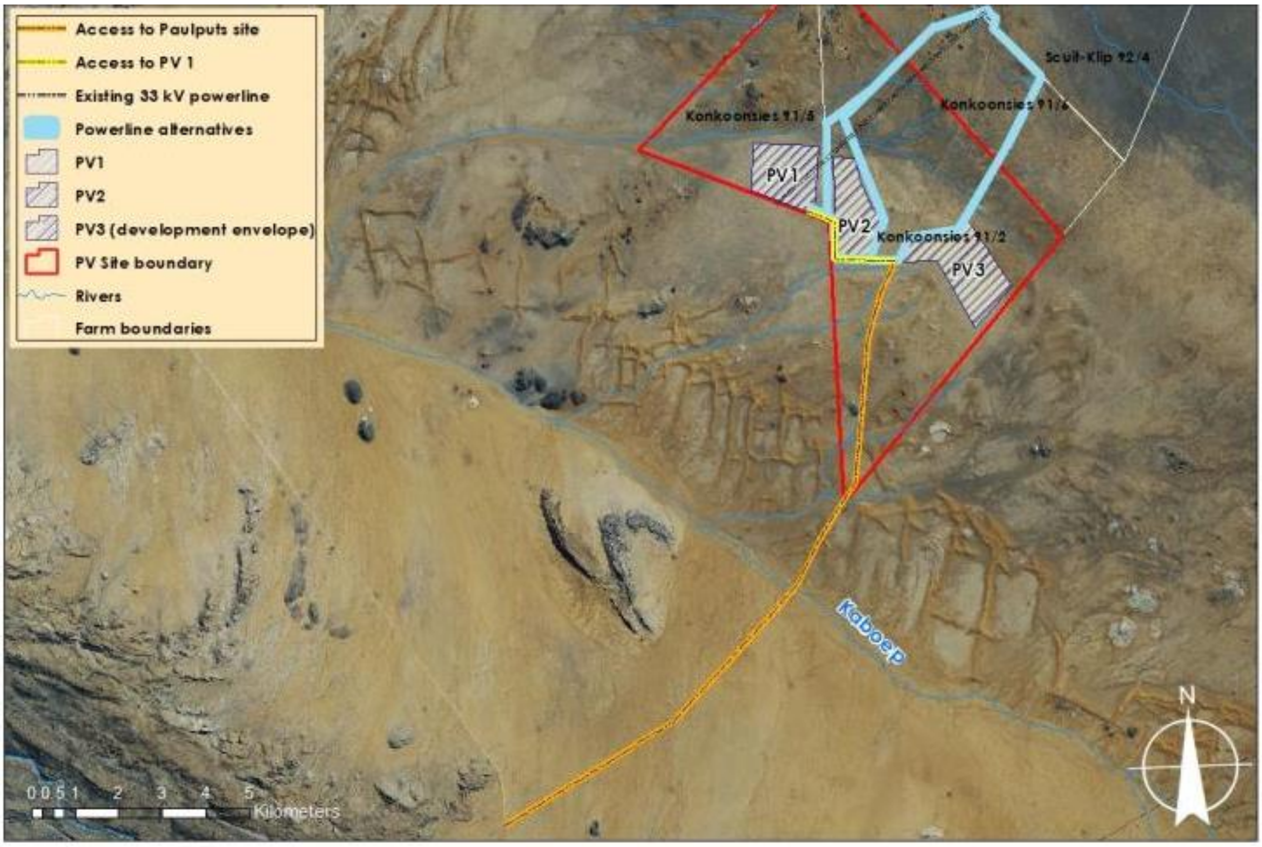


Figure 13 Map showing the southern access route to the Paulputs Phase 2 site.

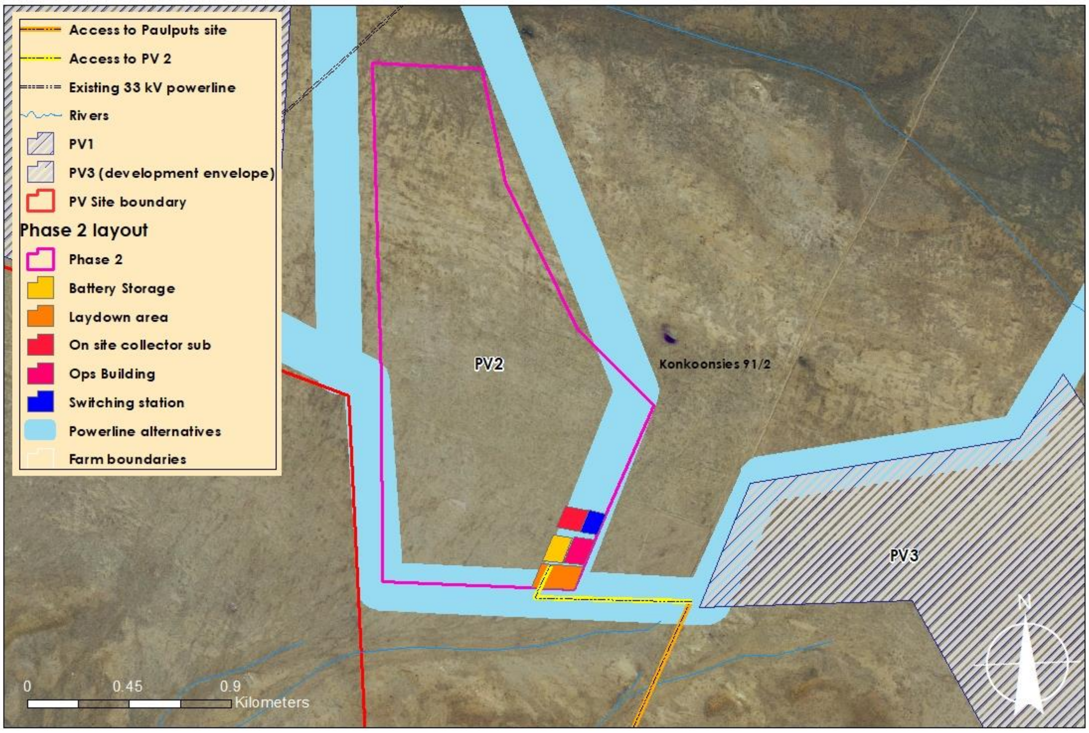


Figure 14 Map of the Paulputs Phase 2 site, showing the proposed location of the facility within the broader site, in relation to the proposed powerline alternatives, existing Eskom 33kV powerline, and the Phase 3 site.

- **Key Issues Identified During the Scoping Phase**

The phases considered here are the design phase (location and layout of the facility), construction, operation and decommissioning. The decommissioning phase is considered to be a similar process to the construction phase, but with the sequence reversed.

Apart from the construction phase, the most significant impacts associated with solar PV facilities are the clearing of vegetation and levelling of the landscape. Areas that have been cleared of indigenous vegetation are subject to a significantly greater alien plant invasion risk, and also the risk of changes in soil structure. For instance, soils in cleared areas can form a crust, as a result of rainfall displacing finer particles and causing compaction. Crusted soils are less permeable, and lead to an increase in runoff. Clearing also leads to significant changes in surface hydrology as vegetation intercepts rainfall and influences the way runoff behaves on the surface, which consequently has an effect on erosion and sedimentation. Removal of vegetation within the PV array footprint leads to an alteration in surface hydrology.

Levelling and grading of areas to remove steep slopes and undulations in the landscape is often associated with the placement of the PV arrays, and this topographic alteration combined with the encroachment of PV arrays into and across drainage lines and wetlands can alter the natural surface hydrology.

Furthermore, hardening of surfaces associated with solar PV facilities would result in significant increases in stormwater runoff and concentration of surface flow patterns. Infrastructural development such as powerlines and roads across watercourse can lead to the interruption of flows, if poles, bridge supports or foundations are laid within a watercourse.
The following sections describe the specific impacts that are expected to affect the biodiversity and/or ecosystem functioning of the inland aquatic ecosystems on the PV1 site and immediate surrounds, and also across the broader Karoo landscape.

- **Overview of impacts resulting from the proposed powerlines**

    - ***Design phase - layout and location of powerlines***

The exact location of the various components of the facility may have an impact on the watercourses identified on the site. These are described below in Table 7.2. There are no design phase impacts associated with the No Go option.

Table 2: Impacts and risks associated with the layout and location of the Phase 2 facility.

Activity	Impact and Risk
Development of the site leading to the loss of open space No matter the location or layout of the facility, development of the site will lead to the loss of some open space. This is due to catchment hardening for the construction of buildings, PV arrays and roads.	The connectivity between the watercourses and the surrounding terrain is particularly important for the movement of flora and fauna across the landscape, and the flow of water and sediment. Fragmentation of this connectivity could lead to deterioration in condition of the site as a whole and may have knock-on effects on the surrounding landscape and biota. This impact may not lead to direct watercourse habitat loss, but rather a lowered ecological state, and may have greater significance as a

	cumulative impact across the broader landscape.

- ***Construction phase***

There are no construction impacts associated with the No-Go option. The table below lists the activities that pose a risk to the inland aquatic environment of the Phase 2 site.

Table 3: Construction phase impacts and risks associated with the Phase 2 activities.

Activity	Impact and Risk
Dumping or storage of building materials (sand, soil, bricks etc) in sensitive areas.	Dumping and storage of building materials can damage the soil structure and destroy or shade out plants growing in and around the watercourses. Dump/storage areas frequently lead to the compaction of soils, which can influence re-growth of plants and surface runoff.
Leakage of waste water, fuels, oils, etc. from toilets and construction machinery, leading to the pollution of aquatic features.	Hydrocarbon (i.e. fuels and oils) pollution can lead to accumulation in sediments, and a loss of permeability of soils. Leakage of substances containing heavy metals may lead to the bioaccumulation of toxins in locally-occurring biota. Leaks from toilets or temporary conservancy /septic tanks can lead to organic pollution of soils and ecosystems.
Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of inland aquatic habitat.	Access across and around the watercourses onto and across the building site, and for road construction and laying of pipes, is likely to lead to damage of soils and vegetation. Regular use of a particular area will lead to the compaction of soils
Noise and light pollution causing disturbance of inland aquatic fauna and flora	The presence of construction teams and their machinery will lead to an increase in noise and light in the area, which will disturb aquatic and terrestrial fauna and flora.
Disturbance of the soils and the use of top material leading to the introduction and spread of alien invasive species.	Top material used for filling and landscaping can lead to the introduction of alien or invasive seeds. The Phase 2 site is currently free of alien invasive species and should be maintained as such. Invasion by alien species, especially of tree species such as Prosopis sp. and alien and invasive grass species, would have an impact on water resources and biodiversity.
Dumping or storage of building materials (sand, soil, bricks etc) in sensitive areas.	Dumping and storage of building materials can damage the soil structure and destroy or shade out plants growing in and around the watercourses. Dump/storage areas frequently lead to the compaction of soils, which can influence re-growth of plants and surface runoff.

- ***Operational phase***

There are no operational phase impacts associated with the No Go option. Below is a table of activities expected to be associated with the operational phase of the Phase 2 PV facility at Paulputs. The impacts and risks are described.

Table 4: Activities, impacts and risks associated with the operational phase of the Phase 2 PV facility at Paulputs.

Activity	Impact and Risk
Water use: In terms of water requirements for operational activities, the applicant is planning on transporting water in from the nearest town or possibly intercepting an existing nearby pipeline. The preferred source of water for the project will be determined in consultation with the local municipality. Water will be required for maintenance activities, dust management, and for human consumption.	• Ground- and surface water resources are scarce in the Karoo, and should be managed carefully. ◦ Drawdown of groundwater can cause a cone of depression in the vicinity of boreholes. This can affect surface water ecosystems that are dependent on groundwater to maintain them.
Discharge of treated waste water	• The discharge of waste water, even if treated, can lead to a decrease in water quality in surface- and groundwater resources. • It is unclear as to how waste water will be treated on the site, but the use of septic tanks and soak-aways on the site would lead to pollution of this low nutrient environment. ◦ An increase in nutrients, in combination with an increased availability of runoff water, will lead to a proliferation of nutrient-tolerant plant and animal species. For instance, certain algal species proliferate in standing water that has a high volume of nutrients. Eutrophication and the proliferation of algae lead to oxygen depletion, and the loss of more sensitive species of flora and fauna.
On-site stormwater management	• The hardened surfaces of the development will lead to an increase in stormwater runoff generated by the site, thus increasing on-site volumes. This can also result from clearing of natural vegetation for the PV arrays. Vegetation (i.e. increased catchment roughness) serves to reduce the runoff rate. • Discharge of stormwater directly into any of the ephemeral watercourses on the site will lead to a loss of habitat quality, as these systems will be inundated for longer than natural and will lose their ephemeral character. • Road maintenance activities on unsurfaced roads may lead to changes in flow patterns, due to the scraping of gravel into berms alongside the road. Overland sheet flow may be blocked, or channelised. • Changes in hydrological regimes (i.e. flow inputs and patterns) of ephemeral watercourses can lead

	to changes in hydrological cues for hatching and breeding, changed vegetation communities, and ultimately the spatial extent of riparian zones of watercourses.
Clearing of vegetation. Soils in cleared areas can form a crust, as a result of rainfall displacing finer particles and causing compaction. Crusted soils are less permeable, and lead to an increase in runoff. It is likely that areas cleared of indigenous vegetation will be invaded by alien and/or invasive plant species, such as grasses and weeds.	• This would lead to changes in surface water flow patterns across the site (not just in watercourses).
Leakage of fuels, oils, etc. from on-site machinery, leading to the pollution of inland aquatic features.	• Hydrocarbon (i.e. fuels and oils) pollution can lead to accumulation in sediments, and a loss of permeability of soils. • This may also lead to the bioaccumulation of toxins in locally occurring biota.

- ***Decommissioning phase***

There are no decommissioning phase impacts associated with the No Go option. The impacts associated with this phase are similar to those described for the construction phase.

Table 5: Decommissioning phase impacts and risks associated with the Phase 2 activities.

Activity	Impact and Risk
Dumping or storage of materials (sand, soil, bricks, PV panels, etc) in sensitive areas.	• Dumping and storage of decommissioned materials can damage the soil structure and destroy or shade out plants growing in and around the watercourses. • Dump/storage areas frequently lead to the compaction of soils, which can influence re-growth of plants and surface runoff.
Leakage of waste water, fuels, oils, etc. from toilets and machinery, leading to the pollution of aquatic features.	• Hydrocarbon (i.e. fuels and oils) pollution can lead to accumulation in sediments, and a loss of permeability of soils. • Leakage of substances containing heavy metals may lead to the bioaccumulation of toxins in locally-occurring biota. • Leaks from toilets or temporary conservancy /septic tanks can lead to organic pollution of soils and ecosystems.
Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of inland aquatic habitat.	• Access across and around the watercourses onto and across the site is likely to lead to damage of soils and vegetation. • Regular use of a particular area will lead to the compaction of soils
Noise and light pollution causing disturbance of inland aquatic fauna and flora	• The presence of decommission teams and their machinery will lead to noise and light in the area, which will disturb aquatic and terrestrial fauna and flora.

Disturbance of the soils and the use of top material leading to the **<u>introduction and spread of alien invasive species</u>**.	• Top material used for filling and rehabilitation of the facility can lead to the introduction of alien or invasive seeds. The Phase 2 site is currently free of alien invasive species and should be maintained as such. • Invasion by alien species, especially of tree species such as Prosopis sp. and alien and invasive grass species, would have an impact on water resources and biodiversity.

- **<u>Assessment of Impacts</u>**

The scores assigned to the criteria used for assessing each impact are provided in Appendix C. The descriptions of the significance of the impacts presented below are before mitigation, and mitigation measures are described in Section 4.10.

- ***Design phase - design and location of facility***

Development of the site leading to the loss of open space. No matter the location or layout of the facility, development of the site will lead to the loss of some open space. This is due to catchment hardening for the construction of buildings, PV arrays and roads. The extent of the PV array for Phase 2 is small (< 200 ha) in relation to the fairly homogenous dryland landscape. Thus, although the loss is long-term (i.e. the life-time of the facility), the intensity of the impact is low and moderately reversible. The probability of this impact carrying a risk for the environment is unlikely (probably 50%), thus the overall significance of this impact is low.

- ***Construction phase***

<u>Dumping or storage of building materials</u> (sand, soil, bricks etc) in sensitive areas. This is likely to occur well away from any watercourses. Thus, the impact is very unlikely, and of low significance.

<u>Leakage of waste water, fuels, oils, etc. from toilets and construction machinery, leading to the pollution of aquatic features</u>. The Phase 2 site is located on a part of the site that slopes away from the main watercourse traversing the site, thus this impact is very unlikely and of low significance.

<u>Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of inland aquatic habitat.</u> This is likely to occur well away from any watercourses. The impact is very unlikely, and of low significance.

<u>Noise and light pollution causing disturbance of inland aquatic fauna and flora.</u> This is likely to occur well away from any watercourses, and the impact is unlikely, and of low significance.

Disturbance of the soils and the use of top material can lead to the **<u>introduction and spread of alien invasive species</u>**. This impact is likely, as disturbed soils are where IAPs are known to establish. The impact is of medium intensity, and of medium significance.

- ***Operational phase***

<u>Water use</u>: In terms of water requirements for operational activities, the applicant is planning on transporting water in from the nearest town or possibly intercepting an existing nearby pipeline. The preferred source of water for the project will be determined in consultation with the local municipality.

Water is a scarce resource in the Karoo, so this impact was assessed as being of medium significance, due to the regional extent of the scarcity.

Discharge of treated waste water. There will be septic tanks for the ablution facilities on the site. The soils on the site are very low in nutrients, so even a small increase in organics will represent pollution, and if this reaches any of the water resources, it may be detrimental. This is unlikely, however, due to the slope of the site away from the main watercourses. The significance of the impact is low.

On-site stormwater management. The site slopes away from the main watercourses on the site, so discharge of stormwater is unlikely to occur towards these ecosystems. It is assumed that water running off the PV arrays will merely flow onto the ground, to filter into the ground. It is not clear what will be done with the stormwater from the on-site substation and switching station. Negative impacts from stormwater runoff are unlikely to pose a risk to the inland aquatic ecosystems on the site, and the impact is of low significance.

Clearing of vegetation. It is likely that areas cleared of indigenous vegetation will be invaded by alien and/or invasive plant species, such as grasses and weeds. Soils in the cleared areas will also harden and this will impact on surface hydrology. These may spread and invade into the watercourses, where seeds can flow downstream after rainfall. The impact is considered to be of medium significance.

Leakage of fuels, oils, etc. from on-site machinery, leading to the pollution of inland aquatic features. This impact is unlikely to pose a risk to the watercourses on the site and is considered to be of low significance.

- ***Decommissioning phase***

Dumping or storage of materials (sand, soil, bricks, PV panels, etc) in sensitive areas. This is likely to occur well away from any watercourses. Thus, the impact is very unlikely, and of low significance.

Leakage of waste water, fuels, oils, etc. from toilets and machinery, leading to the pollution of aquatic features. The Phase 2 site is located on a part of the site that slopes away from the main watercourse traversing the site, thus this impact is very unlikely and of low significance.

Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of inland aquatic habitat. This is likely to occur well away from any watercourses. The impact is very unlikely, and of low significance.

Noise and light pollution causing disturbance of inland aquatic fauna and flora. This is likely to occur well away from any watercourses, and the impact is unlikely, and of low significance.

Disturbance of the soils and the use of top material leading to the **introduction and spread of alien invasive species**. This impact is likely, as disturbed soils are where IAPs are known to establish. The impact is likely and of medium intensity, and of medium significance.

4.8. ASSESSMENT OF CUMULATIVE IMPACTS

All renewable energy projects located within 30km of the Paulputs site, as described in Part 6 of the EIA report, were considered during this cumulative impact assessment. The geographical scope of the most significant cumulative impacts is within 30 km of the proposed site and represent the solar energy node. The solar energy node includes the following renewable energy projects with their associated transmission lines and covers the area around the Paulputs Substation and includes:

- KaXu Solar One CSP facility[10] (100 MW plus 2.5 hours of storage in molten salts) in operation on the Scuilt-Klip Farm No.92 Portion 4;
- Xina Solar One CSP facility (100 MW), in operation on the Scuilt-Klip Farm No.92 Portion 4;
- Konkoonsies I PV facility (10 MW)[11,12] in operation on the Koonkonsies Farm No. 91 Portion 6;
- Konkoonsies II PV facility (75MW), approved on the Koonkonsies Farm No. 91 Portion 6; and
- Paulputs CSP facility, approved on the Scuilt-Klip Farm No.92 Portion 4.

It is assumed that each of these projects will require powerline links to substations, and so would carry similar impacts and risks to the aquatic environment.

The cumulative impacts of most concern in this area are the loss of open space, fragmentation of inland aquatic ecosystems as a result of road crossings, changes in flow input and patterns (and the consequent changes in sediment input) from stormwater discharge off the site, and the introduction and spread of alien invasive (especially Prosopis sp.). The increased demand for and use of water resources, probably groundwater, is also of concern.

Although most of the impacts above were assessed as being of low significance for the Phase 2 facility, some of the impacts increase in significance when assessed in the light of similar projects in the area, without mitigation.

Development of sites leading to the loss of open space. No matter the location or layout of the facility, development of solar facilities in the area will lead to the loss of some open space, and catchment hardening for the construction of buildings, PV arrays and roads. This loss is long-term (i.e. the life-time of the facilities), the intensity of the impact is medium with low reversibility. The probability of this impact carrying a risk for the environment is likely (> 50%), thus the overall significance of this impact is medium.

Fragmentation of inland aquatic ecosystems as a result of road crossings. The construction of roads and road crossings can have the impact of constricting or blocking the free flow of water down rivers and within wetlands, leading to changes in hydrology. Without mitigation this impact is likely to be of medium significance.

Changes in flow input and patterns (and the consequent changes in sediment input) from stormwater discharge off the sites. The hardened surfaces of the PV facilities in the area will lead to an increase in stormwater runoff generated off the sites. This can also result from clearing of natural vegetation for the PV arrays. Discharge of stormwater directly into the ephemeral wetlands and watercourses of the area will lead to a loss of habitat quality, as these systems will be inundated for longer than natural and will lose their ephemeral character. Road maintenance activities on unsurfaced roads may also lead to changes in flow patterns, due to the scraping of gravel into berms alongside the road. Overland sheet flow may be blocked, or channelised.

Without mitigation this impact is likely to be of medium significance.

Introduction and spread of alien invasive (especially *Prosopis* sp.). The area around Paulputs is relatively clear of aliens such as *Prosopis* sp., which makes it all the more important to control these species. Without mitigation, this impact would be of medium significance.

---

10 http://www.abengoasolar.com/web/en/plantas_solares/plantas_propias/sudafrica/

11 https://www.apsolutions.co.za/portfolio-item/konkoonsies-i/

12 http://www.biothermenergy.com/blog/konkoonsies-solar-pv

The **increased demand for and use of water resources** is also of concern. It is not clear where water will be abstracted for use on the Paulputs site, but water in the region is scarce, with most users tapping into the groundwater sources. Water use on a PV facility is relatively low, but the cumulative impact across all the facilities would have an impact of medium significance, without mitigation.

4.9. IMPACT ASSESSMENT SUMMARY

- **Design Phase**

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Development of the site leading to the loss of open space	• Fragmentation of the landscape with an impact on the movement of flora and fauna. • Altered surface hydrology (across slopes and not just in watercourses).	Negative	Local	Long-term	Low	Unlikely	Moderate	Moderate	• Ensure that transformation of the terrain is limited to the proposed Phase 1 footprint, ensuring that developed areas (roads, buildings and landscaped areas)do not encroach into the high and very high sensitivity inland aquatic ecosystems and their buffers. • Fences on the site should allow for the movement of fauna. • Obstructions to surface water flow should be minimised and hardening of the catchment should be avoided wherever possible, such as through the use of permeable surfaces for paved areas and roads.	Low	Low to negligible

- **Construction Phase**

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Dumping or storage of building materials	• Dumping and storage of building materials can damage the soil structure and destroy or shade out plants growing in and around the watercourses. • Dump/storage areas frequently lead to the compaction of soils, which can influence re-growth of plants and surface runoff.	Negative	Local	Medium-term	Low	Very unlikely	High	Low	• Ensure that all building materials are stored at least 50m away from the edge of any watercourse. Storage areas should be bunded adequately to prevent contaminated runoff from exiting the construction site. • Materials should be stored in piles that do not exceed 2m in height and should be protected from the wind, to prevent spread of fine materials across the site. • All areas that are impacted by the storage and/or dumping of materials must be ripped and re-planted after construction is complete.	Low	None

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Leakage of waste water, fuels, oils, etc. from toilets and construction machinery	• Hydrocarbon (i.e. fuels and oils) pollution can lead to accumulation in sediments, and a loss of permeability of soils. • Leakage of substances containing heavy metals may lead to the bioaccumulation of toxins in locally-occurring biota. • Leaks from toilets or temporary conservancy /septic tanks can lead to organic pollution of soils and ecosystems.	Negative	Local	Medium-term	Moderate to low	Very unlikely	Moderate	Moderate	• Machinery prone to oil or fuel leakage must be located at least 50m away from the edge of any aquatic feature, and the area adequately bunded in order to contain leakages. • Water pumps and cement mixers shall have drip trays to contain oil and fuel leaks – these must be cleaned regularly. • Suitable toilet and wash facilities must be provided to avoid the use of sensitive areas for these activities. These service areas must be maintained, and toilets emptied on at least a weekly basis.	Low	None

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Foot and vehicular traffic onto and across the site	• Access across and around the watercourses onto and across the building site, and for road construction and laying of pipes, is likely to lead to damage of soils and vegetation. • Regular use of a particular area will lead to the compaction of soils	Negative	Local	Medium-term	Medium to low	Unlikely	Highly	Moderate	• Pathways and access roads must be routed to avoid watercourses and should cross these as seldom as possible. • Sensitive areas must clearly be demarcated and fenced off (using temporary fencing and danger tape) before any construction work or site preparation begins. These are no-go areas during the construction process. • All impacted areas of high or very high sensitivity must be ripped and re-planted after construction, to the satisfaction of the ECO.	Low	None

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Noise and light pollution	• The presence of construction teams and their machinery will lead to an increase in noise and light in the area, which will disturb aquatic and terrestrial fauna and flora.	Negative	Local	Short-term	Medium	Likely	Highly	Low	• The construction site and pathways must avoid sensitive areas. If lights are used, these must be directed away from all sensitive areas. • The sensitive areas (i.e. the edges of the buffers around watercourses) not affected by construction must clearly be demarcated and fenced off (using temporary fencing and danger tape) before any construction work or site preparation begins. These are no-go areas during the construction process, except where work is occurring.	Medium	Low to negligible

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Disturbance of the soils and the use of top material leading to the introduction and spread of alien invasive species.	• Top material used for filling and landscaping can lead to the introduction of alien or invasive seeds. The Phase 1 site is currently free of alien invasive species and should be maintained as such. • Invasion by alien species, especially of tree species such as Prosopis sp. and alien and invasive grass species, would have an impact on water resources and biodiversity.	Negative	Regional	Medium-term	Moderate	Likely	Low	Low	• Only good quality top soil/material can be used on the site. • Constant monitoring of the construction site by the Site Engineer and ECO must occur, and all alien plant species removed from or destroyed on the site.	Medium	Low

- **Operation Phase**

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Water use	• Ground- and surface water resources are scarce in the Karoo and should be managed carefully. • Drawdown of groundwater can cause a cone of depression in the vicinity of boreholes. This can affect surface water ecosystems that are dependent on groundwater to maintain them.	Negative	Regional	Long-term	Medium to low	Likely	Moderate	Low	• There should be no irrigation of landscaped areas on the site. • Water used for cleaning the PV panels should be recycled if possible, and should be done using treated waste water, if feasible.	Medium	Low

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Discharge of treated waste water	• The discharge of waste water, even if treated, can lead to a decrease in water quality in surface- and groundwater resources. • It is unclear as to how waste water will be treated on the site, but the use of septic tanks and soak-aways on the site would lead to pollution of this low nutrient environment. • An increase in nutrients, in combination with an increased availability of runoff water, will lead to a proliferation of nutrient-tolerant plant and animal species. For instance, certain algal species proliferate in standing water that has a high volume of nutrients. Eutrophication and the proliferation of algae lead to oxygen depletion, and the loss of more sensitive species of flora and fauna.	Negative	Local	Long-term	Medium to low	Unlikely	Moderate	Low	• Water discharged or soaking away from waste water treatment areas (septic tanks and soakaways, or package plants if these are used) must be directed to flow away from any surface inland aquatic ecosystems. • Water treated in package plants can be used for the cleaning of PV panels, if feasible.	Low	Low to negligible

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
On-site stormwater management	• The hardened surfaces of the development will lead to an increase in stormwater runoff generated by the site, thus increasing on-site volumes. This can also result from clearing of natural vegetation for the PV arrays. Vegetation (i.e. increased catchment roughness) serves to reduce the runoff rate. • Discharge of stormwater directly into any of the ephemeral wetlands and watercourses on the site will lead to a loss of habitat quality, as these systems will be inundated for longer than natural and will lose their ephemeral character.	Negative	Local	Long-term	Medium to low	Unlikely	Moderate	Moderate	• Effort should be made to minimise the hardening of surfaces and clearing of natural vegetation. • Strips of undisturbed natural vegetation should be maintained between rows of PV panels, to reduce runoff rates, and to allow local infiltration of water that runs off the panels. • Stormwater should not be conveyed along lined channels or in pipes and discharged directly into watercourses, but must be allowed to flow along unlined swales, permeable areas or bioswales (i.e. vegetated channels). • Parking areas should be constructed of permeable materials to allow for infiltration of water.	Low	Low to negligible

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
On-site stormwater management (cont.)	• Road maintenance activities on unsurfaced roads may lead to changes in flow patterns, due to the scraping of gravel into berms alongside the road. Overland sheet flow may be blocked, or channelised. • Changes in hydrological regimes (i.e. flow inputs and patterns) of ephemeral watercourses can lead to changes in hydrological cues for hatching and breeding, changed vegetation communities, and ultimately the spatial extent of riparian zones of watercourses.	Negative	Local	Long-term	Medium to low	Unlikely	Moderate	Moderate	• Gravel scraped off road surfaces during maintenance must not be pushed into sensitive areas and should be placed with regular drainage points that will allow surface runoff to be spread into the watercourses or surrounding terrestrial landscape, rather than directed into channels along or on either side of the road. This will also lead to less erosion of the unsurfaced roads. As a principle, hardened areas should be associated (where possible) with vegetated filter strips (broad, sloped vegetated areas that accept shallow runoff from hardened surfaces), bioswales (landscaped areas that are designed to remove silt and a number of pollutants from runoff, through ensuring that water flows slowly along these gently sloping (<6% slope) features, often planted with locally occurring grasses or other plant species, mulch or riprap), and / or bio-retention systems (vegetated areas where runoff is filtered through a filter media layer, e.g. sand, as it percolates downwards), all of which are designed to reduce the quantity of runoff leaving a hardened surface and entering the stormwater system.	Low	Low to negligible

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Clearing of vegetation	• This would lead to changes in surface water flow patterns across the site (not just in watercourses).	Negative	Local	Long-term	Medium	Likely	Low	Low	• Effort should be made to minimise the clearing of natural vegetation. • Strips of undisturbed natural vegetation should be maintained between rows of PV panels, to reduce runoff rates, and to allow local infiltration of water that runs off the panels. • The site and road verges must be monitored for IAP establishment.	Medium	Low
Leakage of fuels, oils, etc. from on-site machinery, leading to the pollution of inland aquatic features.	• Hydrocarbon (i.e. fuels and oils) pollution can lead to accumulation in sediments, and a loss of permeability of soils. • This may also lead to the bioaccumulation of toxins in locally occurring biota.	Negative	Local	Long-term	Medium to low	Unlikely	High	Low	• Machinery prone to oil or fuel leakage must be located at least 50m away from the edge of any aquatic feature, and the area adequately bunded in order to contain leakages. • Water pumps shall have drip trays to contain oil and fuel leaks – these must be cleaned regularly.	Low	None

- **Decommissioning Phase**

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Dumping or storage of materials	• Dumping and storage of decommissioned materials can damage the soil structure, and destroy or shade out plants growing in and around the watercourses. • Dump/storage areas frequently lead to the compaction of soils, which can influence re-growth of plants and surface runoff.	Negative	Local	Short-term	Low	Very unlikely	Highly	Moderate	• Ensure that all materials are stored at least 50m away from the edge of any watercourse. Storage areas should be bunded adequately to prevent contaminated runoff from exiting the site. • Materials should be stored in piles that do not exceed 2m in height and should be protected from the wind, to prevent spread of fine materials across the site. • All areas that are impacted by the storage and/or dumping of materials must be ripped and re-planted after decommissioning is completed.	Low	None

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Leakage of waste water, fuels, oils, etc. from toilets and construction machinery, leading to the pollution of aquatic features.	• Hydrocarbon (i.e. fuels and oils) pollution can lead to accumulation in sediments, and a loss of permeability of soils. • Leakage of substances containing heavy metals may lead to the bioaccumulation of toxins in locally-occurring biota. • Leaks from toilets or temporary conservancy /septic tanks can lead to organic pollution of soils and ecosystems.	Negative	Local	Short-term	Medium to low	Very unlikely	Moderate	Low	• Machinery prone to oil or fuel leakage must be located at least 50m away from the edge of any aquatic feature, and the area adequately bunded in order to contain leakages. • Suitable toilet and wash facilities must be provided to avoid the use of sensitive areas for these activities. These service areas must be maintained, and toilets emptied on at least a weekly basis.	Low	None

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of inland aquatic habitat.	• Access across and around the watercourses onto and across the site is likely to lead to damage of soils and vegetation. • Regular use of a particular area will lead to the compaction of soils	Negative	Local	Short-term	Medium to low	Unlikely	Highly	Moderate	• Pathways and access roads must be routed to avoid watercourses and should cross these as seldom as possible. • Sensitive areas must clearly be demarcated and fenced off (using temporary fencing and danger tape) before any work begins. These are no-go areas during the decommissioning process. • All impacted areas of high or very high sensitivity must be ripped and re-planted after decommissioning is completed, to the satisfaction of the ECO.	Low	None

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Noise and light pollution causing disturbance of freshwater fauna and flora	• The presence of decommission teams and their machinery will lead to noise and light in the area, which will disturb aquatic and terrestrial fauna and flora.	Negative	Local	Short-term	Medium to low	Likely	Highly	Low	• The site and pathways must avoid sensitive areas. If lights are used, these must be directed away from all sensitive areas. • The sensitive areas (i.e. the edges of the buffers around watercourses) not affected by decommissioning activities must clearly be demarcated and fenced off (using temporary fencing and danger tape) before any work begins. These are no-go areas during the decommissioning process, except where work is occurring.	Low	Low to negligible

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Introduction and spread of alien invasive species.	• Top material used for filling and rehabilitation of the facility can lead to the introduction of alien or invasive seeds. The Phase 1 site is currently free of alien invasive species, and should be maintained as such. • Invasion by alien species, especially of tree species such as *Prosopis* sp. and alien and invasive grass species, would have an impact on water resources and biodiversity.	Negative	Regional	Medium-term	Medium	Likely	Low	Low	• Only good quality top soil/material can be used on the site. • Constant monitoring of the site by the Site Engineer and ECO must occur, and all alien plant species removed from or destroyed on the site.	Medium	Low

- **Cumulative impacts**

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence / effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Development of the site leading to the loss of open space	• The connectivity between watercourses, wetlands and the surrounding terrain is particularly important for the movement of flora and fauna across the landscape, and the flow of water and sediment. Fragmentation of this connectivity could lead to deterioration in condition of the site as a whole, and may have knock-on effects on the surrounding landscape and biota. • This impact may not lead to direct watercourse habitat loss, but rather a lowered ecological state, and may have greater significance as a cumulative impact across the broader landscape.	Negative	Regional	Long-term	Medium	Likely	Low	Moderate	• Ensure that transformation of the terrain is limited to the proposed footprints, ensuring that developed areas (roads, buildings and landscaped areas) do not encroach into the high and very high sensitivity inland aquatic ecosystems and their buffers. • Fences on the site should allow for the movement of fauna. • Obstructions to surface water flow should be minimised, and hardening of the catchment should be avoided wherever possible, such as through the use of permeable surfaces for paved areas and roads.	Medium	Low

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence / effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Increase in water use	• Ground- and surface water resources are scarce in the Karoo and should be managed carefully. • Drawdown of groundwater can cause a cone of depression in the vicinity of boreholes. This can affect surface water ecosystems that are dependent on groundwater to maintain them.	Negative	Regional	Long-term	Medium	Likely	Low	Low	• There should be no irrigation of landscaped areas on the site. • Water used for cleaning the PV panels should be recycled if possible, and should be done using treated waste water, if feasible.	Medium	Low

River crossings for roads, leading to fragmentation of inland aquatic features and loss of connectivity	• The impacts associated with gravel roads and drift crossings (as for the current road) are:
	  o A raised road level blocking flow of water and sediment transport.
	  o Scraping of road for maintenance can lead to erosion around the road.
	• Significant erosion around the roads can lead to head-cut erosion in the watercourse channel itself.
		Negative	Regional	Long-term	Medium	Likely	Moderate	Moderate to low	• Design road crossings in such a way as minimise disturbance to the watercourse by:
									• Using existing road footprints.
									• Design road crossings as drifts rather than at height above the base level of the channel.
										Medium	Low

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence / effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
On-site stormwater management	• The hardened surfaces of the development will lead to an increase in stormwater runoff generated by the site, thus increasing on-site volumes. This can also result from clearing of natural vegetation for the PV arrays. Vegetation (i.e. increased catchment roughness) serves to reduce the runoff rate. • Discharge of stormwater directly into any of the ephemeral wetlands and watercourses on the site will lead to a loss of habitat quality, as these systems will be inundated for longer than natural and will lose their ephemeral character. • Road maintenance activities on unsurfaced roads may lead to changes in flow patterns, due to the scraping of gravel into berms alongside the road. Overland sheet flow may be blocked, or channelised. • Changes in hydrological regimes (i.e. flow inputs and patterns) of ephemeral watercourses can lead to changes in hydrological cues for hatching and breeding, changed vegetation communities, and ultimately the spatial extent of riparian zones of watercourses. • This would lead to changes in surface water flow patterns across the site (not just in watercourses).	Negative	Regional	Long-term	Medium	Likely	Moderate	Moderate to low	• Effort should be made to minimise the hardening of surfaces and clearing of natural vegetation. • Strips of undisturbed natural vegetation should be maintained between rows of PV panels, to reduce runoff rates, and to allow local infiltration of water that runs off the panels. • Stormwater should not be conveyed along lined channels or in pipes and discharged directly into watercourses, but must be allowed to flow along unlined swales, permeable areas or bioswales (i.e. vegetated channels). • Parking areas should be constructed of permeable materials to allow for infiltration of water. • As a principle, hardened areas should be associated (where possible) with vegetated filter strips (broad, sloped vegetated areas that accept shallow runoff from hardened surfaces), bioswales (landscaped areas that are designed to remove silt and a number of pollutants from runoff, through ensuring that water flows slowly along these gently sloping (<6% slope) features, often planted with locally occurring grasses or other plant species, mulch or riprap), and / or bio-retention systems (vegetated areas where runoff is filtered through a filter media layer, e.g. sand, as it percolates downwards), all of which are designed to reduce the quantity of runoff leaving a hardened surface and entering the stormwater system. • Gravel scraped off road surfaces during maintenance must not be pushed into sensitive areas, and should be placed with regular drainage points that will allow surface runoff to be spread into the watercourses or surrounding terrestrial landscape, rather than directed into channels along or on either side of the road. This will also lead to less erosion of the unsurfaced roads.	Medium	Low

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence / effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact	
										Without Mitigation/ Management	With Mitigation/ Management
Introduction and spread of alien invasive species.	• This would lead to changes in surface water flow patterns across the site (not just in watercourses).	Negative	Regional	Medium-term	Medium	Likely	Low	Low	• Sites and road verges must be monitored for IAP establishment.	Medium	Low

4.10. MITIGATION MEASURES AND MANAGEMENT ACTIONS

- **Design phase**

Activity	Mitigation measures	Management action	Monitoring
Development of the site leading to the loss of open space No matter the location or layout of the facility, development of the site will lead to the loss of some open space, and obstructions to the movement of flora and fauna, and surface water across the site (on slopes, and not just in watercourses). This is due to catchment hardening for the construction of buildings, PV arrays and roads.	Ensure that transformation of the terrain is limited to the proposed Phase 2 footprint, ensuring that developed areas (roads, buildings and landscaped areas) do not encroach into the high and very high sensitivity inland aquatic ecosystems and their buffers. Fences on the site should allow for the movement of fauna. Obstructions to surface water flow should be minimised and hardening of the catchment should be avoided wherever possible, such as through the use of permeable surfaces for paved areas and roads.	At the design phase, locate the facility to avoid all environmental constraints. Maintenance of fences to ensure that gaps for fauna are not blocked.	n/a

- **Construction phase**

Activity	Mitigation measures	Management action	Monitoring
Dumping or storage of building materials (sand, soil, bricks etc) in sensitive areas.	Ensure that all building materials are stored at least 50m away from the edge of any watercourse. Storage areas should be bunded adequately to prevent contaminated runoff from exiting the construction site. Materials should be stored in piles that do not exceed 2m in height and should be protected from the wind, to prevent spread of fine materials across the site. All areas that are impacted by the storage and/or dumping of materials must be ripped and re-planted after construction is complete.	Include mitigation measures in the construction EMPr.	The ECO must check that material storage areas do not encroach into sensitive areas.
Leakage of waste water, fuels, oils, etc. from toilets and construction machinery, leading to the pollution of aquatic features.	Machinery prone to oil or fuel leakage must be located at least 50m away from the edge of any aquatic feature, and the area adequately bunded in order to contain leakages. Water pumps and cement mixers shall have drip trays to contain oil and fuel leaks – these must be cleaned regularly. Suitable toilet and wash facilities must be provided to avoid the use of sensitive areas for these activities. These service areas must be	Include mitigation measures in the construction EMPr.	A construction site map must be produced at the start of construction by the ECO, which clearly identifies the watercourses and the outer edge of the buffers. The location of machinery in relation to these sensitive areas must be mapped. Where machinery is located close to or in watercourses / buffers, these areas must be monitored for leaks. Frequency: monthly Parameters: Fixed point photography is recommended.

	maintained, and toilets emptied on at least a weekly basis.		
Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of inland aquatic habitat.	Pathways and access roads must be routed to avoid watercourses and should cross these as seldom as possible. Sensitive areas must clearly be demarcated and fenced off (using temporary fencing and danger tape) before any construction work or site preparation begins. These are no-go areas during the construction process. All impacted areas of high or very high sensitivity must be ripped and re-planted after construction, to the satisfaction of the ECO.	Include mitigation measures in the construction EMPr.	Pathways and tracks that come close to or encroach into watercourses / buffers, must be monitored for erosion and trampling damage by the ECO. Frequency: monthly Parameters: Fixed point photography is recommended.
Noise and light pollution causing disturbance of inland aquatic fauna and flora	The construction site and pathways must avoid sensitive areas. If lights are used, these must be directed away from all sensitive areas. The sensitive areas (i.e. the edges of the buffers around watercourses) not affected by construction must clearly be demarcated and fenced off (using temporary fencing and danger tape) before any construction work or site preparation begins. These are no-go areas during the construction process, except where work is occurring.	Include mitigation measures in the construction EMPr.	Monitoring should be covered in the faunal study.

Disturbance of the soils and the use of top material can lead to the introduction and spread of alien invasive species.	Only good quality top soil/material can be used on the site. Constant monitoring of the construction site by the Site Engineer and ECO must occur, and all alien plant species removed from or destroyed on the site.	Construction site to be monitored for IAP establishment and encroachment. Include mitigation measures in the construction EMPr.	The whole construction site must be monitored for IAP seedlings by the ECO. Frequency: Weekly.

- **Operation phase**

Activity	Mitigation measure	Management action	Monitoring
Water use: The applicant is planning on transporting water in from the nearest town or possibly intercepting an existing nearby pipeline. The preferred source of water for the project will be determined in consultation with the local municipality. Water will be required for maintenance activities, dust management, and for human consumption.	Used water should be recycled and/or re-used where possible. It is recommended that PV panels be dry-cleaned or cleaned using recycled and/or re-used water. There should be no irrigation of landscaped areas on the site.	Recycling of grey water. Water demand management must be included in the operational EMPr.	Water use should be monitored on site and reported to as part of the Operational EMPr. Frequency: annually
Discharge of treated waste water	Water discharged or soaking away from waste water treatment areas (septic tanks and soak-aways, or package plants if these are used) must be directed to flow away from any surface inland aquatic ecosystems. Water treated in package plants can be used for the cleaning of PV panels, if feasible.	Ensure that the mitigation measures are included in the operational EMPr.	All discharge points that are within a watercourse or buffer (if any) must be monitored for the impacts of pollution. Frequency: Annually Parameters: Due to the lack of surface water throughout most of the year, it is best to monitor the vegetation around the discharge points that may affect the

			watercourses, through fixed point photography and through description of the vegetation community at the discharge point.
On-site stormwater management	Effort should be made to minimise the hardening of surfaces and clearing of natural vegetation. Strips of natural vegetation (i.e. locally occurring species) should be allowed to re-grow between rows of PV panels, to reduce runoff rates, and to allow local infiltration of water that runs off the panels. Stormwater should not be conveyed along lined channels or in pipes and discharged directly into watercourses, but must be allowed to flow along unlined swales, permeable areas or bioswales (i.e. vegetated channels). Parking areas should be constructed of permeable materials to allow for infiltration of water. As a principle, hardened areas should be associated (where possible) with vegetated filter strips (broad, sloped vegetated areas that accept shallow runoff from hardened surfaces), bioswales (landscaped areas that are designed to remove silt and a number of pollutants from runoff, through ensuring that water flows slowly along these gently	Ensure that the mitigation measures are included in the operational EMPr.	Key points of stormwater runoff (such as the downslope boundary of the PV site) should be monitored for erosion. Frequency: every 6 months, and after heavy rainfall events. Parameters: Fixed point photographs of key runoff discharge points.

	sloping (<6% slope) features, often planted with locally occurring grasses or other plant species, mulch or riprap), and / or bio-retention systems (vegetated areas where runoff is filtered through a filter media layer, e.g. sand, as it percolates downwards), all of which are designed to reduce the quantity of runoff leaving a hardened surface and entering the stormwater system. Gravel scraped off road surfaces during maintenance must not be pushed into sensitive areas and should be placed with regular drainage points that will allow surface runoff to be spread into the watercourses or surrounding terrestrial landscape, rather than directed into channels along or on either side of the road. This will also lead to less erosion of the unsurfaced roads.		
Clearing of vegetation. It is likely that areas cleared of indigenous vegetation will be invaded by alien and/or invasive plant species, such as grasses and weeds. Soils in areas cleared of vegetation can form a crust, and become less permeable to rainfall, leading to an increase in runoff.	Effort should be made to minimise the clearing of natural vegetation. Strips of natural vegetation (i.e. locally occurring species) should be allowed to re-grow between rows of PV panels, to reduce runoff rates, and to allow local infiltration of water that runs off the panels. The site and road verges must be monitored for IAP establishment.	IAP clearing programme.	Areas that are cleared of natural vegetation, and road verges must be monitored for IAP seedlings, and for erosion. Frequency: monthly Parameters: fixed point photography is recommended.

Leakage of fuels, oils, etc. from on-site machinery, leading to the pollution of inland aquatic features.	Machinery prone to oil or fuel leakage must be located at least 50m away from the edge of any aquatic feature, and the area adequately bunded in order to contain leakages. Water pumps shall have drip trays to contain oil and fuel leaks – these must be cleaned regularly.	Ensure that the mitigation measures are included in the operational EMPr.	Areas where machinery is used or stored must be inspected to ensure that there has been no leakage of fuels. Rehabilitated areas that have experienced spills or leaks must be monitored. Frequency: monthly. Parameters: fixed point photography is recommended.

- **Decommissioning phase**

Activity	**Mitigation**	**Management Action**	**Monitoring**
Dumping or storage of materials (sand, soil, bricks, PV panels, etc) in sensitive areas.	Ensure that all materials are stored at least 50m away from the edge of any watercourse. Storage areas should be bunded adequately to prevent contaminated runoff from exiting the site. Materials should be stored in piles that do not exceed 2m in height and should be protected from the wind, to prevent spread of fine materials across the site. All areas that are impacted by the storage and/or dumping of materials must be ripped and re-planted after decommissioning is completed.	Include mitigation measures in the decommissioning EMPr.	The ECO must check that material storage areas do not encroach into sensitive areas.
Leakage of waste water, fuels, oils, etc. from toilets and machinery,	Machinery prone to oil or fuel leakage must be located at least 50m away from the edge of any aquatic feature,	Include mitigation measures in the decommissioning EMPr.	A site map must be produced at the start of decommissioning by the ECO, which clearly identifies

leading to the pollution of aquatic features.	and the area adequately bunded in order to contain leakages. Suitable toilet and wash facilities must be provided to avoid the use of sensitive areas for these activities. These service areas must be maintained, and toilets emptied on at least a weekly basis.		the watercourses and the outer edge of the buffers. The location of machinery in relation to these sensitive areas must be mapped. Where machinery is located close to or in watercourses / buffers, these areas must be monitored for leaks. Frequency: monthly Parameters: Fixed point photography is recommended.
Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of inland aquatic habitat.	Pathways and access roads must be routed to avoid watercourses and should cross these as seldom as possible. Sensitive areas must clearly be demarcated and fenced off (using temporary fencing and danger tape) before any work begins. These are no-go areas during the decommissioning process. All impacted areas of high or very high sensitivity must be ripped and re-planted after decommissioning is completed, to the satisfaction of the ECO.	Include mitigation measures in the decommissioning EMPr.	Pathways and tracks that come close to or encroach into watercourses / buffers, must be monitored for erosion and trampling damage by the ECO. Frequency: monthly Parameters: Fixed point photography is recommended.
Noise and light pollution causing disturbance of inland aquatic fauna and flora	The site and pathways must avoid sensitive areas. If lights are used, these must be directed away from all sensitive areas. The sensitive areas (i.e. the edges of the buffers around watercourses) not affected by decommissioning	Include mitigation measures in the decommissioning EMPr.	Monitoring should be covered in the faunal study.

	activities must clearly be demarcated and fenced off (using temporary fencing and danger tape) before any work begins. These are no-go areas during the decommissioning process, except where work is occurring.		
Disturbance of the soils and the use of top material leading to the introduction and spread of alien invasive species.	Only good quality top soil/material can be used on the site. Constant monitoring of the site by the Site Engineer and ECO must occur, and all alien plant species removed from or destroyed on the site.	The site must be monitored for IAP establishment and encroachment. Include mitigation measures in the decommissioning EMPr.	The whole site must be monitored for IAP seedlings by the ECO. Frequency: Weekly.

- **Cumulative impacts**

Activity	Mitigation	Management Action
Development of sites leading to the loss of open space.	Avoid areas of medium to high sensitivity. Ensure that transformation of the terrain is limited to the development footprints, ensuring that developed areas (roads, buildings and landscaped areas) do not encroach into areas of medium to high sensitivity. Fences on the sites should allow for the movement of fauna. Obstructions to surface water flow should be minimised and hardening of the catchment should be avoided wherever possible, such as through the use of permeable surfaces for paved areas and roads.	At the design phase, locate the facility to avoid all environmental constraints. Maintenance of fences to ensure that gaps for fauna are not blocked.
Fragmentation of inland aquatic ecosystems as a result of road crossings.	Clearing of vegetation must be kept to a minimum. Infrastructure should avoid areas of medium to high sensitivity.	At the design stage, crossings should be minimised and designed to impact watercourses and wetlands as little as possible.

Activity	Mitigation	Management Action
	Road crossings should be built as drifts rather than filling in parts of the watercourse. Flow under bridges must be as natural as possible – i.e. allowing unconstructed surface flow wherever possible.	Mitigation measures must be included in the operational EMPr.
Changes in flow input and patterns (and the consequent changes in sediment input) from stormwater discharge off the sites	Effort should be made to minimise the hardening of surfaces and clearing of natural vegetation. Strips of natural vegetation (i.e. locally occurring species) should be allowed to re-grow between rows of PV panels, to reduce runoff rates, and to allow local infiltration of water that runs off the panels. Runoff should be conveyed and stored in unlined channels and ponds, to allow infiltration into the ground. Gravel scraped off road surfaces during maintenance must not be pushed into sensitive areas and should be placed with regular drainage points that will allow surface runoff to be spread into the watercourses or surrounding terrestrial landscape, rather than directed into channels along or on either side of the road. This will also lead to less erosion of unsurfaced roads.	Mitigation measures must be included in the operational EMPr.
Introduction and spread of alien invasive (especially Prosopis sp.).	Monitor and control IAPs.	IAP monitoring and control must be included in the operational EMPr.
Increased demand for and use of water resources	Reduce on-site water use.	Include water demand management in the operational EMPr.

4.11. CONCLUSIONS AND RECOMMENDATIONS

- The Paulputs Phase 2 (PV2) site was visited on the 15 – 16 May 2018 (autumn). A number of watercourses were noted and mapped on and near the site, but no wetlands were found. Two waterholes (natural areas of water accumulation, not connected to watercourses or wetlands) are located within the broad study area, but not within the PV footprint or impacted by any of the roads.
- The watercourses were mapped and assigned to a sensitivity category, based on the current condition, and ecological importance and sensitivity of the watercourse. The larger mainstem watercourses were primarily of high sensitivity and the smaller tributaries of high sensitivity.
- The current location and layout of the Phase 2 footprint does not encroach into any areas of aquatic sensitivity, and the site slopes away from the Kaboep River. The Phase 2 footprint is located more than 100 m from any of the ecological buffers recommended for the watercourses on the site, and so falls outside the regulated area with regards to Section 21 (c) and (i) water use authorisation and is unlikely to have a severe impact on the condition and functioning of any of the inland aquatic ecosystems on the site. The access road to the site will make use of an existing gravel road so no new road crossings are proposed.
- Maintenance or upgrade activities on any of the watercourse crossings may trigger a water use. The level of risk associated with this water use will be assessed using the DWS Risk Assessment Matrix.
- Most of the impacts identified and assessed for the EIA are associated with the construction phase and, to a lesser extent, the decommissioning phase. The most significant of these impacts is the threat of introduction of invasive alien plants, especially Prosopis sp., which is a problem species in the watercourses of the Northern Cape. This species is currently not on the site, so it is important that it not be introduced in fill or through disturbance of soils.
- The construction and decommissioning phase impacts can all be reduced to, at worst, low significance with the implementation of the mitigation measures and management actions proposed in this report.
- The operational and layout impacts of concern are the loss of open space for construction of the PV array and associated operations and maintenance buildings, clearing of vegetation and increase in water use.
- Areas that have been cleared of indigenous vegetation are subject to a significantly greater alien plant invasion risk, and also the risk of changes in soil structure. For instance, soils in cleared areas can form a crust, as a result of rainfall displacing finer particles and causing compaction. Crusted soils are less permeable, and lead to an increase in runoff.
- Clearing also leads to significant changes in surface hydrology as vegetation intercepts rainfall and influences the way runoff behaves on the surface, which consequently has an effect on erosion and sedimentation.
- Levelling and grading of areas to remove steep slopes and undulations in the landscape is often associated with the placement of the PV arrays, and this topographic alteration could alter the natural surface hydrology. Furthermore, extensive hardening of surfaces associated with solar PV facilities would result in significant increases in stormwater runoff and concentration of surface flow patterns.
- These impacts can be reduced to low significance through implementation of the proposed mitigation measures and management actions, which will effectively avoid or mitigate direct or indirect impact on any of the inland aquatic ecosystems identified on the site. There are unlikely to be any significant residual impacts after mitigation, no direct loss of wetland or watercourse habitat, and no significant loss of ecosystem function. As such, there is no requirement for an offset.

- Implementation of the mitigation measures recommended in this report (and by other specialists in their assessment reports) is considered the best approach towards minimising the cumulative impacts associated with renewable energy facilities, in particular solar PV facilities, located within 30 km of the Paulputs site. The location of PV infrastructure in low sensitivity habitat, with specific reference to the watercourses and wetlands of the area, will decrease the significance of the cumulative impacts to low significance.
- Overall, the proposed Phase 2 facility at Paulputs is considered to be acceptable from an inland aquatic ecosystem perspective.

4.12. REFERENCES

Anderson, M. D. 2000. The status of flamingos in the Northern Cape Province, South Africa. Ostrich, 71, 425-437.

Cowden C and Kotze DC, 2008. WETRehab-Evaluate: Guidelines for the monitoring and evaluation of wetland rehabilitation projects. WRC Report No TT 342/08, Water Research Commission, Pretoria.

Department of Water and Sanitation (DWS). 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

DWAF. 1999. Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0, Pretoria. Resource Directed Measures for Protection of Water Resources, Pretoria, South Africa.

Hamer, M., and Rayner, N. A. 1996. A note on the unusual crustacean community of a temporary pool in the Northern Cape. Southern African Journal of Aquatic Sciences, 22, 100-104.

Holness, S. and Oosthuysen, E. 2016. Critical Biodiversity Areas of the Northern Cape: Technical Report. Report submitted to the Department of Environment and Nature Conservation, Northern Cape Province.

Kleynhans, C.J. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo System, South Africa). Journal of Aquatic Ecosystem Health 5: 41-54.

Kleynhans, CJ, Thirion, C, and Moolman, J. 2005. The Development and Refinement of a Level II Ecoregion map for South Africa together with Geomorphological zones for all major Rivers. Project No. 2002-392. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

MacDonald, D. 2009. Botanical Assessment of proposed site for the MeerKAT radio astronomy facilities on the farms Losberg and Mey's Dam near Carnarvon, Northern Cape. Report submitted to SKA, July 2008, 30 pp.

MacFarlane, D.M., Bredin, I.P., Adams, J.B., Zungu, M.M., Bate, G.C. and Dickens, C.W.S. 2014a. Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries. Water Research Commission Report, TT 610/14, 169 pp.

Milner, A.M. 1994. System recovery. In, P.Calow & G.E. Petts (eds.): The rivers handbook. Vol. 2. Blackwell Scientific Publications. London.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. and Kloepfer, D. 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SA/MAB series 9, 360 pp.

Mucina, L., Rutherford, M.C., Palmer, A.R., Milton, S.J., Scott, L., Lloyd, J.W., van der Merwe, B., Vlok, J.H.J., Euston-Brown, D.I.W., Powrie, L.W. and Dold, A.P. 2006. Nama Karoo Biome. In: Mucina, L., and Rutherford, M. C. (Eds.). 2006. The vegetation of South Africa, Lesotho, and Swaziland. SANBI, Strelitzia 19 (2006).

Resh, V.H., A.V. Brown, A.P. Covich, M.E. Gurtz, H.W. Li, G.W. Minshall, S.R. Reice, A.L. Sheldon, J.B. Wallace & R.C. Wissmar. 1988. The role of disturbance theory in stream ecology. Journal of the North American Benthological Society. 7: 433-455.

Southern Waters, 2001. Field Guide to Present Ecological Status Scores. Western Cape Rivers. A Southern Waters Information Report, 01/01.

4.13. APPENDIX A: SPECIALIST DECLARATION

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

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

Signature of the specialist: KSnaddon.

Name of Specialist: _Kate Snaddon____________________

Date: _7th December 2018________________________________

4.14. APPENDIX B: SPECIALIST CURRICULUM VITAE

Kate has 19 years of experience in the field of freshwater ecology (both as a researcher and specialist consultant) and environmental consulting (including environmental auditing and waste management). Her specialist skills lie in the areas of freshwater macro-invertebrate identification and analysis; biomonitoring using freshwater algae and invertebrates, wetland mapping and classification; conservation planning for the aquatic environment; management and implementation of ecological monitoring and research programmes; assessment of impacts of anthropogenic interference in freshwater ecosystems, and urban river and wetland management and rehabilitation. Kate has worked extensively with the South African National Biodiversity Institute, producing fine-scale conservation plans for a number of Western Cape Districts, and a broad-scale freshwater conservation plan for the national Freshwater Ecosystem Priority Area (NFEPA) project. She has worked extensively with the City of Cape Town Municipality, on their Biodiversity Network, the prioritisation of freshwater ecosystems within the City, and has been co-managing the ecological monitoring component of the City's Table Mountain Group Aquifer project for the past three years. Kate has published over 70 specialist consultancy reports, 3 Water Research Commission reports, 2 chapters in international books, and 8 scientific papers. She recently became a founder and Board member of the South African Wetlands Society.

Formal education
MSc (Zoology, University of Cape Town)
BSc Honours (Zoology, University of Cape Town)
BSc (Zoology, University of Cape Town)

Professional Memberships/Accreditations
Professional Natural Scientist (Pr.Sci.Nat) in Ecology – The South African Council for Natural Scientific Professions
Founding Member and Board Member – South African Wetland Society
Member – Western Cape Wetlands Forum and Fynbos Forum
Accredited SASS5 practitioner

Specialisations
Biomonitoring using freshwater algae and invertebrates, freshwater ecological input to environmental impact assessments, conservation planning, wetland mapping, wetland classification

Affiliations
Director and Consultant: Freshwater Consulting Group

Email: katesnaddon@telkomsa.net

4.15. APPENDIX C: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017

Requirements of Appendix 6 – GN R326 of NEMA EIA Regulations as amended (7 April 2017)	Impact Assessment Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	✓
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	✓
c) an indication of the scope of, and the purpose for which, the report was prepared; (ca) an indication of the quality and age of base data used for the specialist report; (cb) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	✓
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	✓
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;	✓
g) an identification of any areas to be avoided, including buffers;	✓
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;	✓
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	✓
k) any mitigation measures for inclusion in the EMPr;	✓
l) any conditions for inclusion in the environmental authorisation;	n/a
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	✓
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 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;	✓
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
q) any other information requested by the competent authority.	✓
(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.	✓

4.16. APPENDIX D: GUIDELINES FOR FIXED POINT PHOTOGRAPHY

Note: This guideline is based primarily on the guidance provided in the following reference:
Cowden C and Kotze DC, 2008. WETRehab-Evaluate: Guidelines for the monitoring and evaluation of wetland rehabilitation projects. WRC Report No TT 342/08, Water Research Commission, Pretoria.

Fixed Point Photography is a tool that enables us to record and monitor visual changes within an ecosystem in response to impact or interventions. It involves taking a photograph, from the same point, at intervals over a period of time. The photographs are then compared to identify where change is occurring and how this is affecting the character and condition of the wetland. In the context of the ephemeral ecosystems located on the Paulputs site, this is the most viable approach to monitoring, as it will be difficult to sample surface water quality with any regularity.
A sufficient number of photo points should be taken so that the photographs will be representative of the targeted area. This should include a combination of panoramic photographs from a high vantage point, combined with permanently established photo-points within the inland aquatic ecosystem or its buffer.

Locating photo-points
The following general guidelines should be followed when locating photographic points for fixed point photographs:

- Photo-points should be selected at points that will be easily accessible at all times;
- A standard object, such as, a soil auger or a metre rule should be included in the photograph as a reference for scale;
- Relevant information about factors that may influence features in the photograph (e.g. a recent fire, late or early rains) should be recorded, especially those relating to the appearance of the site;
- Record the geographical coordinates of each point, with a GPS. This provides any individual with the information required to navigate to the location of each photo point;
- Record the compass bearings / direction to define the boundaries of the photo frame; and
- If possible, place a permanent marker (a fence pole or rebar, spray painted for ease of location) at the site from which the photograph is taken.

Panoramic photographs
The following guidelines should be followed when taking panoramic photographs for monitoring purposes. The photographs should:

- Be able to pick up changes in vegetation or erosion that occur over large areas of the ecosystem / buffer;
- Be taken at a relatively high vantage point;
- Be located close enough to the ecosystem / buffer to allow appropriate detail to be captured in the photo (if taken from too far away, the foreground may dominate which would have little relevance to monitoring change);
- Include the sky-line in each photograph to provide perspective;
- Provide a measure of relative height, by erecting a ranging rod / soil auger at a set distance;
- Include the number of photos included in the sequence (3 is typically appropriate);
- Record the location of certain long term features (fence poles, rocks) within the photograph, to ensure that photographs are taken of exactly the same area, and
- Record the direction in the panoramic series, to ensure that the same frame is taken repeatedly on return to the site.

<u>Photo record</u>

A record of all photographs must be kept (in this case, by the ECO), giving geographic co-ordinates, angle of the photograph, type of camera. Notes taken with each photograph must be recorded. It is recommended that photographs be taken monthly during construction, and then once a season during the operational phase.

4.17. APPENDIX E: SCORING OF IMPACTS FOR IMPACT ASSESSMENT

Impact description	Status	Extent	Extent Score	Duration	Duration score	Reversibility	Potential Intensity	Potential Intensity Score	Probability	Probability Score	Significance (without mitigation) Score	Significance (without mitigation)	Significance (with mitigation)
DESIGN													
Development of the site leading to the loss of open space	Negative	Local (2)	2	Long Term (4)	4	Moderate reversibility	Low (1)	1	Unlikely (0.5)	0.5	3.5	Low	Low to negligible
CONSTRUCTION													
Dumping or storage of building materials	Negative	Local (2)	2	Medium Term (3)	3	Highly reversible	Low (1)	1	Very unlikely (0.25)	0.25	1.5	Low	None
Leakage of waste water, fuels, oils, etc. from toilets and construction machinery, leading to the pollution of aquatic features.	Negative	Local (2)	2	Medium Term (3)	3	Moderate reversibility	Medium-Low (2)	2	Very unlikely (0.25)	0.25	1.75	Low	None
Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of inland aquatic habitat.	Negative	Local (2)	2	Medium Term (3)	3	Highly reversible	Medium-Low (2)	2	Unlikely (0.5)	0.5	3.5	Low	None
Noise and light pollution causing disturbance of freshwater fauna and flora	Negative	Local (2)	2	Short Term (2)	2	Highly reversible	Medium (4)	4	Likely (0.75)	0.75	6	Medium	Low to negligible
Introduction and spread of alien invasive species.	Negative	Regional (3)	3	Medium Term (3)	3	Low reversibility	Medium (4)	4	Likely (0.75)	0.75	7.5	Medium	Low

Impact description	Status	Extent	Extent Score	Duration	Duration score	Reversibility	Potential Intensity	Potential Intensity Score	Probability	Probability Score	Significance (without mitigation) Score	Significance (without mitigation)	Significance (with mitigation)
OPERATION													
Water use	Negative	Regional (3)	3	Long Term (4)	4	Moderate reversibility	Medium-Low (2)	2	Likely (0.75)	0.75	6.75	Medium	Low
Discharge of treated waste water	Negative	Local (2)	2	Long Term (4)	4	Moderate reversibility	Medium-Low (2)	2	Unlikely (0.5)	0.5	4	Low	Low to negligible
On-site stormwater management	Negative	Local (2)	2	Long Term (4)	4	Moderate reversibility	Medium-Low (2)	2	Unlikely (0.5)	0.5	4	Low	Low to negligible
Clearing of vegetation.	Negative	Local (2)	2	Long Term (4)	4	Low reversibility	Medium (4)	4	Likely (0.75)	0.75	7.5	Medium	Low
Leakage of fuels, oils, etc. from on-site machinery, leading to the pollution of inland aquatic features.	Negative	Local (2)	2	Long Term (4)	4	Highly reversible	Medium-Low (2)	2	Unlikely (0.5)	0.5	4	Low	None
DECOMMISSIONING													
Dumping or storage of materials	Negative	Local (2)	2	Short Term (2)	2	Highly reversible	Low (1)	1	Very unlikely (0.25)	0.25	1.25	Low	None
Leakage of waste water, fuels, oils, etc. from toilets and construction machinery, leading to the pollution of aquatic features.	Negative	Local (2)	2	Short Term (2)	2	Moderate reversibility	Medium-Low (2)	2	Very unlikely (0.25)	0.25	1.5	Low	None
Foot and vehicular traffic onto and across the site, leading to the destruction or deterioration of	Negative	Local (2)	2	Short Term (2)	2	Highly reversible	Medium-Low (2)	2	Unlikely (0.5)	0.5	3	Low	None

Impact description	Status	Extent	Extent Score	Duration	Duration score	Reversibility	Potential Intensity	Potential Intensity Score	Probability	Probability Score	Significance (without mitigation) Score	Significance (without mitigation)	Significance (with mitigation)
inland aquatic habitat.													
Noise and light pollution causing disturbance of freshwater fauna and flora	Negative	Local (2)	2	Short Term (2)	2	Highly reversible	Medium-Low (2)	2	Likely (0.75)	0.75	4.5	Low	Low to negligible
Introduction and spread of alien invasive species.	Negative	Regional (3)	3	Medium Term (3)	3	Low reversibility	Medium (4)	4	Likely (0.75)	0.75	7.5	Medium	Low
CUMULATIVE IMPACTS													
Development of the site leading to the loss of open space	Negative	Regional (3)	3	Long Term (4)	4	Low reversibility	Medium (4)	4	Likely (0.75)	0.75	8.25	Medium	Low
Increase in water use	Negative	Regional (3)	3	Long Term (4)	4	Moderate reversibility	Medium (4)	4	Likely (0.75)	0.75	8.25	Medium	Low
River crossings for roads, leading to fragmentation of inland aquatic features and loss of connectivity	Negative	Regional (3)	3	Long Term (4)	4	Moderate reversibility	Medium (4)	4	Likely (0.75)	0.75	8.25	Medium	Low
On-site stormwater management	Negative	Regional (3)	3	Long Term (4)	4	Moderate reversibility	Medium (4)	4	Likely (0.75)	0.75	8.25	Medium	Low
Introduction and spread of alien invasive species.	Negative	Regional (3)	3	Medium Term (3)	3	Low reversibility	Medium (4)	4	Likely (0.75)	0.75	7.5	Medium	Low

5. HERITAGE SPECIALIST IMPACT ASSESSMENT REPORT

5.1. EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by Gaea Enviro (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of three photo-voltaic (PV) solar energy facilities on the remainder of Portion 2 and on Portion 5 of the farm Konkoonsies 91 which is located 26 km northeast of Pofadder in the Kenhardt Magisterial District. The projects are to be known as Paulputs PV1 (located on Farm 91/5), Paulputs PV2 (located on Farm 91/2/rem) and Paulputs PV3 (located on Farm 91/2/rem).

The three study areas are relatively flat, although the PV3 area slopes gently downhill towards the south. The surface tends to be of fine gravel and vegetation is quite sparse. Rare bedrock outcrops occur but these tend to not be more than 30 cm above natural ground level. Water courses are generally absent but two places where water collects after rain were noted.

A palaeontological desktop study found no significant impacts to fossils that might occur, although isolated fossils could be located if alluvial sediments were excavated during construction. The PV1 and PV2 study areas were devoid of significant archaeological resources but one significant site was located within the PV3 study area. No graves were seen in the area and there are no structures within 2 km of any of the study areas. The cultural landscape is rather weakly developed due to the very remote location of the area and has also been compromised by the relatively recent addition of an electrical layer. The precolonial cultural landscape is strongly focused on rocky hills and is of no concern to this study.

There is only one issue of concern which is the archaeological site in the Paulputs PV3 study area. Impacts to this site could be of medium significance. This site would need to be avoided but if this is not possible then archaeological mitigation would need to be carried out by a professional archaeologist under a permit issued to that person by SAHRA. This mitigation could be easily accomplished, and the impact significance would be reduced to very low. Although impacts to the cultural landscape are of medium significance, this is not a great concern since the rating is largely influenced by the high probability of the impact occurring. It is better to cluster electrical facilities and several others are already present in the immediate area. There are no cumulative impacts of concern, largely because of the very low density of heritage resources on the regional landscape.

Because the impacts to heritage resources would be of relatively low significance, it is recommended that the Paulputs PV1, PV2 and PV3 solar energy developments be authorised. However, the following recommendations that should be incorporated into the Environmental Authorisation for each project.

Paulputs PV1

- If any palaeontological or archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate professional. Such heritage is the property of the state and may require excavation and curation in an approved institution; and
- Where technically feasible, pale recessive colours should be used on the built elements of the project.

Paulputs PV2

- If any palaeontological or archaeological material or human burials are uncovered during the course of development, then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate professional. Such heritage is the property of the state and may require excavation and curation in an approved institution; and
- Where technically feasible, pale recessive colours should be used on the built elements of the project.

Paulputs PV3

- Archaeological site KK2018/001 should be avoided if possible. If this is not possible then a professional archaeologist should be appointed to undertake mitigation prior to construction;
- If any palaeontological or archaeological material or human burials are uncovered during the course of development, then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate professional. Such heritage is the property of the state and may require excavation and curation in an approved institution; and
- Where technically feasible, pale recessive colours should be used on the built elements of the project.

5.2. LIST OF ABBREVIATIONS AND GLOSSARY

APHP: Association of Professional Heritage Practitioners
ASAPA: Association of Southern African Professional Archaeologists
CRM: Cultural Resources Management
DEA: National Department of Environmental Affairs
ECO: Environmental Control Officer
EIA: Environmental Impact Assessment
EMPr: Environmental Management Program
ESA: Early Stone Age
GPS: global positioning system
GP: General Protection
HIA: Heritage Impact Assessment
LSA: Later Stone Age
MSA: Middle Stone Age
NBKB: Ngwao-Boswa Ya Kapa Bokoni
NEMA: National Environmental Management Act (No. 107 of 1998)
NHRA: National Heritage Resources Act (No. 25) of 1999
O&M: Operations & Maintenance
PPP: Public Participation Process
PV: Photo-Voltaic
SAHRA: South African Heritage Resources Agency
SAHRIS: South African Heritage Resources Information System

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency
Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.
Holocene: The geological period spanning the last 12 000 years.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.
Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.
Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.
Pleistocene: The geological period beginning approximately 2.5 million years ago and preceding the Holocene.

5.3. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Gaea Enviro (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of three photo-voltaic (PV) solar energy facilities on the remainder of Portion 2 and on Portion 5 of the farm Konkoonsies 91 which is located 26 km northeast of Pofadder in the Kenhardt Magisterial District (Figures 1 - 3). Names and GPS co-ordinates for the mid-point of each PV facility study area are as follows:

Paulputs PV1: located on Farm 91/5 with centre point at S28° 54’ 35” E19° 30’ 54”;
Paulputs PV2: located on Farm 91/2/rem with centre point at S28° 55’ 12” E19° 31’ 54”; and
Paulputs PV3: located on Farm 91/2/rem with centre point at S28° 55’ 52” E19° 33’ 23”.

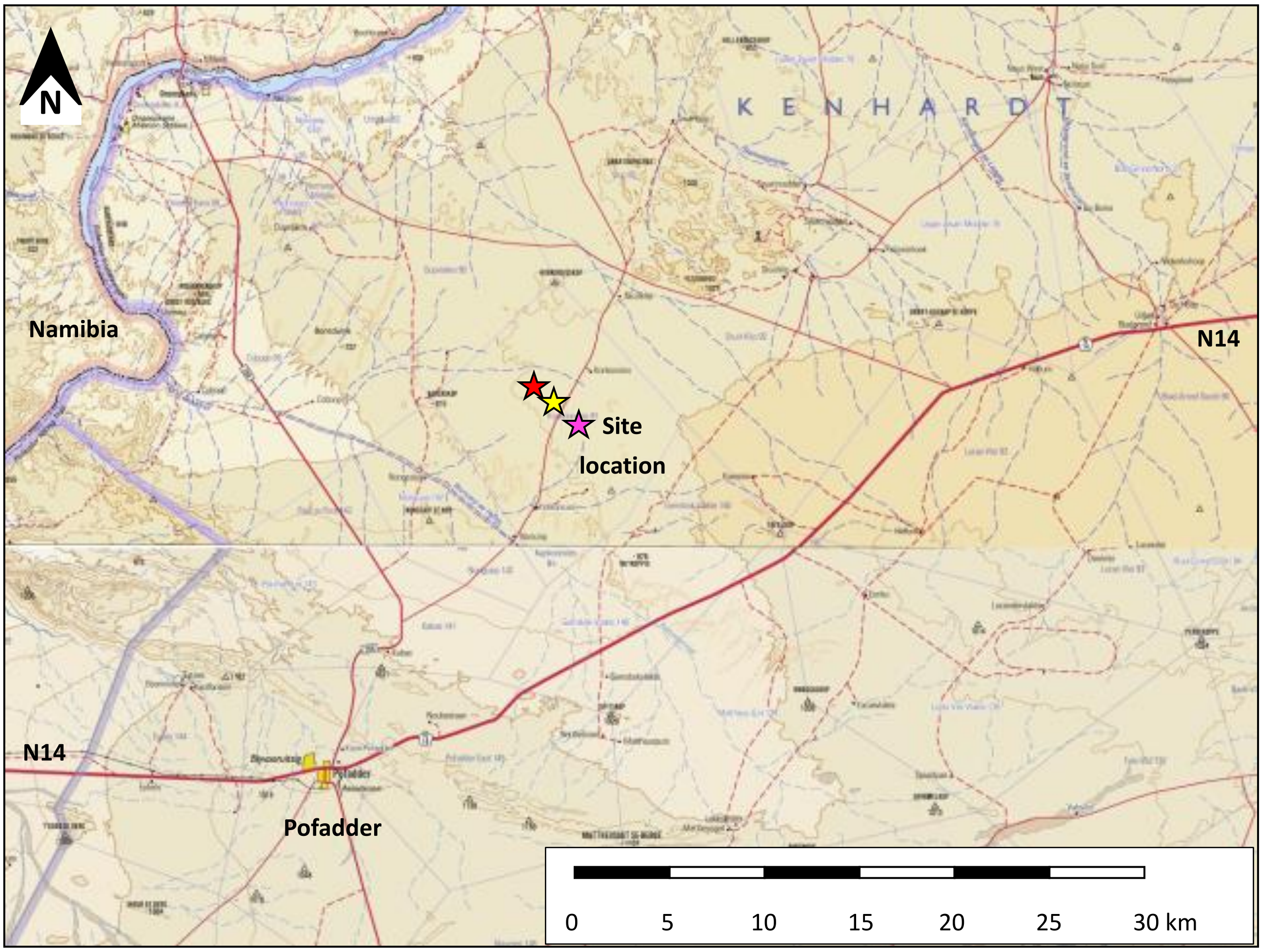


Figure 1: Extract from 1:250 000 topographic maps 2818 & 2819 showing the location of the site. The red, yellow and pink stars indicate Paulputs PV1, PV2 and PV3 respectively. Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.

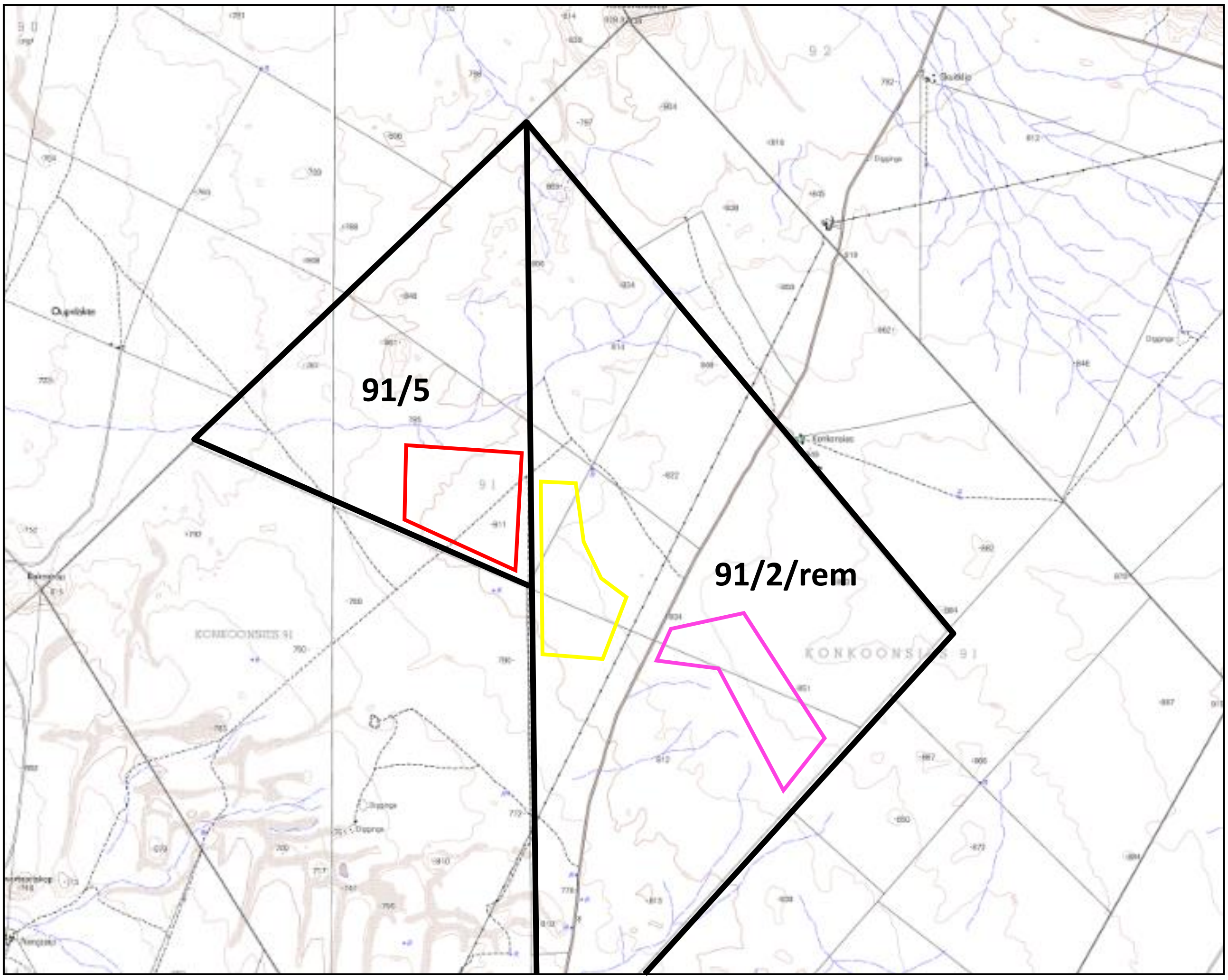


Figure 2: Extract from a 1:50 000 topographic mapsheet 2819DC showing the farm portions (black polygons) and study areas for the Paulputs PV1 (red polygon), PV2 (yellow polygon) and PV3 (pink polygon) facilities.

Project description

Table 1 provides a description of the proposed developments. It should be noted that this description applies equally to all three developments, although the shape of each development footprint varies according to the landscape constraints.

Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant since excavations for foundations may impact on archaeological and/or palaeontological remains, while the above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

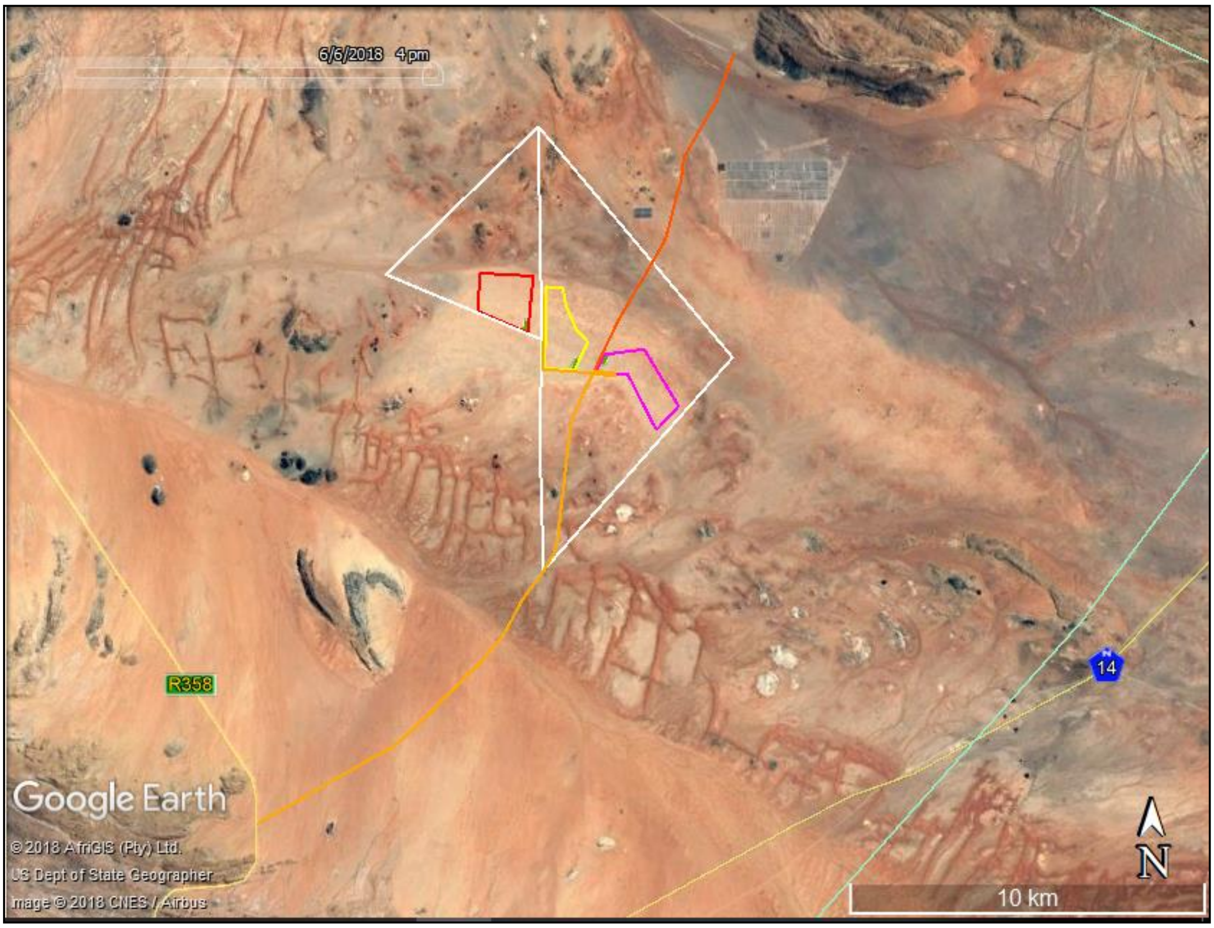


Figure 3: Aerial view of Portions 2/rem and 5 of Konkoonsies 91 (white polygons) showing the study areas for the Paulputs PV1 (red polygon), PV2 (yellow polygon) and PV3 (pink polygon) facilities. The light and dark orange lines represent the south and north access road options. Three existing solar energy facilities are visible to the northwest – a small one just northeast of the remainder of portion 2 and two larger ones side by side to its east.

Scope and purpose of the report

A heritage impact assessment (HIA) is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued for consideration by the National Department of Environmental Affairs (DEA) who will review the Environmental Impact Assessment (EIA) and grant or withhold authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation should this be granted.

Table 1: Description of the various project components involved in each development.

Component	Dimensions
Solar Farm: To be located on Farm 91/5 (PV1) and 91/2/rem (PV2 and PV3)	≤200ha footprint
Battery Storage System: A ≤100MWh battery storage facility for grid storage (stacked containers or multi-storey building) and associated operational, safety and control infrastructure.	≤1ha ≤8m building height
Access road: access to site from the N14 via the R358 (southern access) is approximately 28 km, of which 11 km are travelled on the R358 and the balance on OG73. Access to site from the N14 via the MR759 (northern access) is approximately 31 km, of which 22 km are travelled on the MR759 and the balance on OG73	Maximum width of 13,5 m, including stormwater channels or drainage structures
Service roads: gravel service roads linking the access road and various project components and servicing the solar panel arrays. Roads fitted with traffic control systems and stormwater controls as required.	Maximum width of 6m
Collector substation: ≤2ha onsite substation complex (including a 22/132 kV or 33/132 kV onsite collector substation, a switching station, control rooms and grid control yards for both Eskom and the Independent Power Producer (housing unit to control switch gears in the form of a small concrete single storey building) to receive, convert and step up electricity from the PV facility to a grid suitable power supply. A telecommunication tower up to 50m high (lattice or monopole type) will be established in the onsite substation complex.	≤2ha onsite substation complex up to 30m height Up to 50m high telecommunications tower
Operations & Maintenance (O&M) area: ≤1ha hectare O&M laydown area (near / adjacent substation); Parking, reception area, offices and ablutions facilities for operational staff, security and visitors; Workshops, storage areas for materials and spare parts; Water storage tanks or lined ponds (~160kl/day during first 3 months; ~90kl/day during rest of construction period; ~20kl/day during operation; small diameter water supply pipeline connecting existing boreholes or existing pipeline access points to storage.); Septic tanks and sewer lines to service ablution facilities; and Central Waste collection and storage area. Perimeter fencing and internal security fencing and gates as required. Access control gate and guard house on access road;	≤1ha office, ablutions, workshop complex
Temporary infrastructure: -concrete batching facility, -temporary offices, -construction yard and -laydown area. The concrete batching facility and construction yard will have a combined maximum size of 2 hectares. The laydown area will have a maximum size of 2 hectares and will be used mainly for storage of material and equipment during the construction phase.	≤4ha (Temporary)

Terms of reference

ASHA Consulting was requested to compile a Heritage Impact Assessment that included assessments of archaeology, palaeontology and other relevant types of cultural heritage. The report was to be based on both desktop and field research. It was requested that all three PV facilities be included in a single HIA report but with clearly defined impact assessments and recommendations for each project.

On submission to the South African Heritage Resources Agency (SAHRA) of notification of the proposed development, they responded requesting that an impact assessment report be compiled. The report must include assessments of archaeology and palaeontology as well as any other relevant aspects of heritage.

The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting Heritage Impact Assessments and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

5.4. APPROACH AND METHODOLOGY

Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:250 000 and 1:50 000 topographic maps were sourced from the Chief Directorate: National Geo-Spatial Information.

The palaeontological assessment was commissioned separately and the findings in this HIA are drawn directly from the palaeontological specialist study[13] by Almond (2018).

Field survey

The site was subjected to a survey on the 15th to the 17th May 2018. This was during early winter but in this dry part of South Africa seasonality makes little difference to the vegetation cover in terms of the visibility of heritage resources on the ground. During the survey the positions of finds were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

[13] Note that the palaeontological desktop study covers all three solar PV projects as well as the power line that is assessed separately. The same specialist study is thus incorporated into both HIA reports.

Impact assessment

For consistency among specialist studies, the impact assessment was conducted through application of a scale supplied by Gaea Enviro.

Grading

Section 7 of the NHRA provides for the grading of heritage resources into those of National (Grade 1), Provincial (Grade 2) and Local (Grade 3) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade 1 and 2 resources are intended to be managed by the national and provincial heritage resources authorities, while Grade 3 resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system[14] for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' (GP) and rated as GP A (high/medium significance, requires mitigation), GP B (medium significance, requires recording) or GP C (low significance, requires no further action).

Assumptions and limitations

The study is carried out at the surface only and hence any completely buried archaeological sites will not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. Due to the width of the corridors provided for assessment it was not feasible to cover all the ground in detail. However, the survey aimed to locate potentially sensitive landscape features which, if found, were then examined more closely. This method generally produces good results in Bushmanland and the survey track density is thus not seen as a significant limitation. Alternatives 2 and 3 were realigned after the field survey which means that they were not surveyed as well as Alternative 1. Nevertheless, this is not regarded as a limitation due to the survey method just mentioned.

Consultation processes undertaken

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of an EIA which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP. It is noted that no comments related to heritage issues were received during the Scoping Phase with the exception of SAHRA noting submission of the Scoping Report and reiterating their requirement that an HIA be submitted.

[14] The system is intended for use on archaeological and palaeontological sites only.

5.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

- **SITE CONTEXT**

The site is in a rural context with minimal historical development. Farms are very large and lack infrastructure with houses being widely spaced. The main road through the study area is a gravel road. An existing powerline passes through the PV1 study area, while another passes between the PV2 and PV3 study areas.

In recent years, however, three solar energy facilities have been constructed to the northeast of the present study area. The two larger ones measure just over 300 ha each and the smaller one is about 15 ha in extent. In addition, another large facility was scheduled to start construction on 1st June 2018. This facility will be located between the present study area and the other existing facilities. These, the existing power lines and the Paulputs Substation located to the northeast, have resulted in a significant change to the character of the rural landscape with an electrical layer having been added to it.

Site description

The area in which the three PV facilities have been proposed is relatively flat, although the PV3 area does slope gently downhill towards the south. Vegetation cover tends to be very sparse, although with some rain a few weeks before the fieldwork there was a thin grass covering in places. Small bushes and rare small trees occur throughout the study area but are never dense. The substrate is a coarse granitic sand with patches of fine gravel in places. There are occasional areas of quartz gravel and very rare granite/gneiss bedrock outcrops that are never more than about 30 cm above natural ground level. No water courses were noted in the study area but a small water hole was found in the southern part of the PV3 area. Figures 4 to 9 illustrate the study area.

Figure 4: View towards the west from the eastern side of the PV1 study area showing the small powerline crossing the site and a patch of quartz gravel.

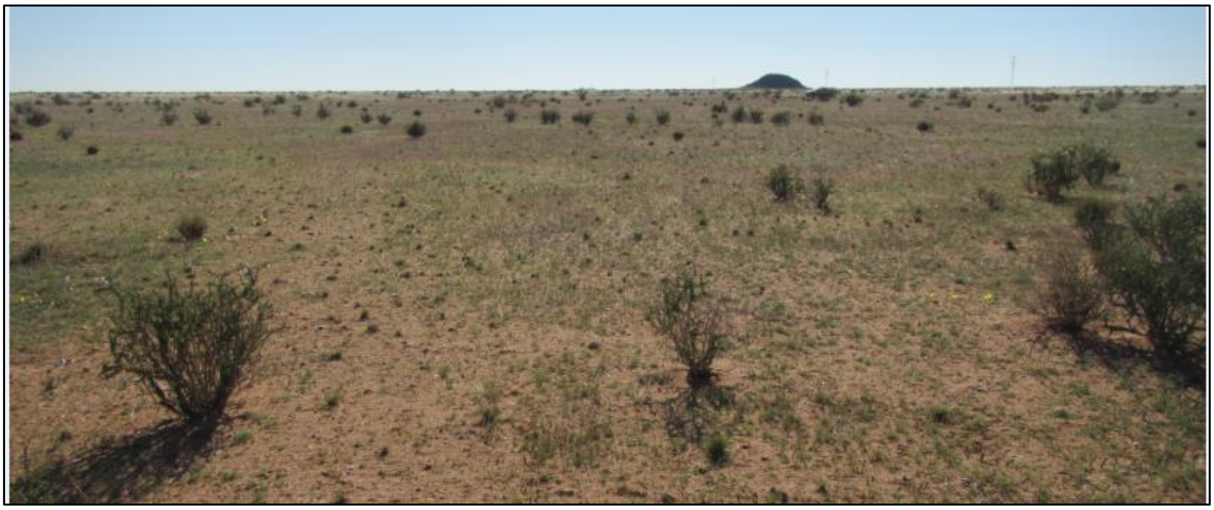


Figure 5: View towards the northeast across the PV2 study area showing the generally very light vegetation cover with scattered bushes. The rocky hill in the distance is just outside the study area and a powerline running just behind it (between the PV2 and PV3 study areas) is visible.

Figure 6: View towards southwest across the PV2 study area showing a farm track and variable but generally sparse vegetation cover.

Figure 7: View towards southwest across the PV2 study area showing a large area of unvegetated fine gravel.

Figure 8: View towards southwest across the PV3 study area showing one of the better grassed parts of the overall study area.

Figure 9: View towards the west across the PV3 study area showing quartz gravel in the foreground and a small bedrock outcrop in the middle ground.

- **ARCHAEOLOGICAL AND HISTORICAL CONTEXT**

This section of the report contains the desktop study and establishes what is already known about heritage resources in the vicinity of the study area. What was found during the field survey as presented below may then be compared with what is already known in order to gain an improved understanding of the significance of the newly reported resources.

Archaeological aspects

Several archaeological sites have been found and excavated from Konkoonsies 91/6. These were located between 2.5 and 3.2 km northeast of the present PV3 study area (Orton 2015a, 2016a). These sites were late Holocene sites that included mostly stone artefacts, ostrich eggshell and pottery but also occasional other finds such as bone, charcoal and a historical glass bead. Most were located around granite bedrock outcrops that had depressions or fissures that held water after rain and thus attracted settlement. The outcrops also had smooth, shallow depressions on them that are interpreted as grinding patches (Orton 2016a). These patches are a particular feature of Bushmanland and are frequently found in close proximity to any water source, no matter how temporary. They are assumed to have functioned as lower grindstones for the processing of food. As other examples, Orton & Webley (2012) recorded such finds to the southwest of Pofadder, while Orton (2016b) found a large number around a water hole to the west of Aggeneys.

Two surveys by Pelser (2011, 2012) recorded a number of scatters of ostrich eggshell some 4 km northeast of the present study area, although some of these may have been quite ephemeral. He also found scatters of quartz artefacts. All were ascribed to the Later Stone Age (LSA). They occurred in open areas as well as around the foot of small rocky koppies. Morris (2012) worked slightly further to the northeast and found ostrich eggshell fragments, a small quartz outcrop quarry and a scatter of Early (ESA) and Middle Stone Age (MSA) artefacts.

Examination of the SAHRIS database shows that many small scale mining operations have been applied for and approved in the mountains to the northeast of the Paulputs Substation. For the most part, heritage studies do not appear to have been requested for these projects. However, a survey of certain areas in and around these granite mountains and the larger koppies further to the northeast yielded a variety of Stone Age sites. These included artefact scatters, sometimes with pottery, ostrich eggshell and bone and also granite bedrock outcrops with a number of grinding grooves (Orton & Webley 2013). Historical sites were also found including some stone-packed graves and a stone-built animal trap (‘tierhok’).

More generally, it can be noted that archaeological sites in the area tend to be more commonly encountered around the fringes of granite hills, on sand dunes or around pans (Beaumont et al. 1995). Other surveys in the region support this contention (Halkett 2010; Morris 2011).

Historical aspects and the built environment

Because it lies so far from the original Cape Colony (i.e. Cape Town), this area was colonised quite late with most farms only granted in the very late 19th or even early 20th centuries. As a result very few historical structures and features exist on the landscape. The majority of buildings date to the early-mid-20th century and tend to be of low or no heritage significance. A number of surveys in the Bushmanland area have recorded possible isolated graves represented by unusual rocks (either isolated standing rocks or unnatural clusters). These could be related to early ‘trekboers’ passing through the area. because they lived a very nomadic lifestyle, their physical traces are extremely ephemeral.

- **FINDINGS OF THE HERITAGE STUDY**

This section describes the heritage resources recorded in the study area during the course of the project.

Palaeontology

Almond (2018) finds that the general area is underlain by Precambrian basement rocks that are entirely unfossiliferous. These are rocks belonging to the Namaqua-Natal Province. There are late Caenozoic superficial deposits including alluvium, gravels and aeolian sands that overlie the basement rocks and are generally of low to very low palaeontological sensitivity. When they occur along water courses, the superficial deposits may contain very rare inclusions of isolated mammalian bones and teeth or freshwater molluscs. Organic-rich alluvial deposits can also contain pollens, spores and diatoms.

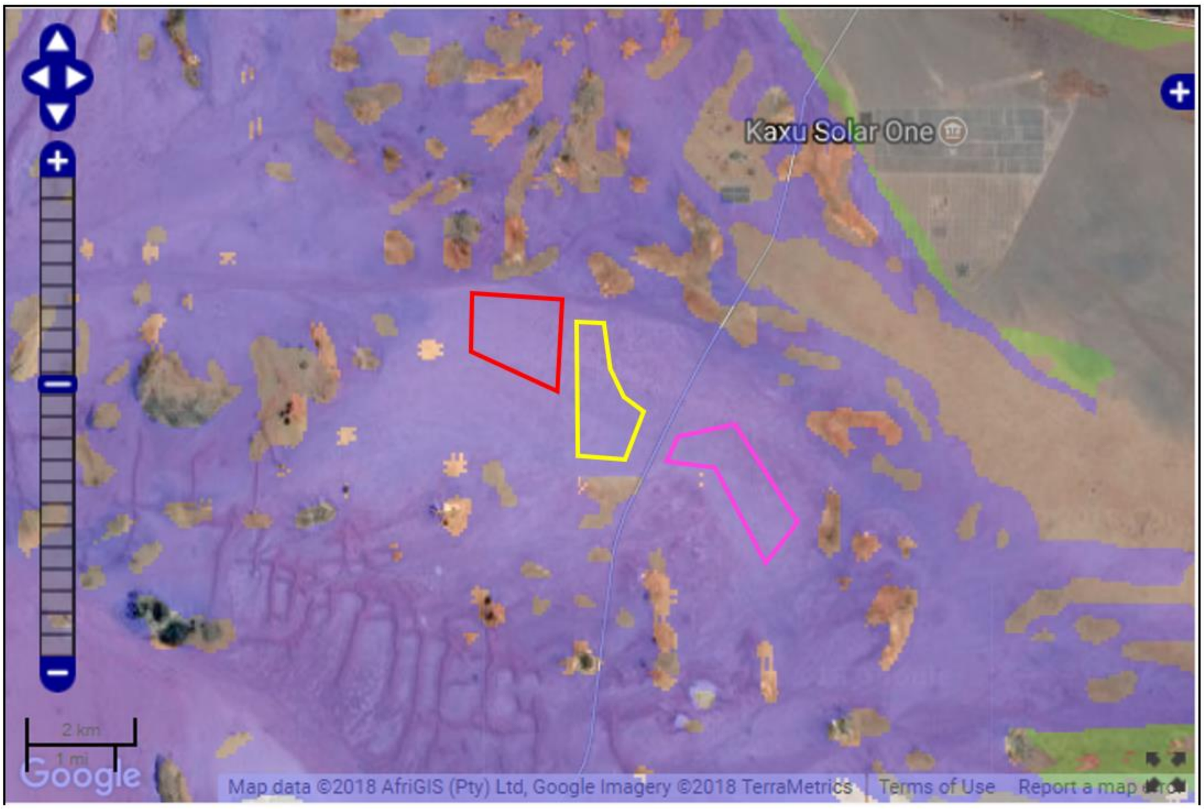


Figure 11: Extract from the SAHRIS Palaeontological Sensitivity Map showing the study areas to be of low palaeontological sensitivity (blue shading) as mentioned by Almond (2018).

Overall, Almond (2018) finds that there are no sensitive areas within the broader study area that would require further attention.

Archaeology

- **PV Site 1**

The archaeological survey covered a large amount of ground and found archaeological resources to be very sparsely distributed in the PV study areas. No archaeological resources worthy of recording were found in the PV1 study area. Isolated artefacts attributable to background scatter were seen from time to time but these have no cultural significance. However, a highly significant archaeological site was found 1 km west of the PV1 study area. This site was similar to those excavated sites reported above but was far larger and far more complex. Because it will not be impacted it is only briefly mentioned here but Appendix 5 can be consulted for further detailed observations. The site consisted of a number of artefact scatters and areas of bedrock grinding around a bedrock hollow that had also been dammed historically with a stone wall to increase its water carrying capacity (Figure 12). Other areas, including a small, deep hole, also trap water (Figure 13). Especially significant at this site was a set of large grooves ground into one bedrock outcrop close to the water source (waypoint 813). These grooves are far deeper than usual and were placed on a steep surface around a single outcrop (Figures 14 & 15). They were clearly not used for grinding food and may have had some sort of ritual significance. Other similar grooves are, to the best of the author's knowledge, unknown. A fragment of a cast iron pot was noted at waypoint 814. Although other historical artefacts were absent, the stone walled dam means that it cannot be confirmed whether this item was left by indigenous or colonial people.

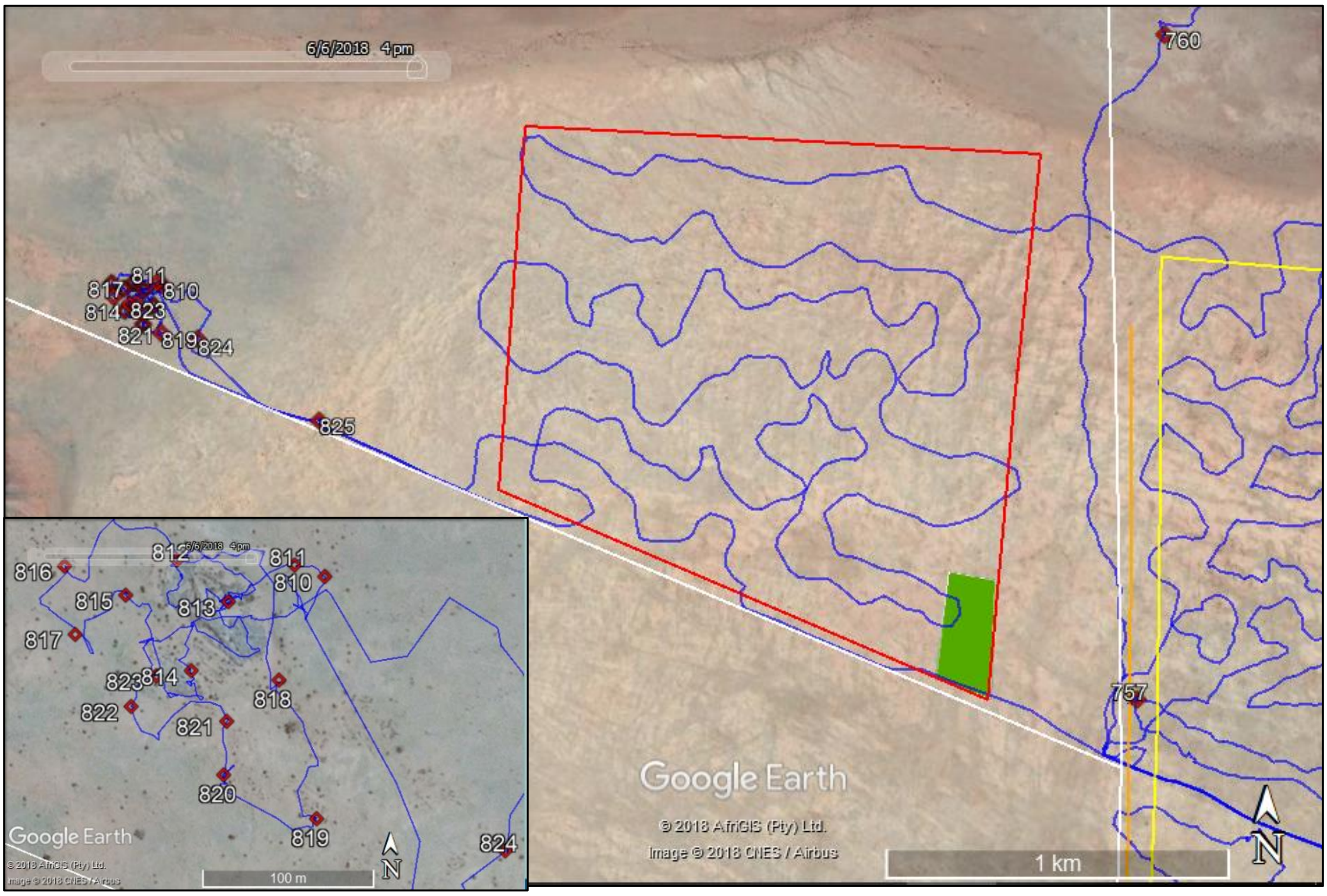


Figure 11: Aerial view of the PV1 study area (red polygon with substation location in green) showing the survey tracks (blue lines) and waypoints (numbered red symbols) recorded during the survey. The inset shows the waypoint cluster in the far west.

Figure 12: Historical stone wall creating a dam at waypoint 813.

Figure 13: Bedrock hole filled with rain water at waypoint 814.

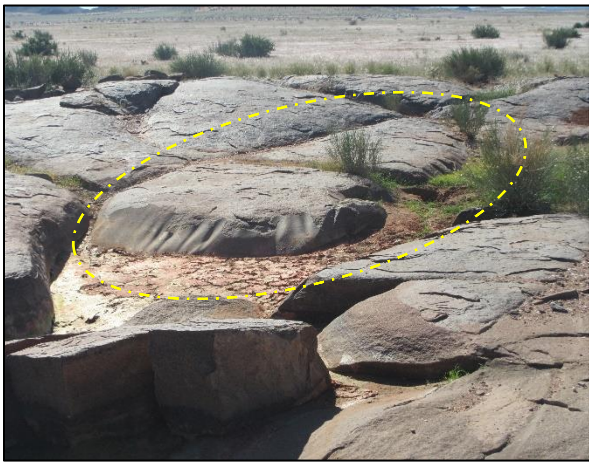


Figure 14: The bedrock outcrop with the steep grooves ground into its edge at waypoint 813.

Figure 15: Close-up of the partly exfoliated steep grooves at waypoint 813.

- **PV Site 2**

A few sites were found in and around the PV2 area (Figure 16). These included a flaked quartz outcrop (waypoint 756), a small stone artefact scatter on the summit of a rocky hill (waypoint 759), a light scatter of likely mid-20th century rubbish including glass and metal items (waypoint 757) and a small stone structure at the northern foot of the same rocky hill just mentioned (waypoint 758). The structure was 2 m by 4 m in dimension (Figures 17 & 18) and, apart from a sheet of corrugated iron lying nearby, the only historical artefact seen in the area was a small white glass cosmetic bottle (Figure 19). The structure was likely used by a shepherd.

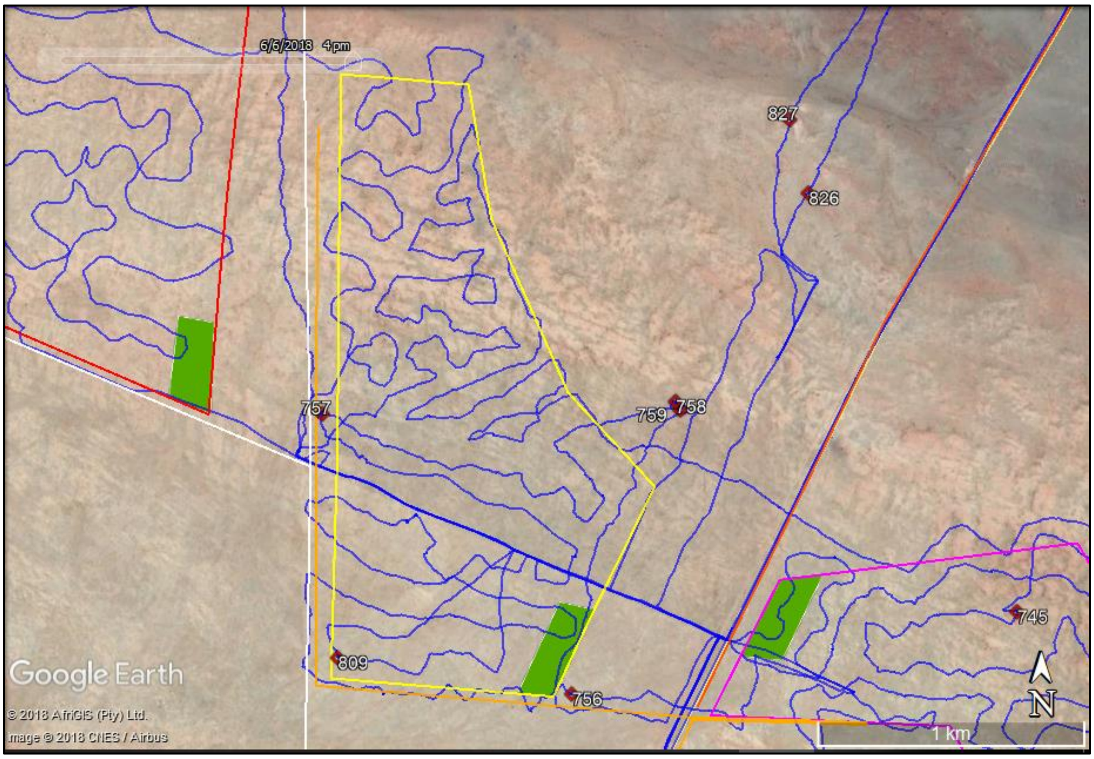


Figure 16: Aerial view of the PV2 study area (yellow polygon with substation location in green) showing the survey tracks (blue lines) and waypoints (numbered red symbols) recorded during the survey.

Figure 17: The stone structure at waypoint 758 facing towards the southwest.

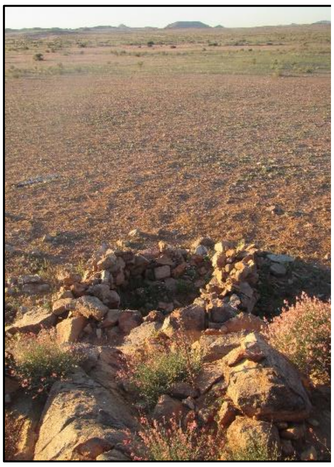


Figure 18: The stone structure at waypoint 758 facing towards the north.

Figure 19: A small glass jar found near waypoint 758.

- **<u>PV Site 3</u>**

The PV3 study area produced two historical cans next to an old tree (waypoint 745), a flaked quartz outcrop (waypoint 754), a granite bedrock outcrop with four ground patches (waypoint 755) and larger site very similar to those excavated on Konkoonsies 91/6 and described above (Figure 20). The latter site, occurring at waypoints 746 to 753, includes a series of low granite bedrock outcrops with several ground patches (Figures 22 & 23), an area that has been excavated to find water alongside an outcrop (Figure 24), and a light artefact scatter located in a deflated area (Figure 25).

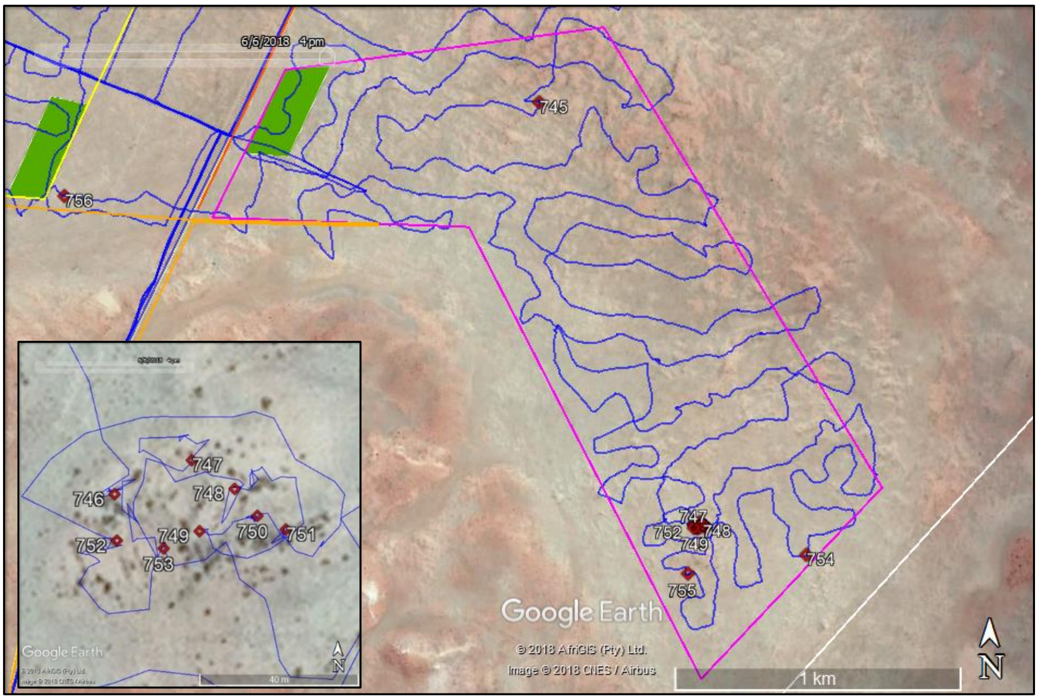


Figure 20: Aerial view of the PV3 study area (pink polygon with substation location in green) showing the survey tracks (blue lines) and waypoints (numbered red symbols) recorded during the survey. The inset shows the waypoint cluster in the southern part of the study area.

Figure 21: View towards the southwest across the large bedrock outcrop at waypoint 746. It had four ground patches on it.

Figure 22: Example of a ground patch at waypoint 746. The scale bar is 30 cm long.

Figure 23: The bedrock shelf under which a hole has been excavated. It acts as a sump and fills with water.

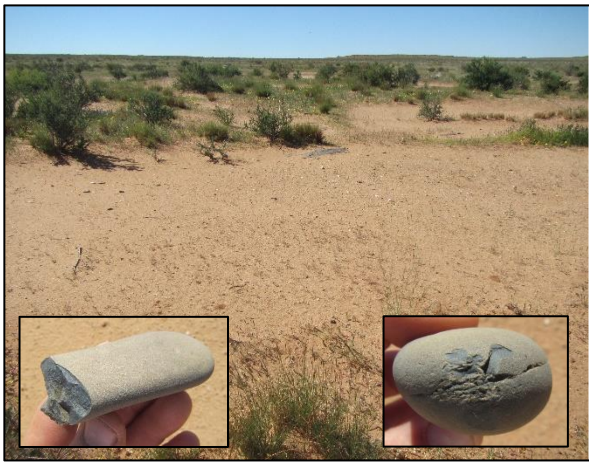


Figure 24: The deflating area with a light quartz scatter at waypoint 752. The inset shows the ends of an elongated hammer stone.

In order to prevent impacts to the site KK2018/001 identified during the heritage specialist fieldwork, a development envelope was created for the PV3 project. The development envelope includes enough area to develop the PV field and associated infrastructure while avoiding site KK2018/001. The development envelope is illustrated in Figure 25 below.

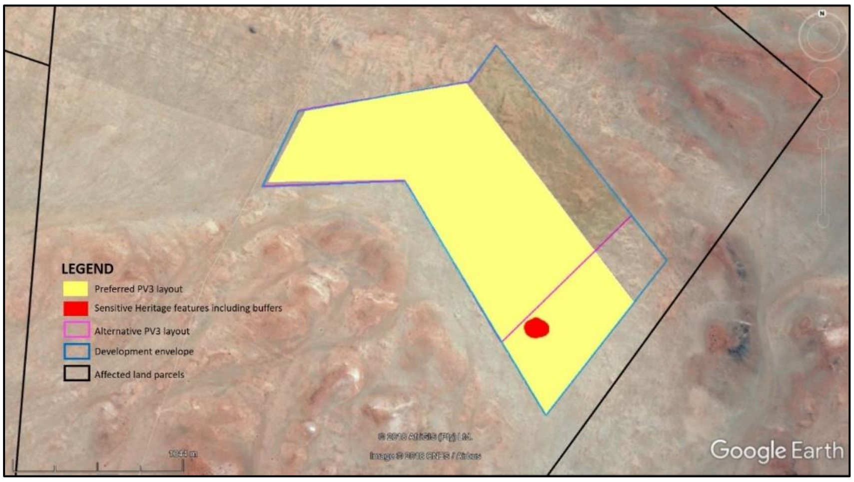


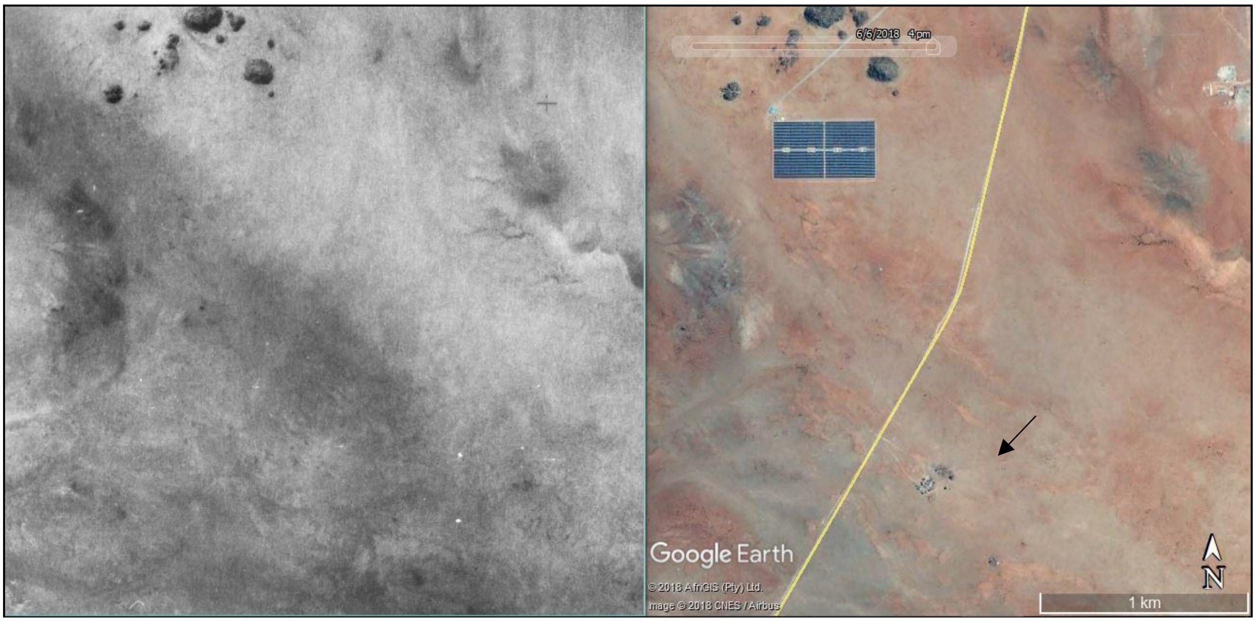
Figure 25: Development envelope for PV3 including the preferred footprint and the alternative footprint.

Graves

No graves were seen in or near the study areas. It is still possible that unmarked graves are present but, in this landscape, where it is very difficult or impossible to excavate graves by hand the chances are extremely small.

Built environment

No structures occur anywhere within or close to the three study areas. The nearest lie on Konkoonsies 91/6 some 2.3 km north of the PV3 study area and 2.8 km northeast of the PV2 study area. They are not visible from these study areas. The 1954 aerial photograph suggests that this farm complex was not present at that time (Figure 26).



Fgure 23: Aerial views from 1954 (Job 345, strip 7, photograph 18136) and 2016 (Google Earth) showing the Konkoonsies 91/6 farm complex (arrowed in modern view) to have not yet been constructed.

Cultural landscape

The area is very remote and undeveloped. Farm complexes are very far apart and the only other anthropogenic features on the landscape are fences and farm tracks. Figure 27 shows an aerial view of most of the study area in which it is clear that the landscape is almost entirely natural. Significantly, the area has experienced the recent addition of an electrical 'layer' as shown in Figure 28. While the N14 running some 12 km southeast of the PV3 study area can be considered a scenic route, the PV facilities would not be visible from that road. The local gravel road through the broader study area provides only farm access and is of no consequence.

There is a precolonial archaeological component to the cultural landscape as well. This is related to the very large number of sites clustered around the rocky hills. However, with no hills implicated in the present proposals and study areas this aspect is not further investigated here. The one hill next to the PV2 study area was actually found to not be surrounded by archaeology. This may be a function of its isolation and the lack of proximate water sources.

Figure 27: Aerial views from 1954 (Job 345, strip 8, photograph 18022) and 2016 (Google Earth) showing just one anthropogenic feature to be visible – the gravel road.

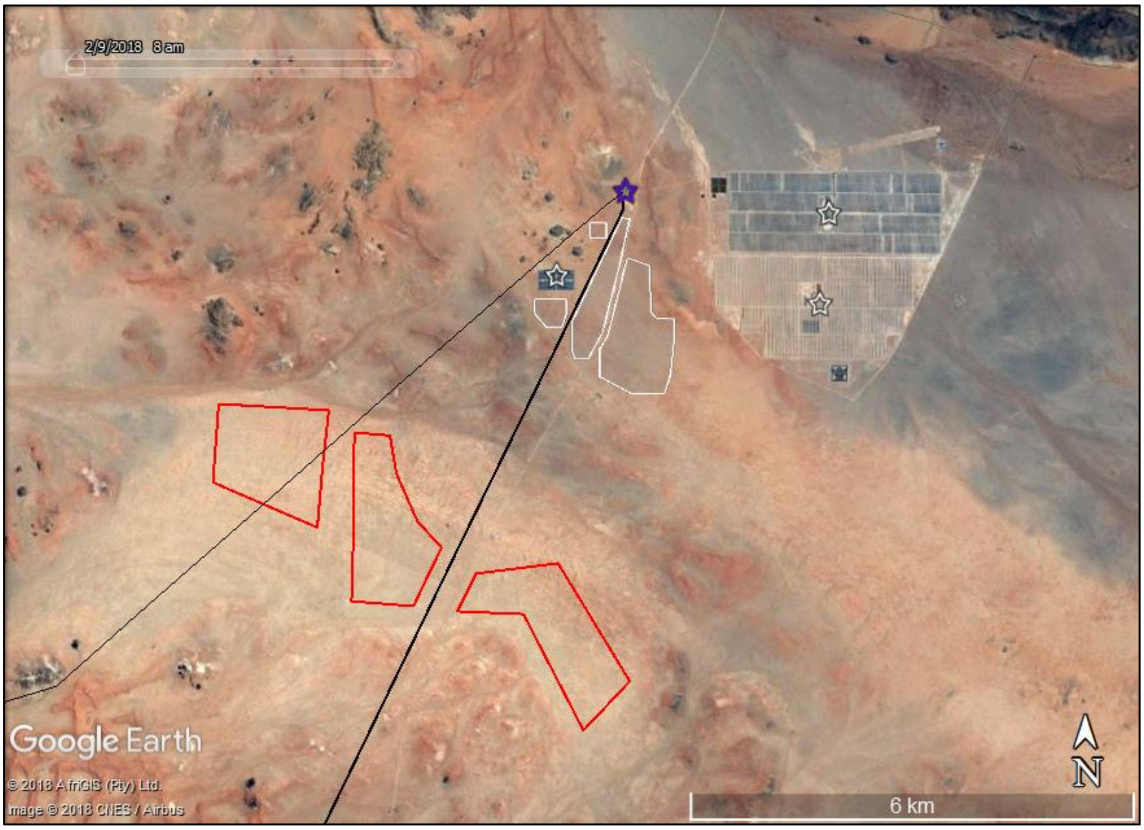


Figure 28: Aerial view of the broader study area showing the present proposals (red polygons), two existing power lines (black lines), the existing solar energy facilities (white stars), the existing Paulputs Substation (purple star) and the new solar energy facility likely commencing construction in 2018 (white polygons).

- **<u>SUMMARY OF HERITAGE INDICATORS</u>**

While rare isolated fossils may exist in the area, the chances of these being present and found are so small as to make palaeontological issues of no further concern to this assessment. Archaeological sites are present in the area but only the PV3 study area contains a site of any significance that will need avoidance or mitigation. Unmarked graves are likely to be entirely absent from the study areas and there are no structures present. Until recently, the landscape was largely natural with only very minimal human alteration but now it has gained a strong electrical 'layer' with several solar energy facilities and related infrastructure present. Clustering of such facilities is more desirable than spreading them out over the landscape.

- **<u>STATEMENT OF SIGNIFICANCE AND PROVISIONAL GRADING</u>**

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

While individual fossils in the area could be of high significance if located, the chances of finding such fossils are very low and in general palaeontological resources are considered to be of low cultural significance for their scientific value. A grading cannot be readily applied because no fossils are currently known from the study area.

Archaeological resources of variable cultural significance were found. However, resources in the PV1 and PV2 areas are of very low significance for their scientific value (grade GP C), while the most important site in the PV3 study area is deemed to be of medium cultural significance for its scientific value and can be graded GP A.

Because it is only very weakly developed (i.e. minimal human imprint on the landscape) and has been altered by modern electrical developments, the cultural landscape is considered to have low cultural significance for its aesthetic and historical values. The archaeological aspect is of greater significance but is most strongly developed around the rocky hills which are not of concern to this assessment.

5.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old as well as military remains more than 75 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: “any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith”;
- Palaeontological material: “any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace”;
- Archaeological material: a) “material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures”; b) “rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation”; c) “wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation”; and d) “features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found”;
- Grave: “means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place”; and
- Public monuments and memorials: “all monuments and memorials a) “erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government”; or b) “which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual.”

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list “historical settlements and townscapes” and “landscapes and natural features of cultural significance” as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of S.38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the consenting authority prior to the issuing of a decision. Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to an EIA. The present report provides the heritage component. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the DEA.

5.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS

Potential impacts to palaeontological resources, archaeological resources and the cultural landscape have been identified.

No consultation has taken place during the assessment process.

- **Overview of key Impacts resulting from the proposed development**

Only one key impact has been identified and this pertains to the PV3 study area only. This is the direct impact to archaeological resources that might occur during the construction phase of the project through destruction of the resources. No impacts to archaeology are envisaged during the operation and decommissioning phases of the project.

Cumulative impacts to archaeology are not considered significant because sites tend to be closely linked with water sources and these are generally avoided by development. Impacts to culturally significant archaeological sites are thus considered unlikely to have occurred through the construction of other renewable energy facilities in the broader region.

- **Overview of key Environmental Management Actions and limits of acceptable changes to the Environment due to the proposed development**

The development of the Paulputs PV3 facility has the potential to completely destroy a significant archaeological resource should it be built over. This is entirely unacceptable but, with adequate mitigation, scientific data would be rescued and this change would then be deemed acceptable. Mitigation would only be needed in the event that avoidance is not possible. If the one significant site in the PV3 area can be avoided then monitoring will simply aim to ensure that the area is not damaged during construction.

The alternative footprint included in the development envelope proposed for PV3, illustrated in Figure 25, has the potential to avoid the significant archaeological resource identified on the Farm 91/2/rem and therefore would reduce the risk to the archaeological resource to low.

The potential impacts identified during the EIA assessment are:

- **Construction Phase impacts**

Potential impacts to palaeontological resources (PV1, PV2 & PV3)

Construction phase impacts to palaeontological resources are expected to be identical for all three proposed projects and are presented in Tables 2 and 3.

Impacts to fossils would be direct impacts related to the destruction of fossils during preparation of the site for construction and/or during the excavation of foundations. The impacts are expected to be of very low significance. Due to the expected very sparse distribution of fossils in the landscape and their generally low cultural significance, no possible indirect impacts have been identified. No mitigation measures are required and there are no areas that need to be avoided by development. Management in the form of a chance finds procedure should be incorporated into the Environmental Management Program (EMPr) such that if any isolated fossils are found during construction then they can be reported, documented and rescued as appropriate. The appended palaeontological specialist study includes the relevant details.

Potential impacts to archaeological resources (PV1 & PV2)

Construction phase impacts to archaeological resources are expected to be identical for the PV1 and PV2 projects and are presented in Table 2.

Impacts to archaeological materials would be direct impacts related to the destruction of artefacts during preparation of the site for construction and/or during the excavation of foundations. The impacts are expected to be of very low significance. Due to the very sparse distribution of culturally significant archaeological resources in the landscape, no possible indirect impacts have been identified. No mitigation measures are required and there are no areas that need to be avoided by development. Management in the form of a chance finds procedure should be incorporated into the EMPr such that if any archaeological sites (or graves) are found during construction then they can be reported, assessed and mitigated as appropriate.

Potential impacts to archaeological resources (PV3)

Construction phase impacts to archaeological resources for PV3 are presented in Table 3.

Impacts to archaeological materials would be direct impacts related to the destruction of artefacts during preparation of the site for construction and/or during the excavation of foundations. Because a culturally significant site was located in the proposed footprint, an impact of moderate consequence is very likely to occur. The impacts are thus expected to be of high significance. Due to the very sparse distribution of culturally significant archaeological resources in the landscape, no possible indirect impacts have been identified. However, should this archaeological site be protected from harm then it would be at risk of indirect impacts occurring. Since it is within the currently proposed development footprint indirect impacts are not assessed here. The significant archaeological site will need to either be avoided with a minimum 30 m buffer (as a best practice principle) or excavated. It is not of such significance as to warrant being a no-go area and mitigation is thus acceptable. With mitigation the impacts would be of very low significance.

As indicated previously, the development envelope proposed for PV3 includes the required area to develop the PV field and associated infrastructure and avoid site KK2018/001 and therefore would reduce the risk to the archaeological resources to low significance with indirect impacts being the only concern.

Management in the form of a chance finds procedure should be incorporated into the EMPr such that if any archaeological sites (or graves) are found during construction then they can be reported, assessed and mitigated as appropriate.

Potential impacts to the cultural landscape (PV1, PV2 & PV3)

Construction phase impacts to the cultural landscape are expected to be identical for all three proposed projects and are presented in Tables 2 and 3.

Impacts to the cultural landscape are direct impacts related to the introduction of incompatible equipment and materials to the rural landscape. The landscape is generally of low cultural significance, partly due to the existing presence of much electrical infrastructure in the vicinity. As such, the expected impacts are rated as being of very low consequence but due to the high probability of occurrence the impacts might be of medium significance. No indirect impacts to the landscape have been identified. There are no feasible mitigation measures to screen such large developments but one measure that should be applied is to use paint colours that will help built elements of the facility to recede into the background. A visual assessment practitioner can be consulted in this regard. It is understood, however, that some elements of solar energy facilities are required to be painted white. After mitigation the impacts are expected to be of low significance.

- **<u>Operation Phase impacts</u>**

Potential impacts to the cultural landscape (PV1, PV2 & PV3)

Operation phase impacts to the cultural landscape are expected to be identical for all three proposed projects and are presented in Table 4.

Impacts to the cultural landscape are direct impacts related to the presence of an industrial type facility in the rural landscape. The landscape is generally of low cultural significance, partly due to the existing presence of much electrical infrastructure in the vicinity. As such, the expected impacts are rated as being of very low consequence but due to the high probability of occurrence the impacts might be of medium significance. No indirect impacts to the landscape have been identified. There are no feasible mitigation measures since it is not possible to screen such large developments. The after mitigation significance thus remains medium.

- **<u>Decommissioning Phase impacts</u>**

Potential impacts to the cultural landscape (PV1, PV2 & PV3)

Decommissioning phase impacts to the cultural landscape are expected to be identical for all three proposed projects and are presented in Table 5.

Impacts to the cultural landscape are direct impacts related to the introduction of incompatible equipment and materials to the rural landscape. The landscape is generally of low cultural significance, partly due to the existing presence of much electrical infrastructure in the vicinity. As such, the expected impacts are rated as being of very low consequence but due to the high probability of occurrence the impacts might be of medium significance. No indirect impacts to the landscape have been identified. There are no feasible mitigation measures since it is not possible to screen such large developments and equipment. The after mitigation significance thus remains medium.

- **Existing impacts**

The only impact that currently exists is the potential trampling of archaeological materials at the archaeological site in the PV3 area by grazing livestock and/or farm vehicles. As previously mentioned the development envelope proposed for PV3 and illustrated in Figure 25, would allow for avoidance of the archaeological site identified on Farm 91/2rem if the alternative layout is developed.

- **Levels of acceptable change**

For palaeontology, archaeology and graves any total or partial destruction of significant fossils, sites or graves without recording or sampling is unacceptable. For the landscape, any development that completely dominates the surroundings would be unacceptable.

5.8. ASSESSMENT OF CUMULATIVE IMPACTS

Cumulative impacts are expected to be identical for all three proposed projects and are presented in Table 6.

Palaeontological and archaeological resources tend to be very rare on the Bushmanland landscape and are focused on drainage lines and water sources respectively – both areas typically avoided by developments. Cumulative impacts are thus likely to be of very low significance for palaeontology. However, because some water sources can be located in open grasslands, as documented in this report and by Orton (2016), there is the potential for some of these sites to be missed and destroyed and the potential impact to archaeology before mitigation is therefore rated as being of medium significance. With adequate mitigation this would be reduced to very low significance.

Impacts to the cultural landscape are direct impacts related to the introduction of incompatible equipment and materials to the rural landscape. The landscape is generally of low cultural significance, partly due to the existing presence of much electrical infrastructure in the vicinity. As such, the expected impacts are rated as being of very low consequence but due to the high probability of occurrence the impacts might be of medium significance. No indirect impacts to the landscape have been identified. There are no feasible mitigation measures to screen such large developments and equipment but the use of pale recessive colours on built elements where technically feasible would marginally reduce the visual intrusion in the landscape. However, the impacts would remain at medium significance

5.9. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development. The proposed projects would result in extra electricity generation which would help with the stabilisation of South Africa's electricity supply. This is, in turn, good for economic development. The projects will likely generate some short terms construction jobs and a few long term opportunities during the operational phase. These benefits clearly outweigh the relatively insignificant impacts to heritage resources that might occur.

5.10. IMPACT ASSESSMENT SUMMARY

Table 2: Impact assessment summary table for the Construction Phase: PV1 and PV2.

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Preparation of site for construction and excavation of foundations	Destruction of palaeontological resources	Negative	Site	Permanent	Very low	Rare	Low	High	None required	Very low	Very low	Very Low
Preparation of site for construction and excavation of foundations	Destruction of archaeological resources	Negative	Site	Permanent	Very low	Rare	Low	High	None required	Very low	Very low	Very Low
All construction activities	Introduction of incompatible elements into the landscape	Negative	Local	Long term	Very low	Very likely	High	Low	Pale recessive paint colours on built elements where technically feasible	Moderate	Low	Moderate

Table 3: Impact assessment summary table for the Construction Phase: PV3.

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Preparation of site for construction and excavation of foundations	Destruction of palaeontological resources	Negative	Site	Permanent	Very low	Rare	Low	High	None required	Very low	Very low	Very Low
Preparation of site for construction and excavation of foundations	Destruction of archaeological resources	Negative	Site	Permanent	Moderate	Very likely	Low	High	Avoid or archaeological excavation	High	Very low	Very Low
Preparation of site for construction and excavation of foundations based on alternative footprint for PV3 within development envelope	Destruction of archaeological resources	Negative	Site	Permanent	Very low	Rare	Low	High	None required	Very low	Very low	Very Low
All construction activities	Introduction of incompatible elements into the landscape	Negative	Local	Long term	Very low	Very likely	High	Low	Pale recessive paint colours on built elements where technically feasible	Moderate	Low	Low

Table 4: Impact assessment summary table for the Operational Phase: PV1, PV2 & PV3.

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
All activities	Introduction of incompatible elements into the landscape	Negative	Local	Long term	Very low	Very likely	High	Low	None feasible	Moderate	Moderate	Moderate

Table 5: Impact assessment summary table for the Decommissioning Phase: PV1, PV2 & PV3.

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
All construction activities	Introduction of incompatible elements into the landscape	Negative	Local	Long term	Very low	Very likely	High	Low	None feasible	Medium	Medium	Moderate

Table 6: Impact assessment summary table for Cumulative Impacts: PV1, PV2 & PV3.

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Resource	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Preparation of site for construction and excavation of foundations	Destruction of palaeontological resources	Negative	Regional	Permanent	Very low	Rare	Low	High	None required	Very low	Very low	Very Low
Preparation of site for construction and excavation of foundations	Destruction of archaeological resources	Negative	Regional	Permanent	Moderate	Likely	Low	High	Avoid or excavate sites	Medium	Very low	Very Low
Preparation of site for construction and excavation of foundations based on alternative footprint for PV3 within development envelope	Destruction of archaeological resources	Negative	Site	Permanent	Very low	Rare	Low	High	None required	Very low	Very low	Very Low
All construction activities	Introduction of incompatible elements into the landscape	Negative	Regional	Long term	Very low	Very likely	High	Low	Pale recessive paint colours on built elements where technically feasible	Medium	Medium	Moderate

5.11. MITIGATION MEASURES AND MANAGEMENT ACTIONS

- **Mitigation**

All mitigation measures would need to be applied at the construction phase since it is then that the impacts initially occur. Mitigation measures are listed in Table 7. Figure 29 shows the locations of significant archaeological resources. The individual waypoints are buffered by 50 m which allows for the area of the site and a further buffer of at least 30 m around each site.

Table 5: Mitigation measures suggested for the proposed Paulputs PV1, PV2 and PV3 solar energy facilities

Heritage aspect	Alternative 1	Alternative 2	Alternative 3
Palaeontology	• No mitigation required.	• No mitigation required.	• No mitigation required.
Archaeology	• No mitigation required.	• No mitigation required.	• Site KK2018/001 (waypoints 748-753) should be avoided or else excavated by a professional archaeologist prior to construction.
Cultural landscape	• Pale recessive paint colours should be used on built elements where technically feasible.	• Pale recessive paint colours should be used on built elements where technically feasible.	• Pale recessive paint colours should be used on built elements where technically feasible.

The archaeological excavation of KK2018/001 should include spatial mapping of the site and excavation of patches where scatters of artefacts occur. Radiocarbon dating may or may not be required depending on the materials recovered. This would need to be done under a permit issued in the name of the appointed professional archaeologist.

- **Management**

Management measures are listed in Table 8.

Table 6: Management measures suggested for the proposed Paulputs PV1, PV2 and PV3 solar energy facilities.

Heritage aspect	Alternatives 1-3
Palaeontology	• A chance finds procedure should be written into the EMPr. Please see Appendix 4 for details.
Archaeology	• Dense accumulations of stone artefacts found during construction should be reported to the ECO who should then report to an archaeologist or SAHRA. Mitigation may then be required. • To protect other sites, all activities must remain within the authorised footprint.
Cultural landscape	• Pale recessive paint colours should be used on built elements where technically feasible.

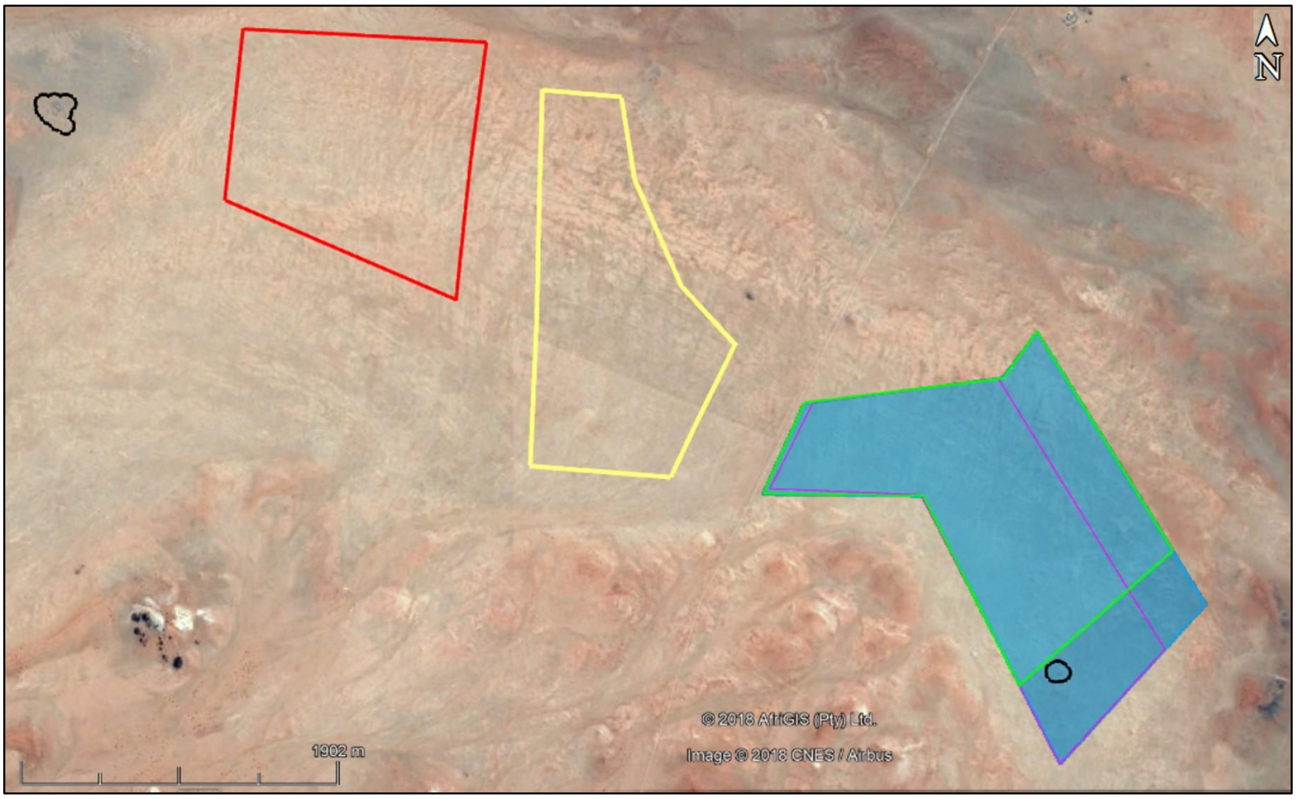


Figure 25: Aerial view of the PV1 (red outlined polygon), PV2 (yellow outlined polygon) and PV3 (pink outlined polygon) with the development envelope for PV3 (blue polygon) and alternative layout (green outlined polygon) and the significant archaeological sites (including buffers) ringed in black. Site KK2018/041 lies to the northwest and KK2018/001 lies to the southeast.

5.12. CONCLUSIONS AND RECOMMENDATIONS

Only one significant heritage resource was found within any of the three study areas – this is an archaeological site within the southern part of the Paulputs PV3 study area. The site can be avoided (by avoiding, fencing and protecting the site during construction or by selection of the alternative footprint for PV3) but is certainly easy to mitigate via archaeological excavation should this be required. There are no fatal flaws for any of the three project areas and it is concluded that development of all three is feasible. Provision should be made in the EMPr for the protection and reporting of any chance finds of fossils, archaeological materials or human burials. There are no significant concerns from the point of view of cumulative impacts.

Because the impacts to heritage resources would be of relatively low significance and are easily manageable, it is recommended that the Paulputs PV1, PV2 and PV3 solar energy developments be authorised. However, the following recommendations that should be incorporated into the Environmental Authorisation for each project:

Paulputs PV1

- If any palaeontological or archaeological material or human burials are uncovered during the course of development, then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate professional. Such heritage is the property of the state and may require excavation and curation in an approved institution; and
- Where technically feasible, pale recessive colours should be used on the built elements of the project.

Paulputs PV2

- If any palaeontological or archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate professional. Such heritage is the property of the state and may require excavation and curation in an approved institution; and
- Where technically feasible, pale recessive colours should be used on the built elements of the project.

Paulputs PV3

- Archaeological site KK2018/001 should be avoided if possible. If this is not possible then a professional archaeologist should be appointed to undertake mitigation prior to construction;
- If KK2018/001 is avoided then the site should be fenced and declared a no-go area during construction;
- If any palaeontological or archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate professional. Such heritage is the property of the state and may require excavation and curation in an approved institution; and
- Where technically feasible, pale recessive colours should be used on the built elements of the project.

5.13. APPENDIX A: REFERENCES

Beaumont, P.B., Smith, A.B., & Vogel, J.C. 1995. Before the Einiqua: the archaeology of the frontier zone. In A. B. Smith (ed.) *Einiqualand: studies of the Orange River frontier*. Cape Town: UCT Press.

Halkett, D. 2010. An assessment of impact on archaeological heritage resulting from replacement of a section of the existing bulkwater supply pipeline from Pella to Pofadder, Northern Cape. Unpublished report prepared for Van Zyl Environmental. St James: ACO Associates cc.

Morris, D. 2011. A Phase 1 Heritage Impact Assessment for the proposed Aggeneis – Paulputs 220kV transmission line. Unpublished report for SSI Engineers and Environmental Consultants. Kimberley: McGregor Museum.

Morris, D. 2012. Pofadder Solar Thermal Facility KaXu Solar One Specialist Input for the Environmental Impact Assessment Phase and Environmental Management Plan: Archaeology. Unpublished report for Savannah Environmental (Pty) Ltd. Kimberley: McGregor Museum.

Orton, J. 2015a. Final archaeological survey for the proposed Konkoonsies II Solar Energy Facility, Kenhardt Magisterial District, Northern Cape. Unpublished report prepared for Savannah Environmental (Pty) Ltd. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2015b. Heritage impact assessment for a proposed 132 kV Power Line and Substation at the Konkoonsies II Solar Energy Facility, Kenhardt Magisterial District, Northern Cape. Unpublished report prepared for Savannah Environmental (Pty) Ltd. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016a. Archaeological mitigation for the proposed Konkoonsies II Solar Energy Facility, Kenhardt Magisterial District, Northern Cape. Unpublished report prepared for Ramizone (RF) (Pty) Ltd. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016b. Heritage Impact Assessment for the proposed Sol Invictus 4 PV Facility, Namakwaland Magisterial District, Northern Cape. Unpublished report prepared for Savannah Environmental (Pty) Ltd. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. & Webley, L. 2013. Heritage impact assessment for proposed granite prospecting near Pofadder, Northern Cape. Unpublished report prepared for Sizisa Ukhanyo Trading 830 cc. Diep River: ACO Associates cc.

Pelser, A.J. 2011. A report on an archaeological impact assessment (AIA) for the proposed solar energy plant on Konkoonsies 91, Pofadder District, Northern Cape. Unpublished report prepared for Robert de Jong and Associates. Wonderboompoort: Archaetnos.

Pelser, A.J. 2011. A report on a heritage impact assessment (HIA) for the proposed photo-voltaic solar power generation plant on Konkoonsies 91, Pofadder District, Northern Cape. Unpublished report prepared for EScience Associates (Pty) Ltd. Wonderboompoort: Archaetnos.

SAHRA. 2007. Minimum Standards: archaeological and palaeontological components of impact assessment reports. Document produced by the South African Heritage Resources Agency, May 2007.

5.14. APPENDIX B: SPECIALIST IMPACT ASSESSMENT CRITERIA

The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of the predicted environmental impacts and risks is described in Part 5 - Section 4 of the EIA report.

5.15. APPENDIX C: SPECIALIST DECLARATION

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

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

Name of Specialist: JAYSON ORTON

Signature of the specialist:

Date: 17 OCTOBER 2018

5.16. APPENDIX D: SPECIALIST CURRICULUM VITAE

Jayson David John Orton
ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 40 Brassie Street, Lakeside, 7945
Telephone: (021) 789 0327
Cell Phone: 083 272 3225
Email: jayson@asha-consulting.co.za

Birth date and place: 22 June 1976, Cape Town, South Africa
Citizenship: South African
ID no: 760622 522 4085
Driver's License: Code 08
Marital Status: Married to Carol Orton
Languages spoken: English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science)	1997
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:
Principal Investigator: Coastal shell middens (awarded 2007)
Stone Age archaeology (awarded 2007)
Grave relocation (awarded 2014)
Field Director: Rock art (awarded 2007)
Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43
Accredited Professional Heritage Practitioner

Memberships and affiliations:

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –

Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

Fieldwork and project experience:

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

<u>Feasibility studies:</u>
Heritage feasibility studies examining all aspects of heritage from the desktop

<u>Phase 1 surveys and impact assessments:</u>
Project types
Notification of Intent to Develop applications (for Heritage Western Cape)
Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
Archaeological specialist studies
Phase 1 archaeological test excavations in historical and prehistoric sites
Archaeological research projects
Development types
Mining and borrow pits
Roads (new and upgrades)
Residential, commercial and industrial development
Dams and pipe lines
Power lines and substations
Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

<u>Phase 2 mitigation and research excavations:</u>
ESA open sites
Duinefontein, Gouda, Namaqualand
MSA rock shelters
Fish Hoek, Yzerfontein, Cederberg, Namaqualand
MSA open sites
Swartland, Bushmanland, Namaqualand
LSA rock shelters
Cederberg, Namaqualand, Bushmanland
LSA open sites (inland)
Swartland, Franschhoek, Namaqualand, Bushmanland
LSA coastal shell middens
Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
LSA burials
Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
Historical sites
Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
Historic burial grounds
Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

Awards:

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

5.17. APPENDIX E: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017

Requirements of Appendix 6 – GN R326 of NEMA EIA Regulations as amended (7 April 2017)	**Please indicate where it is addressed in the Specialist Report:**
1. (1) A specialist report prepared in terms of these Regulations must contain- details of- the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 1.4 & Appendix 1
a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 2
an indication of the scope of, and the purpose for which, the report was prepared; (ca) an indication of the quality and age of base data used for the specialist report; (cb) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.2 n/a Sections 8.4, 8.5 & 8.6
the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.2
a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
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 1.1.1 Figure 3
an identification of any areas to be avoided, including buffers;	Section 9
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;	Figure 28
a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.5
a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Sections 6, 7 & 8
any mitigation measures for inclusion in the EMPr;	Section 9.1
any conditions for inclusion in the environmental authorisation;	Section 12
any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9.2
a reasoned opinion- whether the proposed activity, activities or portions thereof should be authorised; (ia) regarding the acceptability of the proposed activity or activities; and if the opinion is that the proposed activity 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 12
a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 3.6
a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
any other information requested by the competent authority.	n/a
(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.	n/a

5.18. APPENDIX F: PALEONTOLOGY STUDY SPECIALIST REPORT

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

John E. Almond PhD (Cantab.)
Natura Viva cc, PO Box 12410 Mill Street,
Cape Town 8010, RSA
naturaviva@universe.co.za

June 2018

EXECUTIVE SUMMARY

It is proposed to construct a PV Solar Farm in three phases (Paulputs PV1, PV2 and PV3) on Portion 5 and Portion 2 / Remainder of Farm Konkonsies 91, located *c.* 27 km NE of Pofadder in the Khaî-Ma Local Municipality of the Northern Cape. The underlying Precambrian basement rocks (granitoids, metasediments) of the Namaqua-Natal Province are unfossiliferous while the overlying Late Caenozoic superficial deposits (alluvium, gravels, aeolian sands *etc*) are generally of low to very low palaeontological sensitivity. No sensitive palaeontological sites or no-go areas have been identified within the Paulputs PV Solar Farm study area or the associated short transmission line corridor options to Paulputs Substation. Narrow zones of Late Caenozoic alluvium associated with minor water courses in the broader study region might contain fossils such as isolated mammalian bones and teeth or freshwater molluscs but these are probably very sparse, at most. Since the Paulputs PV Phase 1-3 project areas are situated away from drainage lines and the placement of pylon footings close to drainage lines is unlikely, direct impacts on alluvial fossils are unlikely.

Impacts on unique or irreplaceable fossil heritage resources due to the proposed development are improbable and their severity is anticipated to be negligible since (1) significant fossil sites are unlikely to be affected, (2) the footprints involved are small, and (3) in most cases any impacts can be mitigated through application of an appropriate Chance Fossil Finds Procedure (See Appendix). The overall impact significance of the proposed Paulputs PV Solar Farm (Phases 1-3) and associated electrical infrastructure developments (overhead transmission lines, on-site substations) is rated as VERY LOW in terms of palaeontological heritage resources. This assessment applies equally to all transmission line route options under consideration. Given the general low palaeontological sensitivity of the region, cumulative impacts inferred for the various powerline and alternative energy developments in the Aggeneys – Pofadder – Paulputs region of the Northern Cape are assessed as very low.

Pending the potential discovery of significant fossil remains (*e.g.* mammalian bones or teeth) during the construction phase, no further specialist palaeontological studies or mitigation are recommended for the Paulputs PV Solar Farm project (Phases 1-3) and associated electrical infrastructure developments. Chance fossil finds such as vertebrate bones and teeth or shells should be safeguarded - preferably *in situ* - and reported by the ECO as soon as possible to the South African Heritage Resources Agency, SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). This is so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented (Please refer to the tabulated Chance Fossil Finds Procedure appended to this report). The palaeontologist concerned

with mitigation work would need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved repository (*e.g.* museum or university collection) (SAHRA 2013). These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed developments.

1. INTRODUCTION & BRIEF

It is proposed to construct a PV Solar Farm in three phases (Paulputs PV1, PV2 and PV3) on Portion 5 and Portion 2 / remainder of Farm Konkonsies 91, located some 27 km NE of Pofadder and 100 km west of Kakamas in the Khaî-Ma Local Municipality of the Northern Cape (Fig. 1).

Each phase of the PV Solar Farm would have a footprint of ≤ 200 ha. Associated infrastructure includes a battery storage system (≤ 1 ha), gravel access and service roads (≤8 m wide), a collector substation (≤ 1 ha) and adjoining operations and maintenance area (≤ 1 ha) as well as a temporary construction yard and laydown area (≤ 4 ha). The Solar Farm will be connected by short overhead transmission lines to the National Grid *via* the existing Paulputs Substation situated on the adjoining farm Scuit-Klip 92. A proposed layout of the three phases of the Paulputs PV Solar Farm, showing route options for the transmission line corridors to Paulputs Substation, is provided in Figure 2.

The present short palaeontological desktop report contributes to the comprehensive heritage impact assessments for the Paulputs PV Solar Farm and associated transmission lines compiled by Dr Jayson Orton of ASHA Consulting (Pty) Ltd (Contact details: ASHA, 40 Brassie Street, Lakeside, 7945. E-mail: jayson@asha-consulting.co.za. Tel: 021 789 0327. Cell: 083 272 3225. Website: www.asha-consulting.co.za).

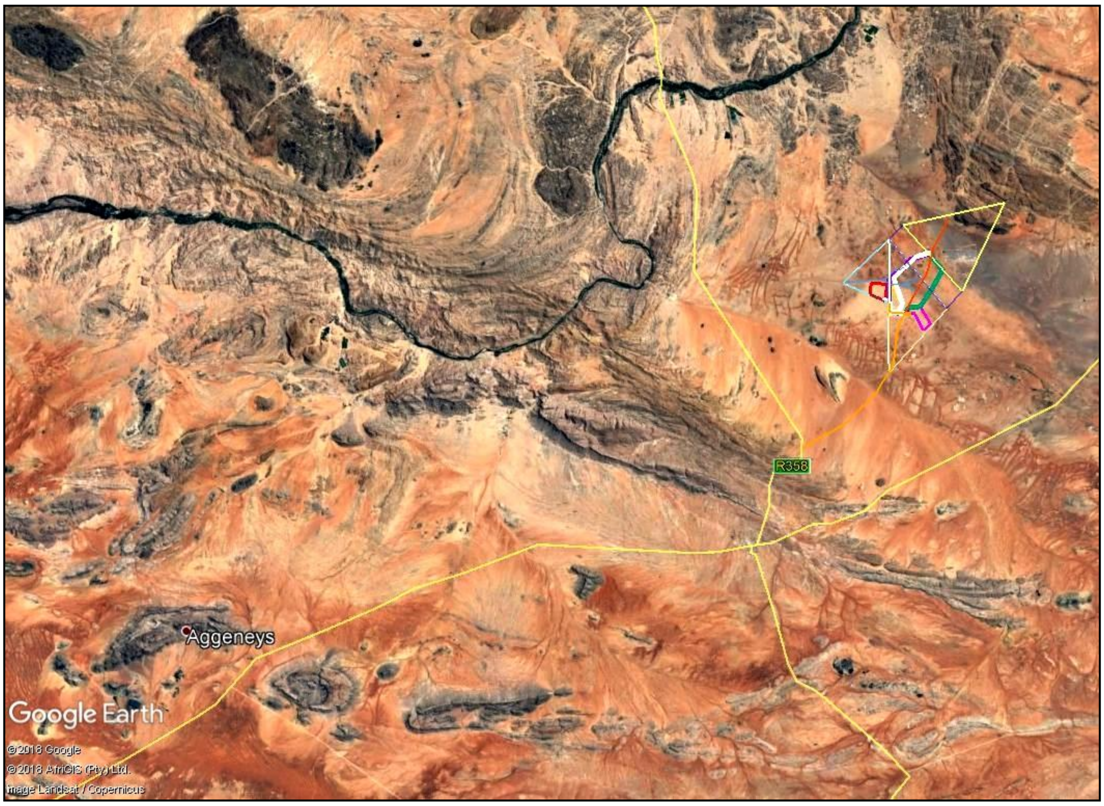


Figure 1: Google Earth© satellite image showing the location of the Paulputs PV Solar Farm project area on Farm Konkoonsies 91 situated between the N14 trunk road and the Orange River (Gariep), *c*. 27 km NE of Pofadder.

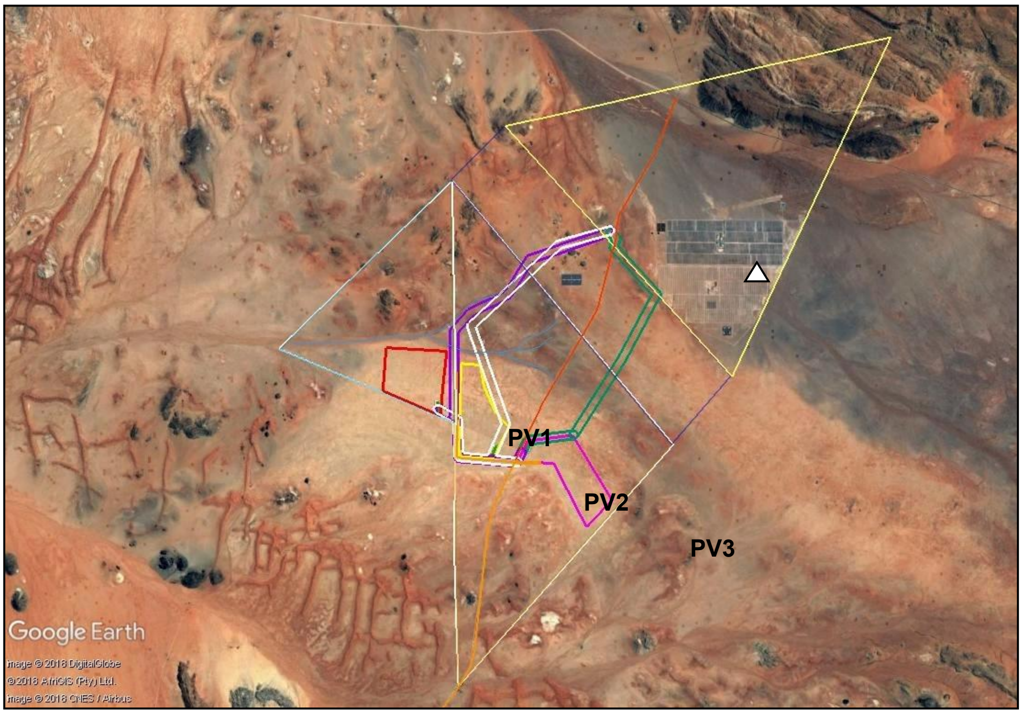


Figure 2: Google Earth© satellite image showing the location of the three proposed phases of the Paulputs PV Solar Farm (PV1, PV2, PV3) on Farm Konkoonsies 91, the main access roads (orange) as well as transmission line corridor options (purple, white, green) to the nearby Paulputs Substation on Farm Scuit-Klip 92 (small white triangle). The desert terrain in this part of northern Bushmanland, situated on the south-western margins of the Ysterberg, features sandy to gravelly *vlaktes* (pale brown / orange), networks of aeolian sand dunes (orange) and numerous small, isolated Inselberge of basement rocks (dark hues). Note that several existing or proposed solar energy facilities, including the Kaxu and Xina CSP projects, are located on the Farm Scuit-Klip. Scale bar = 4 km. N towards top of image.

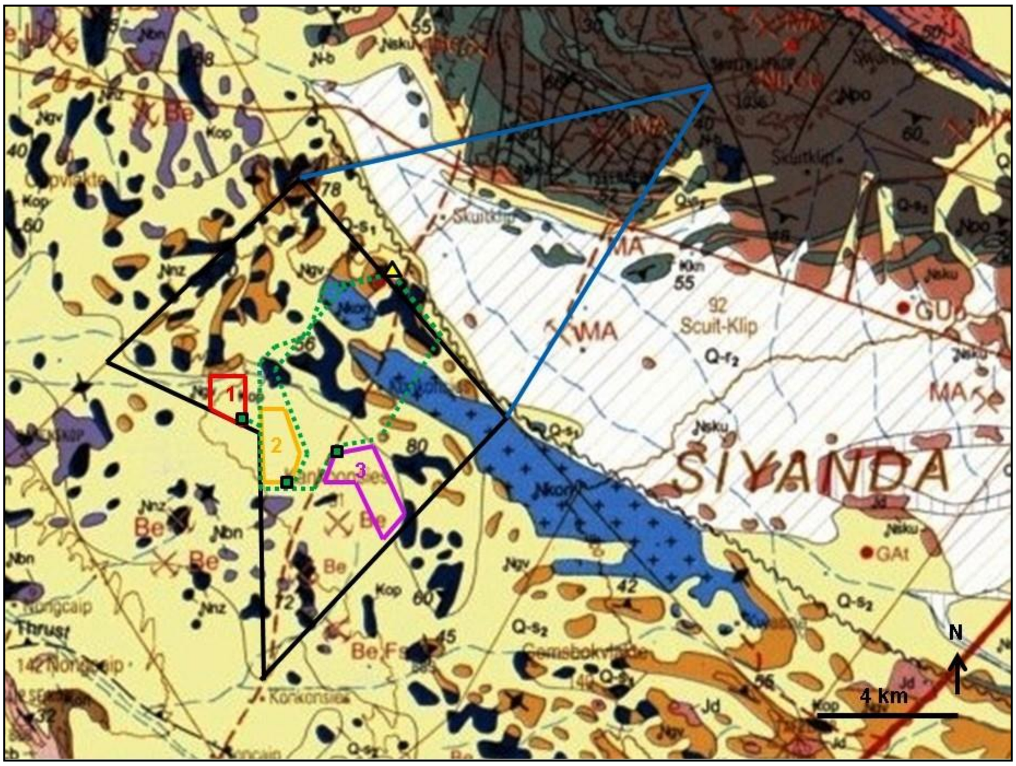


Figure 3: Extract from 1: 250 000 geology sheet 2818 Onseepkans (Council for Geoscience, Pretoria) showing the main rock units represented in the Paulputs PV Solar Farm project area (Phases 1-3 indicated by the red, yellow and purple polygons respectively). These rocks include several different units of Late Precambrian

(Mokolian) metasediments and granitoid intrusive rocks of the Namaqua-Natal Province that build the rocky Inselberge shown in dark colours (*e.g.* Ncon, middle blue – Konkonsies Granite) and which are all unfossiliferous. These are mantled with a range of Late Caenozoic superficial deposits – such as aeolian sands (Qs1, dark yellow), scree, rock rubble, sandy and gravelly soils (Qs2, darker yellow), granitic gravels or *grus* (Q-r2, white with cross-hatch) as well as alluvium - that can be broadly included within the Quaternary to Recent Kalahari Group and are, at most, sparsely fossiliferous. Crossed hammer symbols marked Be, Fs, MA are defunct or active beryllium, feldspar and granite mines.

2. GEOLOGICAL BACKGROUND

The Paulputs PV Solar Farm study area is situated within a very arid region of northern Bushmanland between the Orange River (Gariep) and the N14 tar road between Springbok and Kakamas (Figs. 1 & 2). This mixed sandy and rocky desert region – assigned to the Lower Vaal & Orange Valleys Geomorphic Province of Partridge *et al.* (2010) - is drained by non-perennial tributaries of the Gariep drainage system (*e.g.* Kaboep Rivier). The new Paulputs PV solar project area, as well as the existing Paulputs Substation and several recently-constructed or proposed solar energy facilities (*e.g.* Kaxu and Xina CSP, Paulputs CSP, Konkonesies 1 Solar PV facilities) are located on the south-western margins of the Ysterberg (1075 m amsl), some 30 km SE of Onseepkans. The surface terrain within the majority of the present study region, away from the rocky *rante* and *koppies*, is predominantly sandy to gravelly, with low hills and patchy outcrops of basement rocks as well as a number of shallow, ephemeral streams. The Paulputs PV Solar Phase 1-3 project areas are all situated in flat-lying, sandy to gravelly areas between drainage lines at *c*. 800-850 m amsl.

The geology of the Paulputs region is shown on 1: 250 000 geological map 2818 Onseepkans (Council for Geoscience, Pretoria) (Fig. 3) (Moen & Toogood 2007) and has been outlined in a recent palaeontological assessment report for the proposed Aggeneis-Paulputs 400 kV Transmission Powerline by Almond (2017) as well as a desktop palaeontological study for the Farm Scuit-Klip 92 by Pether (2010). The scattered small basement inliers here are composed of a variety of resistant-weathering igneous and high grade metamorphic rocks - mainly granites, gneisses, schists, quartzites and amphibolites - of Late Precambrian (Mokolian / Mid-Proterozoic) age. These ancient basement rocks are assigned to the Namaqua Sector of the Namaqua-Natal Province and are approximately one to two billion years old (Cornell *et al.* 2006, Moen 2007, Agenbacht 2007, Moen & Toogood 2007). Since none of these basement rocks is fossiliferous, they will not be treated in more detail in this report.

The flatter, lower-lying portions of the study area – including those parts that will be directly affected by the proposed solar PV and associated electrical infrastructure development - are underlain by a spectrum of unconsolidated superficial sediments of Late Caenozoic age. These are largely mapped as Quaternary to Recent sands and gravels of probable braided fluvial or sheet wash origin (Q-s_2 in Fig. 3). The alluvial and colluvial sediments are locally overlain, and perhaps also underlain, by unconsolidated aeolian (*i.e.* wind-blown) sands of the Gordonia Formation (Kalahari Group) that are Pleistocene to Holocene in age (Q-s_1 in Fig. 3; see network of orange dunes on satellite images, *e.g.* Fig. 2). All these superficial sediments can be broadly subsumed into the Late Cretaceous to Recent Kalahari Group, the geology of which is reviewed by Haddon (2000) and Partridge *et al.* (2006). Narrow strips of Late Caenozoic sandy to gravelly alluvium occur along local drainage courses that are unlikely to be directly impacted by the proposed development.

3. PALAEONTOLOGICAL HERITAGE

The Mid Proterozoic (Mokolian) igneous and metasedimentary basement rocks of the Namaqua-Natal Province are entirely unfossiliferous (Almond & Pether 2008). Fossil biotas recorded from each of the main sedimentary rock units mapped in the Aggeneys region and along the Orange River to the north have been reviewed in several previous palaeontological heritage assessments by Almond (*e.g.* 2011, 2012, 2013a, 2013b, 2014, 2015, 2016, 2017; see also Almond & Pether 2008, Almond 2009, Pether 2010, Almond *in* Macey *et al.* 2011 and extensive references therein).

The various younger superficial deposits of the Kalahari Group in Bushmanland, including aeolian sands, alluvium, surface gravels, calcretes and pan deposits, are poorly known in palaeontological terms. The fossil record of the Kalahari Group as a whole is generally sparse and low in diversity; no fossils are recorded here in the adjoining Pofadder and Onseepkans geology sheet explanations by Agenbacht (2007) and Moen and Toogood (2007) respectively. The Kalahari beds may very occasionally contain important Late Caenozoic fossil biotas, notably the bones, teeth and horn cores of mammals (usually isolated and abraded) as well as remains of reptiles like tortoises, non-marine molluscs (bivalves, gastropods), ostrich egg shells, trace fossils (*e.g.* calcretised termitaria, coprolites), plant remains such as peats or palynomorphs (pollens, spores) in organic-rich alluvial horizons as well as siliceous diatoms in pan sediments. Calcrete hardpans might also contain trace fossils such as rhizoliths, termite nests and other insect burrows, or even mammalian trackways.

4. CONCLUSIONS & RECOMMENDATIONS

Precambrian basement rocks underlying the Paulputs PV Solar project area at depth are unfossiliferous while the overlying Late Caenozoic superficial deposits (alluvium, gravels, aeolian sands *etc*) are generally of low to very low palaeontological sensitivity. No sensitive palaeontological sites or no-go areas have been identified within the Paulputs PV Solar Farm study area or the associated short transmission line corridor options to Paulputs Substation. Narrow zones of Late Caenozoic alluvium associated with minor water courses in the broader study region might contain fossils such as isolated mammalian bones and teeth or freshwater molluscs but these are probably very sparse, at most. Since the Phase 1-3 project areas are situated away from drainage lines and the placement of powerline pylon footings close to drainage lines is unlikely, direct impacts on alluvial fossils are unlikely.

Impacts on unique or irreplaceable fossil heritage resources due to the proposed development are improbable and their severity is anticipated to be negligible since (1) significant fossil sites are unlikely to be affected, (2) the footprints involved are small, and (3) in most cases any impacts can be mitigated through application of an appropriate Chance Fossil Finds Procedure (See Appendix). The overall impact significance of the proposed Paulputs PV Solar Farm (Phases 1-3) and associated electrical infrastructure developments (overhead transmission lines, on-site substations) is rated as VERY LOW in terms of palaeontological heritage resources. This assessment applies equally to all transmission line route options under consideration. Given the general low palaeontological sensitivity of the region, cumulative impacts inferred for the various powerline and alternative energy developments in the Aggeneys – Pofadder – Paulputs region of the Northern Cape are assessed as very low.

Pending the potential discovery of significant fossil remains (*e.g.* mammalian bones or teeth) during the construction phase, no further specialist palaeontological studies or mitigation are recommended for the Paulputs PV Solar Farm project (Phases 1-3) and associated electrical infrastructure developments. Chance fossil finds such as vertebrate bones and teeth or shells should be safeguarded - preferably *in situ* - and reported by the ECO as soon as possible to the South African Heritage Resources Agency, SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). This is so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented (Please refer to the tabulated Chance Fossil Finds Procedure appended to this report). The palaeontologist concerned with mitigation work would need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection) (SAHRA 2013). These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed developments.

5. REFERENCES

AGENBACHT, A.L.D. 2007. The geology of the Pofadder area. Explanation of 1: 250 000 geology sheet 2918. 89 pp. Council for Geoscience, Pretoria.

ALMOND, J.E. 2008a. Fossil record of the Loeriesfontein sheet area (1: 250 000 geological sheet 3018). Unpublished report for the Council for Geoscience, Pretoria, 32 pp.

ALMOND, J.E. 2008b. Palaeozoic fossil record of the Clanwilliam sheet area (1: 250 000 geological sheet 3218). Unpublished report for the Council for Geoscience, Pretoria, 49 pp. (To be published by the Council in 2009).

ALMOND, J.E. 2009. Contributions to the palaeontology and stratigraphy of the Alexander Bay sheet area (1: 250 000 geological sheet 2816), 117 pp. Unpublished technical report prepared for the Council for Geoscience by Natura Viva cc, Cape Town.

ALMOND, J.E. 2011. Proposed Sato Energy Holdings (Pty) Ltd photovoltaic project on Portion 3 of Farm Zuurwater 62 near Aggeneys, Northern Cape Province. Recommended exemption from further specialist palaeontological studies or mitigation, 7 pp. Natura Viva cc.

ALMOND, J.E. 2012. Proposed 75 MW solar facility on Farm Zuurwater 62 (Portions 2 & 3) near Aggeneys, Northern Cape Province. Recommended exemption from further specialist palaeontological studies or mitigation, 6 pp. Natura Viva cc.

ALMOND, J.E. 2013a. Proposed wind energy facility and associated infrastructure on Namies Wind Farm (Pty) Ltd near Aggeneys, Northern Cape Province. Palaeontological heritage assessment: desktop study, 16 pp. Natura Viva cc.

ALMOND, J.E. 2013b. Proposed upgrade & repair of water supply infrastructure, Onseepkans, Northern Cape. Recommended exemption from further palaeontological studies, 6pp. Natura Viva cc.

ALMOND, J.E. 2014. Three proposed Mainstream wind energy facilities and a solar energy facility on Farms 209 and 212 near Pofadder, Northern Cape. Palaeontological heritage basic assessment: desktop study 19 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015. Proposed Sol Invictus 600 MW solar PV development on Portion 5 of Farm Ou Taaisbosmond 66 near Aggeneys, Northern Cape Province. Palaeontological heritage desktop assessment, 7 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016. Letsoai and Enamandla Solar Energy Facilities on Farm Hartebeestvlei near Aggenys, Northern Cape: palaeontological heritage, 7 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2017. Proposed Aggeneis-Paulputs 400 kV Transmission Powerline and Substation Upgrades, Namaqua & Siyanda Districts, Northern Cape Province. Palaeontological heritage assessment: desktop study, 19 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

CORNELL, D.H. et al. 2006. The Namaqua-Natal Province. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp 325-379. Geological Society of South Africa, Johannesburg & Council for Geoscience, Pretoria.

DE WIT, M.C.J., MARSHALL, T.R. & PARTRIDGE, T.C. 2000. Fluvial deposits and drainage evolution. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.55-72. Oxford University Press, Oxford.

HADDON, I.G. 2000. Kalahari Group sediments. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp. 173-181. Oxford University Press, Oxford.

KLEIN, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.

KLEIN, R.G. 1988. The archaeological significance of animal bones from Acheulean sites in southern Africa. The African Archaeological Review 6, 3-25.

MACEY, P.H., SIEGFRIED, H.P., MINNAAR, H., ALMOND, J. AND BOTHA, P.M.W. 2011. The geology of the Loeriesfontein Area. Explanation to 1: 250 000 Geology Sheet 3018 Loeriesfontein, 139 pp. Council for Geoscience, Pretoria.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa, 305 pp. The Geological Society of South Africa, Johannesburg.

MALHERBE, S.J., KEYSER, A.W., BOTHA, B.J.V., CORNELISSEN, A., SLABERT, M.J. & PRINSLOO, M.C. 1986. The Tertiary Koa River and the development of the Orange River drainage. Annals of the Geological Survey of South Africa 20, 13-23.

McCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

MOEN, H.F.G. 2007. The geology of the Upington area. Explanation to 1: 250 000 geology Sheet 2820 Upington, 160 pp. Council for Geoscience, Pretoria.

MOEN, H.F.G. & TOOGOOD, D.J. 2007. The geology of the Onseepkans area. Explanation to 1: 250 000 geology Sheet 2818, 101 pp. Council for Geoscience, Pretoria.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

PARTRIDGE, T.C., DOLLAR, E.S.J., MOOLMAN, J. & DOLLAR, L.H. 2010. The geomorphic provinces of South Africa, Lesotho and Swaziland: a physiographic subdivision for earth and environmental scientists. Transactions of the Royal Society of South Africa 65, 1-47.

PETHER, J. 2010. Proposed Pofadder Solar Thermal Plant, Portion 4 of the Farm Scuit-Klip 92, Kenhardt District, Northern Cape. Desktop study, 9 pp.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

THOMAS, M.J. 1981. The geology of the Kalahari in the Northern Cape Province (Areas 2620 and 2720). Unpublished MSc thesis, University of the Orange Free State, Bloemfontein, 138 pp.

THOMAS, D.S.G. & SHAW, P.A. 1991. The Kalahari environment, 284 pp. Cambridge University Press, Cambridge.

6. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest, Mpumalanga, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has previously served as a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

<table>
<tr><td colspan="3">CHANCE FOSSIL FINDS PROCEDURE: Paulputs PV Solar Farm and associated electrical infrastructure, Farm Konkoonsies 91</td></tr>
<tr><td>Province & region:</td><td colspan="2">Khaî-Ma Local Municipality , Northern Cape</td></tr>
<tr><td>Responsible Heritage Management Authority</td><td colspan="2">SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa.
Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Late Caenozoic alluvium along water courses</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Bones, teeth and horn cores of mammals, freshwater molluscs, petrified wood, calcretised termitaria and other trace fossils</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Management Authority and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Management Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Management Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Management Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Management Authority</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Management Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Management Authority minimum standards.</td></tr>
</table>

5.19. APPENDIX G: ARCHEOLOGICAL FINDS

Note that this table lists all finds recorded during the survey for the three PV facilities and access roads which are assessed in this report and also the powerline alternatives which are assessed in a separate report. This is purely to emphasise the skewed distribution of archaeological resources which are heavily biased towards rocky areas. The "project component" column in the table indicates which aspect is affected by each archaeological resource (PV1, PV2 & PV3 denote the PV facilities, AR denotes the access road and PL1, PL2, PL3 the powerline alternatives). Names have been allocated to those archaeological sites that are more than just isolated occurrences.

GPS	Project compo-nent	Site Name	Co-ordinates	Description	Significance (mitigation)
745	PV3	---	S28 55 33.2 E19 33 11.6	Two cans next to a tree. One was a large (possibly fuel) can that seemed to have been modified for reuse.	---
746	PV3	KK2018/001	S28 56 20.7 E19 33 31.5	A low granite outcrop with four ground patches on it.	Medium (12 hours)
747			S28 56 20.4 E19 33 32.2	Ephemeral artefact scatter with quartz, CCS and ostrich eggshell	
748			S28 56 20.6 E19 33 32.6	Granite outcrop with one ground patch. Also a place where animals have dug into the sand alongside another outcrop in search of water. This outcrop has two ground patches and possibly more under the sand. This place may have been open regularly when more wild animals were around, or even opened by people to facilitate rainwater collection.	
749			S28 56 21.0 E19 33 32.3	A small scatter of ostrich eggshell fragments.	
750			S28 56 20.8 E19 33 32.9	A low granite outcrop with four ground patches on it.	
751			S28 56 20.9 E19 33 33.1	A low granite outcrop with one ground patch on it.	
752			S28 56 21.0 E19 33 31.6	A light quartz artefact scatter in a deflating area with occasional other materials including a long hammerstone/core in fine-grained black rock	
753			S28 56 21.1 E19 33 32.0	A light quartz artefact scatter in a deflating area. Note that this whole site has a very ephemeral scatter over it but it is not always possible to tell what is recent and associated with the site and what is background scatter. A fragment of an upper grindstone was also seen between the GPS points.	

754	PV3	KK2018/002	S28 56 24.1 E19 33 46.0	A quartz outcrop with evidence of having been flaked.	Very low
755	PV3	KK2018/003	S28 56 26.2 E19 33 30.8	A low granite outcrop with four ground patches on it. Three are in a tight cluster and their edges partially overlap.	Very low
756	PV2 AR PL1 PL2 PL3	KK2018/004	S28 55 43.5 E19 32 10.0	A quartz outcrop with evidence of having been flaked. There are some quartz flakes in the gravel around the outcrop.	Very low
757	PV2 AR PL1 PL2 PL3	---	S28 55 09.3 E19 31 35.1	Very widespread but ephemeral scatter of 20th century rubbish. A piece of a small glass, a bottle neck with a screw top, several cans (ham, fuel and other food tin), some sections of piping(?) and some wire. Probably mid-20th century.	---
758	PV2 PL3	KK2018/005	S28 55 07.8 E19 32 24.4	A small stone structure located at the base of a small rocky hill on its northern side. It is 2 m by 4 m and the walls are 1 m high. A sheet of corrugated iron nearby suggests it may have been in use not too long ago. Also a small white glass cosmetic bottle nearby but no other artefacts.	Low-medium (outside study area)
759	PV2 PL3	KK2018/006	S28 55 08.7 E19 32 25.0	A light scatter of quartz artefacts located on the summit of the rocky hill.	Very low (outside study area)
760	PL2	KK2018/007	S28 54 06.8 E19 31 38.2	Quartz outcrop with evidence of flaking.	Very low
761	PL2 PL3	KK2018/008	S28 52 59.4 E19 33 03.6	Large quartz artefact scatter with much ostrich eggshell in front of a small rocky hill. In front of the scatter is a bedrock outcrop with at least 15 grinding patches on it. The scatter includes quartz, CCS, 'other', ostrich eggshell and a few pieces of bone.	Medium-high (Avoid)
762			S28 52 59.2 E19 33 03.2	Bedrock exposure with at least 15 ground patches.	
763	PL2 PL3	KK2018/009	S28 53 00.4 E19 33 04.3	A light quartz artefact and ostrich eggshell scatter.	Low
764	PL2 PL3	KK2018/010	S28 53 02.0 E19 33 05.0	Bedrock exposure with 3 ground patches.	Low
765	PL2 PL3	KK2018/011	S28 53 01.7 E19 33 07.1	Bedrock exposure with at least 15 ground patches. Also a light quartz artefact scatter around it.	Low
766	PL2 PL3	KK2018/012	S28 53 00.3 E19 33 09.0	A light quartz artefact scatter and 6 ground patches on a low shelf at the base of the rocky hill.	Low

767			S28 53 00.0 E19 33 08.1	Bedrock exposure with 1 ground patch.	Low
768			S28 53 00.0 E19 33 07.7	Bedrock exposure with 3 ground patches. Also a portable lower grindstone in the sand nearby (face up).	Low
769			S28 53 00.1 E19 33 07.3	Bedrock exposure with 2 ground patches. Also a light quartz artefact scatter in the area behind 768 and 769.	Low
770	PL2 PL3	KK2018/013	S28 53 03.0 E19 33 06.8	Bedrock exposure with 10 ground patches. There seems to have been an attempt to dam the water here at some point (a few bricks and stones lying across the low point behind the outcrop).	Low
771	PL2 PL3	---	S28 53 10.2 E19 33 02.8	Portable lower grindstone (face up) with ephemeral quartz artefact scatter nearby.	Low
772	PL2 PL3	KK2018/014	S28 53 10.8 E19 33 01.4	A light scatter of ostrich eggshell and quartz artefacts.	Low
773	PL2 PL3	KK2018/015	S28 53 12.9 E19 33 00.7	A light quartz artefact scatter.	Medium (4 hours)
774			S28 53 13.2 E19 33 01.6	A large quartz artefact scatter.	
775	PL2 PL3	---	S28 53 11.8 E19 33 04.3	Bedrock exposure with 1 ground patch and an ephemeral quartz artefact scatter.	Low
776	PL2 PL3	KK2018/016	S28 53 10.1 E19 33 10.8	Widespread quartz artefact scatter.	Low
777	PL2 PL3	KK2018/017	S28 53 02.4 E19 33 13.1	A light quartz artefact scatter on a shelf at the base of the rocky hill.	Low
778	PL2 PL3	KK2018/018	S28 53 01.9 E19 33 13.6	A huge and very dense quartz artefact scatter with occasional other materials also present.	Medium (8 hours)
779			S28 53 02.1 E19 33 15.0		
780			S28 53 00.9 E19 33 14.4		
781	PL2 PL3	KK2018/019	S28 53 00.7 E19 33 15.7	A light quartz artefact scatter	Low
782	PL2 PL3	KK2018/020	S28 53 01.4 E19 33 16.6	A very dense quartz artefact scatter.	Medium (4 hours)
783	PL2 PL3	KK2018/021	S28 53 02.1 E19 33 17.5	A very dense quartz artefact scatter.	Medium (4 hours)

784	PL2 PL3	KK2018/022	S28 53 02.1 E19 33 18.6	A very dense quartz artefact scatter.	Medium (4 hours)
785	PL2 PL3	KK2018/023	S28 53 01.8 E19 33 20.6	A dense quartz artefact scatter.	Medium (4 hours)
786	PL2 PL3	KK2018/024	S28 53 01.3 E19 33 21.1	A light quartz artefact scatter	Low
787	PL2 PL3	KK2018/025	S28 52 57.0 E19 33 21.1	An extensive but light scatter of quartz artefacts.	Low
788	PL2 PL3	KK2018/026	S28 52 57.3 E19 33 17.8	A dense quartz artefact scatter.	Medium (4 hours)
789	PL2 PL3	KK2018/027	S28 52 55.7 E19 33 17.9	A dense quartz artefact scatter.	Medium (8 hours)
790	PL2 PL3		S28 52 55.4 E19 33 18.9	A dense quartz artefact scatter.	
791	PL2 PL3	KK2018/028	S28 52 57.0 E19 33 16.2	A very dense quartz artefact scatter.	Medium (4 hours)
792			S28 52 57.6 E19 33 15.5		
793	PL2 PL3	KK2018/029	S28 52 58.3 E19 33 15.8	A dense quartz artefact scatter.	Medium (4 hours)
794	PL2 PL3	KK2018/030	S28 52 50.1 E19 33 09.6	A light quartz artefact scatter	Low
795	PL2 PL3	KK2018/031	S28 52 47.3 E19 33 12.8	An extensive but light scatter of quartz artefacts.	Low
796	PL2 PL3	---	S28 52 45.8 E19 33 12.7	Bedrock exposure with 4 ground patches.	Low
797	PL2 PL3	KK2018/032	S28 52 43.6 E19 33 13.5	A scatter of ostrich eggshell fragments. Some burnt pieces present.	Low
798	PL2 PL3	KK2018/033	S28 52 42.6 E19 33 17.0	A dense quartz artefact scatter.	Medium (4 hours)
799	PL2 PL3	KK2018/034	S28 52 44.4 E19 33 17.4	A large bedrock exposure at the foot of a rocky hill and with many grinding patches on it. In one place there is a very large ground area. There is a light quartz artefact scatter around the outcrop.	Low
800	PL2 PL3	KK2018/035	S28 52 49.3 E19 33 20.4	A small light scatter of quartz artefacts.	Low

801	PL1	KK2018/036	S28 53 22.9 E19 34 24.7	A quartz outcrop with evidence of flaking.	Low
802	PL1		S28 54 06.3 E19 34 13.8	A small, low bedrock outcrop with a light quartz artefact scatter and some pottery. Includes a horizontally pierced lug. Also some CCS. Excavated in 2016.	---
803	PL1	KK2018/037	S28 54 07.3 E19 34 13.7	A light quartz artefact scatter. Also one quartzite flake seen. Recorded as waypoint 664 in Orton (2015).	Low
804	PL1	---	S28 54 07.0 E19 34 13.9	Bedrock exposure with 1 ground patch.	Low
805	PL1	KK2018/038	S28 54 08.0 E19 34 12.8	An extensive light quartz artefact scatter. Also some 'other'.	Low-medium (4 hours)
806	PL1	KK2015/012	S28 54 09.5 E19 34 13.2	A low granite outcrop with a water hole in it and five ground patches. There is also a light quartz and CCS artefact scatter around the outcrop. Excavated in 2016.	---
807	PL1	---	S28 54 10.7 E19 34 14.7	A large quartz scatter which may be mostly background scatter with some LSA overprinted.	Low
808	PL1	KK2018/039	S28 55 08.0 E19 33 37.7	A quartz outcrop with evidence of flaking.	Low
809	PV2 AR PL1 PL2 PL3	KK2018/040	S28 55 39.2 E19 31 37.1	Quartz outcrop with evidence of flaking.	Very low
810	n/a	KK2018/041	S28 54 30.1 E19 29 50.0	Bedrock exposure with 10 ground patches.	High (outside study area)
811	n/a		S28 54 29.9 E19 29 49.3	A low stone alignment of unknown function.	
812	n/a		S28 54 29.8 E19 29 46.8	A bedrock outcrop with a water hole and many ground patches.	
813	n/a		S28 54 30.6 E19 29 47.9	A set of large grinding grooves on rock that is at about a 60 degree angle. They are all around the edge of a single section of bedrock with some leading down into where the pool would be if full.	
814	n/a		S28 54 31.9 E19 29 47.1	A deep water hole in a granite outcrop with stone artefacts around it and a few potsherds (all plain body sherds about 4 mm thick) and a piece of a cast iron potjie.	
815	n/a		S28 54 30.5 E19 29 45.7	An area with dense artefact and ostrich eggshell scatter.	

816	n/a		S28 54 29.9 E19 29 44.4	Bedrock exposure with 5 ground patches and surrounded by a dense artefacts scatter.	
817	n/a		S28 54 31.2 E19 29 44.6	An area with widespread dense artefact scatter.	
818	n/a		S28 54 32.1 E19 29 49.0	A stone cluster.	
819	n/a		S28 54 34.7 E19 29 49.8	A bedrock exposure with extensive grinding on it (large areas rather than discrete patches).	
820	n/a		S28 54 33.9 E19 29 47.8	An area with extensive dense artefact scatter. Also a hammer stone/upper grindstone here.	
821	n/a		S28 54 32.8 E19 29 47.9	An area with extensive dense artefact scatter.	
822	n/a		S28 54 32.6 E19 29 45.8	An area with extensive dense artefact scatter.	
823	n/a		S28 54 32.0 E19 29 46.3	A stone cluster.	
824	n/a	---	S28 54 35.2 E19 29 53.8	Bedrock exposure with 2 ground patches.	
825	n/a	KK2018/042	S28 54 43.0 E19 30 07.0	Bedrock exposure with 5 ground patches.	
826	n/a	KK2018/043	S28 54 42.4 E19 32 42.9	A quartz outcrop with evidence of flaking.	Low
827	n/a	Kk2018/044	S28 54 33.4 E19 32 40.3	A quartz outcrop with evidence of flaking.	Low
665	PL1	---	S28 54 06.0 E19 34 12.7	Bedrock exposure surrounded by wind-blown sand and with two ground patches on it. Recorded by (Orton 2015).	Very low
670	PL1	KK2015/014	S28 53 42.7 E19 34 27.6	A lower grindstone lying on a sand dune on the southern side of a small river bed 250 m outside the north-eastern edge of the layout area. There could be buried archaeological material present. Recorded by (Orton 2015).	Low

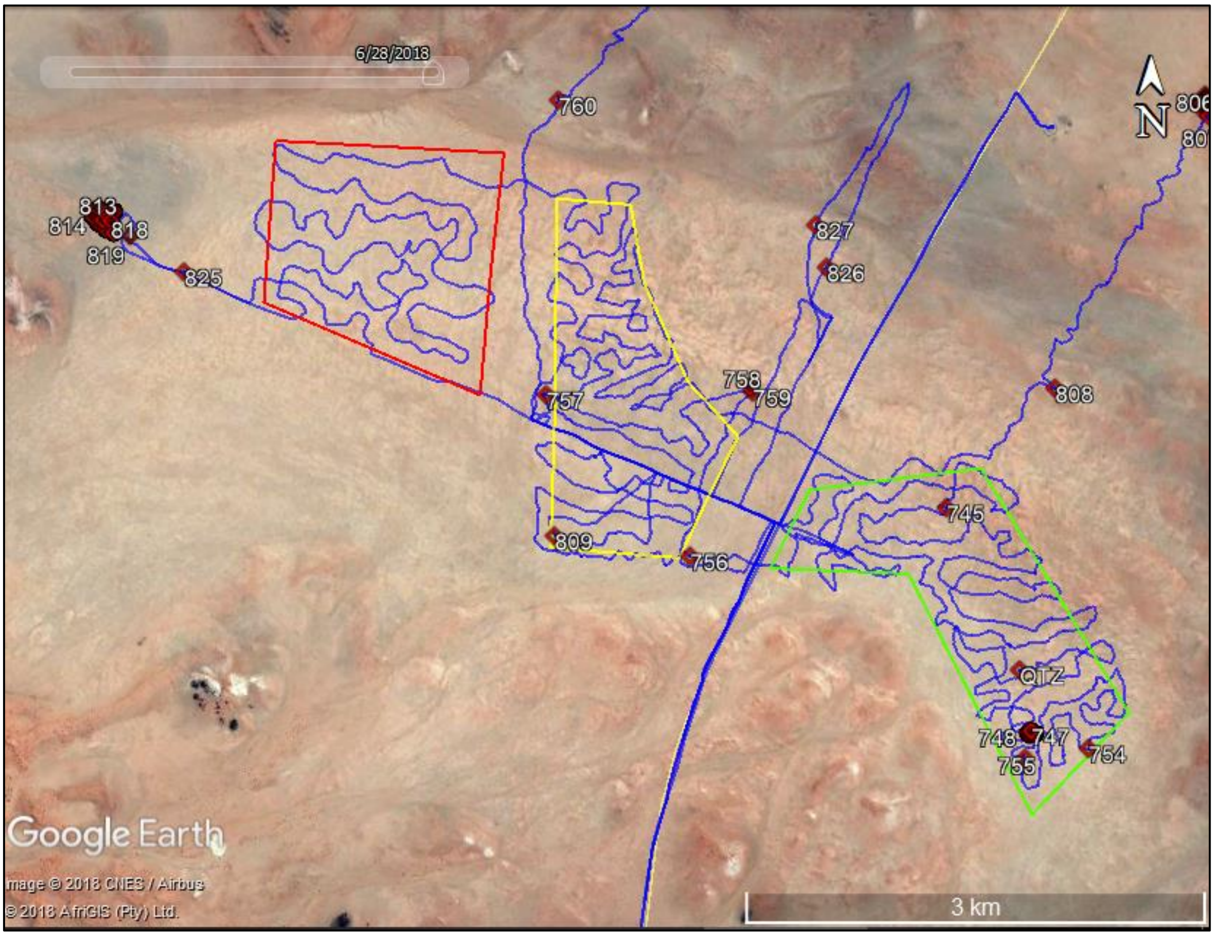


Figure A6.1: Overview of the study area showing all survey tracks (blue lines) and waypoints recorded during the survey (numbered red symbols). Phase 1 in red, Phase 2 in yellow, Phase 3 in green.

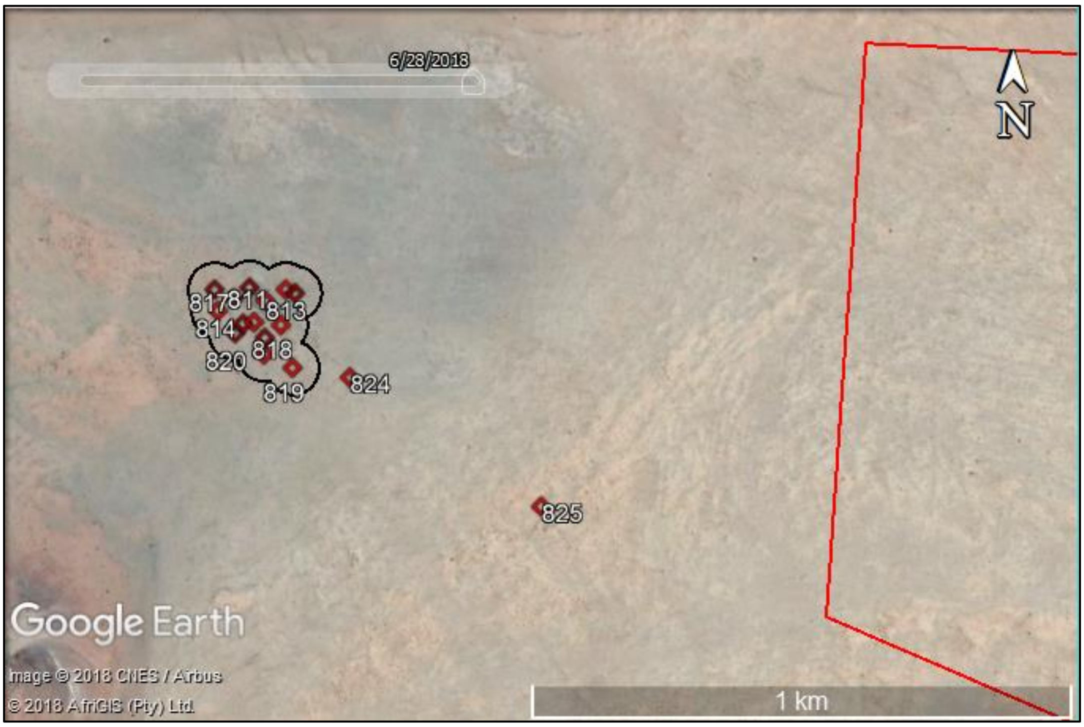


Figure A6.2: Aerial view of the western end of the Phase 1 study area showing a significant site well beyond its boundary.

Figure A6.3: Aerial view of the southern end of the Phase 3 study area showing the one significant site.

6. VISUAL SPECIALIST IMPACT ASSESSMENT REPORT

6.1. EXECUTIVE SUMMARY

The proposed Paulputs Solar Energy Facility (SEF) and connecting powerline are located in a remote and sparsely populated part of the Northern Cape, in an area that has attracted a number of other solar energy facilities. The proposed site does not fall within a gazetted Renewable Energy Development Zone (REDZ) but lies within the proposed Northern Corridor of the Electrical Grid Infrastructure. Pofadder is the nearest town, some 25 km away.

The study area consists of a gently undulating peneplain, interrupted by a number of rock outcrops, with red sand dunes to the south of the site. The proposed siting and layout of the SEF avoids any sensitive landscape features. The only potential receptors are a number of farmsteads in the area and users of the N14 National Route and the R358 Route. However, given the distance of the proposed SEF from the farmsteads and arterial routes, as well as the relatively low profile of the solar PV arrays, visibility of the SEF tends to be low.

Potential visual impacts can be expected during the construction phase of the project as a result of earthworks for access roads and laydown areas, as well as dust and noise from construction machinery and trucks. However, these impacts would be at the local site scale, except for trucks using district roads, and over the short term of the construction period. The visual significance of these impacts is expected to be moderate without mitigation, and moderate to low with mitigation for the 3 phases of the SEF and for the 3 connecting powerline alternatives.

The potential visual impacts during the operational phase of the project would include visual intrusion on the largely rural landscape and lights at night in an area of dark skies, affecting the area's sense of place. These would however be at the local area scale, but over the long term. A number of mitigations have been recommended that could help to minimize adverse visual impacts. The visual significance of the proposed SEF and powerline / switching station at the operational phase would be moderate without mitigation and moderate to low with mitigation for all 3 phases.
Potential visual significance at the decommissioning phase, assuming removal of above-ground structures and rehabilitation of the site, would be low. The fact that the SEF can be dismantled after decommissioning, and most visual impacts reversed, is a positive consideration.

The cumulative visual impacts considered existing and proposed solar energy projects within 30 km of the site, however main impacts were associated with the existing and proposed solar energy projects in the immediate vicinity (say within 10 km). The significance of these impacts is moderate to low, given the remoteness of the area, the limited zone of visual influence of solar energy facilities, and the fact that the projects form a relatively compact solar energy node. The cumulative visual impact of the connecting powerline / switching station for all 3 alternatives, in association with the 2 existing powerlines, is considered to be low. The probability of the visual impacts occurring is likely and the confidence high in all cases.

No fatal flaws are expected to occur as a result of the proposed SEF and powerline / switching stations. No amendments to the proposed layout are considered to be necessary from a visual perspective. Provided the recommended mitigations form part of the Environmental Management Programme (EMPr) and the authorisation conditions, the project should be approved from a visual perspective.

6.2. LIST OF ABBREVIATIONS

CSP	Concentrated Solar Power
DEA	Department of Environmental Affairs
DEM	Digital Elevation Model
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
O&M	Operations and Maintenance
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
SEA	Strategic Environmental Assessment
SRTM	Shuttle Radar Topography Mission
VIA	Visual Impact Assessment
SACAA	South African Civil Aviation Authority
SEF	Solar Energy Facility

6.3. INTRODUCTION

- **<u>Scope and Objectives</u>**

The Visual Impact Assessment (VIA) is one of several specialist studies being carried out as part of the Scoping and Environmental Impact Assessment (EIA) for the proposed Paulputs Solar Energy Facility (SEF) near Pofadder in the Northern Cape.

The VIA includes an assessment of potential visual impacts and risks associated with the proposed SEF and provides recommended mitigations to minimise potential visual impacts. These are used to inform the siting and layout of the project and for inclusion in the Environmental Impact Report (EIR). The recommended mitigations and Environmental Management Programme (EMPr) form part of the conditions for environmental authorisation.

The visual assessment of the powerline grid connection and switching station forms part of the Basic Assessment Report (BAR).

- **<u>Terms of Reference</u>**

The following form part of the Terms of Reference for the visual specialist study:

- A description of the regional and local landscape features;
- Identification and mapping of landscape features and visually sensitive receptors;
- Assessing (identifying and rating) potential visual impacts on the environment / receptors;
- Identification of relevant legislation and legal requirements;
- Formulation of possible mitigation measures and rehabilitation procedures /management guidelines; and

- Comment on any potential fatal flaws relating to visual aspects, along with recommendations regarding approval of the project.

- **Description of the Solar PV Project**

The proposed SEF project, which is located on two farm portions about 25 km north-east of Pofadder in the Northern Cape, is planned to consist of a 300 MWac facility. The facility would be developed in three phases of 100 MWac each covering about 200 hectares. These would consist of long arrays of solar photovoltaic (PV) panels reaching a height of about 5m at their maximum tilt (see Figure 1).
Associated infrastructure that have visual implications include a battery storage system covering about 1 ha, 8m in height, as well as an onsite substation complex of 2 ha with transformers reaching up to 30m in height and a telecommunications tower of 50m height for each of the 3 phases.
An operations and maintenance (O&M) complex adjacent to the collector substation, would also cover about 1 ha, and would consist of a laydown area, offices, workshops, ablutions, parking and storage areas. Water storage tanks would be required to serve these facilities.
Perimeter fencing about 3m high, and internal security fencing would be required, along with an access control gate and guard house on the access road. Security and area lighting would also be required.

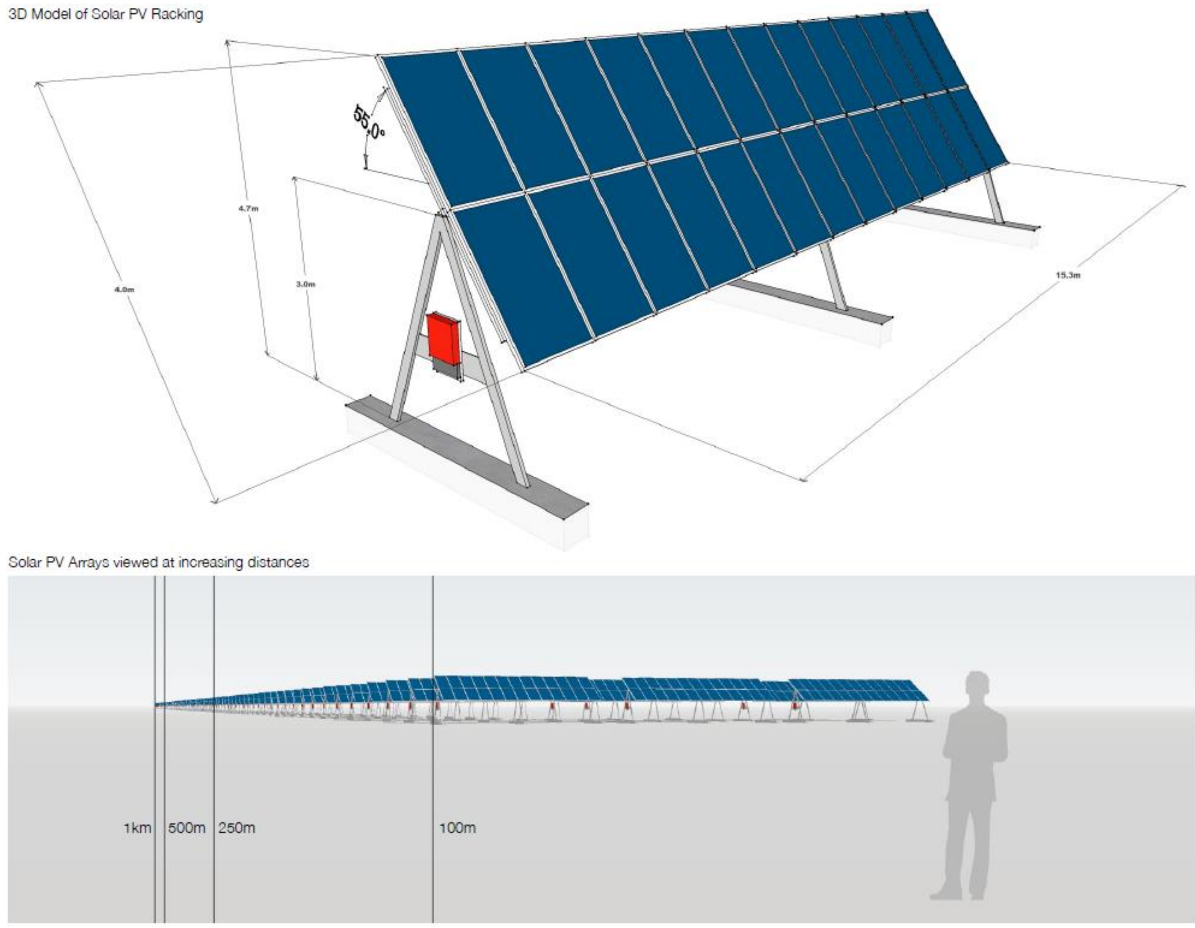


Figure 1 · 3D Models : Solar PV Arrays

During the construction phase a temporary construction yard, batching plant, temporary offices and laydown area would be located on the site. The batching plant can be dis-assembled and moved to each of the construction sites.

It is envisaged that the SEF will connect to the Eskom Paulputs Substation via a 132 kV powerline over a distance of approximately 10 km. The proposed powerline will form part of a separate basic assessment.
A list of components for the proposed SEF, that have a potential visual impact, is given in Table 1 below. A general layout of the project is indicated on Map 3.

Table 1: Description of each proposed 100MWac Solar Energy Facility at the Paulputs Site

Facility	Extent/Footprint	Height	Comments
PAULPUTS PV FACILITY			
SEF project area including PV arrays, inverters and mini-substations	± 200 ha	n/a	5m top of panels
Battery storage system	1 ha	8m	Stacked containers or multi-storey structure and operational, safety and control infrastructure.
Main access road	Access to site from N14 via R358 (southern access) approximately 28 km, of which 11 km on R358 and balance on OG73. Access to site from N14 via MR759 (northern access) approximately 31 km, of which 22 km on MR759 and balance on OG73.	n/a	maximum width of 13,5 m, including stormwater channels or drainage structures
Internal service roads	Gravel service roads linking the access road and various project components and servicing the solar panel arrays. Roads fitted with traffic control systems and stormwater controls as required.	n/a	maximum width of 6m.
Onsite substation complex	2 ha	30 m	22kV or 33 kV /132 kV capacity. Location to be determined.
Telecommunication tower	n/a	50m	Monopole type in the substation area.

Operations and main-tenance structures	1 ha Workshop/office buildings, maintenance, waste collection, storage facilities.	8m	Located adjacent to substation.
Water storage tanks	Located next to the O&M buildings	n/a	Jojo-type tanks or lined ponds.
Security fencing	Perimeter and internal security fencing.	± 3 m	Access control gate and guard house on access road.
Security Lighting	To be confirmed.	To be confirmed.	Including substation and O&M buildings.
Temporary lay down area, construction yard and concrete batching plant for each phase.	± 4 ha. Temporary site camp, laydown areas incl. access road, site offices.	Single storey structures	Temporary gravel hard standing and prefab structures.
PAULPUTS EGI			
132 kV overhead powerline	± 10 km	30m	3 alternative routes
Switching station	within onsite substation complex	30m	within onsite substation complex

6.4. APPROACH AND METHODOLOGY

- **<u>Approach and Methodology</u>**

The methodology involves a number of standard procedures including those in the Guideline for Involving Visual and Aesthetic Specialists (Oberholzer, B. 2015). The methodology includes the following steps:

Baseline Study
This involves the identification of existing scenic resources and sensitive receptors in and around the study area. The context of the proposed development within its surroundings, as well as the intactness of the landscape and sense of place are further considerations. Typical layers include topographic and geological features, vegetation cover and existing land use activities that define the essential characteristics of the study area.
Other base information involves the siting, footprint and height of the proposed solar PV facilities. This includes related infrastructure that has visual implications, such as connecting powerlines, access roads, fencing and lighting at night.

Determining the Zone of Visual Influence
This includes mapping of viewsheds and view corridors in relation to the proposed facilities, as well as important viewpoints, in order to assess the zone of visual influence of the proposed project. Some areas may be in a view shadow from which the proposed project would not be visible. Distance radii are used to give an idea of levels of visibility to surrounding receptors.

Identifying Visual Issues
Visual issues are identified during the public participation process, which is being carried out by others. Visual issues may also be identified by the visual, social or heritage specialists. The significance and proposed mitigation of the visual issues are addressed as part of the visual assessment.

Reviewing the Legal Framework
The legal, policy and planning framework may have implications for visual aspects of the proposed development. Heritage legislation relates to both natural and cultural landscapes, while Strategic Environmental Assessments (SEAs) for renewable energy provide a guideline at the regional scale.

Assessing Potential Visual Impacts
An assessment is made of the significance of potential visual impacts resulting from the proposed project for the construction, operational and decommissioning phases of the project. The rating of visual significance is based on a number of quantitative criteria, such as visibility, as well as qualitative criteria, such as the effect on landscape integrity. Cumulative visual impacts of the combined project phases along with other existing and approved renewable energy projects, powerlines and infrastructure in the area.

Formulating Mitigation Measures
Possible mitigation measures are identified to avoid or minimise negative visual impacts of the proposed project. The intention is that these would be included in the project design, the Environmental Management programme (EMPr) and the authorisation conditions.

- **<u>Assumptions and Limitations</u>**

Some assumptions have to be made at the planning stage regarding the nature of the proposed substation and O&M buildings, as well as lighting and fencing relating to the proposed project, as indicated in Table 1, as architectural details of these will only become available at a later stage.

- **<u>Sources of Information</u>**

The main sources of information for the visual baseline study included the following:

- Chief Directorate : National Geospatial Information 1:50000 Topographic and 1:250000 Topo-Cadastral series
- Council for Geoscience : 1:2 000 000 Geological Map of South Africa, 2008.
- Shuttle Radar Topography Mission (SRTM) 3 arcSEC 90m DEM Data 2012
- Google Earth Satellite Imagery 2018
- Google Maps and Open Street Map (OSM) Data 2018
- DEA : Renewable Energy EIA Application Database (REEA) Official Release 2018 Quarter 1
- SANBI : National Freshwater Ecosystem Priority Areas (NFEPA) River and Wetland Datasets 2017
- SAHRA : National Heritage Sites Inventory Database 2017
- Various GIS Datasets provided by the proponent.

- **<u>Site Investigation</u>**

A visit to the Paulputs project site and surroundings was carried out by members of the Team on 14-17 May 2018. The season was not a consideration, nor had any effect on carrying out a visual assessment. Photographs were taken from several viewpoints.

6.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

Relevant landscape features of the receiving environment are described below, and the general character of the study area is illustrated in Figure 2.

Location and Context (Map 1)
The project site is located in the Khâi-Ma Local Municipality, Namakwa District Municipality, in the Northern Cape. The nearest settlement is Pofadder, about 25 km north-west of the proposed site. Access to the study area is via the N14 National Route, which links Springbok in the west with Upington on the Orange River to the north-east. Access to the site is via the R358 Route and gravel district roads.

The Orange River, which lies about 20 km to the north-west of the site, forms the boundary with Namibia. The Augrabies Falls National Park lies adjacent to the Orange river, about 75 km to the north-east. A vast semi-arid plain, known as Bushmanland, lies to the south. The implication of this is that the site is located in a remote part of the country, generally far from major settlements.

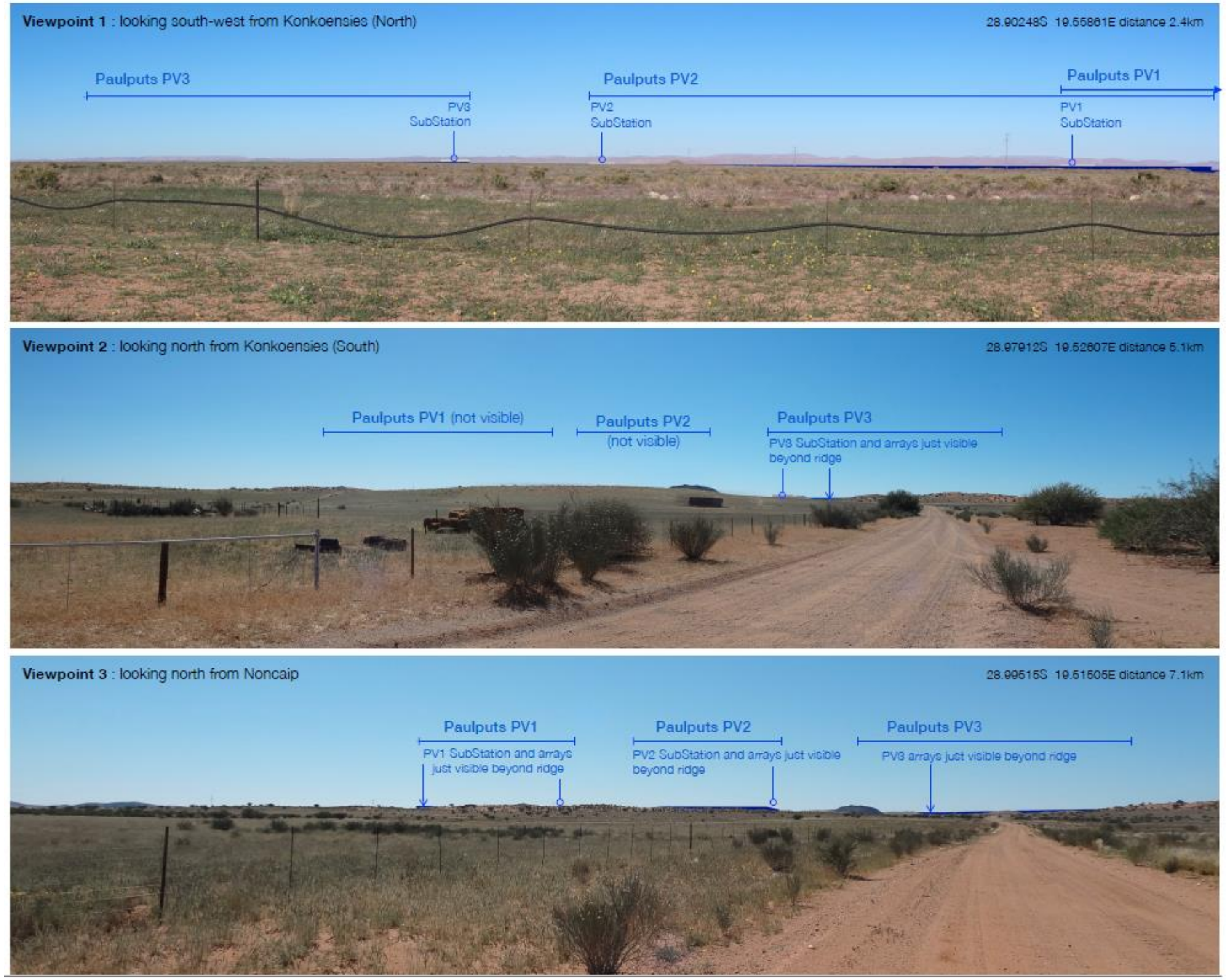
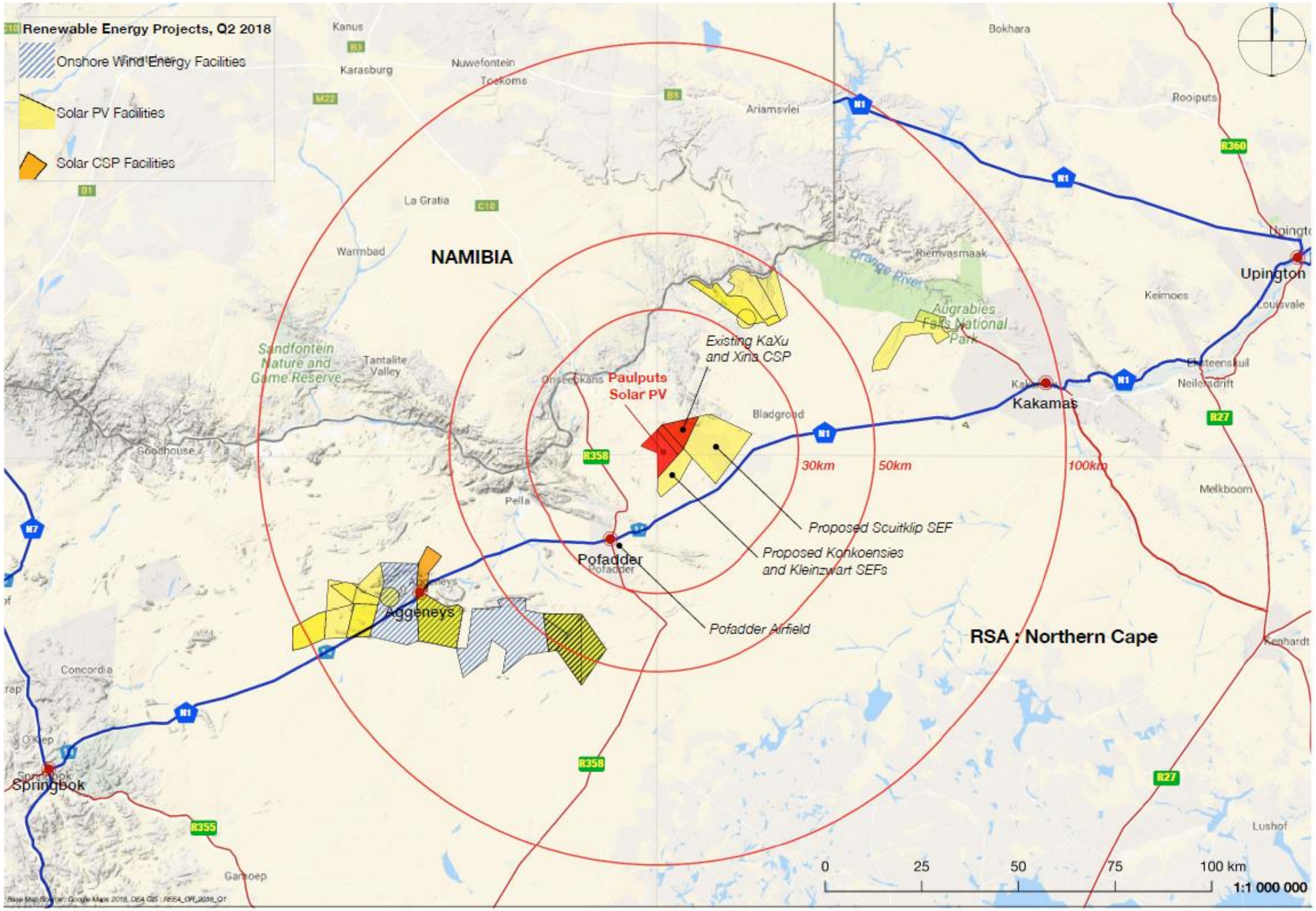


Figure 2 • Viewpoint Photomontages



Map 1 • Paulputs SEF Locality indicating Cumulative REEA projects

Geology and Physical Landscape (Maps 2 and 4)

The general area is characterised by the wide open spaces of the vast Bushmanland pene-plain, punctured by occasional inselberg-type mountains, being gneissic terrain of the Namaqualand Metamorphic Province .

The project site is located on a flattish plain consisting of Quaternary sand, gravel, alluvium and calcrete. The elevation of the site ranges from about 800 to 850m, the land draining towards the west in the direction of the Orange River, 24 km away. A landscape feature is the series of reddish dunes to the south of the site.

Rock outcrops and low mountains to the north and north-east of the site reach 1039m in elevation at Skuitklipkop, and consist of gneiss and granodiorite, intruded by dark-coloured dolerite, in places . There are no special topographical or geological features on the proposed development site itself.

Vegetation

The vegetation type of the plain is classified as Bushmanland Arid Grassland (NKb 3) and Bushmanland Sandy grassland (NKb 4) being part of the Nama-Karoo Biome, and consisting of sparsely vegetated grassland with low shrubs in places. This varies further south to dense sandy grassland with drought-resistant shrubs. After rains, rich displays of annuals can occur . More detailed information on vegetation is provided in the biodiversity specialist study.

The flattish plain and sparse vegetation mean that any structures in the landscape will be visible over a long distance. Furthermore, revegetation of disturbed areas resulting from construction activities will be slow in the arid conditions.

Land Use and Cultural Landscape

The site has been largely untransformed, as the low rainfall limits agricultural activities. Where grazing occurs, these tend to be dorper sheep. Farms tend to be large and farmsteads far apart in the semi-arid landscape. There are no known nature reserves or guest farms in the area surrounding the proposed SEF, the Augrabies Falls National Park being about 75 km away.

According to the Agricultural Impact Assessment, the study area has a low to very low capability and is only suitable for low density grazing.

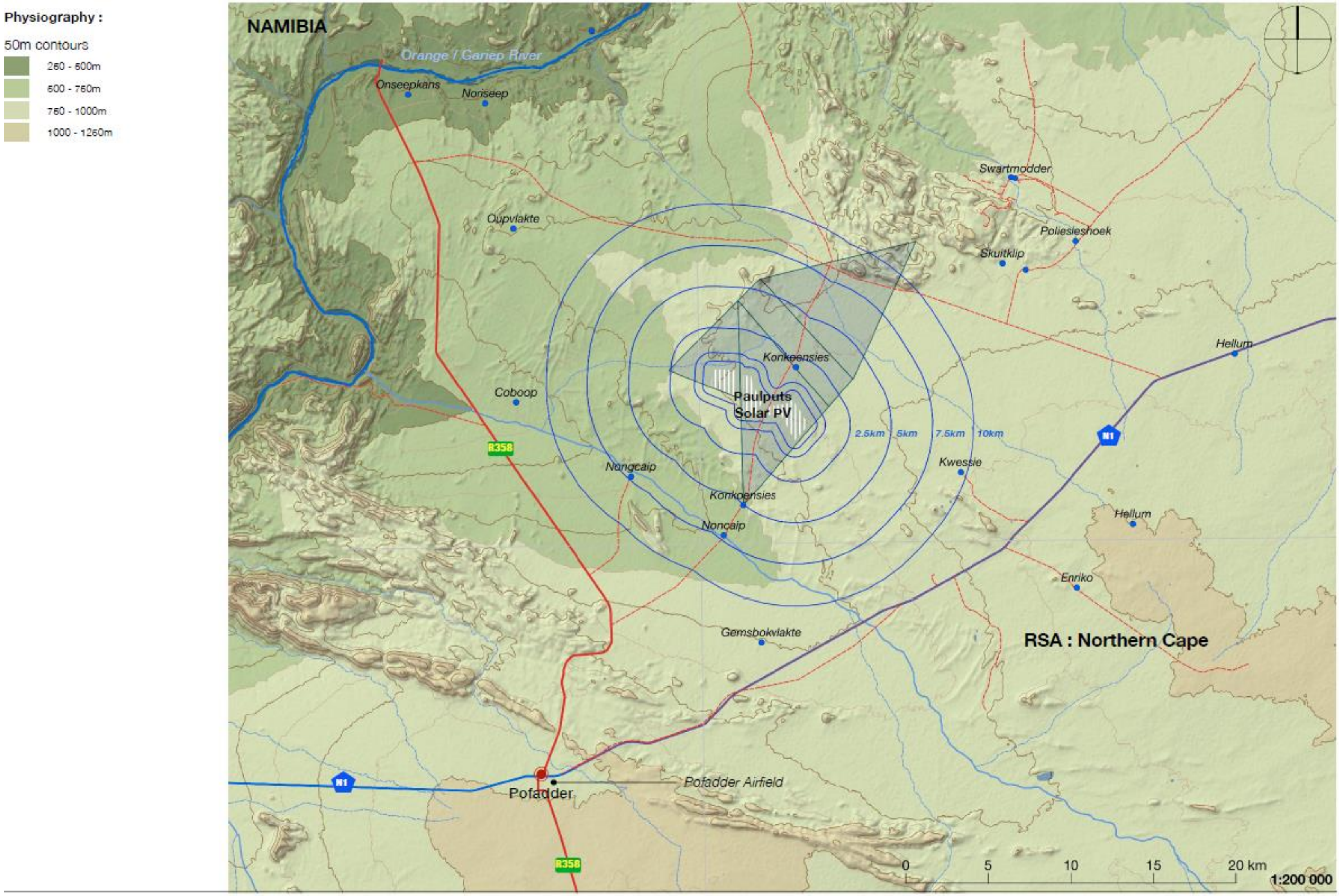
According to the Heritage Impact Assessment, the cultural landscape is considered to have low cultural significance in terms of aesthetic and historical value.

Some mining has taken place in the region and recent solar projects have been developed in the proximity of the site to the north-east, (see Maps 1 and 3). Two existing powerlines cross the study area.

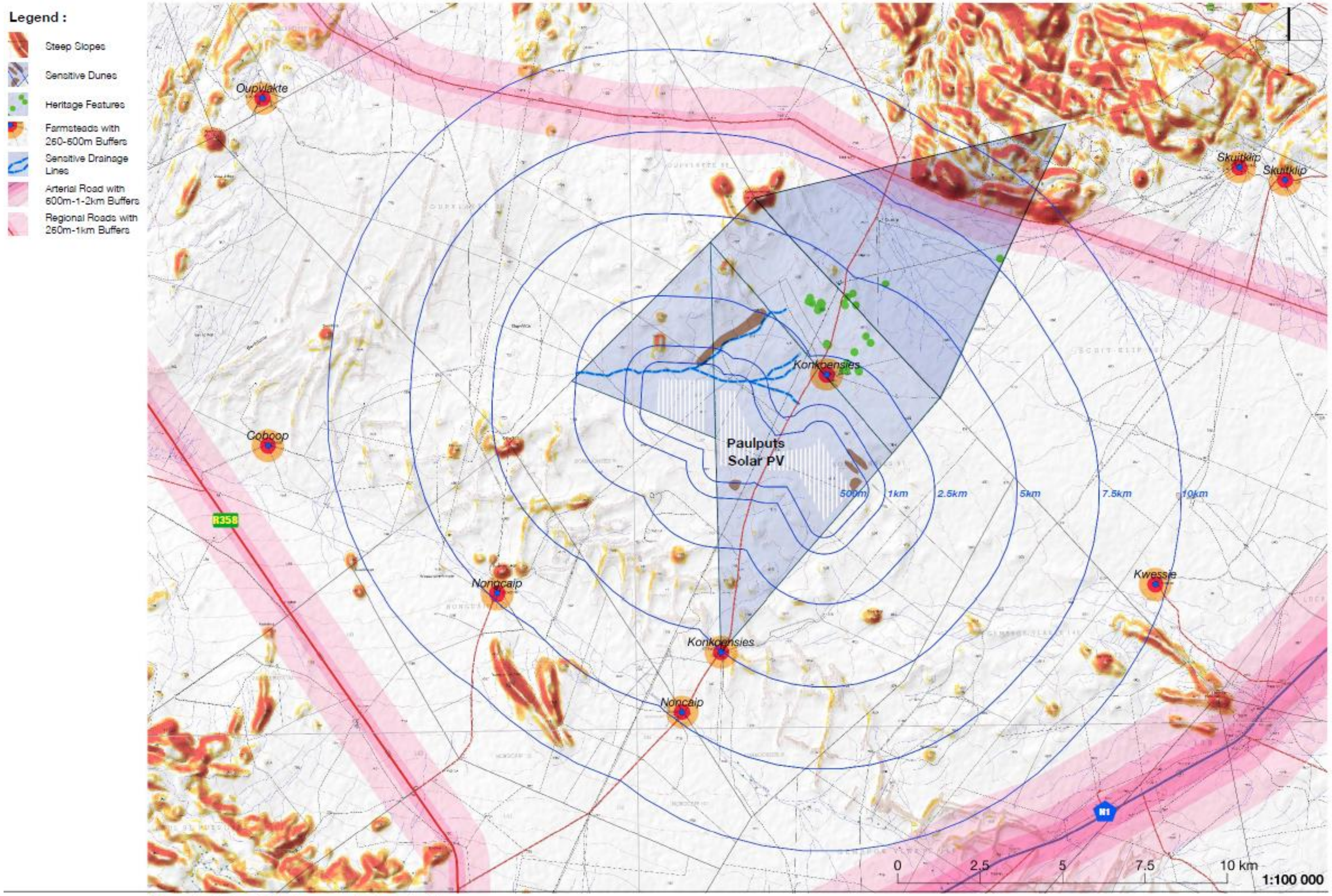
Visual Features and Constraints (Map 4)

The main visual features of the area, such as steep slopes, dunes, rock outcrops, drainage courses and farmsteads, as well as the visual buffers for these, are outside the development site and not affected by the proposed SEF project. The site therefore has few or no significant visual constraints.

The Pofadder airstrip is located about 25,3 km from the proposed Paulputs SEF site, and therefore would not be affected by the proposed project. The nearest commercial airport is at Springbok, 175km to the west and therefore not affected.



Map 2 · Local Context and Physiography



Map 4 · Visual Features and Constraints

6.6. APPLICABLE LEGISLATION 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 solar energy facility is a listed activity requiring a Scoping study and EIA. 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 archaeological and paleontological sites within the study area. This report deals with visual considerations, including scenic resources, which form part of the National Estate. Archaeological, paleontological and historical sites are covered by the heritage specialist.

Other than the above legislation, there are no specific policies or guidelines for visual and scenic resources for the 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.

The site does not fall within a gazetted Renewable Energy Development Zone (REDZ) but does lie within the Electricity Grid Infrastructure Northern Corridor. The Strategic Environmental Assessments (SEAs) for these were used as background information.

The South African Civil Aviation Authority (SACAA) has an Obstacle Notice 4/2017 requiring solar project applications to be accompanied by a Glint and Glare Impact Assessment Report with relevance to aviation. None was required for the proposed project (see Section 6.7 below).

6.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS

- **Key Issues Identified During the Scoping Phase**

The potential visual issues identified by the specialists during the scoping phase of this EIA process include the following:

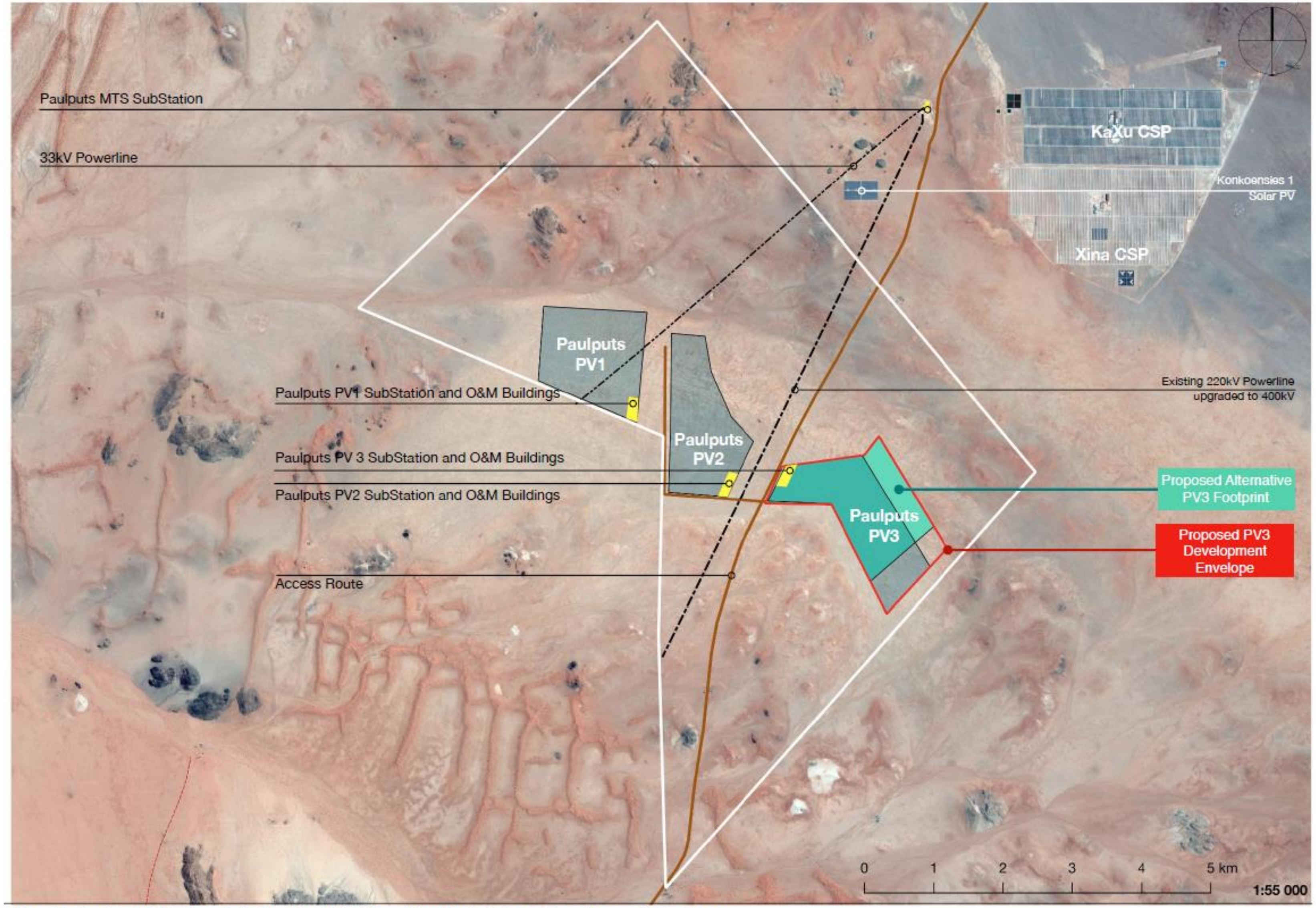
  - Potential visual scarring caused by earthworks for access roads and construction laydown areas;
  - Potential visual effect of solar PV arrays, substation and related infrastructure on the open landscape;
  - Dust and noise during construction from heavy machinery and truck traffic.

- **Key Issues Identified During the other specialist studies**

Other issues have been identified in the Socio-economic Impact Assessment, some of the potential impacts being positive.15 Additional issues may be added during the public participation process.

An archaeological site was identified within the PV3 preferred layout, including a series of low granite bedrock outcrops with several ground patches and a light artefact scatter located in a deflated area (site KK2018/001). In order to prevent impacts to this site, a development envelope was created for the PV3 project which includes an alternative layout for the PV3 project. The development envelope includes sufficient area to develop the PV field and associated infrastructure and avoid the site KK2018/001. The development envelope is illustrated in Map 7.

[15] Van Zyl, H. and Kinghorn, J. 2018. Socio-Economic Impact Assessment Report: Proposed Development of the 300 MW Paulputs Solar PV Energy Facility near Pofadder, Northern Cape.



Map 7 • Paulputs SEF layout, indicating PV3 Alternative Footprint and Development Envelope

The consideration of a development envelope for the PV3 project and alternative layout does not present additional impacts or issues in terms of visual aspects and does not influence the impact assessment conducted during the visual assessment. In terms of visual impacts, no amendments to the proposed layout are considered to be necessary from a visual perspective, provided the recommended mitigations form part of the Environmental Management Programme (EMPr) and the authorisation conditions.

- **Overview of key Environmental Management Actions and limits of acceptable changes to the Environment due to the proposed development**

There are no particular thresholds or regulations pertaining to visual or scenic resources in South Africa at present. Visual assessments generally form part of heritage assessments, mainly because of the prevailing heritage legislation. As part of this legislation, scenic resources can be considered as a component of the 'national estate' and therefore afforded some protection.

In the absence of specific regulations regarding visual and scenic resources, the guidelines developed by the authors in relation to visual buffers for the Wind and Solar SEA, have been used in the current visual assessment for the proposed SEF, (see Table 2 below and Map 4).

Table 2: Recommended buffers for Solar PV Facilities

Landscape features/criteria	Visual Guidelines (2015)	Comments relating to proposed Paulputs SEF
Project area boundary	-	Farm boundary setback usually 30m.
Ephemeral streams/ tributaries	-	Subject to freshwater assessment. 32 m buffers indicated in the interim.
Steep slopes (gradient)	>1:4 (v. high) 1:4 -1:10 (high)	None on the development sites.
Prominent ridgelines, peaks and rock outcrops	250 m (v. high)	None on the development sites.
Arterial / district gravel roads	0-250m (v. high) 250m-1 km (moderate)	District roads and their buffers are some distance from the development sites.
Scenic routes, passes	0-500m (v. high)	None in the immediate area.
Protected Areas	0-1,5 km (v. high) 1,5-2 km (high) 2-3 km (moderate)	None in the immediate area.
Private reserves/ game farms/ guest farms.	0-1 km (v. high) 1-2 km (high) 2-3 km (moderate)	None in the immediate area.
Farmsteads	0-250m (high) 250-500m (moderate)	Surrounding farmsteads and their buffers are some distance from the development sites.

- **<u>Criteria for Determining Visual Impact Intensity (Table 4)</u>**

Visibility **(Table 3 and Map 5):**
The proposed solar PV facility could potentially be visible from a number of farmsteads in the area, most of which are some distance away. Estimated degrees of visibility are indicated below:

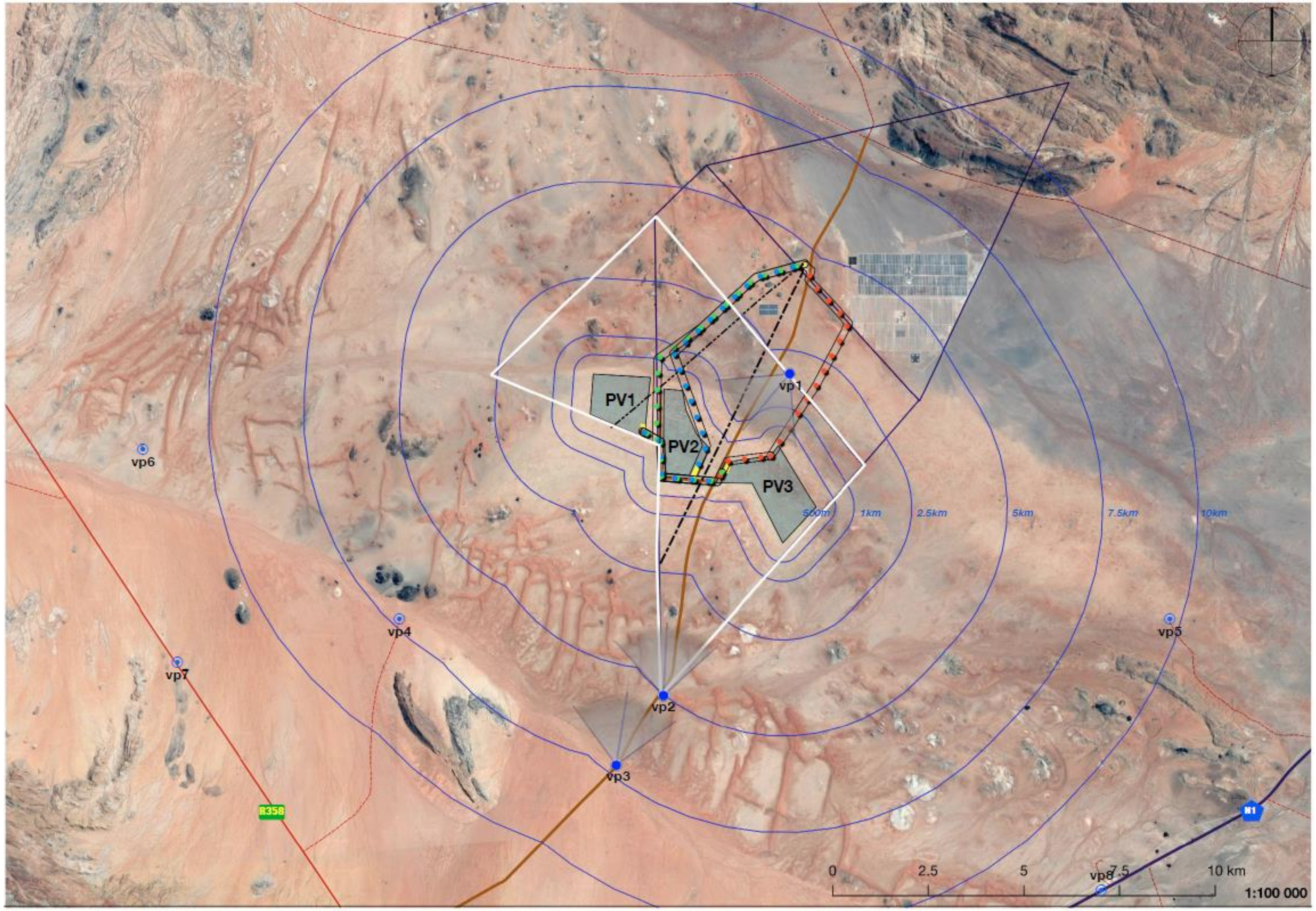
- High visibility: Prominent feature within the observer's viewframe 0-500mm
- Mod-high visibility: Relatively prominent within observer's viewframe 500m-1 km
- Moderate visibility: Only prominent with clear visibility as part of the wider landscape 1-2 km
- Marginal visibility: Seen in very clear visibility as a minor element in the landscape 2-4 km

Because of the relatively low height of the solar PV arrays, the proposed development would not be significantly visible beyond about 2 km. Some of the related infrastructure is higher than the PV arrays but has a relatively small footprint. Possible degrees of visibility from a number of viewpoints are indicated in Table 3 below. (See also photomontages in Figure 2), **(Low)**.

Visibility of lights at night would similarly not be significant. **(Low).** Visibility of the proposed powerline connection alternatives would not be significant, **(Low).**

Table 3: Viewpoints and Potential Visibility of Solar PV Energy Facility (SEF)

View - point	Location	Coordinates	Distance to SEF	Visibility of SEF
VP1	Konkoonsies II (North) access road	28.90248S 19.55861E	2.4km	Marginally visible
VP2	District Road at Konkoonsies (South)	28.97912S 19.52607E	5.1km	Hardly visible beyond low ridges
VP3	District Road at Noncaip	28.99515S 19.51505E	7.1km	Practically not visible beyond low ridges
VP4	Noncaip Farmstead	28.96249S 19.45701E	7.3km	Practically not visible beyond low ridges
VP5	Kwessie Farmstead	28.96224S 19.66194E	9.8km	Not visible because of distance
VP6	Coboop Farmstead	28.92124S 19.38624E	11.8km	Not visible because of distance
VP7	R358 Route	28.97884S 19.40159E	12.6km	Not visible because of distance
VP8	N14 National Route	29.02654S 19.64195E	12.3km	Not visible because of distance



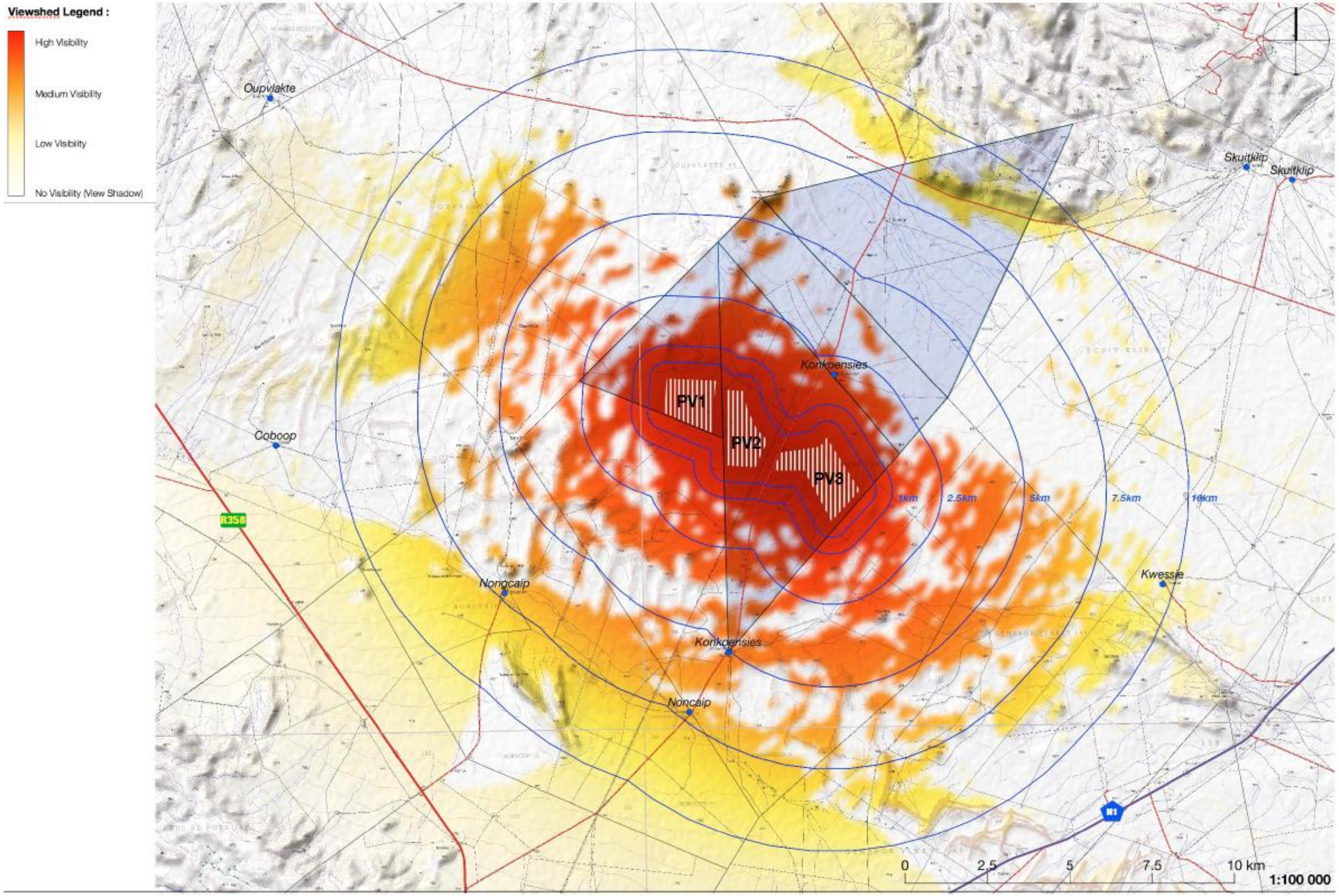
Map 5 • Viewpoints and Distance Radii

Visual Exposure: **(Map 6)**
The viewshed, or zone of visual influence, potentially extends for some distance to the south-west, but is more restricted to the north-east by the broken topography. Parts of the area are in a view shadow, created by the topography, including the effect of the dunes. The zone of visual influence of the proposed SEF and powerline would therefore be fairly limited, **(Medium)**.

Scenic Resources / sensitive receptors: **(Map 4)**
There are few topographic or scenic features along the proposed powerline route alternatives, and none within the development sites. The general area is sparsely populated, the farmsteads being far apart, and mostly some distance from the SEF. Visual sensitivity is therefore not considered significant, **(Low)**.

Landscape Integrity:
The surrounding area is renowned for its expansiveness and wilderness quality. However, the intactness of the area has been altered to some extent by other existing solar energy facilities and powerlines. In addition, the clustering of the existing and proposed solar facilities would help to minimise visual intrusion in the larger landscape, **(Medium)**.

Visual Absorption Capacity**: (Figure 2)**
The area around the project site is generally flat to gently undulating, with low grass and scrub vegetation and therefore visually exposed, with a moderate visual absorption capacity, i.e. medium potential to screen any proposed structures, given the low profile of the proposed PV arrays, **(Medium)**.



Map 6 • Viewshed : 6m high Solar PV racks

The above visual criteria are summarised in Table 4 below in order to determine visual intensity (severity) for the proposed SEF, related infrastructure and powerline grid connection.

Table 4: Visual Impact Intensity (severity)

Visual Criteria	**Comments**	**Solar PV arrays**	**Related Infra-structure**	**Powerline/ switching station**
Visibility of facilities	Marginally to hardly visible.	Low	Low	Low
Visibility of lights at night	Security lighting at substation and O&M buildings.	Low	Medium	Low
Visual exposure	Viewshed extends mainly to south-west and restricted elsewhere by undulating topography or dunes.	Medium	Medium	Medium
Scenic resources and receptors (sensitivity)	Few scenic features and sensitive receptors, mainly isolated farmsteads. Distance is a mitigating factor.	Low	Low	Low
Landscape integrity	wilderness / rural character, with previous disturbance by solar energy facilities and powerlines.	Medium	Medium	Medium
Visual absorption capacity	Visually exposed plain, partly undulating. Low scrub vegetation, low visual absorption capacity.	Medium	Medium	Medium
Impact intensity	**Summary**	**Low-medium**	**Low-medium**	**Low-medium**

- **<u>Potential Visual Impact of the proposed Solar Facilities and Powerline Grid</u>**

Using the impact assessment criteria provided by the Environmental Assessment Practitioner (EAP), the various types and degree of visual impact, as well as overall significance without and with mitigation, are indicated in Tables 5 and 6 below.

Given the relatively uniform site conditions across all 3 phases of the SEF, and the similar compact nature of the layouts, it was considered rational to use the same tables for all 3 phases, i.e. their potential visual impacts were likely to be the same.

In addition, the relatively short distance of the proposed powerline connection across the site, and the fact that the proposed switching station would be adjacent to the collector substations of the SEF meant that the potential visual impacts, and their relative significance, would be very similar to those of the proposed SEF, as indicated in Tables 4, 5 and 6.

The difference between the 3 powerline alternatives was also considered to be marginal. Therefore, the same summary tables have been used for the SEF and the powerlines / switching station. (See also Tables 7, 8 and 9).

As the Pofadder airstrip is some 25,3 km from the project site, no Glint and Glare Impact Assessment, in terms of Obstacle Notice 4/2017, was considered necessary, given that small aircraft taking off and landing would not be affected. This was confirmed by the Obstacle Inspector of the SACAA[16].

[16] Email from Lizell Stroh, Obstacle Inspector, PANS-OPS Section, Air Navigation Services Department, 09 October 2018.

The distance of the proposed solar facilities from Pofadder, (the nearest residential area) would be 25 km, and from Aggeneys 77 km. The distance from the SKA would be about 175 km, which means that there would be no visual effect on any of the aforementioned.

Table 5: Type of Potential Visual Impacts

Type of Impact	Description
Direct impact	***Construction Phase: medium-low intensity*** *(see Table 4)* Potential dust and noise caused by heavy construction vehicles and cranes. Potential visual detraction resulting from construction yard, material stockpiles and litter. Potential visual scarring caused by earthworks for access roads, laydown areas, and borrow-pits. ***Operation Phase: medium-low intensity*** *(see Table 4)* Potential visual intrusion caused by solar PV arrays in the predominantly rural landscape. Potential visual clutter caused by substation and operations/maintenance structures and overhead powerlines/switching station. Potential visual intrusion of lights at the solar facility on the traditionally dark skies of the area at night. ***Decommissioning Phase: low intensity*** Assumes removal of above-ground structures after decommissioning in the long term. Potential visual effect of remaining roads, platforms and concrete slabs on the landscape after decommissioning of the SEF.
Indirect impact	Loss of natural attributes of the area, including sense of expansiveness and remoteness. Remoteness is also a benefit in that it affects few sensitive receptors. Therefore **medium-low** intensity given the local scale of the project.
Cumulative impact	Increased visual intrusion and general change in character of the area from a rural or wilderness type landscape to a more industrialised landscape when seen together with other renewable energy projects and powerlines in the vicinity. Potentially **medium-low** intensity, given the clustering of the existing and proposed solar projects, forming a renewable energy node.

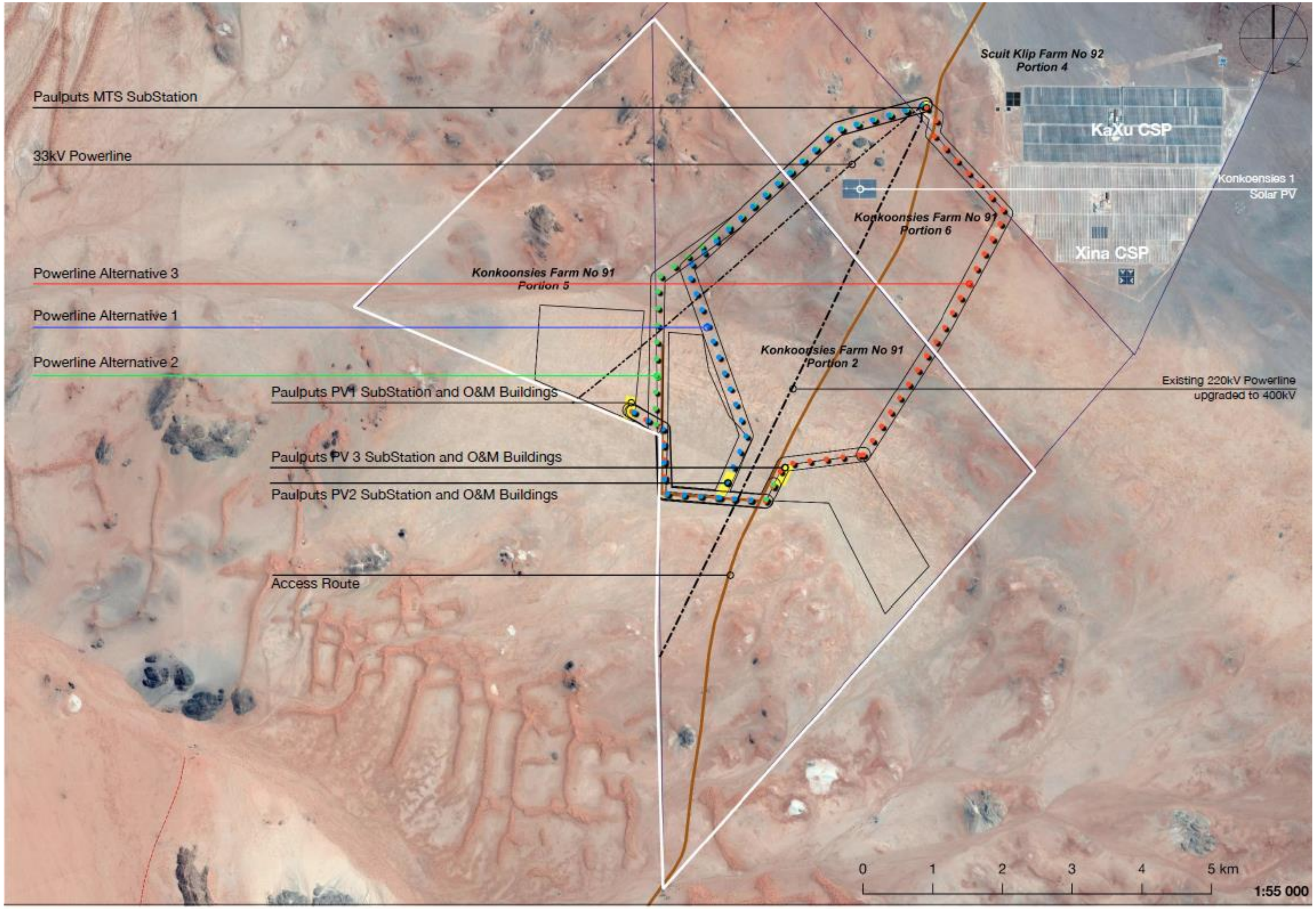
Table 6: Degree of Potential Visual Impacts

Criteria	Description
Nature of impact	Construction Phase: **Negative**, owing to visual effect of construction activities and increased truck traffic. Operation Phase: **Negative**, owing to visual intrusion of solar PV facilities, related infrastructure and overhead powerlines. Offset to some extent by perception of clean renewable energy. Decommissioning Phase: **Neutral**, owing to reversibility of visual impacts after decommissioning.
Spatial extent	Construction Phase: Predominantly **site scale**, with some impact (Construction traffic) on the surroundings at the local scale. Operation Phase: **Local scale** with little or no visual effect beyond about 4km. Decommissioning Phase: **Site scale** after rehabilitation of the site after decommissioning.
Duration	Construction Phase:

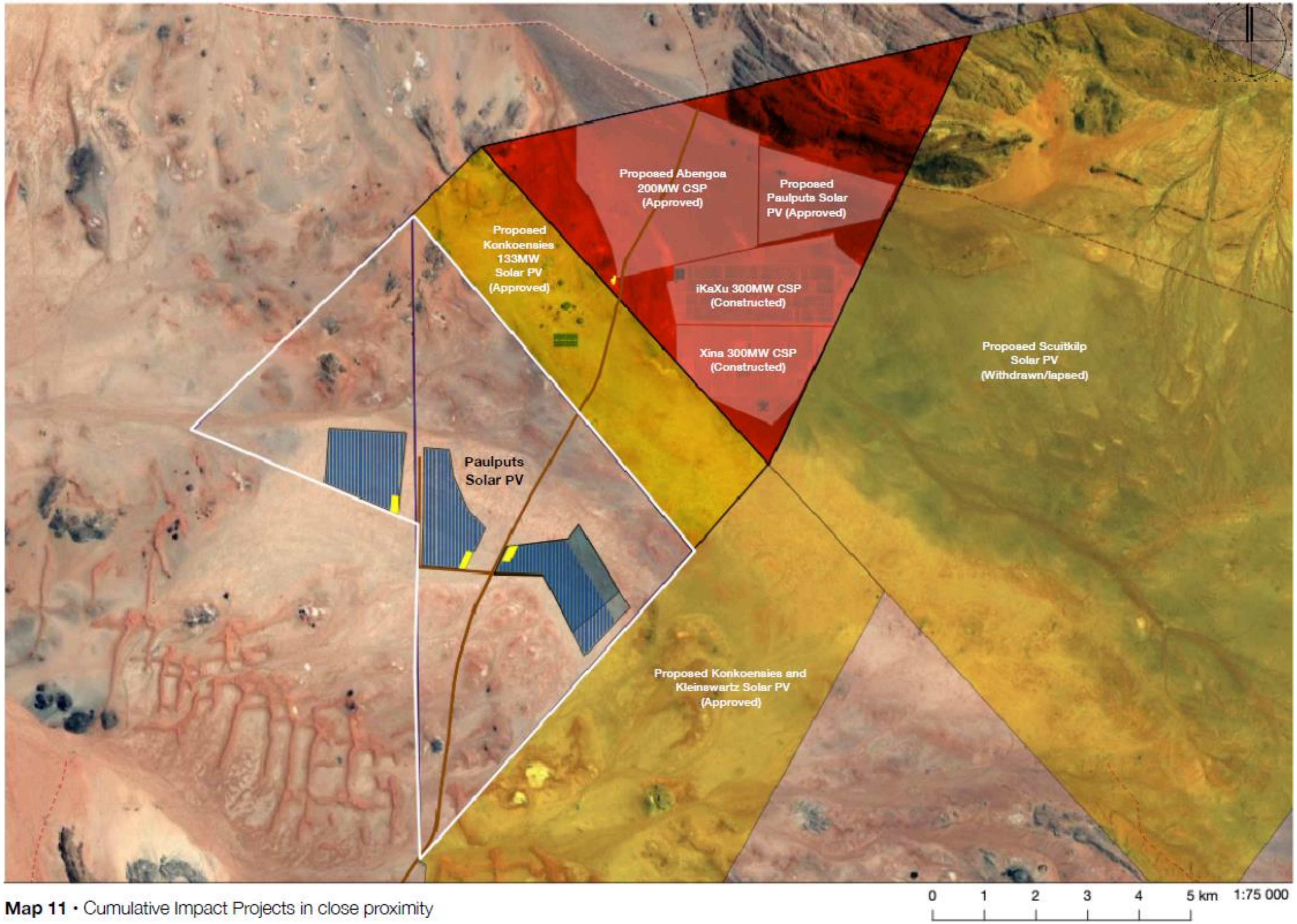
	Short term for construction activities. Operation Phase: **Long term** over the duration of the project. Decommissioning Phase: **Short term** for rehabilitation.
Reversibility of impacts	Construction Phase: **Reversible** in that construction impacts can be mitigated or rehabilitated. Operation Phase: **Reversible** in the long term after decommissioning once the site is restored to its original state. Some infrastructure may remain. Decommissioning Phase: **Reversible** after rehabilitation.
Irreplaceability of resource	Construction Phase: No known visual or scenic resources are lost. Operation Phase: No known visual or scenic resources are lost. Decommissioning Phase: No known visual or scenic resources are lost. Site can be rehabilitated.
Probability	Construction Phase: Visual effects of construction activities are **likely**. Operation Phase: Visual effects of operational activities are **likely**. Decommissioning Phase: Visual effects **not likely** after decommissioning with rehabilitation of the site.
Consequence	Construction Phase: Substantial visual effects expected **(moderate)**. Operation Phase: Substantial visual effects expected **(moderate)**. Decommissioning Phase: Negligible alteration expected after decommissioning with rehabilitation of the site **(low)**.
Significance (Consequence combined with probability) See also Tables 8, 9 and 10.	Construction Phase: **Moderate** significance without mitigation. **Moderate-low** significance with mitigation. Operation Phase: **Moderate** significance before mitigation. **Moderate-low** significance with mitigation. Decommissioning Phase: **Moderate** significance before mitigation. **Low** significance with mitigation.

6.8. ASSESSMENT OF CUMULATIVE IMPACTS

Cumulative visual impacts could arise from the proximity of the constructed KaXu CSP and Xina CSP, and the approved Konkoonsies 1 Solar PV (See Maps 1, 3 and 11). Another solar PV facility has been approved immediately to the south of the site, being the Konkoonsies and Kleinzwart project. All of these are within 7,5 km of the site and would result in the creation of a solar energy node, which in turn would affect the rural character of the area to some extent. The transformed area of nearby solar farms is indicated in Table 7 below. The proposed Paulputs Solar PV would add about another 600 ha.



Map 3a • Paulputs Powerline Route Alternatives



Map 11 · Cumulative Impact Projects in close proximity

Table 7: Cumulative projects in the area

Solar Facility	Area	Comments
Existing KaXU CSP	397 ha	Constructed
Existing Xina CSP	498 ha	Constructed
Paulputs 200MW CSP	937 ha	Under construction
KaXu 200MW Solar PV	323 ha	Under construction
Konkoonsies 1 Solar PV	14.5 ha	Approved

Other existing and proposed wind energy and solar energy facilities in the region are located more than 30 km away. These would have limited or no influence on the cumulative visual impacts because of their considerable distance from the site.

The site is not within a gazetted Renewable Energy Development Zone (REDZ) but is within the Northern Corridor of the Electricity Grid Strategic Corridors, which in itself is likely to attract further renewable energy development.

The proposed SEF would form part of a node consisting of several solar energy facilities mentioned above, which is considered preferable to the dispersal of these facilities across the landscape. The remoteness of the site from settlements and other renewable energy facilities is a further consideration. The potential cumulative visual impact significance of the proposed SEF is considered to be **moderate to low** and could therefore be approved from a visual perspective.

The cumulative visual impacts relating to the proposed powerlines and switching station in relation to the 2 existing powerlines is considered to be **low**, given their relatively short distance and their low visual impact significance. This will form part of the Basic Assessment for the Paulputs connecting transmission line.

6.9. COMPARATIVE ASSESSMENT OF ALTERNATIVES

The preliminary layout of the PV phases on the proposed site was determined in accordance with exclusion areas specified by the landowner and taking into consideration natural features such as drainage areas, red dune systems, and sensitive “koppies” on the site'. The solar facility layouts being assessed are therefore the preferred alternatives, as all visual (and other) constraints were taken into account.

Some micro-siting of the proposed infrastructure may be required as the project progresses and will result in a final preferred layout that minimises potential negative impacts. To facilitate minor layout changes post-authorisation, a development envelope is proposed for the visual impact assessment. The proposed development envelope includes the preferred footprint with a 50m buffer and avoids all visual sensitive features.

In the no-go alternative, there would be no solar energy facilities or additional powerlines and therefore no additional visual intrusion on the rural landscape and on surrounding farmsteads. At the same time no renewable energy would be produced at the site for export to the national grid.

The potential visual impact significance of the no-go scenario would be neutral as there would be no further visual impacts. It is assumed that low intensity grazing would continue with possible detrimental effects on the vegetation cover.

Three alternative routes for powerline grid connections for the 3 phases have been provided (Map 3), all of which are considered to have low visual impact significance. Alternatives 2 and 3, being marginally closer to the existing powerlines, have a slight preference over Alternative 1, provided they avoid the nearby sensitive dune indicated on Map 4.

6.10. IMPACT ASSESSMENT SUMMARY

Table 8 Impact assessment summary table for the Construction Phase (SEF and Powerline)

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact: Without Mitigation/ Management	Significance of Impact: With Mitigation/ Management	Residual Impact after mitigation
Direct Impacts												
Visual effect of construction activities of SEF and powerline	Visual intrusion, dust and noise.	negative	local	short-term	moderate	likely	low	low	Control of construction activities. Implementation of EMPr.	Moderate	Moderate-Low	Mod-low
Indirect Impacts												
Visual effect of construction activities of SEF and powerline	Change in character of the area	negative	Local	Short-term	Moderate-low	likely	Low	low	Control of construction activities.	Moderate-low	Moderate-Low	Mod-low

Table 9 Impact assessment summary table for the Operational Phase (SEF and Powerline)

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures (Section 11.1)	Significance of Impact: Without Mitigation/ Management	Significance of Impact: With Mitigation/ Management	Residual Impact after mitigation
Direct Impacts												
Visual effect of SEF on rural landscape	Visual intrusion of infrastructure	negative	local	Long-Term	moderate	likely	low	low	Avoidance of landscape features	moderate	moderate-low	mod-low
Visual effect of related infrastructure.	Visual clutter of infrastructure on the open landscape.	negative	local	long-term	moderate	likely	low	low	Careful siting and screening of substation and O&M buildings.	moderate	moderate-low	mod-low
Introduction of lighting at the SEF	Effect of lighting at night on dark skies.	negative	local	long-term	low	likely	low	low	Low-level lighting and use of reflectors.	moderate-low	low	low
Visual effect of overhead powerline and switching station	Visual clutter of pylons in the exposed landscape	negative	local	long-term	moderate	likely	low	low	Use of monopoles. Screening of switching station.	moderate	moderate-low	mod-low
Indirect Impacts												
Visual effect of solar facilities and powerline	Change in character of the area	negative	local	long-term	moderate-low	likely	low	low	Screening with berms	moderate-low	low	low

Table 10 Impact assessment summary table for the Decommissioning Phase (SEF and Powerline)

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures (Section 11.1)	Significance of Impact: Without Mitigation/ Management	Significance of Impact: With Mitigation/ Management	Residual Impact after mitigation
Direct Impacts												
Visual effect of solar facilities and powerline	Remaining roads, platforms and slabs.	negative	local	long-term	moderate	likely	low	low	Demolition and rehabilitation	moderate	low	neutral
Indirect Impacts												
Visual effect of solar facilities and powerline	Change in character of the area	negative	local	long-term	moderate-low	likely	low	low	Demolition and rehabilitation	moderate-low	low	neutral

6.11. MITIGATION MEASURES AND MANAGEMENT ACTIONS

Construction mitigation measures:

- Location of the construction yard, batching plant and related storage/stockpile areas in unobtrusive positions in the landscape.
- Employment of dust suppression measures. Implementation of litter control measures.
- Formulation and adherence to an Environmental Management Programme (EMPr), monitored by an Environmental Control Officer (ECO).

Operation mitigation measures:

- Location of internal powerlines underground, where possible.
- Use of mono poles for the overhead connecting powerline, where possible.
- Screening of the substation / switching station and O&M buildings with earth berms.
- Access roads kept as narrow as possible and existing roads used as far as possible.
- Security lighting kept as unobtrusive as possible through use of low-level bollard type lights where possible.
- A lighting plan should be prepared by the proponent or the electrical or lighting engineer/consultant to monitor the type and intensity of lighting and any light spillage and avoid high-mast lighting.
- Outdoor lighting should be fitted with reflectors to minimise light spillage on the surroundings.
- External signage to be discrete and avoid commercial advertising. Billboard signs to not be permitted. Signs to be fixed to buildings or walls where possible to minimize free-standing signposts.

Decommissioning mitigation measures:

- Solar PV arrays removed and building structures demolished or recycled for new uses.
- Hardened platform areas and access roads no longer required to be ripped and regraded.
- Exposed or disturbed areas revegetated or returned to grazing pasture or natural vegetation to blend with the surroundings.

It is assumed that some access roads and concrete pads would remain.

The revegetation measures are not described here as they would fall under the auspices of the vegetation/biodiversity specialist.

Construction Phase Monitoring:

Ensure that visual management measures are included as part of the EMPr, monitored by an ECO, including siting of construction yard and stockpiles, dust suppression and litter control measures, as well as rehabilitation of borrow pits and haul roads, with regular reporting to an environmental management team.

Operation Phase Monitoring:

Ensure that visual mitigation measures are monitored by management on an on-going basis, including the control of signage, lighting and wastes on the site, with interim inspections by a delegated ECO.

Decommissioning Phase Monitoring:

Ensure that procedures for the removal of structures and stockpiles during decommissioning 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.

6.12. CONCLUSIONS AND RECOMMENDATIONS

Proposed Solar PV Energy Facility:
The proposed site for the Paulputs SEF lies within a flattish to gently undulating, semi-arid peneplain. The site proposed for the development has few landscape features, is remote from any settlements and is sparsely populated. Given the climatic conditions, the region has attracted a number of renewable energy developments, including solar CSP and PV type developments.

There are a number of small farmsteads in the otherwise sparsely populated area, but it is unlikely that these would be significantly affected by visual impacts because of the relatively low profile of the PV arrays and the distance of the receptors from the proposed SEF.

The visual impact significance for the SEF is therefore considered to be moderate without mitigation and moderate to low with mitigation for both the construction and operational phases, and low with mitigation at the decommissioning phase.

Powerline Grid Connection and Switching Station:
The visual impact significance for the powerline grid connection is similar to that of the SEF, both without and with mitigation. The visual impact assessment of the connecting powerline and switching station is included in this Report.

Cumulative Visual Impacts:
Some cumulative visual impacts could be expected, along with a change in the character of the area as proposed solar energy projects planned for the region are completed. However, it is considered that the overall effect would be marginal given the remoteness and general context of the site.

The potential cumulative visual impact is considered to be moderate to low for the 3 phases of the proposed SEF, and low for the proposed connecting powerline, for all 3 of the alternatives.

Mitigations:
A number of visual mitigations have been recommended for the various phases of the development, but it is unlikely that these would require any changes to the siting and layout of the development.

It is recommended that the mitigation measures be included in the design process and in the EMPr, as well as the authorisation conditions. There would be no fatal flaws relating to the proposed SEF and powerline connection from a visual perspective, and it is recommended therefore that the project be authorised.

6.13. APPENDIX A: SPECIALIST IMPACT ASSESSMENT CRITERIA

The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of the predicted environmental impacts and risks is described in Part 5 - Section 4 of the EIA report.

6.14. APPENDIX B: SPECIALIST DECLARATION

APPENDIX B:
Specialist Declaration

We, Quinton Lawson and Bernard Oberholzer, as the appointed independent visual specialists, in terms of the 2014 EIA Regulations, hereby declare that I:

- We act as the independent specialist in this application;
- We 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 true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- We declare that there are no circumstances that may compromise my objectivity in performing such work;
- We 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;
- We will comply with the Act, Regulations and all other applicable legislation;
- We have no, and will not engage in, conflicting interests in the undertaking of the activity;
- We have no vested interest in the proposed activity proceeding;
- We 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;
- We 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;
- We have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by us in this specialist input/study are true and correct; and
- We realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signatures of the specialists:

Name of Specialists: Quinton Lawson and Bernard Oberholzer

Date: 31 October 2018

6.15. APPENDIX C: SPECIALIST CURRICULUM VITAE

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 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 served as a member of the Stanford Heritage Committee.

Quinton Lawson Architect
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.

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.

6.16. APPENDIX D: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017

Requirements of Appendix 6 – GN R326 of NEMA EIA Regulations as amended (7 April 2017)	**Please indicate where it is addressed in the Specialist Reports:**
1. (1) A specialist report prepared in terms of these Regulations must contain- details of- the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix A
a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B
an indication of the scope of, and the purpose for which, the report was prepared; (ca) an indication of the quality and age of base data used for the specialist report; (cb) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4.1 Section 5.3 Section 10
the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 5.4
a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5.1
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 alternative;	Section 9 Map 3
an identification of any areas to be avoided, including buffers;	Map 4
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;	Map 4
a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5.2
a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 12
any mitigation measures for inclusion in the EMPr;	Section 11.1
any conditions for inclusion in the environmental authorisation;	Section 11
any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11.2
a reasoned opinion- whether the proposed activity, activities or portions thereof should be authorised; (ia) regarding the acceptability of the proposed activity or activities; and if the opinion is that the proposed activity 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 12 Section 11
a description of any consultation process that was undertaken during the course of preparing the specialist report;	Refer to EIA report
a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Refer to EIA report
any other information requested by the competent authority.	Refer to EIA 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.	Refer to EIA report

7. TRAFFIC SPECIALIST IMPACT ASSESSMENT REPORT

7.1. EXECUTIVE SUMMARY

juwi Renewable Energies (Pty) Ltd, is proposing to develop a 300 MWac solar PV facility and associated electrical infrastructure north of Pofadder within the Khâi-Ma Local Municipality of the Northern Cape Province. The development will be constructed in three phases, each with a capacity of 100 MW of alternating current (MWac) .

The existing road network, within the study area, is operated at well below design capacity and at a good level of service.

This report evaluated the expected traffic impact on the surrounding road network during the construction, operational and decommissioning stages of the facility. The most significant traffic impact was found to occur in both the morning and afternoon peaks, during the construction and decommissioning stages of the facility. The predicted increase in traffic on the road network is less than 50 vehicles per day, which is the threshold as stipulated in the South African Traffic Impact and Site Traffic Assessment Manual. Thus, the impact of the additional traffic on the road network is considered to be negligible.

There are many renewable projects earmarked for the Northern Cape, especially in the Pofadder area. The most direct route to the proposed development from the N14 is via the R358. While the most direct route to the other proposed facilities from the N14 is via MR759. Thus, none of the proposed facilities would utilise the routes that are to be used during the construction, operational or decommissioning stages of the proposed project. Thus, negating the requirement of detailed study of a combined traffic impact on the existing road network.

Thus, from a traffic and transportation perspective, there are no constraints or notable impacts that would jeopardise the implementation of the proposed 300 MWac solar PV project.

7.2. LIST OF ABBREVIATIONS

Abbreviation	Meaning
CSP	Concentrated Solar Power
DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
I&AP	Interested and Affected Parties
MW	Megawatt
PV	Photovoltaic
SANRAL	South African National Roads Agency
veh/h	Vehicle per hour

7.3. INTRODUCTION

Scope and Objectives

The Project Applicant, juwi Renewable Energies (Pty) Ltd, is proposing to develop a 300 MWac solar PV facility and associated electrical infrastructure north of Pofadder in the Northern Cape Province. The development will be constructed in three phases, each with a capacity of 100 MWac.

Phase 1 of the proposed PV facility is to be constructed on Konkoonsies Farm Number 91 Portion 5, while Phases 2 and 3 of the proposed PV facility are to be constructed on Konkoonsies Farm Number 91 Remainder of Portion 2, as shown in Figure 1.

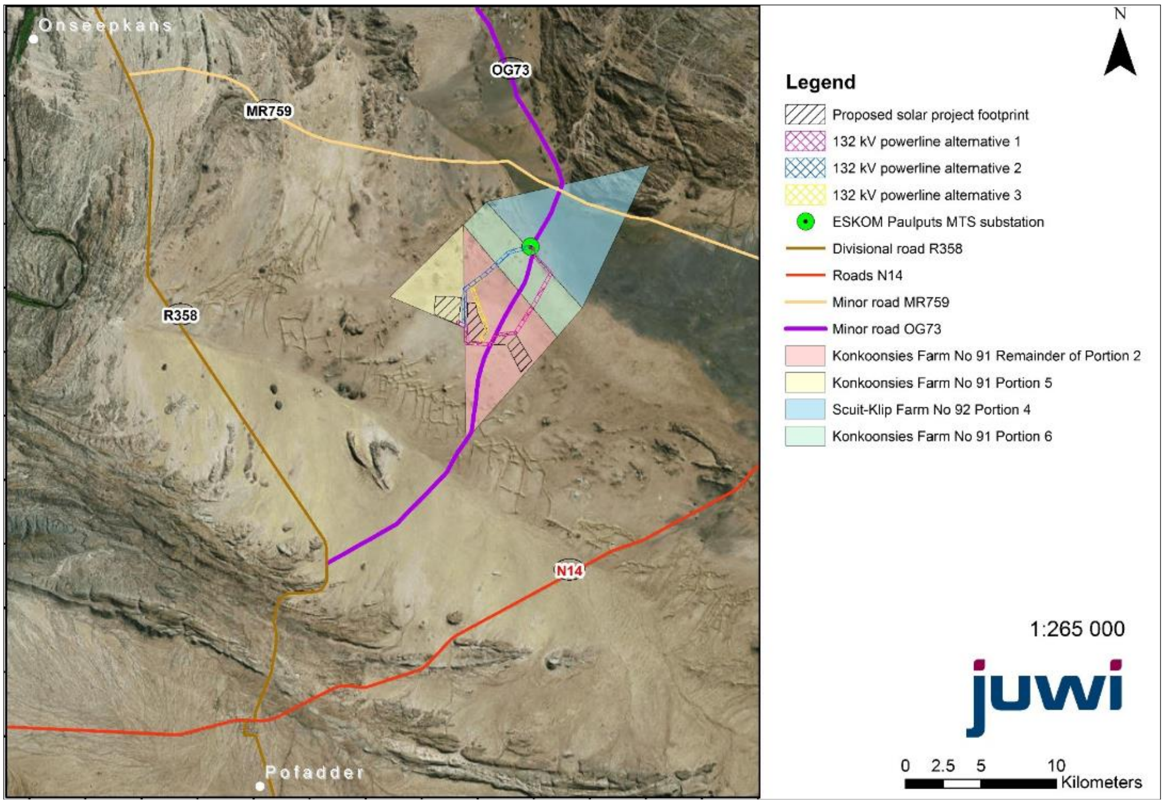


Figure 1 - Site Layout

The scope of this traffic assessment includes, inter alia

- Determine a traffic baseline against which the potential traffic impacts can be measured;
- Identify potential impacts and cumulative impacts that may occur during the construction, operational and decommissioning phases of development;
- Determine mitigation and/or management measures which could be implemented to, as far as possible, reduce the effect of negative impacts; and
- Incorporate and address all issues and concerns raised by I&APs and the public (if applicable)
- The objective of this report is to determine the potential traffic impact, that the proposed 300 MWac solar PV facility will have on the existing road network.

Terms of Reference

Gaea Enviro (Pty) Ltd appointed Mr A Schwarz to provide a Traffic Impact Assessment for the proposed 300 MWac solar facility that is to be constructed on Konkoonsies Farm Number 91, Remainder of Portion 2 and Portion 5.
This Traffic Impact Assessment form an integral part of the supportive documentation required for the Scoping and Environmental Impact Assessment and application to the Department of Environmental Affairs.

7.4. APPROACH AND METHODOLOGY

Approach and Methodology

The South African Traffic Impact and Site Assessment Manual, the South African Traffic Impact and Site Traffic Assessment Standards and the Manual for Traffic Impact Studies form the bases for this traffic impact assessment.
Most of the roads within the study area are gravel surfaced. The existing traffic volumes on these routes are low, the methodology adopted in this report is as follows:

- Trip generation: Estimate the number of vehicle trips generated during the construction, operational and decommissioning stages of each of the three phases of the proposed solar facility.
- Modal split: Determine the mode of transport, vehicle type and size for each trip or category of trip generated during the construction, operational and decommissioning stages of each of the three phases of the proposed solar facility.
- Peak Hour Rate: Establish the peak hour vehicle trip rate generated during the construction, operational and decommissioning stages of each of the three phases of the proposed solar facility.
- Impact assessment: Assess the significance and severity of project related traffic on the existing road network. Where possible compare the volumes of traffic generated by the project with the capacity of the roads.
- Impact rating: Rate the significance of potential transport and infrastructure development impacts using the rating system provided in Appendix A.
- Impact mitigation: Propose, as far as possible, measures to mitigate the impacts of project related traffic on the existing road network.

Assumptions

- The construction of each of the three, 100 MWac phases of this project are assumed to be conducted consecutively. This implies that once phase 1 becomes operational the construction of phase 2 will commence, and once phase 2 becomes operational the construction of phase 3 will commence, between the phases there could be a short overlapping period, which is ignored for analysis purposes.
- The operation of each of the three 100 MWac phases of this project are assumed to be operated independently of each other.
- The decommissioning of each of the three 100 MWac phases of this project are assumed to be conducted consecutively.
- It is assumed that all data and information concerning the materials and personnel required for the construction, operation and decommissioning stages of each of the three 100 MWac phases of this project, is reliable and sufficiently accurate to make reasonable estimates of the road traffic generated.
- Assessment of impacts relates to the impacts of project-related traffic on road network and the users of these networks. Risks and impacts associated with loading or offloading of the vehicles at the site or at associated facilities are not addressed, since these will be dealt with in general terms in the Environmental Management Programmes, and in greater detail in Standard Operating Procedures developed by the Engineering, Procurement, Construction and Management (EPCM) Contractor for the construction stages and by juwi Renewable Energies (Pty) Ltd for the operational phase.
- The cumulative impact assessment assumes that the other approved renewable energy developments, in the study area, will be awarded preferred bidder status. The construction

of these projects is unknown. However, as a precautionary approach, all developments within the study area were included in the cumulative impact assessment.

Limitations

- No visual road assessments have been done of the proposed Transport Routes from the point of import and/or manufacture, to the site of the proposed 300 MWac solar PV facility.
- The Site Development Plan for the proposed 300 MWac solar PV facility and associated electrical infrastructure is not addressed as part of this report.
- This report does not present or discuss any details regarding the design of the entrance and internal infrastructure.

Source of Information

- The information used for the compilation of this report was drawn from the following sources:
- Manual for Traffic Impact Studies, Department of Transport, RR 93/635, 1995.
- TMH 16, Volume 1 - South African Traffic Impact and Site Traffic Assessment Manual, COTO 2012
- TMH 16, Volume 2 - South African Traffic Impact and Site Traffic Assessment Standards and Requirements Manual, COTO 2012
- TRH 4, Structural Design of Flexible Pavement for Interurban and Rural Roads, 1996
- Satellite imagery of the site available on Google Earth was also used for evaluation.
- DENC reference number NC/BA/06/NAM/KHA/PAU1/2017 - Final Basic Assessment for the Realignment of a section of the MN73 (OG73) to accommodate Solar Energy Facility near Paulputs Substation, Northern Cape

7.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

Road Network

The National Route 14 (N14), transverse the Northern Cape through the town of Pofadder. To the east of Pofadder there is a Divisional Road (R358) that connects the N14 to Onseepkans border post. Approximately 45 km east of Pofadder there is a Minor Road (MR759) that also connects the N14 to Onseepkans border post. The proposed site is located on Minor Road (OG73), which is accessible from both the Divisional Road (R358) and the Minor Road (MR759).

Prior to compiling this report preliminary sensitive areas were identified, including sensitive dune features and a Martial Eagle nesting site, identified on Konkoonsies Farm Number 91, Remainder of Portion 2.

The Martial Eagle nest was found on the existing Aggeneis-Paulputs 220kV power line on site. The pair of eagles bred successfully in 2016 but did not breed in 2017. On site monitoring indicated that the eagles had not started breeding by May 2018. It was confirmed via a third party that as at 5 September 2018 breeding had still not commenced nor was the nest occupied. We conclude that the eagles have not bred in 2018, making it two consecutive seasons without breeding.

With the exception of the Minor Road (OG73) which passes through the 1.5 km buffer zone around the nesting site of the Martial Eagle, none of the other preliminary exclusion areas are impacted by the road network.

The existing road network and potential exclusion areas are shown in Figure 2.

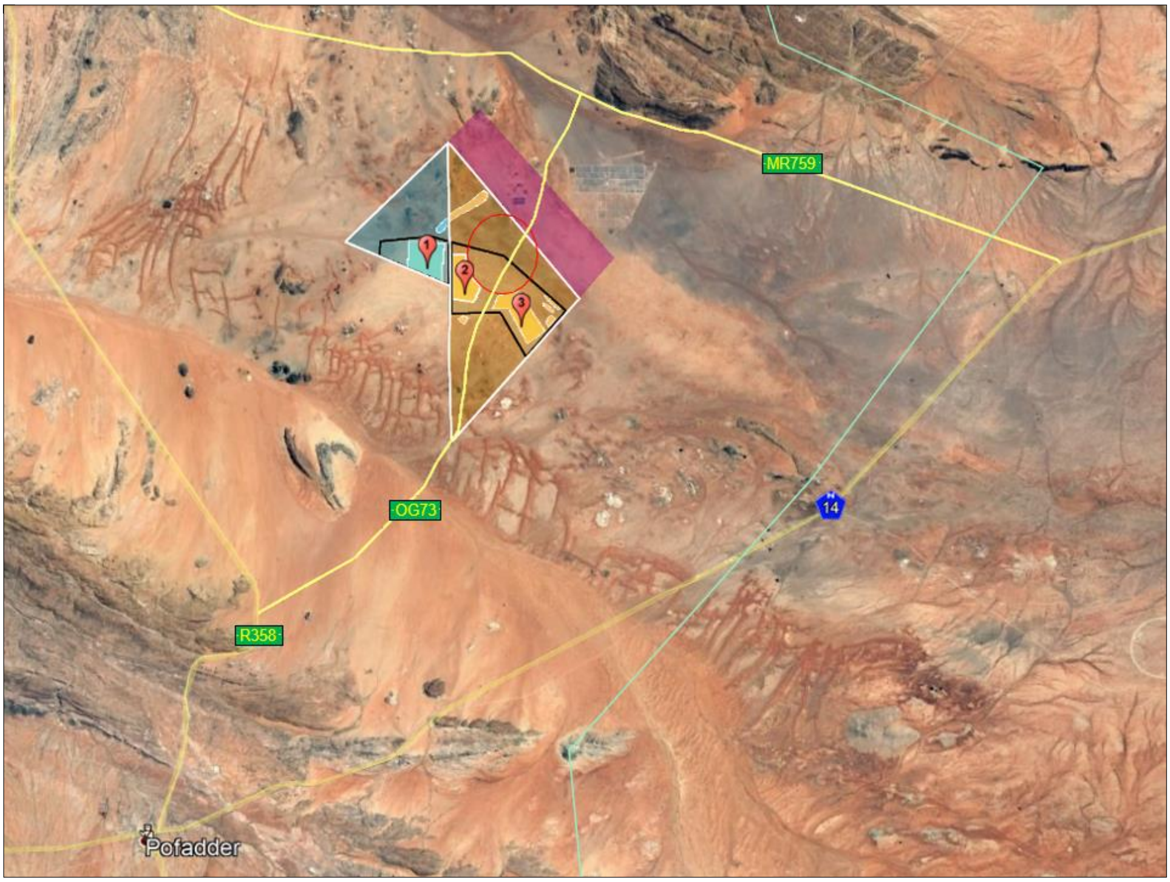


Figure 2 - Road Network and Exclusion Areas

National Route 14

The National Route 14 (N14) is a national freeway in South Africa, under the jurisdiction of the South African National Road Agency, and transverses the Northern Cape from Springbok (in the west) to Kuruman (in the east) through various towns including Pofadder.

The N14 is a single carriageway paved road, with one lane in each direction and paved shoulders, as shown in Figure 3.

Figure 3 - N14 (west wards)

The road is approximately 8 m wide, which is located within a 45 m wide road reserve. The speed limit of the road is 120 km/h, reducing to 60 km/h when passing through the towns along the route. The horizontal alignment of this road within the study area ranges from fairly gentle to moderately winding in some sections. The vertical alignment of this road ranges from fairly flat in some sections to rolling in other sections. As such, the general geometric design of this road is conducive to the movement of heavy vehicle traffic.

Since this road is a national road, it is prudent to assume that this road was built to fairly high structural standards. As such, the road pavement will have the structural strength to convey the additional volumes of heavy vehicles that will be generated by this project without showing signs of any major structural distress. The current pavement condition on the N14 within the study area ranges from good to fair throughout its length within the study area.

The general road safety conditions on the N14 within the study area is good as no road safety hazards were observed during the site visit. There was very little pedestrian and cyclist activity observed along this section of the N14.

The design criteria for this road is unknown. However, since this is a freeway, the classification of this road should be Road Category A, thus in accordance with TRH-4, the road would have been designed for a daily traffic in excess of 4000 equivalent vehicles units.

Divisional Road – R358

The Divisional Road – R358, extends from Bitterfontein (on the N7) to Onseepkans (on the Namibia Border) in the Northern Cape, and passes through the town of Pofadder. This road falls under the jurisdiction of the Northern Cape Department of Transport.

The intersection of R358 onto the N14 is shown in Figure 4.

Figure 4 – N14/R358 intersection

The intersection of OG73 onto the R358, is shown in Figure 5.

Figure 5 - R358/OG73 intersection

The R358 is a gravel road, which is approximately 10 m wide and located within a road reserve that varies between 20 to 50 m wide. The road condition of R358 is fair with wide verges, for most of its length within the study area.

The horizontal alignment is moderately winding in some sections but can be described as gentle for most other sections. The vertical alignment can be described as rolling given the topography of the area however no excessively steep slopes were encountered that will hinder the movement of heavy vehicles. The riding quality of this road is fair, however there is a lot of loose gravel lying on the surface of the road which poses traction problems for vehicles using this road. It is recommended that this road is re-bladed by the road authority to remove the loose gravel from the surface of the road. In the absence of speed restriction signs on this road, it is envisaged that the speed limit on this road is 60 km/h as speeds beyond this will be dangerous to motorists. There was limited pedestrian and cyclist activity observed on this road.

The design criteria for this road is unknown. However, since this is a main rural road, the classification of this road should be Road Category C, thus in accordance with TRH-4, the road would have been designed for a daily traffic usage in excess of 600 equivalent vehicle units.

Minor Road – MR759

The Minor Road – MR759, extends from the National Road N14 (approximately 45 km north east of Pofadder) to the Divisional Road R358 (approximately 6 km south of Onseepkans border post). This road falls under the jurisdiction of the Northern Cape Department of Transport.

The first 23 km of this road is a single carriageway paved road with one lane in each direction, and gravel shoulders as shown in Figure 6.

Figure 6 - MN759 (at 23 km from the N14)

The road is approximately 6 m wide and is located within a 45 m wide road reserve.

The horizontal alignment of this road within the study area is fairly straight. The vertical alignment of this road is considered fairly flat. As such, the general geometric design of this road is conducive to the movement of heavy vehicle traffic. There was no pedestrian and cyclist activity observed along this road.

The design criteria for this road is unknown. However, since this is a minor rural road, the classification of this road should be Road Category D, thus in accordance with TRH-4, the road would have been designed for a daily traffic usage in excess of 500 equivalent vehicle units.

The last section of this road is a gravel road, as shown in Figure 7.

Figure 7 - MR759 (on route to Onseepkans)

Minor Road – OG73

The Minor Road – OG73, extends from the Divisional Road R358 (approximately 11 km north of Pofadder) to the Minor Road MR759 (approximately 23 km from N14). This road falls under the jurisdiction of the Northern Cape Department of Transport. This is a gravel road, as shown in Figure 8.

Figure 8 – OG73 (towards MR759)

The OG73 is a gravel road, the width of the road varies between 6 and 10 m wide and is located within a road reserve of approximately 50 m wide.

The horizontal alignment is fairly straight over its entire length. The vertical alignment can be described as rolling given the topography of the area however no excessively steep slopes were encountered that will hinder the movement of heavy vehicles. The riding quality of this road is poor, as there is a lot of loose gravel lying on the surface of the road which poses traction problems for vehicles using this road. It is recommended that this road is re-bladed by the road authority to remove the loose gravel from the surface of the road. In the absence of speed restriction signs on this road, it is envisaged that the speed limit on this road is 60 km/h as speeds beyond this will be dangerous to motorists. There was limited pedestrian and cyclist activity observed on this road.

The design criteria for this road is unknown. However, since this is a minor rural road, the classification of this road should be Road Category D, thus in accordance with TRH-4, the road would have been designed for a daily traffic usage in excess of 500 equivalent vehicle units.

The Northern Cape Department of Roads and Public Works submitted an application for environmental authorisation for the proposed realignment of the northern section of the OG73 to accommodate solar energy facilities near the Paulputs Substation, on Portion 4 of Farm 93 Scuitklip, as shown in Figure 9.

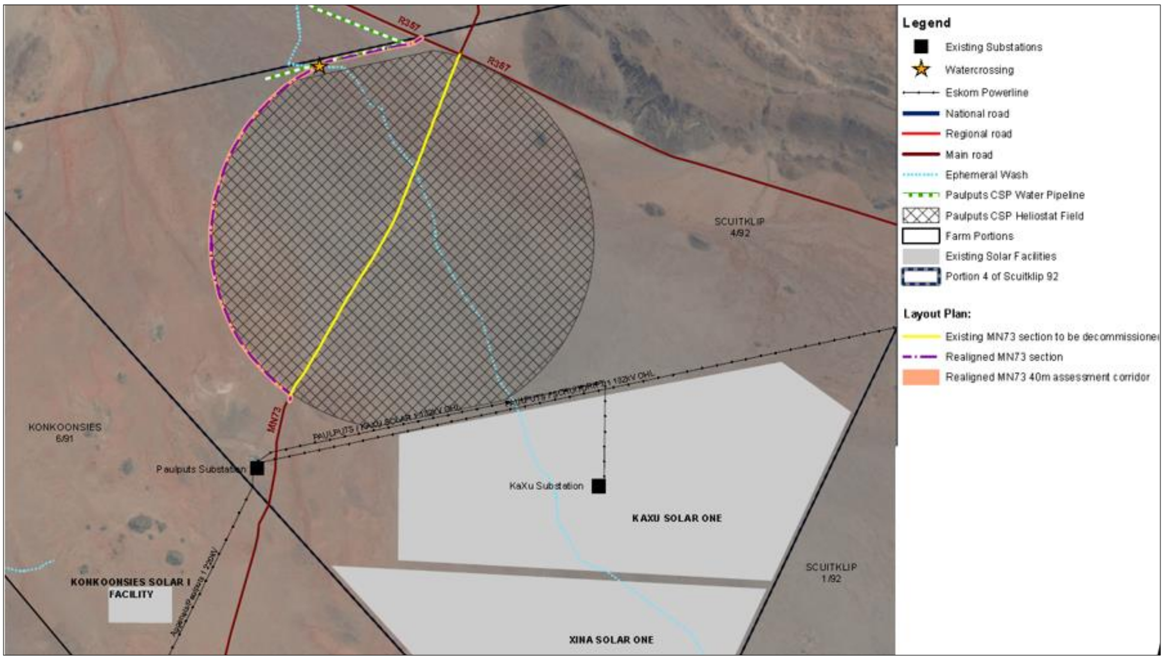


Figure 9 – The proposed realignment of OG73

Site Access

Access to site of the proposed 300 MWac facility, from the N14, is either via the R358 or MR759, as shown in Figure 10.

The detailed design regarding the geometry layout at the entrance to the site from OG73, is not addressed in this report and will be the subject of a separate detailed design.

Route via R358

Access to site from the N14 via the R358 is approximately 28 km, of which 11 km are travelled on the R358 and the balance on OG73.

This route does not pass through any identified exclusion areas.

Route via MR759

Access to site from the N14 via the MR759 is approximately 31 km, of which 22 km are travelled on the MR759 and the balance on OG73. This does not take-into account the proposed realignment of the road. This route passes through the 1.5 km buffer area, identified around a Martial Eagle nest, as shown in Figure 2. According to the ornithologists report the nest appears to be inactive since 2017.

Existing Facilities

Within the study area, there are three renewable facilities that have already been constructed and are operational, each of which are connected to the Paulputs Substation, as shown in Figure 10.

Figure 10 - Existing Facilities

Access from the N14 to; Konkoonsies PV Solar is via OG73, which can be accessed either via R358 or the MR759, while access to both KaXu Solar One and Xina CSP South Africa is via MR759.

Konkoonsies PV Solar
Technology - Solar Photovoltaic
Capacity - 9.7 MW
Programme - REIPPP Window 1
Status - Fully operational (December 2013)
Access – via OG73

KaXu Solar One
Technology - Concentrated Solar Thermal (CSP) - parabolic trough
Capacity – 100 MW
Programme - REIPPP Window 1
Status - Fully operational (March 2015)
Access – via MR759

Xina CSP South Africa
Technology - Concentrated Solar Thermal (CSP) - parabolic trough
Capacity – 100 MW
Programme - REIPPP Window 3
Status - Fully operational (August 2016)
Access – via MR759

Future Facilities

The future renewable facilities earmarked for the Northern Cape can be grouped into four zones, as shown in Figure 11.

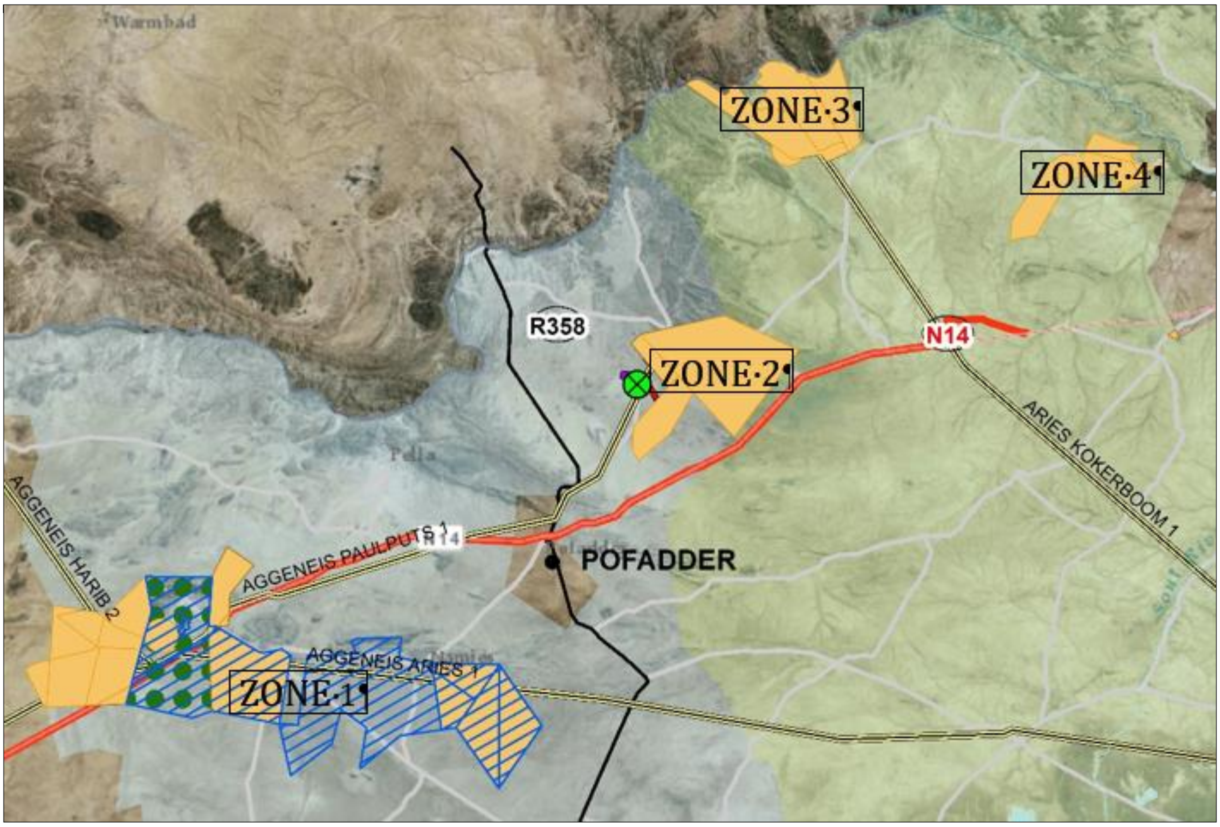


Figure 11 - Future Facilities

Zone 1

Future renewable projects in zone 1, are centralised around Aggeneys and is a combination of PV, CSP and wind. The proposed facilities are to be developed on portions of; Farm 21 Namies Suid, Farm 56 Aggeneys, Farm 57 Aroams, Farm 61 Bloemhoek, Farm 62 Zuurwater, Farm 87 Kykgat, Farm 88 Vogelstruis Hoek and Farm 209 Poortje. This development is approximately 75 km south-west of the Paulputs solar PV facility.

Access to these facilities would be provided by the N14 and will not affect the road network within 20 km radius of the proposed facility, which is the subject of this report.

Zone 2

Future renewable projects in zone 2, are limited to the developments on portions of Farm 91 Konkoonsies and Farm 92 Scuit-Klip, as shown in Figure 12.

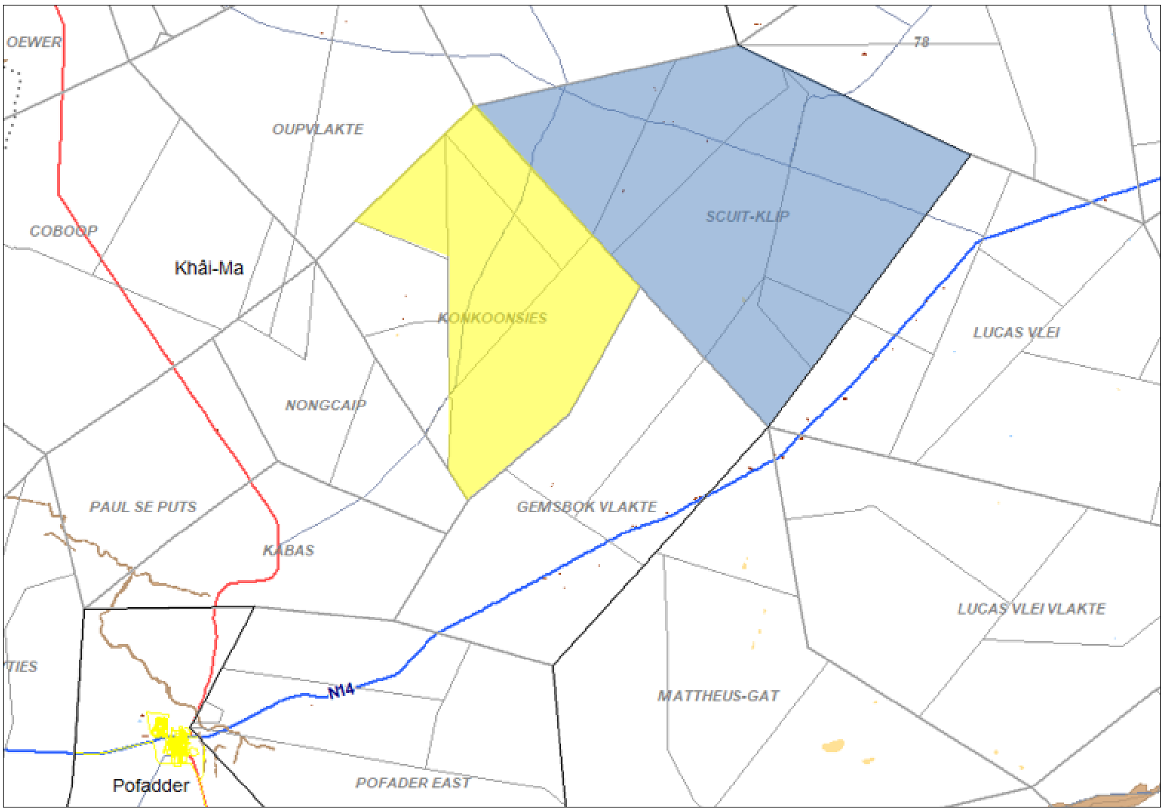


Figure 12 - Developments in Zone 2

The 9.7 MW Konkoonsies Solar PV facility has already been constructed on Portion 6 of Farm 91 Konkoonsies. The proposed development of the 300 MWac solar PV facility, which is the subject of this report, is planned to be constructed on Portions 2 and 5 of Farm 91 Konkoonsies. Further possible development of a 75 MW solar PV facility on Portion 6 of Farm 91 Konkoonsies and other possible developments on Portion 1 of Farm 91 Konkoonsies. Access from the N14 to these developments is via the OG73.

Two 100 MWac Concentrated Solar Power (parabolic trough) plants have already been constructed on Portion 4 of Farm 92 Scuit-Klip.

An additional Concentrated Solar Power (tower) plant is to be constructed on Portion 4 of Farm 92, Scuit-Klip, as shown in Figure 9. Abengoa Solar Power South Africa (Pty) Ltd, received environmental authorisation for development of the Concentrated Solar Power (tower) plant on 16 November 2016. Access to all development earmarked on Farm 92 Scuit-Klip will be provided from the N14 via the MR759.

Thus, the transportation related with the development on Farm 92 Scuit-Klip will not have any impact on the transport routes associated with the development of Farm 91 Konkoonsies, the subject of this report.

Zone 3
Future renewable projects in zone 3, appears to be solar PV and are to be developed on portions of; Farm 6 Schuitdrift, Farm 7 Narries and Farm 410. This development is approximately 50 km north-east of the 300 MWac solar PV facility which is the subject of this report.

The main transportation access to these developments will be provided by the N14 and will not affect the road network within 20 km radius of the proposed facility, which is the subject of this report.

Zone 4
Future renewable projects in zone 4, appears to be solar PV and are to be developed on; portions of; Farm 13 Padrooi and Farm 15 Rooipad. This development is approximately 80 km east-north-east of the 300 MWac solar PV facility, which is the subject of this report, in the vicinity of Augrabies.

Transportation access to these facilities will be provided via; N14, R64 and R359, and will not affect the road network within 20 km radius of the proposed facility, which is the subject of this report.

7.6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

The overarching environmental legislation for the management of the environment in South Africa is the National Environmental Management Act, 1998 (Act 107 of 1998 "NEMA"). Its preamble states that sustainable development requires the integration of social, economic and environmental factors in the planning, implementation and evaluation of environmental decisions to ensure that development serves present and future generations.

The relevant legislation associated to the road (infrastructure), transportation and traffic include, inter alia:

- National Water Act 36 of 1998 – with regards to all crossings of water courses,
- National Road Traffic Act (Act No. 93 of 1996),
- Advertising on Road and Ribbon Development Act 21 of 1940,

  To regulate the display of advertisements outside certain urban areas at places visible from public roads, and the depositing or leaving of disused machinery or refuse and the erection, construction or laying of structures and other things near certain public roads, and the access to certain land from such roads.
  Section 9 - Prohibition of erection of structures near certain roads
  Section 9A - Prohibition of erection of structures or construction of other things near intersections of certain roads
  Section 10 - Restriction of access to land through fence, etc., along certain roads
- Roads Ordinance Number 19 of 1976,

  To consolidate and amend the law relating to public roads and public paths and to provide for matters incidental thereto.
  Section 13 - Erection of gates across public roads and public paths.
  Section 17 - Erection of structures on or near public roads.
  Section 18 - Access to and exit from certain public roads and public paths.

7.7. IDENTIFICATION AND ASSESSMENT OF IMPACTS

- **Key Issues Identified During the Scoping Phase**

The potential traffic impacts relating to the proposed development of the project have been identified and are discussed below. It should be noted that these impacts will occur both in the short-term (during the construction and decommissioning stages) and medium-to-long-term (during the operational stage).

Traffic Volume

Any new and additional activity in an area will result in an increase of traffic volume. Considering the proposed project, the morning and afternoon traffic peaks will be more affected than during the rest of the day. The reason for this is that most of the traffic related to the proposed project is associated with the transportation of the workforce to and from the site. The traffic related to the delivery of material and equipment to site is less and dispersed over working hours.

Road Incidents

With the increase of added traffic along the roads, come the potential increase in incidents. The incidents could vary from minor damage to vehicle due to the road conditions to fatal collisions with other vehicles or even animals.
Since the road conditions will dictate the speed limit along the route, high speed collisions are unlikely. Thus, reducing the likelihood of fatalities. However, evasive action taken by drivers are more likely to cause severe injuries than incident with other vehicles.
Thus, it is strongly recommended that all key personnel be equipped with sufficient driver training on gravel roads and learn how to handle a vehicle in the event of a tire blow-out or an antelope jumping in the road, as the incorrect evasive action could have dire consequences.

Road Geometry

Direct access to the proposed development site will be provided from the N14 via R358 and OG73.

The intersection of R358 onto the N14, is on the outskirts of the town of Pofadder. The speed limit in this area is 60 km/h. The road in this area is flat and straight, thus sighting distances are considered very good. The impact on vehicles moving on the N14 is deemed to be low, since majority of the traffic on route to the site will enter the N14/R358 intersection from the west at a low speed, before turning left onto the R358. While, the volume of traffic entering the intersection for the east will be nominal.

The sighting distances along both the R358 and OG73 are good, with minimal bends or dips.
The intersection of OG73 onto the R358, is located on flat and straight sections of the roads, thus the sighting and stopping distances are good.

Road Condition

Given the status of roads R358 and OG73, it is assumed that both these roads have been constructed to cater for the heavy loads to the border post at Onseepkans.

These gravel roads should ideally be maintained four times per year to ensure that the surface remains in an acceptable condition. Such maintenance involves blading of the road and reworking the gravel surface. Should the gravel wearing course diminished to unacceptable levels, then additional gravel should be imported.

The majority of vehicles using the roads will be light vehicles, with very few vehicles transporting materials and equipment to the site, thus mechanical damage to the road surface will be nominal.

Traffic Safety

Traffic safety is directly related to the attitude of the drivers using the roads.

The driver's ability to change his driving style depending the road and weather conditions, together with the adherence to speed limits and road signs will go a long way to improve traffic safety on the road.

Thus, to improve traffic safety on the roads it is strongly suggested that all key personnel, including mini-bus and bus drivers, be equipped with sufficient driver training on gravel roads.

Noise

Majority of the heavy vehicles are diesel powered. The engine noise and exhaust brakes may generate considerable noise. Added to this would be noise generated by the equipment utilised on site during construction.

Vehicle and machinery emissions

The extent of exhaust emissions from construction vehicles and machinery is unknown but will certainly be a negative factor.

Dust

The quantity of dust generated by traffic on the road will depends on the speed of the vehicle and the properties of the road surfacing. An increase in traffic volumes will result in an increase in the generation of dust which may impact on the following:

- Visibility which will impact on safety conditions; and
- Damage to vehicle moving parts.

- **Road freight limitations**

The current limitations for road freight transportation are, inter alia;

- Steering Axle load limitation of 7.7 t on front axle, 9.0 t on dual wheel single rear axles;
- Axle unit limitations are 18 t for dual axle unit and 24 t for three axle unit;
- Maximum vehicle length of 22.0m for interlink, 18.5m for horse and trailer and 12.5 for a single unit;
- Width limit of 2,6m; and
- Height limit 4,3m.

All vehicles exceeding these limitations will require an abnormal transportation permit.

- **Anticipated Freight**

Equipment and material envisaged to be transported to site include, inter alia:

- Building material (bricks, sand, aggregate, cement, gravel, sheeting, fencing, etc.);
- Construction equipment (piling rigs, rollers, graders, batch plant, etc.);
- Solar panels (panels, frames, etc.);
- Electrical components (transformers, switch gear, inverters, cables, etc.);
- Substation and overland powerline steelwork.

- The transportation of the above-mentioned equipment and material are based on the following assumptions
- All bulk material required on site, shall be transported to site on vehicles, which conform with the legal limits listed above.
- Solar panels and most of the electrical components required on site, shall be transported to site on heavy vehicles, which conform with the legal limits listed above.
- Transformers are to be transported to site by abnormal vehicles.
- A detailed transportation plan and schedule for the transport of components, main assembly cranes and other large pieces of equipment will be compiled during the detailed design phase prior to the commencement of the construction activities.

- **<u>Traffic Generation</u>**

The proposed facility will generate additional traffic on the surrounding road network during the construction, operational and decommissioning stages of each of the three proposed phases.

Construction Stage - It is assumed that each of the three 100 MWac phases are to be constructed consecutively. This implies that once phase 1 becomes operational the construction of phase 2 will commence, and once phase 2 becomes operational the construction of phase 3 will commence.

Operational Stage – It is assumed that each of the three 100 MWac phases are operated independently, each by a team of no more than 6 individuals.

Decommissioning Stage - It is assumed each of the three 100 MWac phases are to be decommissioned consecutively. This implies that once phase 1 no longer generates power, decommissioning of phase 1 will commence. A similar approach will be adopted for phases 2 and 3.

Thus, the high-level program together with the cumulative effect on the traffic is provided in Table 1.

Table 1 – Project Program

		Stages of each Phase						
Phase	*1*	*Construction*	*Operation*			*Decommission*		
	2		*Construction*	*Operation*			*Decommission*	
	3			*Construction*	*Operation*			*Decommission*
Cumulative effects		*Construction*	*Construction + Operation*	*Construction + 2 x Operation*	*3 x Operation*	*2 x Operation + Decommission*	*Operation + 2 x Decommission*	*Decommission*

For analysis purposes the traffic generation for the construction, operational and decommissioning stages will be analysed separately.

The cumulative effects of the traffic generation during the construction, operational and decommissioning stages will be addressed in Section 7.8.

<u>Construction Stage</u>

The developers of this project anticipate that the construction stage and associated infrastructure (including overland powerlines) provision of each phase will take approximately 18 months to complete. During the construction stage traffic will be generated through two distinct sources, namely:

- *The transportation of the construction workforce; and*
- *The delivery of materials and equipment to site*
- *It is envisaged that deliveries of material and equipment to site will be distributed throughout the day, while the transportation of the construction workforce will result in the morning and afternoon peaks.*

For analysis purposes, it has been estimated that the construction of the facility will require a workforce of approximately 500 workers, during the peak of the construction. The developers of this project have indicated that no accommodation will be provided on site. Thus, the workforce will have to be accommodated in surrounding area and commute to site.

Based on previous experience on similar projects, the developers have made the following assumptions with regard to the workforce and their probable travel patterns:

It is assumed that the construction managers, supervisor and other key staff will constitute ±10% of the construction workforce. This sector of the workforce will commute to site in pairs, using light vehicles.

As a maximum impact scenario, the remaining 90% of the workforce, which will predominantly comprise of semi-skilled and unskilled workers. These workers are expected to travel to the site by mini-bus (20%) and bus (80%). The average occupancy rate of 10 people per mini-bus and 60 people per bus were used in the trip generation calculations.

For the traffic generation purposes, it has been assumed that 30 deliveries of material and equipment are to be delivered to site, which are distributed over a six-hour day, thus resulting in 5 vehicles per hours.

The envisaged traffic generated during the construction stages, are provided in Table 2.

Table 2 – Daily Traffic Generation (Construction Stage)

Time	*7:00 AM Veh/h 8:00*	*Daily Veh/h 16:00*	*PM Veh/h 17:00*
Management, Supervision and other Key Staff	*25 veh/h*		*25 veh/h*
Semi and unskilled workers in mini-buses	*9 veh/h*		*9 veh/h*
Semi and unskilled workers in buses	*6 veh/h*		*6 veh/h*
Delivery of material and equipment		*5 veh/h*	
Traffic generation volume for construction stage	*40 veh/h*	*5 veh/h*	*40 veh/h*

This is regarded as negligible traffic. According to section 2.6 of the "South African Traffic Impact and Site Traffic Assessment Manual", "A Traffic Impact Assessment shall be undertaken and submitted when an application is made for a change in land use and when the highest total additional hourly vehicular trip generation (including pass-by and diverted trips) as a result of the application exceeds 50 trips per hour".

Operational Stage

The developers of this project anticipate that the facility will be operated for a period of 20 to 25 years. For analysis purposes it is assumed that each phase will be independently operated by a team of 6 individuals.

It is envisaged that deliveries of material and equipment to site will be distributed throughout the day, while the transportation of the operating staff will contribute to the morning and afternoon peaks.

It is envisaged that the operating staff will travel to site, in pairs, using light vehicles.

For the traffic generation purposes of the operational stage, it has been assumed that a single delivery shall be made to each of the three phases, which occur in the same hour.

The envisaged traffic generated during the operational stages, are provided in Table 3.

Table 3 - Daily Traffic Generation (Operational Stage)

Time	*7:00 AM Veh/h 8:00*	*Daily Veh/h*	*16:00 PM Veh/h 17:00*
Management, Supervision and other Key Staff	*3 veh/h*	-	*3 veh/h*
Semi and unskilled workers in mini-buses	-	-	-
Semi and unskilled workers in buses	-	-	-
Delivery of material and equipment		*3 trips per day*	
Traffic generation volume for operational stage	*3 veh/h*	*3 veh/h**	*3 veh/h*

** assuming that the 3 trips all coincide within the same hour*

This is regarded as negligible traffic. According to section 2.6 of the "South African Traffic Impact and Site Traffic Assessment Manual", "A Traffic Impact Assessment shall be undertaken and submitted when an application is made for a change in land use and when the highest total additional hourly vehicular trip generation (including pass-by and diverted trips) as a result of the application exceeds 50 trips per hour".

Decommissioning Stage

The developers of this project anticipate that the decommissioning stage and associated infrastructure (including overland powerlines) provision of each phase will take approximately 12 months to complete. During the decommissioning stage traffic will be generated through two distinct sources, namely:

- The transportation of the construction workforce; and
- The removal of materials and equipment from site

It is envisaged that the removal of material and equipment from site will be distributed throughout the day, while the transportation of the construction workforce will result in the morning and afternoon peaks.

Like the construction stages, it has been estimated that the decommissioning of the facility will require a workforce of approximately 500 workers, during the peak of the decommissioning. The developers of this project have indicated that no accommodation will be provided on site. Thus, the workforce will have to be accommodated in surrounding area.

The developers have made the following assumptions with regard to the workforce and their probable travel patterns:

- It is assumed that the decommissioning managers, supervisor and other key staff will constitute approximately 10% of the construction workforce. This sector of the workforce will travel to site in pairs, using light vehicles.

  As a maximum impact scenario, the remaining 90% of the workforce, which will predominantly comprise of semi-skilled and unskilled workers. These workers are expected to travel to the site by mini-bus (20%) and bus (80%). The average occupancy rate of 10 people per mini-bus and 60 people per bus were used in the trip generation calculations.

For the traffic generation purposes, it has been assumed that 40 loads of material and equipment are to be removed from site, which are distributed over an eight-hour day, thus resulting in 5 vehicles per hours.

The envisaged traffic generated during the decommissioning stages, are provided in Table 4.

Table 4 - Daily Traffic Generation (Decommissioning Stage)

Time	*7:00 AM Veh/h 8:00*	*Daily Veh/h*	*16:00 PM Veh/h 17:00*
Management, Supervision and other Key Staff	*25 veh/h*		*25 veh/h*
Semi and unskilled workers in mini-buses	*9 veh/h*		*8 veh/h*
Semi and unskilled workers in buses	*6 veh/h*		*6 veh/h*
Delivery of material and equipment		*5 veh/h*	
Traffic generation volume for decommission stage	*40 veh/h*	*5 veh/h*	*40 veh/h*

This is regarded as negligible traffic. According to section 2.6 of the "South African Traffic Impact and Site Traffic Assessment Manual", "A Traffic Impact Assessment shall be undertaken and submitted when an application is made for a change in land use and when the highest total additional hourly vehicular trip generation (including pass-by and diverted trips) as a result of the application exceeds 50 trips per hour".

7.8. ASSESSMENT OF CUMULATIVE IMPACTS

In this case the cumulative impact is twofold, the first is the cumulative effect of the phased approach of this specific project and the second is the cumulative effect of other developments in the area. These are addressed in detail below.

Cumulative Impact – Phased Development

It is assumed that each of the three 100 MWac phases of the project, are to be constructed consecutively. This implies that once phase 1 becomes operational the construction of phase 2 will commence, and once phase 2 becomes operational the construction of phase 3 will commence. The same approach will apply to the decommissioning.

Based on information provided in Section 7.7, regarding the traffic generation volumes for the construction, operational and decommissioning stages, the cumulative effect of the traffic generated during morning (7:00 to 8:00) and evening (16:00 to 17:00) peaks, are provided in Table 5.

Table 5 - Cumulative Impact (Morning and Afternoon Peak)

<table>
<tr><td colspan="2"></td><td colspan="7">Stages of each Phase</td></tr>
<tr><td rowspan="3">Phase</td><td>1</td><td>40 veh/h</td><td colspan="3">3 veh/h</td><td>40 veh/h</td><td colspan="2"></td></tr>
<tr><td>2</td><td></td><td>40 veh/h</td><td colspan="3">3 veh/h</td><td>40 veh/h</td><td></td></tr>
<tr><td>3</td><td colspan="2"></td><td>40 veh/h</td><td colspan="3">3 veh/h</td><td>40 veh/h</td></tr>
<tr><td colspan="2">Cumulative effects</td><td>40 veh/h</td><td>43 veh/h</td><td>46 veh/h</td><td>9 veh/h</td><td>46 veh/h</td><td>43 veh/h</td><td>40 veh/h</td></tr>
</table>

The morning and afternoon peak volumes are regarded as negligible traffic. According to the "South African Traffic Impact and Site Traffic Assessment Manual", section 2.6 which reads "A Traffic Impact Assessment shall be undertaken and submitted when an application is made for a change in land use and when the highest total additional hourly vehicular trip generation (including pass-by and diverted trips) as a result of the application exceeds 50 trips per hour".

While, the cumulative effect of the traffic generated during the day (8:00 to 16:00,) are provided in Table 6.

Table 6 - Cumulative Impact (Daily)

<table>
<tr><td colspan="2"></td><td colspan="7">Stage of each Phase</td></tr>
<tr><td rowspan="3">Phase</td><td>1</td><td>5 veh/h</td><td colspan="3">3 veh/h</td><td>5 veh/h</td><td colspan="2"></td></tr>
<tr><td>2</td><td></td><td>5 veh/h</td><td colspan="3">3 veh/h</td><td>5 veh/h</td><td></td></tr>
<tr><td>3</td><td colspan="2"></td><td>5 veh/h</td><td colspan="3">3 veh/h</td><td>5 veh/h</td></tr>
<tr><td colspan="2">Cumulative effects</td><td>5 veh/h</td><td>8 veh/h</td><td>11 veh/h</td><td>9 veh/h</td><td>11 veh/h</td><td>8 veh/h</td><td>5 veh/h</td></tr>
</table>

Due to the phased development of the project the traffic impact on the existing road network is considered negligible.

Cumulated Impact – Other Developments

In the immediate vicinity of the proposed project, on Farm 91 Konkoonsies, there are future renewable projects earmarked on Farm 92 Scuit-Klip, as described in above.

To date access to all development at Paulputs Substation and on Farm 92 Scuit-Klip has been from the N14 via the MR759. It is envisaged that access to all developments on Farm 91 Konkoonsies is via the R358 and OG73. Thus, based on historical events, it is unlikely that traffic to development on Farm 92 Scuit-Klip will travel on OG73.

Thus, the transportation related with the development on Farm 92 Scuit-Klip will not have any impact on the transport routes associated with the development of Farm 91 Konkoonsies.

7.9. IMPACT ASSESSMENT SUMMARY

The traffic impacts generated by the proposed development of the solar facility are detailed in

Table 7 – Impact Assessment for the Construction Stage
Table 8 – Impact Assessment for the Operational Stage
Table 9 – Impact Assessment for the Decommissioning Stage

The majority of the impacts will occur during the construction and decommissioning stage for each phase of the project, since this is when the highest volume of traffic will be generated.

The impacts identified and assessed as part of this study relating to the increase in traffic generation are defined in Section 7.7.

Table 7 - Impact assessment summary table for the Construction Phase

Direct Impacts												
Impact source/ cause	**Description of Impact**	**Nature of Impact (negative or positive)**	**Spatial Extent of Impact**	**Duration of Impact**	**Consequence of Impact**	**Probability of Impact**	**Reversibility of Impact**	**Irreplaceability of Impact**	**Potential Mitigation Measures**	**Significance of Impact**		**Residual Impact after mitigation**
										Without Mitigation/ Management	**With Mitigation/ Management**	
Traffic generation	Increase in traffic	Negative	Regional	Short Term	Moderate	Very Likely	Yes	Replaceable	• Introduce car-pooling • Advance driver training to key personnel, including mini-bus and bus drivers • Schedule deliveries during working hours • Enforce speed limits	Low	Low	Low
Traffic generation	Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads	Negative	Local	Short Term	Moderate	Likely	No	High irreplace-ability	• certified and trained drivers on-site, including mini-bus and bus drivers • Schedule deliveries during working hours, to minimise traffic during morning and afternoon peaks • Enforce speed limits • Incident monitoring programme should be established • Implement clear and visible signage at access to site and intersections.	High	Moderate	Moderate
Traffic generation	Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment	Negative	Local	Medium Term	Moderate	Likely	Yes	Replaceable	• Implement management strategies for dust generation e.g. apply dust suppressant on the roads, exposed areas and stockpiles. • Postpone or reduce dust-generating activities during periods with strong wind. • Earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased. • Ensure that all construction vehicles are roadworthy and adhere to vehicle safety standards implemented by the Project Owner. • Avoid using old and noisy construction equipment and ensure equipment is well maintained	Moderate	Low	Low

Table 7 - Impact assessment summary table for the Construction Phase

Direct Impacts												
Impact source/ cause	**Description of Impact**	**Nature of Impact (negative or positive)**	**Spatial Extent of Impact**	**Duration of Impact**	**Consequence/ effects of Impact**	**Probability of Impact**	**Reversibility of Impact**	**Irreplaceability of Impact**	**Potential Mitigation Measures**	**Significance of Impact**		**Residual Impact after mitigation**
Traffic generation	Change in quality of surface condition of the roads	Negative	Local	Short term	Slight	Likely	Yes	Replaceable	• Construction activities will have a higher impact than the normal road activity and therefore the road should be inspected on a weekly basis for structural damage; • A Road Maintenance Plan should be developed for the section of road that will be used to addresses the following: • Grading requirements; • Dust suppressant requirements; • Drainage requirements; • Signage; and • Speed limits.	Low	Low	Low

Table 8 - Impact assessment summary table for the Operational Phase

Operation Phase												
Direct Impacts												
Impact source/ cause	**Description of Impact**	**Nature of Impact (negative or positive)**	**Spatial Extent of Impact**	**Duration of Impact**	**Consequence/ effects of Impact**	**Probability of Impact**	**Reversibility of Impact**	**Irreplaceability of Impact**	**Potential Mitigation Measures**	**Significance of Impact**		**Residual Impact after mitigation**
										Without Mitigation/ Management	**With Mitigation/ Management**	
Traffic generation	Increase in traffic	Negative	Regional	Long Term	Slight	Very Likely	Yes	Replaceable	• Adhere to requirements made within Transport Traffic Plan; • Limit access to the site to personnel; • Introduce car-pooling • Advance driver training to key personnel, including mini-bus drivers • Schedule deliveries during working hours • Enforce speed limits	Very Low	Very Low	Very Low
Traffic generation	Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads	Negative	Local	Long Term	Moderate	Likely	No	High irreplace-ability	• Advance driver training to key personnel, including mini-bus drivers • Schedule deliveries during working hours, to minimise traffic during morning and afternoon peaks • Enforce speed limits • An incident monitoring programme should be established • Due to negligible traffic increases, increase in accidents is minimal.	Very Low	Very Low	Very Low
Traffic generation	Impact on air quality due to dust generation, noise and release of air pollutants from vehicles	Negative	Local	Medium Term	Moderate	Likely	Yes	Replaceable	• Implement management strategies for dust generation e.g. apply dust suppressant on the roads, exposed areas and stockpiles. • Limit noisy maintenance/operational activities to daytime only.	Very Low	Very Low	Very Low

Table 8 - Impact assessment summary table for the Operational Phase

Direct Impacts												
Impact source/ cause	**Description of Impact**	**Nature of Impact (negative or positive)**	**Spatial Extent of Impact**	**Duration of Impact**	**Consequence / effects of Impact**	**Probability of Impact**	**Reversibility of Impact**	**Irreplaceability of Impact**	**Potential Mitigation Measures**	**Significance of Impact**		**Residual Impact after mitigation**
Traffic generation	Change in quality of surface condition of the roads	Negative	Local	Long Term	Slight	Likely	Yes	Replaceable	• Implement requirements of the Road Maintenance	Low	Low	Low

Table 9 - Impact assessment summary table for the Decommissioning Phase

Direct Impacts												
Impact source/ cause	**Description of Impact**	**Nature of Impact (negative or positive)**	**Spatial Extent of Impact**	**Duration of Impact**	**Consequence/ effects of Impact**	**Probability of Impact**	**Reversibility of Impact**	**Irreplaceability of Impact**	**Potential Mitigation Measures**	**Significance of Impact**		**Residual Impact after mitigation**
										Without Mitigation/ Management	**With Mitigation/ Management**	
Traffic generation	Increase in traffic	Negative	Regional	Short Term	Moderate	Very Likely	Yes	Replaceable	• Introduce car-pooling • Advance driver training to key personnel, including mini-bus and bus drivers • Schedule deliveries during working hours • Enforce speed limits	Low	Low	Low
Traffic generation	Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads	Negative	Local	Short Tern	Moderate	Likely	No	High irreplace-ability	• Advance driver training to key personnel, including mini-bus and bus drivers • Schedule deliveries during working hours, to minimise traffic during morning and afternoon peaks • Enforce speed limits • Incident monitoring programme should be established • Implement clear and visible signage at access to site and intersections.	High	Moderate	Moderate
Traffic generation	Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment	Negative	Local	Medium Term	Moderate	Likely	Yes	Replaceable	• Implement management strategies for dust generation e.g. apply dust suppressant on the roads, exposed areas and stockpiles. • Postpone or reduce dust-generating activities during periods with strong wind. • Earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased. • Ensure that all construction vehicles are roadworthy and adhere to vehicle safety standards implemented by the Project Developer. • Avoid using old and noisy construction equipment and ensure equipment is well maintained	Moderate	Low	Low

Table 9 - Impact assessment summary table for the Decommissioning Phase

Direct Impacts												
Impact source/ cause	**Description of Impact**	**Nature of Impact (negative or positive)**	**Spatial Extent of Impact**	**Duration of Impact**	**Consequence/ effects of Impact**	**Probability of Impact**	**Reversibility of Impact**	**Irreplaceability of Impact**	**Potential Mitigation Measures**	**Significance of Impact**		**Residual Impact after mitigation**
Traffic generation	Change in quality of surface condition of the roads	Negative	Local	Short Term	Slight	Likely	Yes	Replaceable	• Decommissioning activities will have a higher impact than the normal road activity and therefore the road should be inspected on a weekly basis for structural damage; • A Road Maintenance Plan should be developed for the section of road that will be used to addresses the following: • Grading requirements; • Dust suppressant requirements; • Drainage requirements; • Signage; and • Speed limits.	Low	Low	Low

7.10. MITIGATION MEASURES AND MANAGEMENT ACTIONS

Mitigation Measures

Measures to improve the safety of the existing road and to mitigate against the impact of the additional traffic volumes generated are listed below.

Road surface
The gravel roads in the study area are fair to poor condition. It would appear that the current maintenance conducted on these roads are less than acceptable, this could be a reflection of departmental budgetary constraints.

It is strongly suggested that the Project Owner conduct routine maintenance of the road surface, as a result of the addition traffic generated by the project.

Dust
Dust will be prevalent for a few days after the road is bladed, as during the blading process fine material from the road edge is worked into the road surface. However, the dust will generally dissipate after a few days.

During dry periods dust will hang in the air when disturbed and can interfere with visibility, particularly during calm (windless) conditions when there is little air movement to disperse the dust.
It is also noted that the higher the speed of vehicles, the more dust will be created. Enforcement of the 60kph speed limit would therefore result in less dust.

To ensure that dust emissions from construction activities do not result in adverse health or other negative effects, the contractor shall, inter alia;

- Avoid excavation, handling and transporting of erodible materials during periods of excessive wind.
- Reduce operating speeds on unconsolidated areas and dirt roads and additional dust suppression techniques shall be implemented to minimise dust generation.
- Administer appropriate dust suppression techniques e.g. watering, chemical stabilisation, use of wind fencing, covering of surfaces and the vegetating of open areas. These techniques shall be site specific depending on the local environmental conditions.
- Temporarily suspend all construction activities during extreme windy periods to prevent excessive dust generation.
- Cover all exposed soil surfaces appropriately to prevent excessive dust generation.
- Implement appropriate dust-suppression techniques where dust generation is unavoidable – such measures shall include wet suppression, chemical stabilisation, use of wind fencing, covering of surfaces with straw, brush packs or chippings, and the re-vegetation of open areas.
- Maintain all exposed areas such as unpaved access roads and stockpiles in a damp condition through the application of water from mobile water tankers whose timing and extent of application will depend on weather conditions.
- Re-vegetate or stabilise all exposed soil that has the potential for generating dust, as soon as possible after construction work is completed, or keep damp until re-vegetation or stabilisation occurs.

- Stage the stripping of topsoil to ensure that areas are not opened too far in advance of work commencing.
- Ensure that the loads of all trucks which carry material on public roads and which are likely to generate dust, are covered with tarpaulins.

Noise

To ensure that noise from road construction activities and equipment does not result in the exceeding of relevant limits and /or result in a nuisance disturbance, the contractor shall, inter alia;

- Utilise low noise emission vehicles and equipment on site. The details of all construction machinery and vehicles must be determined prior to construction in order to identify potentially noisy machinery and to seek possible alternatives. These details will include the manufacturer, type and noise emission data of each machinery/vehicle and how many will be used at any time along each section of the route. Where this information is not available, noise measurements must be conducted prior to use of such machinery or vehicles.
- Turn off all equipment when not in use.
- Ensure that all equipment is kept in good working order.
- Operate all equipment within specifications and capacity (i.e. do not overload machines).
- Familiarise himself with, and adhere to, any local bylaws and regulations regarding the generation of noise.
- Route all heavy vehicles around noise sensitive areas wherever possible.
- Conform to defined speed limits.

Vehicle and machinery emissions

To minimise the vehicle and machinery emissions the contractor shall, inter alia;

- Service the construction vehicles and machinery as per manufacturer's requirements.
- Inspect all construction vehicles and machinery every morning for defects (indicator lights, oil leaks, etc) and excessive emissions. All vehicles with excessive emissions shall be removed from service.
- Record all complaints received pertaining to construction vehicle emissions, and shall take the appropriate actions to rectify the situation

Management Actions

The following management actions should be implemented in order to minimise the impact of the development on the infrastructural environment:

Road Maintenance

Maintenance (especially along OG73) during the construction, operation and decommissioning of the project will minimise potential damage caused by traffic generated by the project

Additional warning traffic signs

Appropriate warning traffic signs, in accordance with the South African Road Traffic Signs Manual, should be erected to protect road users on the approaches to the sharp curves and the access road junction.

Temporary signs should be erected on the approaches to the access road junction warning motorists of heavy vehicle traffic during the construction stage.

7.11. CONCLUSIONS AND RECOMMENDATIONS

This report represents the traffic impact assessment for the 300 MWac solar PV facility and associated electrical infrastructure that juwi Renewable Energies (Pty) Ltd intends developing north of Pofadder in the Northern Cape Province. The development will be constructed in three phases, each with a capacity of 100 MWac.

It is envisaged that the construction, operations and decommission activities of the proposed solar facility will generate additional volumes of traffic on the existing road network within the study area. However, this report has assessed the impact of this additional traffic on the surrounding road network and found that the existing road network is currently operating at well below its capacity and at a good level of service.

This report showed that the traffic generated during the construction, operations and decommission stages of the proposed solar facility will generate negligible volumes of traffic during the morning and afternoon peak hours. It is proposed that the existing road network has sufficient capacity to accommodate these additional low volumes of traffic and is considered negligible.

Thus, from a traffic and transportation perspective, and since there are no constraints or notable impacts that would jeopardise the implementation of the proposed project, it is recommended that the proposed project be approved for implementation.

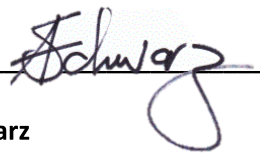
7.12. APPENDIX A: SPECIALIST IMPACT ASSESSMENT CRITERIA

The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of the predicted environmental impacts and risks is described in Part 5 - Section 4 of the EIA report.

7.13. APPENDIX B: SPECIALIST DECLARATION

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

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

Signature of the specialist: 

Name of Specialist: **Athol Schwarz**

Date: **25th May 2018**

7.14. APPENDIX C: SPECIALIST CURRICULUM VITAE

Athol Schwarz
Independent Consultant

EDUCATION & QUALIFICATIONS
Master's Diploma in Technology – Civil: Structures, Technikon Pretoria, Pretoria, South Africa, 1989
Higher National Diploma - Civil Engineering, Vaal Triangle Technikon, Gauteng, South Africa, 1987
National Diploma - Civil Engineering, Vaal Triangle Technikon, Gauteng, South Africa, 1986

PROFESSIONAL AFFILIATIONS
ECSA - Professional Engineering Technologist
SAICE - South African Institution of Civil Engineering - Member

EXPERIENCE
35+ years

SPECIALITIES
Civil infrastructure, Structures, and Constructing Management

Athol, is a Professionally Registered Civil Engineering Technologist with more than 35 years of experience, specialising in Civil and Structural Engineering services for renewable energy facilities and infrastructure. These services range from concept phase all the way through to project close-out, including inter alia: design, contract and construction management phases.
Since 2010, Athol was employed by Hatch, as a Civil Engineering Consultant working on numerous infrastructure and renewable energy projects (including wind farms, fixed and rotating PV solar plants, CPV solar plants) for various Independent Power Producers (IPP) / Developers.
Athol has experience in traffic impact assessments, transportation route analysis, infrastructure development and design, construction and project management (NEC), with a keen eye for detail.

RELEVANT RENEWABLE ENERGY PROJECT EXPERIENCE
CLIENT: CPV1 Solar
PROJECT & SITE: Touwsriver Solar, Western Cape, Republic of South Africa, 36 MW Concentrated Photovoltaic Plant (1500 trackers)
INVOLVEMENT: (July 2014 to March 2017 – 32 months) As the Clients Engineer for this project, for Hatch (Pty) Ltd, Athol supervised all civil infrastructure activities on site.

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Moorreesberg Wind Energy Facility, Moorreesberg, Western Cape, Republic of South Africa, consisting of 25 wind Turbine Generators, with a total generation capacity of 87 MW.
INVOLVEMENT: (December 2014 to August 2015 – 9 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided a feasibility study for the routing of the access roads and platforms to each of the WTG, there were a number of constraints and limitations (i.e. noise, environmental, waterways, boundaries, etc.), resulting in a close collaboration with the client for the best location of the WTG to meet their requirements.

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Garob Wind Farm, Copperton, Northern Cape, Republic of South Africa, consists of 46 Acciona 3.0 MW Wind Turbine Generators, with a total generation capacity of 138 MW
INVOLVEMENT: (June and July 2015 – 2 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol conducted a hydrological study for the proposed Garob Wind Farm. In order to determine the

potential impact of the flood levels on the development, a flood simulation on the site for the development is required to calculate maximum expected flood water levels specifically in the location of the proposed wind turbine bases and the access roads.

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Wolf Wind Farm, Kleinpoort, Eastern Cape, Republic of South Africa, consisting of 28 Wind Turbine Generators, with a total generation capacity of 98 MW
INVOLVEMENT: (May to July 2015 – 3 months) As Lead Civil Designer, for Hatch (Pty) Ltd, Athol had to identify the most viable access point onto the property and internal access road between the wind turbine generators.

CLIENT: SCATEC SOLAR AS (NORWAY)
PROJECT & SITE: Filter Yard (Capacitor bank)
Dreunberg – 75 MW Single-axis Crystalline Silicon Solar Photovoltaic plant – Burgersdorp, Eastern Cape, Republic of South Africa
Linde – 36.8 MW Single-axis Crystalline Silicon Solar Photovoltaic plant – Hanover Northern Cape, Republic of South Africa
Kalkbult – 75 MW Single-axis Crystalline Silicon Solar Photovoltaic plant – De Aar, Northern Cape, Republic of South Africa
INVOLVEMENT: (August to November 2014 – 4 months), As the Clients Engineer on this project, for Hatch (Pty) Ltd, Athol was responsible to all civil issues related to the project

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Keiskammahoek Wind Farm, King William's Town, Eastern Cape, Republic of South Africa, consisting of 16 Wind Turbine Generators, with a total generation capacity of 40 MW.
INVOLVEMENT: (July 2014 – 1 month) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided the client with a feasibility study determine the reduction in the commercial plantation due to the development of Keiskammahoek Wind Farm, which is within the Pirie Forest of the Amatola Forest Complex

CLIENT: SOUTH AFRICA MAINSTREAM RENEWABLE POWER DE AAR PV (Pty) Ltd
PROJECT & SITE: 50 MW Crystalline Silicon Photovoltaic Solar Power Plan – De Aar, Northern Cape, Republic of South Africa
INVOLVEMENT: (February 2012 to April 2014 – 27 months) As the Clients Engineer on this project, for Hatch (Pty) Ltd, Athol supervised all civil related issues on the project.

CLIENT: SOUTH AFRICA MAINSTREAM RENEWABLE POWER DROOGFONTEIN PV (Pty) Ltd
PROJECT & SITE: 50 MW Crystalline Silicon Photovoltaic Solar Power Plan – Kimberly, Northern Cape, Republic of South Africa
INVOLVEMENT: (February 2012 to April 2014 – 27 months) As the Clients Engineer on this project, for Hatch (Pty) Ltd, Athol supervised all civil related issues on this project

CLIENT: JUWI SOLAR ZA CONSTRUCTION 3 (Pty) Ltd
PROJECT & SITE: Aries, 9.7 MW Crystalline Silicon Photovoltaic Solar Power Plan – Kenhardt, Northern Cape, Republic of South Africa
INVOLVEMENT: (May 2012 to January 2014 – 21 months) As the Clients Engineer, for Hatch (Pty) Ltd, Athol provided the required professional consultant services, which included inter alia; the design, specification and drawing for access and internal gravel roads and the Traffic Impact Assessment for Aries.

CLIENT: JUWI SOLAR ZA CONSTRUCTION 3 (Pty) Ltd

PROJECT & SITE: Konkoonsies, 9.7 MW Crystalline Silicon Photovoltaic Solar Power Plan – Pofadder, Northern Cape, Republic of South Africa
INVOLVEMENT: (February 2012 to January 2014 – 24 months) As the Clients Engineer, for Hatch (Pty) Ltd, Athol provided the required professional consultant services, which included inter alia; the design, specification and drawing for access and internal gravel roads and the Traffic Impact Assessment for Konkoonsies

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Namies Wind Energy Facility, near Aggeneys, Northern Cape, Republic of South Africa, and consist of between 46 and 58 wind turbine generators, with a total generation capacity of 140 MW.
INVOLVEMENT: (October and November 2013 – 2 months), As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol compiled a transportation route assessment for the large components of the wind turbines from various ports in Southern Africa to the site.

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Outeniqua Wind Farm (North), Uniondale, Western Cape, Republic of South Africa
INVOLVEMENT: (July to Oct 2013 – 4 months), As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol compiled a transportation route assessment for the large components of the wind turbines from various ports in Southern Africa to the site, for inclusion in the EIA report.

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Wolf Wind Farm, Kleinpoort, Eastern Cape, Republic of South Africa, consisting of 25 Wind Turbine Generators, with a total generation capacity of 75 MW.
INVOLVEMENT: (April to May 2013 – 2 months), As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided a feasibility study for the access routes from the main road to the various positions of the Wind Turbine Generators.

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Outeniqua Wind Farm (South), Uniondale, Western Cape, Republic of South Africa, 16 Wind Turbine Generators, with a total generation capacity of 40 MW.
INVOLVEMENT: (January to May 2013 – 5 months), As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided a feasibility study for the access routes from the main road to the various positions of the Wind Turbine Generators.

CLIENT: UMOYA ENERGY (Pty) Ltd
PROJECT & SITE: Hopefield Wind Farm, approximately 6 km south-east of the town of Hopefield, Western Cape, Republic of South Africa, consisting of 37, Vestas 1.8 MW Wind Turbines Generators, with a total generation capacity of 66.6 MW.
INVOLVEMENT: (September 2012 to April 2013 – 8 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided the architectural, civil and structural design and specifications for the construction of the terrace, foundations and structures of the HV Yard and Substation.

CLIENT: SOUTH AFRICA MAINSTREAM RENEWABLE POWER JEFFREYS BAY (Pty) Ltd
PROJECT & SITE: Jeffreys Bay Wind Farm, Humansdorp, Eastern Cape, Republic of South Africa, consists of 60 Siemens 2.3 MW Wind Turbine Generators, with a total generation capacity of 138 MW
INVOLVEMENT: (February to March 2013 – 2 months), Hatch (Canada) was appointed to review the foundation design for the wind towers, Athol review the designs for compliance to the national standards.

CLIENT: JUWI SOLAR ZA CONSTRUCTION 3 (Pty) Ltd

PROJECT & SITE: RustMo1, 6.8 MW Crystalline Silicon Photovoltaic Solar Power Plan – Rustenburg, North-West, Republic of South Africa
INVOLVEMENT: (December 2011 to March 2013 – 16 months) As the Clients Engineer, for Hatch (Pty) Ltd, Athol provided the required professional consultant services, which included inter alia; the design, specification and drawing for access and internal gravel roads.

CLIENT: BARRICK AFRICA (Pty) Ltd
PROJECT & SITE: Buzwagi Gold Mine in Tanzania
INVOLVEMENT: (March to August 2012 – 5 months) As the Lead Civil Designer, together with my Lead Electrical Designer and Project Manager, for Hatch (Pty) Ltd, the provided Barrick Africa (Pty) Ltd with a preliminary design for the installation of a solar photovoltaic (PV) power plant at the Buzwagi Gold Mine.

CLIENT: JUWI RENEWABLE ENERGIES (Pty) Ltd
PROJECT & SITE: Garob Wind Farm, Copperton, Northern Cape, Republic of South Africa, consists of 46 Acciona 3.0 MW Wind Turbine Generators, with a total generation capacity of 138 MW
INVOLVEMENT: (October to December 2012 – 3 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol developed and compiled a transportation management plan associated with moving the large components of the wind turbine generator from suitable ports to the Garob Wind farm, as part of the Environmental Management Plan (EMP) submission.
CLIENT: SLIM SUN SWARTLAND SOLAR PARK
PROJECT & SITE: SlimSun Solar - 5 MW Crystalline Silicon Photovoltaic Solar Power Plan – Malmesbury, Western Cape, Republic of South Africa
INVOLVEMENT: (March to August 2012 – 6 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided the architectural, civil and structural design and specifications for the construction of the terrace, foundations and structures of the HV Yard and Substation.

CLIENT: CENNERGI (Pty) Ltd
PROJECT & SITE: Kopleegte Switching Station at Amakhala Emoyen Phase 1, Bedford, Eastern Cape, Republic of South Africa, consisting of 56 Nordex, 2,4 MW Wind Turbines Generators, with a total generation capacity of 134.4 MW.
INVOLVEMENT: (June to August 2012 – 2 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided the architectural, civil and structural design and specifications for the construction of the terrace, foundations and structures of the HV Yard and Substation.

CLIENT: EXXARO RESOURCES LTD AND WATT ENERGY (Pty) Ltd
PROJECT & SITE: Wittekleibosch Switching Station at Tsitsikamma Community Wind Farm, Tsitsikamma, Eastern Cape, Republic of South Africa, consists of 31 Vestas 3.0 MW Wind Turbine Generators, with a total generation capacity of 93 MW
INVOLVEMENT: (June to August 2012 – 2 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided the architectural, civil and structural design and specifications for the construction of the terrace, foundations and structures of the HV Yard and Substation.

CLIENT: WINDLAB DEVELOPMENTS SOUTH AFRICA (Pty) Ltd
PROJECT & SITE: AMAKALA EMOYENI – Phase 2, Bedford, Eastern Cape, Republic of South Africa, consisting of 66 Wind Turbine Generators with a total generation capacity of 165 MW.
INVOLVEMENT: (April to June 2012 – 3 months) As the civil consultant, for Hatch (Pty) Ltd, Athol provided a feasibility study for the proposed road network for the project.

CLIENT: WINDLAB DEVELOPMENTS SOUTH AFRICA (Pty) Ltd

PROJECT & SITE: AMAKHALA EMOYENI – Phase 1, Bedford, Eastern Cape, Republic of South Africa, consisting of 56 Nordex, 2,4 MW Wind Turbines Generators, with a total generation capacity of 134.4 MW.
INVOLVEMENT: (February to May 2012 – 4 months) As the civil consultant, for Hatch (Pty) Ltd, Athol provided a feasibility study for the access routes to and on site, for the various WTG positions, taking into account the Transportation Criteria of the vehicles delivering the components and the environmental constraints

CLIENT: IBERDROLA
PROJECT & SITE: Kip Heuwel Switching Station at Caledon Wind Farm, Caledon, Western Cape, Republic of South Africa, consisting of 9, Sinovel 3.0 MW Wind Turbines Generators, with a total generation capacity of 27.0 MW.
INVOLVEMENT: (February to March 2013 – 2 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided the architectural, civil and structural design and specifications for the construction of the terrace, foundations and structures of the HV Yard and Substation.

CLIENT: EXXARO RESOURCES LTD
PROJECT & SITE: Lephalale 60 MW Thin Film Photovoltaic Solar Power Plant, 13 km north west of the town of Lephalale, Limpopo, Republic of South Africa
INVOLVEMENT: (October to December 2011 – 2 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided the design and specifications for the architecture, civil and structural elements of plant.
CLIENT: SASOL TECHNOLOGY
PROJECT & SITE: 3.6 MW Demonstration Plant
INVOLVEMENT: (May to August 2011 – 4 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol provided the civil and structural input into the basic engineering planning of the Concentrated Solar Power (CSP) Technology selected by Sasol Technology and Sasol New Energy as a suitable technology offering to enable Sasol to produce electricity from solar energy.

CLIENT: SOLAFRICA PTY (LTD)
PROJECT & SITE: Bokpoort CSP Project, a 50 MW Concentrating Solar Thermal Power Station (CSP – parabolic trough) is located approximately 80 km east south east of Upington, Northern Cape, Republic of South Africa
INVOLVEMENT: (June to November 2010 – 6 months) As the Lead Civil Designer, for Hatch (Pty) Ltd, Athol prepared enquiry documentation for the geotechnical investigation and topographic survey of the proposed site for CSP, in order to provide the necessary information required for the subdivision and rezoning process, assist with the decision regarding the placement of the CSP on the farm and to provide preliminary geotechnical information for the design and construction of the CSP and identify any fatal flaws.
Athol, compiled the technical input of the enquiry document and conducted the technical adjudication of the tenders.
In addition, Athol was responsible for the feasibility study for the water abstraction, pumping stations, pipe line and raw water storage reservoir.

7.15. APPENDIX D: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017

Requirements of Appendix 6 – GN R326 of NEMA EIA Regulations as amended (7 April 2017)	Please indicate where it is addressed in the Specialist Reports:
(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;	APPENDIX B
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	APPENDIX C
c) an indication of the scope of, and the purpose for which, the report was prepared; (ca) an indication of the quality and age of base data used for the specialist report; (cb) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	May 2018
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5
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 alternative;	Section 6
g) an identification of any areas to be avoided, including buffers;	Section 6
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;	Section 6
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 8
k) any mitigation measures for inclusion in the EMPr;	N/A
l) any conditions for inclusion in the environmental authorisation;	N/A
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	N/A
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 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;	N/A
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
(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.	N/A

8. SOCIO-ECONOMIC SPECIALIST IMPACT ASSESSMENT REPORT

8.1. EXECUTIVE SUMMARY

This report is the socio-economic specialist study forming part of the EIA process for the proposed Paulputs solar PV facility near Pofadder in the Northern Cape which consists of three individual projects or phases of 100 MW each. The phases were assessed individually and all figures and ratings in this report pertain to an assessment of one of the 100 MW phases.

An important indicator of economic desirability is whether the proposed project complements national energy planning, economic development planning and spatial development planning. Each individual project achieves a high degree of fit with energy planning policy for renewable energy and should further the goals of local and regional economic development planning. Financial viability risks are also considered minor particularly if a long-term contract can be agreed on with the relevant authorities that secures payment for the electricity generated through the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP).

Each individual 100 MW project has the potential to have a significantly positive impact on economic activity in the local area and region given the size of the new spending injection associated with it and the clear need for economic opportunities in the area. Whilst increasing economic activity, the project would also result in the increased diversification of the local economy. For each 100 MW project, construction would represent a significant investment of between R900 million and R1.3 billion. Roughly 464 to 526 jobs of 12 to 18-month duration would be associated with the construction phase. In addition, it is anticipated by the applicant that roughly R6 million to R9 million would be spent annually on operation, resulting in the creation of between 35 and 44 full-time direct employment opportunities. It is anticipated that roughly 70% of these available opportunities would go to residents of the local community. The significance of this impact with mitigation was rated as moderate during construction and moderate to high during the operational phase.

The REIPPPP bidding process specifies that significant contributions to local socio-economic development are mandatory for all bidders. For each 100 MW project, the value of socio-economic development, enterprise development and community shareholdings should amount to between R2 million and R2.8 million per year. Assuming average discount rates, the present values of these funding flows would be between R30 million and R43 million. This is a highly significant flow of funds and, assuming good fund management and project selection, it has the potential to result in the creation of much needed socio-economic benefits in the local area. Note that the local community would also be given the opportunity to own shares in the project. This impact was rated as moderately significant with mitigation.

There exists the potential for negative impacts associated with an influx of workers and job seekers particularly during the construction phase of the projects. These concerns are common especially in smaller communities and include those associated with negative impacts on social structures and increased 'social ills' such as increased crime levels, increased alcohol and drug use, increased teenage and unwanted pregnancies, increased prostitution and increases in sexually transmitted diseases (STDs). It is expected that a significant proportion of workers would be sourced locally especially low and medium skilled workers. These workers would already be part of the local community and its social structures thereby reducing the risk posed by influx. With mitigation, it is expected that impacts could be reduced to low levels of significance in this regard for each of the three projects.

Surrounding land owners are likely to experience somewhat greater risks due to greater activity and the presence of workers particularly during construction. These risks would essentially include further deterioration of local gravel roads, increased risk of stock theft and poaching, damage to farm infrastructure such as fences, increased littering and increased potential for veld fires. In keeping with the findings of social impact assessments for other renewable energy and similar projects, it was found that these risks are relatively common and that their significance can be reduced to low levels with adequate mitigation for each of the three projects.

There does not seem to be potential for the site to have any significantly negative impacts on tourism in the surrounding area and region. All of the tourism attractions, facilities and activities identified are relatively far from the site. The visual specialist also did not identify any potentially sensitive tourism visual receptors in the area. It thus seems most reasonable to conclude that the project would not make a significant change to the current sense of place of the site and surrounds and would not introduce significant tourism risks. Furthermore, the proposed project has the potential to result in a slight boost in tourism to the project area through its facilitation of increased business tourism. Net tourism risks have been rated as having a very low significance with mitigation during the construction and operational phase.

Cumulative impact assessment focused on the scenario where one of the three projects and associated transmission infrastructure go ahead along with other renewable energy projects approved or planned for the area, as well as the scenario where all three of the projects and associated transmission infrastructure go ahead along with the other renewable energy projects approved or planned for the area. As the two scenarios were not deemed to be significantly different from one another, given the small difference in the magnitude of development relative to the large number of planned and approved projects, they were assessed congruently. In essence, both scenarios would result in a significant amplification of impacts. Positive impacts associated with project expenditure and the funding of local socio-economic development initiatives would both increase to a cumulative high significance. Cumulative social impacts associated with the influx of people and impacts on surrounding land owners would increase to a cumulative medium significance given their intensity. Cumulative tourism impacts should increase to a similar degree, although the risk of negative impacts would be at least partially offset by a substantial increase in business tourism, and cumulative risks to tourism are thus rated as having a low to moderate significance.

In summary, it seems most likely that the overall positive impacts of each 100 MW project would outweigh negative impacts with adequate mitigation measures as outlined in the report, of which, the following are considered particularly important:

- Setting targets for the use of local labour and for training opportunities.
- Exploring ways to enhance local community benefits with a focus on broad-based BEE and preferential procurement, etc.
- Establishing a Monitoring Forum for the project to monitor the project and the implementation of the recommended mitigation measures.
- Developing a Code of Conduct for project workers.

8.2. LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
BBBEE	Broad Based Black Economic Empowerment
CEQ	Council on Environmental Quality
DCGHSTA	Department of Cooperative Governance, Human Settlements and Traditional Affairs
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning

DoE	Department of Energy
DRDLR	Department of Rural Development and Land Reform
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
GN	Guide Number
HIV	Human Immunodeficiency Virus
IDC	Industrial Development Corporation
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IRP	Integrated Resource Plan
KMM	Khâi-Ma Municipality
kV	Kilovolt
LED	Local Economic Development
MW	Megawatt
MTS	Mixed Technology Switchgear
NDP	National Development Plan
NPV	Net Present Value
PV	Photovoltaic
REFIT	Renewable Energy Feed-In Tariff
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SDF	Spatial Development Framework
STD	Sexually Transmitted Disease
ToR	Terms of Reference

8.3. INTRODUCTION

This report presents the socio-economic specialist study prepared by Dr Hugo Van Zyl and James Kinghorn of Independent Economic Researchers (see abbreviated CV and declaration of independence in the appendices) as part of the EIA for a 300 MW solar PV facility in three phases of 100 MW each near Pofadder in the Northern Cape Province.

Each of the 100 MW developments will consist of the components outlined in Table 1.

Table 1 Description of the project components involved in each development

Component	Dimensions
Solar Farm: To be located on Farm 91/5 (PV1) and 91/2/rem (PV2 and PV3)	≤200ha footprint
Battery Storage System: A ≤100MWh battery storage facility for grid storage (stacked containers or multi-storey building) and associated operational, safety and control infrastructure.	≤1ha ≤8m building height
Access road: access to site from the N14 via the R358 (southern access) is approximately 28 km, of which 11 km are travelled on the R358 and the balance on OG73. Access to site from the N14 via the MR759 (northern access) is approximately 31 km, of which 22 km are travelled on the MR759 and the balance on OG73	Maximum width of 13,5 m, including stormwater channels or drainage structures
Service roads: gravel service roads linking the access road and various project components and servicing the solar panel arrays.	Maximum width of 6m

Roads fitted with traffic control systems and stormwater controls as required.	
onsite substation complex: ≤2ha onsite substation complex (including a 22/132 kV or 33/132 kV onsite collector substation, a switching station, control rooms and grid control yards for both Eskom and the Independent Power Producer (housing unit to control switch gears in the form of a small concrete single storey building) to receive, convert and step up electricity from the PV facility to a grid suitable power supply. A telecommunications tower up to 50m high (lattice or monopole type) will be established in the onsite substation complex.	≤2ha onsite substation complex up to 30m height Up to 50m high telecommunications tower
Operations & Maintenance (O&M) area: ≤1ha hectare O&M laydown area (near / adjacent substation); Parking, reception area, offices and ablutions facilities for operational staff, security and visitors; Workshops, storage areas for materials and spare parts; Water storage tanks or lined ponds (~160kl/day during first 3 months; ~90kl/day during rest of construction period; ~20kl/day during operation; small diameter water supply pipeline connecting existing boreholes or existing pipeline access points to storage.); Septic tanks and sewer lines to service ablution facilities; and Central Waste collection and storage area. Perimeter fencing and internal security fencing and gates as required. Access control gate and guard house on access road;	≤1ha office, ablutions, workshop complex
Temporary infrastructure: -concrete batching facility, -temporary offices, -construction yard and -laydown area. The concrete batching facility and construction yard will have a combined maximum size of 2 hectares. The laydown area will have a maximum size of 2 hectares and will be used mainly for storage of material and equipment during the construction phase.	≤4ha (Temporary)

A 132kV transmission power line approximately 10 km long will be constructed to connect the development to the Eskom 220/132kV Paulputs MTS Substation (currently proposed for upgrade to 400/132kV).

The proposed project site can be seen in Figure 1. Each of the three Solar PV arrays, along with their inverters and mini-subs, were assessed separately and are considered as different phases of the project. Phase 3 has been altered slightly due to the discovery of a sensitive site during the archaeological assessment forming part of this EIA (see Lawson and Oberholzer, 2018). The difference, however, between the original layout and the altered layout is negligible from a socio-economic standpoint, and is thus not considered further in this report.

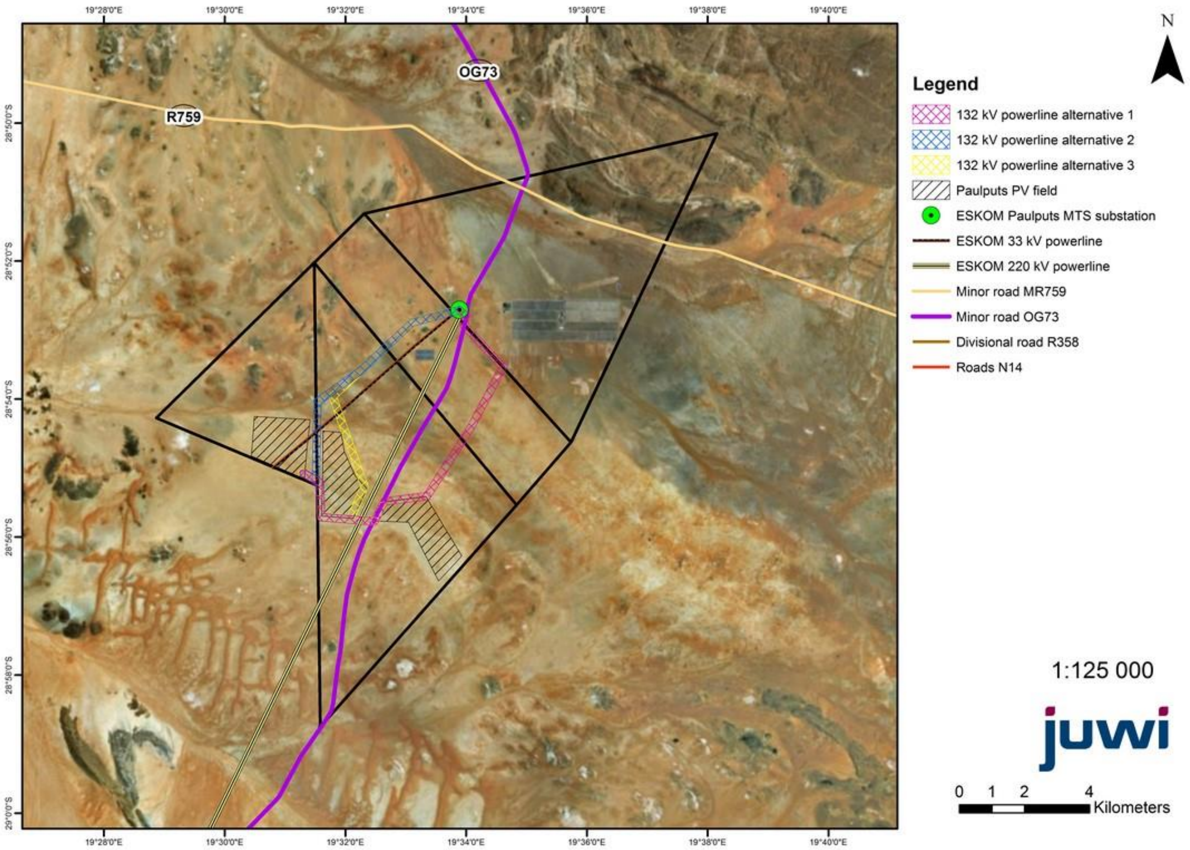


Figure 1. Map outlining the construction phase of each 100 MW project location, affected farms and access from national roads network

Scope and Objectives

The study aimed to assess the impacts of the three 100 MW solar PV phases of the project and the electricity infrastructure focusing on the local and regional scales. An assessment of the cumulative impacts of all phases and aspects was also conducted. Adverse, positive, direct and indirect impacts were identified for the establishment and operational phases.

The overall objectives of the study were to:

- Determine the current conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured.
- Identify potential impacts that may occur during the construction, operational and decommissioning phases of development, as well as impacts associated with future environmental changes if the “no-go” option is implemented (both positive and negative).
- Assess the impacts, in terms of direct, indirect and cumulative impacts.
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts.
- Incorporate and address all issues and concerns raised by Interested and affected parties (I&APs) and the public.

Terms of Reference

While it is difficult to be sure of all relevant impacts before commencing with the assessment of the development, the ToR deemed it likely that the following impacts would need to be assessed:

- Broad level review of the need and financial viability/risks associated with the project. This would be based primarily on information from the client. It is assumed that an adequate assessment of technical and financial feasibility of the project has been conducted to establish viability and justify further assessment of the project in the EIA phase.
- Degree of fit with local, regional and national economic development visions and plans including renewable energy plans.
- Impacts on overall economic development potential in the area including impacts on other sectors and commercial enterprises nearby the site (E.g. tourism and other businesses).
- Social impacts associated primarily with the presence of people from outside of the local community in the area.
- Impacts associated with project activities and expenditure with a focus on employment and household income impacts. These impacts would be investigated through an examination of how the project and the spending injection associated with it may impact particularly on the local and regional economy. Impacts associated with upstream and downstream economic linkages and spin-offs would also be assessed taking import content and other relevant factors into consideration.
- Impacts associated with required socio-economic and enterprise development contributions and community shareholding allocations under the REIPPP.
- Impacts associated with environmental impacts that cannot be mitigated and have economic implications. This would focus on potential negative impacts on neighbouring land owners should they be relevant.

8.4. APPROACH AND METHODOLOGY

The approach adopted involved the following steps in line with accepted EIA practice :

1. Investigate the existing context within which the project would be established.
2. Identify impacts.
3. Assess impacts without mitigation measures.
4. Recommend mitigation measures.
5. Re-assess impacts assuming mitigation measures are implemented.

Guidance on the approach was taken primarily from the Department of Environmental Affairs and Development Planning (Western Cape) guidelines on economic specialist input to EIA processes (van Zyl et al., 2005) augmented by the guidelines on social specialist input to EIA processes (Barbour, 2007). This included guidance on the appropriate level of detail required for the assessment in order that it be adequate for informing decision-making without going into superfluous detail (i.e. superfluous detail in this report as well as superfluous detail when the briefs of other specialist studies forming part of the EIA are taken into account).

Details on the approaches used to assess impacts are contained in the individual sections dealing with the impacts.

Assumptions and Limitations

The following assumptions apply to the study:

- All technical, financial (i.e. market surveys, business plans and costs) and other information provided by the applicant, the applicant’s project team, other official sources and other specialists involved in the EIA is assumed to be correct unless there is a clear reason to suspect incorrect information.

- The quantification of economic impacts in order to inform the assessment of the significance of impacts was not possible, nor considered necessary, for all impacts. Where possible, quantification focused on impacts considered to be most important in the overall assessment. Assessments of impact significance made without quantification (and based on a consideration of the likely magnitudes of impacts and/or expert judgements) are, however, considered adequate unless otherwise specified.
- All impacts are assessed individually and then as a whole to the degree possible and appropriate. An overall assessment and discussion of net impacts (i.e. whether overall benefits exceed costs) was undertaken to the degree thought appropriate and justifiable combining quantifiable and unquantifiable impacts. Given uncertainties and the potentially subjective nature of comparisons between impact categories, the emphasis in the report is on presenting assessments of impact categories with less emphasis on trying to reconcile them in an overall assessment of net effects. To a large degree this role of comparing and weighing up different (and hard to reconcile) impacts is the ambit of the relevant decision-making authorities.
- The findings of the assessment reflect the best professional assessment of the author drawing on relevant and available information within the constraints of time and resources thought appropriate and made available for the assessment. See Appendix B for the disclaimer associated with this report.

The following limitations apply to the study:

- The assessment only considers the impacts of the proposed projects and the no-go alternative. It does not make comparisons with other solar energy projects which may or may not be more desirable. The Department of Energy (DoE) is primarily responsible for making the necessary comparisons between projects as part of the process of awarding contracts to aspirant competing renewable energy developers.

Sources of Information
Key information sources used in the assessment include:

- Census data and other socio-economic baseline data
- Policy document focused on renewable energy, economic development planning, spatial planning
- Literature on the impacts of solar energy facilities and assessment of other solar projects in the area.
- Inputs from the other specialists making contributions to the EIA.

Interviews were conducted with the following stakeholders and informants:

Name	Affiliation
Sean van der Colf	Farm Manager, Konkoonsies 91
Zirk Botha	Economic Development and Land Acquisition Manager, Juwi
Thorsten Rauch	General Manager, KaXu Solar One
Bennie Josop	Councillor, Khai Ma Ward 1
Klasie Brand	Neighbouring Landowner
Floris Nicolaas Brand	Neighbouring Landowner
Marelize Brand	Neighbouring Landowner
Fanie van den Heewer	Neighbouring Landowner
Ishmael Kolberg	Manager: Special Programmes, Khai Ma Municipality
Alfredo Green	Communications Officer, Khai Ma Municipality

8.5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

The significance of impacts is often highly dependent on the socio-economic environment or context within which they occur. For example, job creation or losses in a small local community with a stagnating economy and high unemployment will be far more significant than it would be in a larger community with a healthy economy. In order to offer such baseline information to the impact assessment this section describes the socio-economic environment.

The main information sources used were Census 2001 and 2011 data (StatsSA, 2002; 2012), The Khâi-Ma Local Municipality Integrated Development Plan (IDP) 2016-2017 Final Review (KMM, 2016) and the Namakwa District Municipality Rural Development Plan (DRDLR, 2017).

The proposed site is situated within Ward 1 of the Khâi-Ma Municipality which, in turn, forms part of the Namakwa District Municipality of the Northern Cape Province. Pofadder is the largest settlement in the Khâi-Ma Municipality and is also the closest town to the proposed site. Other towns within the Municipality, and which are relatively nearby, include Pella, Aggeneys and Onseepkans. The border of the Kai! Garib Municipality is around 80km from the proposed site.

Current land uses
The proposed facility would cover two portions of land which are at present being used for livestock rearing. Surrounding land use has traditionally been agriculture-focussed, but the portion of land to the North-East of the proposed site has been developed into a concentrated solar thermal plant, KaXu Solar One. Significant portions of land in the wider area surrounding the site has been proposed for the development of renewable energy facilities, mainly solar with some wind energy facilities proposed as well. A list of these projects, along with their required environmental approval processes and statuses, is provided in Appendix C.

In addition to agriculture, land use in the wider area also includes some mining. Aggeneys, located about 80km to the South-West of the proposed site, is a mining town which was established in 1976 for workers engaged in the mining of base minerals such as zinc, tin, silver and copper. The Vedanta zinc mine has been established in recent times near Aggeneys.

There does not appear to be much tourism activity in the immediate surroundings of the proposed site. There is some tourism activity in the wider area, which includes angling and rafting on the Orange River, as well as 4-by-4 and hiking eco trails in the Pella-Aggeneys area.

Demographics
According to Statistics South Africa, the Namakwa District had a population of around 116 000 in 2011 (see Table 2). The Khâi-Ma Municipality had a population of 12 466 in the same year, which was up from 11 469 in 2001, implying an annual growth rate of 0.83% during this period. Pofadder had a population of 3 287 in 2011.

Table 2 Population numbers in the wider study area (2011)

Population Group	Northern Cape	Namakwa District	Khâi-Ma Municipality	Pofadder	Pella	Aggeneys	Onseepkans	Khâi-Ma Ward 1	Kai !Garib Municipality
Black African	576 986	7 904	2 195	122	69	522	396	1 268	18 657
Coloured	461 899	96 360	9 359	2 952	2 373	1 397	1 633	2 093	40 997
Indian or Asian	7 827	612	55	16	6	13	9	14	524
White	81 246	10 113	754	176	10	323	31	97	4 177
Other	17 903	853	103	21	12	6	21	48	1 514
Total	**1 145 861**	**115 842**	**12 466**	**3 287**	**2 470**	**2 261**	**2 090**	**3 520**	**65 869**

Source: StatsSA, 2012

Employment and sectors

The Northern Cape had an unemployment rate of 27% in 2011. This is higher than the rate for the Namakwa District (20%), as well as for the Khâi-Ma Municipal area (22%). Pofadder had the highest unemployment rate in the area at 44%, while Aggeneys had the lowest at 9% (see Table 3).

Table 3 Unemployment in the wider study area (2011)

Employment status	Northern Cape	Namakwa District	Khâi-Ma Municipality	Pofadder	Pella	Aggeneys	Onseepkans	Khâi-Ma Ward 1	Kai !Garib Municipality
Employed	282 791	33 684	4 600	660	465	998	679	1 737	27 853
Unemployed	106 723	8 471	1 304	520	284	99	350	416	3 096
% Unemployed	**27%**	**20%**	**22%**	**44%**	**38%**	**9%**	**34%**	**19%**	**10%**

Source: StatsSA, 2012

The informal sector provides around 18% of jobs in the Northern Cape (see Table 4). This figure is slightly higher for the Namakwa District (22%) and slightly lower for the Khâi-Ma Municipal area (16%). The settlements of Aggeneys and Onseepkans have low levels of informal sector employment: 3% and 1% respectively.

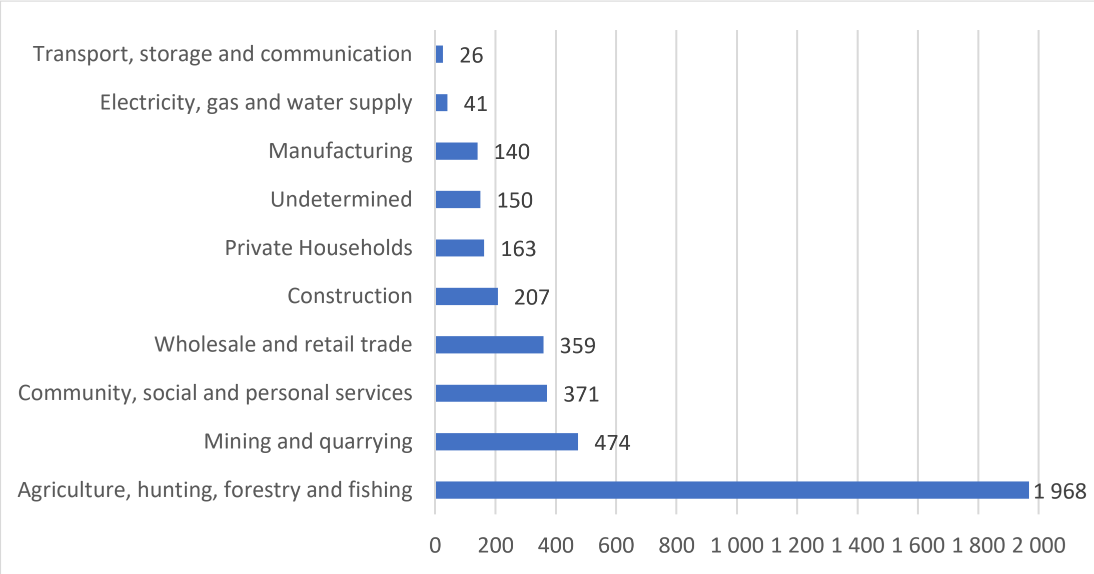
Table 4 Formal versus informal employment in the wider study area (2011)

Employment Sector	Northern Cape	Namakwa District	Khâi-Ma Municipality	Pofadder	Pella	Aggeneys	Onseepkans	Khâi-Ma Ward 1	Kai !Garib Municipality
Formal sector	205 824	24 383	3 590	554	327	906	662	1 490	19 914
Informal sector	43 863	6 762	690	73	94	25	8	218	4 739
% informal sector	**18%**	**22%**	**16%**	**12%**	**22%**	**3%**	**1%**	**13%**	**19%**

Source: StatsSA, 2012

When the census was conducted in 2011, the majority of employment in the Khâi-Ma Municipality was within the agriculture, hunting, forestry and fishing sector (1 968 jobs), followed by the mining and quarrying sector (474 jobs) and community, social and personal services (371 jobs). See Figure 2 for more information. It should be noted that a more recent employment sector breakdown would likely show more jobs in the renewable energy sector, which has been growing strongly in recent years (Discover South Africa, 2017). KaXu Solar One, situated adjacent to the proposed site, employs around 80 permanent staff members.

Figure 2 Employment numbers by sector in the wider study area (2011)



Income levels

The distribution of household per annual income level is quite consistent across the wider study area, with the highest proportion of households falling in the R19 601 to R38 200 category for the Northern Cape, the Namakwa District, the Khâi-Ma Municipality and Pofadder. Pella’s distribution reveals slightly lower household income levels, where 25% of households earn between R9 601 and R19 600 per year. Aggeneys has, on average, higher household income levels in keeping with it low unemployment levels. Here the majority of households (33%) earn between R76 401 and R153 800 per year, and only 2% of households reported earning no income, as opposed to Pofadder where this figure was 14% (see Table 5).

Table 5 Household incomes in the wider study area (2011)

Annual household income	Northern Cape	Namakwa District	Khâi-Ma Municipality	Pofadder	Pella	Aggeneys	Onseepkans	Khâi-Ma Ward 1	Kai !Garib Municipality
No income	12%	9%	8%	14%	12%	2%	10%	6%	6%
R 1 - R 4800	4%	3%	3%	4%	5%	0%	4%	3%	2%
R 4801 - R 9600	6%	5%	5%	6%	8%	1%	6%	5%	4%
R 9601 - R 19 600	19%	19%	18%	17%	25%	2%	24%	22%	26%
R 19 601 - R 38 200	21%	22%	22%	22%	23%	5%	28%	28%	27%
R 38 201 - R 76 400	15%	17%	19%	15%	13%	10%	18%	24%	18%
R 76 401 - R 153 800	10%	12%	13%	14%	9%	33%	6%	8%	8%
R 153 801 - R 307 600	7%	8%	7%	5%	2%	29%	3%	2%	5%
R 307 601 - R 614 400	4%	4%	4%	2%	1%	15%	1%	2%	3%
R 614 001 - R 1 228 800	1%	0.9%	0.6%	0%	-	2%	0.2%	0.3%	-
R 1 228 801 - R 2 457 600	0.3%	0.3%	0.2%	0.1%	-	-	-	-	-
R 2 457 601 or more	0.2%	0.3%	0.1%	0.2%	0.1%	0%	0%	0.2%	0.2%

Source: StatsSA, 2012

Education levels

Differences in education levels across the wider study area are somewhat correlated with differences in income levels. The proportion of people who had achieved Grade 12 in 2011 was 15% for the Northern Cape, 13% for the Namakwa District and the Khâi-Ma Municipality, and 14% for Pofadder. For Pella the figure is somewhat lower – 10%, while for Aggeneys it is higher at 19% (see Table 6).

Table 6 Highest education levels achieved in the wider study area (2011)

Highest education level obtained	Northern Cape	Namakwa District	Khâi-Ma Municipality	Pofadder	Pella	Aggeneys	Onseepkans	Khâi-Ma Ward 1	Kai !Garib Municipality
No schooling	11%	8%	7%	6%	7%	4%	8%	8%	10%
Some primary	24%	23%	22%	23%	27%	14%	28%	26%	27%
Completed Primary	6%	9%	8%	8%	10%	4%	9%	8%	8%
Some Secondary	28%	32%	36%	34%	34%	33%	36%	39%	33%
Grade 12	15%	13%	13%	14%	10%	19%	8%	10%	11%
Higher	3%	3%	3%	2%	1%	8%	1%	1%	2%
Other	0.4%	0.5%	0.4%	0.6%	0.2%	0.6%	0.1%	0.1%	0.2%
Not Applicable	12%	12%	11%	13%	10%	17%	11%	8%	10%

Source: StatsSA, 2012

Availability of municipal services

The proportion of households who live in temporary structures varies across the wider study area. In the Northern Cape, 13% of households reported living in a temporary structure in 2011. This figure was lower for the Namakwa District and for the Khâi-Ma Municipality, at 3% and 4% respectively. None of the households living in Aggeneys reported living in temporary structures, while only 3 households in Pella reported this (see Table 7).

Table 7 Dwelling types in the wider study area (2011)

Main dwelling type	Northern Cape	Namakwa District	Khâi-Ma Municipality	Pofadder	Pella	Aggeneys	Onseepkans	Khâi-Ma Ward 1	Kai !Garib Municipality
Permanent modern structure	248 312	31 766	3 268	778	594	566	346	894	14 766
Made of traditional materials	9 505	662	337	7	107	-	187	215	388
Temporary Structure	39 605	846	131	101	3	-	22	22	1 052
% Temporary Structure	**13%**	**3%**	**4%**	**11%**	**0.4%**	**0%**	**4%**	**2%**	**6%**

Source: StatsSA, 2012

As with dwelling types, water access varies across the study area. In 2011, 46% of households in the Northern Cape had access to piped water. This was slightly higher for the Namakwa District (63%) and about the same for the Khâi-Ma Municipality (45%) and for Pofadder (47%). Only 36% of households in Pella had access to piped water inside their dwelling, which is substantially lower than for Aggeneys (99%) (see Table 8).

Table 8 Access to water in the wider study area (2011)

Access to Water	Northern Cape	Namakwa District	Khâi-Ma Municipality	Pofadder	Pella	Aggeneys	Onseepkans	Khâi-Ma Ward 1	Kai !Garib Municipality
Piped water inside dwelling	46%	63%	45%	47%	36%	99%	30%	25%	41%
Piped water inside yard	32%	32%	47%	51%	61%	1%	66%	59%	42%
Community stand within 200m	13%	2%	4%	1%	1%	0%	1%	11%	9%
Community stand further than 200m	7%	1%	1%	0%	0%	0%	0%	2%	2%
No access to piped water	3%	2%	3%	1%	2%	0%	3%	3%	7%

Source: StatsSA, 2012

Socio-economic growth and development plans/priorities

In terms of future economic development goals, the 2016-2017 review of the 2012-2017 Integrated Development Plan (IDP) of the Khâi-Ma Municipality (KMM) is most instructive. According to this plan, the Municipality "has four main economic sectors: livestock grazing, mining, agriculture and tourism. The two emerging sectors are renewable energy and conservation and ecological restoration." (KMM, 2016: 82-83) The IDP identifies the following Strategic Pillars:

1. "Increased accessibility
2. Infrastructure investment

3. Wealth creation
4. Broadening the economic base
5. Attracting visitors and investors
6. Conducive LED environments"

Within the 4th Strategic Pillar of broadening the economic base, the following key priority areas are identified (KMM, 2016: 83):

- "Establish green business hub
- SMME opportunities
- Better service delivery
- Job creation
- Local entrepreneurship
- Promote investment
- Green energy development"

With regards to Pofadder in particular, the 2010 KMM Spatial Development Framework / Land Development Plan highlights the following priorities for development (KMM, 2010: 137):

"Pofadder should be developed as a primary activity node in terms of its strategic location on the N14, existing functions and services provided, expected future development considering the mining possibilities.

The aim should be to attract private and public investments to Pofadder to increase economic and social opportunities, to accommodate regional and sub-regional growth and to provide a full range of services and goods.

Pofadder needs to form the focus area to which catalyst development projects are directed providing for sustainable communities involving:

- Urban renewal initiatives and economic regeneration;
- Human resources development;
- Neighbourhood development;
- Upgrading and restructuring of engineering and social infrastructure;
- Urban management; and
- Transportation and roads"

The Namakwa District Municipality (NDM) IDP 2017-2022, as well as the 2018-2019 revision of the IDP, list the following as being strategic objectives for the area (NDM, 2017: 41; NDM, 2018: 53):

- "Monitor and support local municipalities to deliver basic services which include water, sanitation, housing, electricity and waste management
- Support vulnerable groups
- Improve administrative and financial viability and capability
- Promote and facilitate Local Economic development
- Enhance good governance
    - Promote and facilitate spatial transformation and sustainable urban development
    - Improve communication and communication systems
    - Establish a customer care system
    - Invest in the improvement of ICT systems
    - To render a municipal health services

- To coordinate the disaster management and fire management services in the district
- Implement the climate change response plan
- Caring for the environment"

The Namakwa District Municipality Rural Development Plan lists the following development priorities within the area (DRDLR, 2017: 54):

- Tourism development;
- Transport strategy;
- Linkages with Namibia;
- Renewable energy generation;
- Mining development; and
- Nodal policy"

8.6. IDENTIFICATION AND ASSESSMENT OF IMPACTS

This section provides an assessment of the impacts identified above and suggests management and mitigation actions to avoid or reduce negative impacts or to enhance positive benefits. Summary impact rating tables are provided in section 9 based on the methodology for assessment of impact significance provided by the EAP outlined in Appendix A.

The purpose of this study is to identify potential impacts that may occur during the construction, operational and decommissioning phases of development. It should be noted that decommissioning may not necessarily occur after the 20-year minimum life cycle of the project. Instead the facility could undergo a regeneration/refurbishment in which PV panels and other project elements are upgraded or replaced. This would result in temporary positive impacts including those from additional expenditure and temporary employment, as well as risks. Following the regeneration, operational impacts similar to those experience during the first 20 years of operations would continue to occur. Aside from this discussion, assessing the impacts from a potential regeneration phase are beyond the scope of this assessment and the probability of this phase occurring is unknown.

- **Key Issues Identified During the Scoping Phase**

The potential socio-economic issues or impacts identified during the assessment thus far include:

- Changes to the local economy resulting from expenditure and job creation
- Socio-economic implications surrounding the influx of people
- Issues which may potentially be raised by surrounding landowners
- Risks to the tourism industry resulting from land-use change.

I&AP comments on the scoping report, with specific relevance to socio-economic impacts, include one comment on social impacts that "The project might have adverse social impacts on the community and our staff are from the local community" from the General Manager of KaXu Solar One, the concentrated solar power plant on Scuit-Klip 92/4.

- **Overview of key Impacts resulting from the proposed development**

Aside from fit with planning and financial viability (and associated risks), the following impacts were identified as relevant for assessment at this stage based on the guidelines for socio-economic specialist inputs, information from I&APs inputs and consultations and the nature of the project and receiving environment:

1. Impacts linked to expenditure on project construction and operation
2. Impacts associated with the funding of local socio-economic development, enterprise development and shareholding
3. Social impacts associated primarily with the influx of people
4. Impacts on surrounding land owners
5. Impacts on tourism

Note that impacts on agriculture impacts are not assessed in this report as they are dealt with in a separate agricultural specialist study.

- **<u>Compatibility with policy and planning guidance</u>**

The issues discussed in this section would apply to the construction and operation of all three of the proposed Solar PV facilities as well as supporting infrastructure.

The proposed project's key strategic objectives can be summarised as providing additional generation capacity and grid stability whilst meeting national renewable energy and climate change targets. This section contextualises the project with respect to these objectives along with a wider consideration of the project's fit or compatibility with socio-economic and associated spatial development planning objectives and guidance.

- **<u>Energy policy imperatives and the environment</u>**

Historically, South Africa has relied heavily on non-renewable fossils fuels (primarily coal) for energy generation purposes. This reliance remains a key feature of the current energy mix with just over 90% of our electricity generation needs met by non-renewables. Given our abundance of coal reserves relative to most other countries, it is not particularly surprising that our energy mix favours coal and it is to be expected that coal will remain dominant at least in the short and medium term. However, substantial improvements in cost-effectiveness, imperatives with regard to global warming, other environmental impacts associated with 'dirty' fuels and energy security have elevated renewable energy solutions. Most governments in the global community now recognise that the roll-out of renewable energy will be needed among a number of other actions to curb global warming. In addition, the renewable energy industry is now a major economic sector contributing to socio-economic development goals.

With the above in mind, South African longer-term energy policy has rapidly changed from one that did very little to encourage renewable energy to one that actively encourages it. The first draft version of the national Integrated Resource Plan (IRP) released in 2010 set a target for 30% of new generation to come from renewables by 2030. This was subsequently increased to a target of 42% from renewables in the final IRP approved by cabinet in 2011. Meeting the target, and likely any revised targets in a new IRP, will require substantial investment given the extremely low base.

In order to facilitate the roll-out of renewable energy and meet ambitious targets, the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) was launched in 2011 to replace the previously mooted Renewable Energy Feed-In Tariff (REFIT) programme. Through the REIPPPP, aspirant renewable developers bid for contracts in terms of which government commits to purchase power from them in keeping with national targets. The REIPPPP has the following key features:

A two-phase tender system in which bidders must first meet qualification criteria (including legal, environmental and financial requirements) and will then be evaluated on bid price and economic-development objectives.
The programme's evaluation criteria currently scores 70% on price and 30% on a range of socio-economic development requirements.

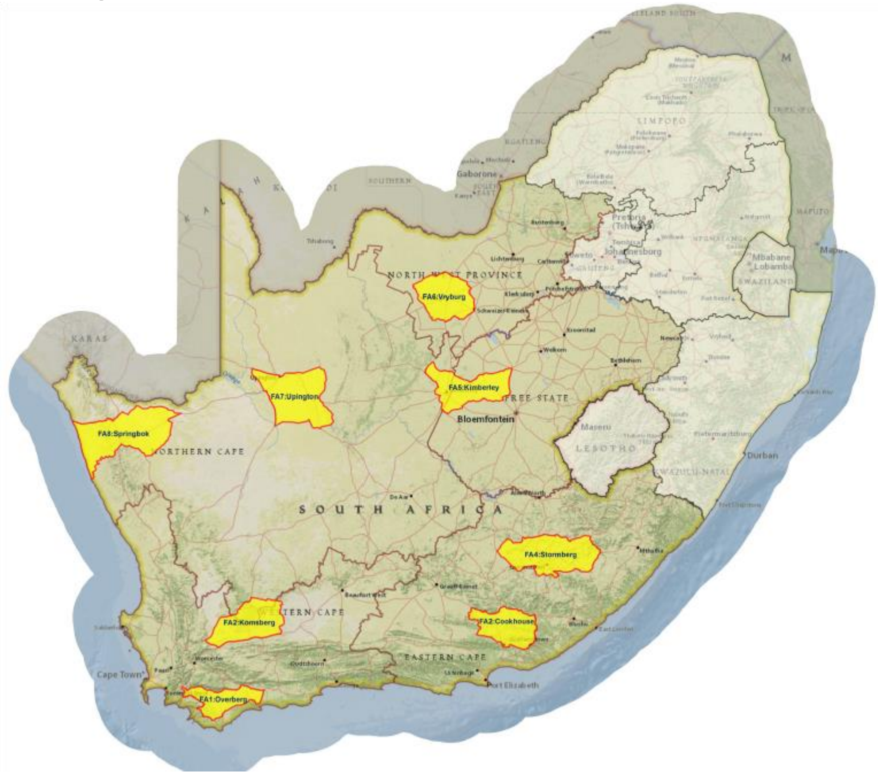
It is expected that the second phase of the IRP, out for comment soon, will be submitted to cabinet for approval and the Request for Proposals is then expected to be released in December 2018.

In summary, the policy case for the roll-out of renewable energy in South Africa has been made at a national and provincial government level using arguments that are in line with international policy trends. Targets that include solar energy have been set and incentives have been offered to renewable energy developers through the REIPPPP in order to encourage projects. Aside from impacts on the achievement of national goals and policy imperatives, the project also has the potential to contribute to greater energy supply stability and security in the province and local area to the benefit of local residential electricity consumers as well as farmers and businesses.

- <u>**Strategic spatial planning for solar and wind areas in South Africa**</u>

A Strategic Environmental Assessment (SEA) commissioned by the Department of Environmental Affairs in 2015 identified Renewable Energy Development Zones (REDZs) for the roll-out of wind and solar PV energy in South Africa. The identification of these areas is aimed at enabling the development of large-scale wind and solar PV energy facilities in a manner that avoids or minimises significant negative impact on the environment while being commercially attractive and maximizing socio-economic benefit to the country. The location of the REDZs is shown in Figure 3. The proposed project site falls in between Focus Areas 7 near Upington and Area 8 around Springbok.

Figure 3. Renewable Energy Development Areas identified in the Strategic Environmental Assessment indicating Focus Areas 7 and 8



Source: DEA, 2015

- **<u>Socio-economic development and spatial planning</u>**

Socio-economic development imperatives inform spatial planning imperatives. A critical aspect of socio-economic desirability is thus whether the proposed development complements economic planning as reflected in spatial development planning. Integrated Development Plans (IDPs) and their accompanying Spatial Development Frameworks (SDFs) are particularly important in this regard. SDFs are central to economic development planning and are drawn up in order to guide overall development in a direction that local and provincial authorities see as desirable. Indeed, the basic purpose of an SDF is to specify the spatial implications of IDPs designed to optimise economic opportunities.

The proposed development thus ideally needs to 'fit' or be compatible with what is envisaged in SDFs, structure plans and other planning documents in order for it to clearly 'fit' with the optimal distributions of economic activity as envisaged in these plans. Or, if it doesn't obviously fit with existing planning, there need to be clear and compelling reasons why a deviation from planning should be considered.

The following provincial and regional planning documents were found to be of relevance and were consequently reviewed:

- Northern Cape Provincial Development and Resource Management Plan / Provincial Spatial Development Framework
- Namakwa District Municipality Integrated Development Plan 2017-2022
- Namakwa District Municipality IDP Revision 2018/2019
- Namakwa District Municipality Rural Development Plan
- Khâi-Ma Local Municipality IDP 2017-2022
- Khâi-Ma Local Municipality IDP Revision 2018/2019
- Khâi-Ma Local Municipality SDF

Considered as a whole these documents recognise the importance of integrated and diversified economic development that makes optimal use of each area's comparative advantages and creates economic opportunities. The concept of a solar energy project is thus broadly supported provided environmental impacts and impacts on other land uses and potentials are acceptable.

At a provincial level, renewable energy is a key focus area and the potential of solar energy in particular is recognised in the Provincial Development and Resource Management Plan (DCGHSTA, 2012). This includes a recognition of the solar resource in the province as well as objectives focussed on the promotion and development of large-scale renewable energy supply schemes. The DCGHSTA (2012: 139) states that "… renewable energy projects are a high priority". At the district level, the Namakwa District Rural Development Plan lists renewable energy generation as one of six development priorities within the area (DRDLR, 2017), and the NDM IDP states that "[t]he Namakwa area has the highest solar radiation intensity in Southern Africa; which makes private and large-scale solar energy appropriate" (NDM, 2017: 46). Finally, at the local level, the Khâi-Ma Municipality has green energy development as one of its focus areas of the strategic pillar of broadening the economic base, as outlined in the IDP (KMM, 2016), while the KMM SDF lists the "employment of renewable energy technology" as a strategy forming part of "Spatial Objective 2: Create sustainable urban and rural settlements" (KMM, 2010: 134).

Summary

Based on the findings above, it can be concluded that the project is largely compatible with relevant energy policy imperatives around energy supply, diversification and security. It is also compatible with strategic spatial planning being done for solar energy development and with wider economic development and associated spatial planning for the area provided environmental impacts can be kept to an acceptable minimum.

- **Financial viability and risks**

The issues discussed in this section would apply to the construction and operation of all three of the proposed Solar PV facilities as well as supporting infrastructure.

Long term positive economic impacts can only flow from a project that is financially sustainable (i.e. financially viable in the long term with enough income to cover costs). As outlined in Section 5.1.1, the REIPPPP essentially ensures relatively low levels of financial risks for appropriate renewables projects in order to encourage these types of projects. The Project is thus highly likely to prove financially viable assuming it is able to secure a long term contract through the REIPPPP and then proceed to control its costs and meet revenue and other expectations - this has been confirmed with the applicant.

As mentioned previously, under the REIPPPP competitive bidding process, the relevant authorities will only be offering limited producers long term power purchase contracts. The Project will therefore have to compete with other projects. At this stage it is not possible to determine whether the Project will be one of those chosen - the adjudication process will determine this. The existence of a number of alternative solar energy developers and sites looking to access REIPPPP contracts means that the state can be selective in allocating contracts to those projects and project alternatives that meet stringent qualification criteria and offer the cheapest electricity and highest socio-economic development commitments.

The balance between financial benefits and costs are thus likely to be positive for the applicant and land owners partners barring unforeseen risks. These financial returns that motivate developments such as the proposed project are necessary as the promise of profit is what fuels much of our economy. The remainder of this report focuses on the economic impacts (including costs and benefits) that would accrue to wider society in order to provide information on the overall economic desirability of the project.

- **Impacts from expenditure on the construction and operation of the project**

The impacts assessed in this section would apply to the construction and operation of each of the three proposed 100 MW Solar PV facilities and their supporting infrastructure.

The construction and operational phases of the project would both result in positive spending injections into the area that would lead to increased economic activity best measured in terms of impacts on employment and associated incomes. Bear in mind that at this stage of project planning estimates of expenditure and employee needs are generally tentative and not detailed resulting in a broad level of assessment.

All new expenditures will lead to linked direct, indirect and induced impacts. Taking employment as an example, impacts would be direct where people are employed directly on the project in question (e.g. jobs such as construction workers), indirect - where the direct expenditure associated with a project leads to jobs and incomes in other sectors (e.g. purchasing building materials maintains jobs in that sector) and induced where jobs are created due to the expenditure of employees and other consumers that gained from the project. Direct impacts are the most important of these three categories as they are the largest and most likely to impact on the local area. Their estimation also involves the lowest level of uncertainty. The quantification of indirect and induced impacts is a far less certain exercise due to uncertainty surrounding accurate multipliers particularly at a local and regional level. This uncertainty makes it inadvisable to quantify indirect employment unless an in-depth analysis is required. Potential direct employment impacts are consequently quantified here and likely indirect impacts are considered in a qualitative sense when providing overall impact ratings.

Construction phase impacts

Construction expenditure would not displace other investment and would constitute a positive injection of new investment. During the construction phase the civil and other construction, specialised industrial machinery and building construction sectors would benefit substantially. The development would provide a major injection for contractors and workers in the area that would in all likelihood purchase goods and services in the local area and the wider region.

Preliminary estimates indicate that a total of between R900 million and R1.3 billion would be spent on the entire construction phase including infrastructure and building construction as well as other specialised machinery installation (see Table 9). The local area would benefit primarily from expenditure on civils and buildings. The majority of the more technical components of the facility would need to be imported as these items are not currently available in South Arica. Based on currently likely availability of inputs, in the third round of the IPP bidding process, the DoE has set a target a minimum threshold for South African content at 40% and a target at 65%. Notwithstanding the need for imports, the construction of the project represents a significant investment spread over roughly 12 to 18 months. Bear in mind that estimates are only meant to give an approximate indication of potential expenditure and are subject to revision.

Table 9: Construction expenditure estimate and likely allocation per area

	Spend in 2018 rands spread over construction phase		
100 MW PV plant			
Civils, roads and buildings	R 300 000 000	-	R 500 000 000
Solar PV array, inverters, mini-subs and other equipment	R 600 000 000	-	R 800 000 000
Total	**R 900 000 000**	**-**	**R 1 300 000 000**
On local suppliers within 50km	R 9 000 000	-	R 13 000 000
On suppliers in the rest of the Northern Cape	R 153 000 000	-	R 221 000 000
On suppliers in the rest of South Africa	R 297 000 000	-	R 429 000 000
On imports	R 441 000 000	-	R 637 000 000
Total	**R 900 000 000**	**-**	**R 1 300 000 000**

Employment during construction

In order to estimate direct temporary employment during construction standard construction industry estimates for labour required were used. Table 10 shows the employment that would be associated with the main components of the construction phase over 12 to 18 months (the estimated timeline for the construction of a single 100MW phase). Roughly 464 to 526 jobs of 12 to 18-month duration would be associated with the entire construction period of a single 100MW phase. Again, bear in mind that the estimates are not to be regarded as highly accurate and are meant to give an indication of potential impacts.

In keeping with the goal set out in the DoE scorecard for potential REIPPPP bidders, the applicant intends sourcing as high a possible portion of construction employees from the local area followed by the region and province.

Table 10: Estimated direct temporary employment during construction

Construction component	Number of workers: Highly skilled	Medium skilled	Low skilled	Total	Duration of employment
100 MW PV plant					
Civils, roads and buildings	5 - 7	12 - 16	90 - 110	107 - 133	12 - 18 months
Solar PV array, inverters, mini-subs, other equip.	9 - 11	18 - 22	330 - 360	357 - 393	12 - 18 months
Total	**14 - 18**	**30 - 38**	**420 - 470**	**464 - 526**	

Table 11 presents estimates of how much employment is likely to go to workers from different areas. It is anticipated that approximately 259 to 291 temporary jobs would be allocated to workers from the local municipal area and a further 184 to 208 jobs to workers from the rest of the province given the project's skills profile.

Table 11: Employment per area during construction

	Construction workers: Highly skilled	Medium skilled	Low skilled	Total
100 MW PV plant				
Anticipated % of workers from the local municipal area	5%	20%	60%	
Number from the local municipal area	1 - 1	6 - 7.6	252 - 282	**259 - 291**
Anticipated % of workers from the rest of the province	25%	40%	40%	
Number from the rest of the province	4 - 5	12 - 15.2	168 - 188	**184 - 208**
Anticipated % of workers from the rest of South Africa	67%	40%	0%	
Number from rest of SA	9 - 12	12 - 15.2	0 - 0	**21 - 27**
Anticipated % of workers from overseas	3%	0%	0%	
Number from overseas	0 - 1	0 - 0	0 - 0	**0 - 1**
Total	14 - 18	30 - 38	420 - 470	**464 - 526**

Incomes during construction

Direct household income impacts would flow from all wages paid during construction. These were estimated by multiplying the projected number of direct jobs associated with the project above by assumed average monthly salaries for each skill category (i.e. R6,000 for low skilled, R15,000 for medium skilled and R30,000 for highly skilled employees). Again, these estimates are to be treated as indicators. The results of this exercise in Table 12 indicate that incomes flowing to workers would be between R47 million and R55 million.

Table 12: Household incomes during construction (2018 rands '000)

	Direct income during construction (R '000): Highly skilled	Medium skilled	Low skilled	Total
100 MW PV plant				
Workers from local municipality area	R 294 - R 378	R 1 260 - R 1 596	R 21 168 - R 23 688	**R 22 722 - R 25 662**
Worker from the rest of the province	R 1 470 - R 1 890	R 2 520 - R 3 192	R 14 112 - R 15 792	**R 18 102 - R 20 874**
Workers from the rest of SA	R 3 940 - R 5 065	R 2 520 - R 3 192	R 0 - R 0	**R 6 460 - R 8 257**
Workers from overseas	R 176 - R 227	R 0 - R 0	R 0 - R 0	**R 176 - R 227**
Total	R 5 880 - R 7 560	R 6 300 - R 7 980	R 35 280 - R 39 480	**R 47 460 - R 55 020**

In addition to the above direct employment and associated income opportunities, a significant number of temporary indirect opportunities would be associated with the project. These would stem primarily from expenditure by the project in the local area and region as well as expenditure by workers hired for the construction phase.

Operational phase impacts

Once established, the operation of the facility would result in direct and indirect economic opportunities. These would stem from expenditure on operations including expenditure on employees that would not otherwise have occurred, particularly in the local area. It is anticipated by the applicant that between R6 million and R9 million would be spent annually on operations escalating gradually in line with inflation (see Table 13). The local area would benefit from annual expenditure between R1.2 and 1.8 million primarily in the form of salaries, municipal services, security, transport, supplies and general running expenses.

Table 13: Preliminary estimate of annual operational expenditure (2018 Rands)

Operational spend categories	Annual spend in 2018 Rands once project is fully operational
Salaries and wages	R 2 500 000 - R 3 800 000
Municipal services	R 1 000 000 - R 1 500 000
Outsourced engineering services	R 650 000 - R 1 000 000
Sundry supplies	R 280 000 - R 400 000
Other	R 1 570 000 - R 2 300 000
Total	**R 6 000 000 - R 9 000 000**
On local suppliers within 50km	R 1 200 000 - R 1 800 000
On suppliers in the rest of the Northern Cape	R 660 000 - R 990 000
On suppliers in the rest of South Africa	R 4 140 000 - R 6 210 000
On imports	R - - R -
Total	**R 6 000 000 - R 9 000 000**

Employment and associated incomes during operations

With regard to direct employment during operations, the below table outlines what should be expected. It is anticipated that between 35 and 44 direct employment opportunities would be created by the project equally spread across skill levels (see Table 14).

Table 14: Employment associated with operations

Employment categories	Number of employees				Likely annual salary per employee
	Highly skilled	Medium skilled	Low skilled	Total	
Site manager	1 - 2			1 - 2	R 840 000
Maintenance engineers	1 - 2			1 - 2	R 540 000
Maintenance workers	9 - 11			9 - 11	R 300 000
Security		11 - 13		11 - 13	R 70 000
Cleaning		1 - 2	12 - 14	13 - 16	R 65 000
Total	**11 - 15**	**12 - 15**	**12 - 14**	**35 - 44**	

It is anticipated by the applicant that between 25 and 30 jobs (roughly 70% of available opportunities) would go to residents of the local community (see Table 15). Available skills dictate that the majority of high skill positions will initially have to be filled by people from outside the local area and province in some cases. It should be possible and desirable to place locals in the majority of medium skill and all low skill positions, but it should be noted that this could prove challenging. The following section outlines the major towns and settlements within the Khâi-Ma Municipality from which the project should be able to source labour. These include Pofadder, Onseepkans, Pella and Aggeneys. Given the substantial number of renewable energy facilities planned in the area, it is likely that labour from the further-away towns (such as Pella and Aggeneys) will be more likely to seek work in facilities which are being developed nearer to them. Furthermore, discussions with the local municipality revealed that local businesses experience challenges in the area of employee retention. Many members of the local community have been out of work for extended periods, and so can have difficulty adjusting to the lifestyle required of full-time employees. There have been cases where employees from the local area have been absent from work for extended periods of time or resigned shortly after being hired (I. Kolberg, A. Green, Khâi-Ma Municipality; B. Josop, Ward 1 Councillor, pers com). These instances may have created an impression among some people that local employees are unreliable, making it more attractive for them to seek employees outside of the local area, such as from Kakamas and the other settlements surrounding Upington. It is important to note that the challenges faced when employing locals from the Khâi-Ma area can be addressed with an effective HR strategy, elements of which are discussed in the mitigation section below.

Employing workers from Onseepkans creates another challenge for employers. Despite Onseepkans being closer to the proposed facility, it is more difficult to reach given that the only way to do so is by gravel road. The municipal SDF notes that the upgrading of the road will provide substantial benefits to the local area, but no plans to do so are outlined as yet. As such, the gravel road marginalises the Onseepkans community and, according to the local ward councillor, the few workers from this community who are currently employed at the renewable energy facilities in the area are required to provide their own transport to and from work (B. Josop, Ward 1 Councillor, pers com). KaXu Solar One's General Manager has expressed a desire to provide support to upgrade the road to Onseepkans, but the substantial financial investment needed will likely require additional support from other partners (T. Rauch, KaXu Solar One, pers com).

Table 15: Operational employment per area

	Operational employees			
	Highly skilled	**Medium skilled**	**Low skilled**	**Total**
100 MW PV plant				
Anticipated % of workers from the local municipal area	5%	80%	100%	
Number from the local municipal area	1 - 1	12 - 15	12 - 14	**25 - 30**
Anticipated % of workers from the rest of the province	55%	20%	0%	
Number from the rest of the province	6 - 8	0 - 0	0 - 0	**6 - 8**
Anticipated % of workers from the rest of South Africa	40%	0%	0%	
Number from rest of SA	4 - 6	0 - 0	0 - 0	**4 - 6**
Anticipated % of workers from overseas	0%	0%	0%	
Number from overseas	0 - 0	0 - 0	0 - 0	**0 - 0**
Total	11 - 15	12 - 15	12 - 14	**35 - 44**

Aside from these direct employment opportunities, the operational expenditure on the project (detailed above) and the spending of those employed directly would result in positive indirect impacts on the local and regional economy. Essentially those that secure jobs on the project would spend some portion of their increased income on local goods and services generally purchased by households. This would benefit those businesses where the money is spent.

As the project site is currently being used as farmland, the farm manager was asked whether the project would be likely to reduce agricultural activity to the extent that employment would be adversely affected. As the farm currently only employs one worker in addition to the manager, the conclusion was that the project, and the associated reduction in land available for grazing, would not lead to a reduction in employment on the farm.

The potential for the project and other future solar energy projects to result in greater impacts on local economies and the South African economy as a whole is primarily dependent on economies of scale. Currently, import content is necessarily high. However, as the solar programme grows in size (aided by projects such as the Paulputs Solar PV project) it should provide opportunities for manufacturing and servicing at scale and the additional benefit that would flow from it. The intention of the DoE is also clearly in this direction and it has gradually increased local content targets with this in mind.

Mitigation measures

National government is placing significant emphasis on the local economic development initiatives which renewable energy project developers propose when deciding which projects to support financially. This should ensure that only projects which have made significant commitments to this aspect will be selected as preferred bidders in the REIPPPP. Section 8.17 contains the DoE scorecard with regard to its economic development sub-criteria covering aspects such as job creation, local content, ownership, management control, preferential procurement, enterprise development and socio-economic development. Among other things, the scorecard should ensure that project developers pay attention to:

- Setting targets for how much local labour should be used based on the needs of the applicant and the availability of existing skills and people that are willing to undergo training. Opportunities for the training of unskilled and skilled workers from local communities should be maximized.
- Using local sub-contractors where possible and requiring that contractors from outside the local area that tender also meet targets for how many locals are given employment.
- Exploring ways to enhance local community benefits with a focus on broad-based BEE and preferential procurement, etc. (Provision for this should be made in an Industrial Relations Policy, which should, together with input from local stakeholders, inform a Service Level Agreement intended to guide procurement and employment to ensure optimisation of local socio-economic impacts stemming from expenditure) (Z. Botha, Juwi, pers com).

The DoE requirements for local benefit enhancement that would be included in the project are adequate in principle. Their fair and transparent application will, however, require extensive interactions and collaborative engagement with the local community and its representatives. The applicant should therefore ensure that adequate time and resources are devoted to these activities. Particular attention should be paid to the following objectives, some of which are derived from discussions with the General Manager of the neighbouring KaXu Solar One Solar Facility board (T. Rauch, KaXu Solar One, pers com):

Setting up a skills and services database in partnership with the local municipality and civil society for the local area before any hiring or contracting decisions are made. This can help to ensure fairness and limit potential interference in hiring processes.

An effective employee induction programme is essential to ensuring that new employees, some of whom will be unfamiliar with the responsibilities of maintaining employment, are adequately prepared and motivated to adjust to the lifestyle required of them. This programme should incorporate life skills training as well as basic financial literacy training.
Counselling services should be made available to employees to ensure that they have adequate guidance throughout their careers.
Assisting smaller enterprises where possible in tendering for contracts and in accessing finance which are common constraints to their participation in projects.
Avoiding potential service provider decisions that may lead to abuse or local dissatisfaction. For example, only appointing one accommodating rental agent or one catering supplier may lead to local dissatisfaction regarding the spreading of project benefits.
As far as possible, avoid significant variation in salaries between various contractors for the same types of jobs. When variations are too high, the likelihood of dissatisfaction increases.

It is also important to anticipate that there are likely to be people whose (potentially unrealistic) expectations will not be met leading to dissatisfaction. This is difficult to avoid and can affect community relations. However, its impacts can be lessened by ensuring that all local benefits are carefully monitored and also communicated to local communities.

Significance of impacts

Impacts during construction with the mitigation proposed would be of a moderate significance given the size of the expenditure injection, construction period and the number of potential employment and income generation opportunities involved.

Impacts during operations with the mitigation proposed, for each of the three 100 MW phases, would be positive with a moderate to high significance with mitigation at a regional scale. With time local impacts should become more pronounced as the sourcing of goods and services becomes easier.

The no-go would have no impact in the locality relative to these benefits as there would be no expenditure injection. Government renewable energy targets will still need to be met even if the project (or any other renewable energy project) is not approved. To a degree, expenditure that would have flowed from the project would therefore essentially be ‘replaced’ by expenditure on other renewable energy projects that are given approval. It is not possible to confidently predict where these projects would occur other than to say that the government seems committed to matching need for energy with spreading projects, and the investment that they bring, throughout the country.

Decommissioning would essentially result in no more operational expenditure or jobs associated with the project which would result in negative impacts as the project is withdrawn from the economy.

- **Impacts associated with the funding of local socio-economic development, enterprise development and shareholding**

The impacts assessed in this section would apply to the construction and operation of each of the three proposed 100 MW Solar PV facilities and their supporting infrastructure.

The project applicant intends ensuring that a relatively large portion of the proceeds from the project make a contribution to socio-economic development particularly in the local area. This is in keeping with the requirements of the REIPPPP bidding process in which significant contributions to economic development are mandatory for all bidders. These requirements distinguish between ‘thresholds’ (i.e. minimum requirements that must be met) and ‘targets’ (i.e. amounts that should be aimed for in order to increase the chances of a successful bid) as outlined in latest Economic Development Scorecard associated with the REIPPPP bidding process, of 2015. They include the following categories of contribution:

- A minimum/threshold of 1% and a target of 1.5% of annual revenue to be committed to Socio-economic Development Contributions in the local community.
- A target of 0.6% of annual revenue should be earmarked for Enterprise Development (there is no minimum threshold for this aspect but it was assumed the applicant would reach a minimum of 0.3%).
- A minimum/threshold of 2.5% and a target of 5% of the shares in the project to be reserved for the local community.

Table 16 presents the results of this exercise and shows that between R1.1 million and R1.6 million per year, per 100MW phase, should flow to the local community from the applicant's likely Socio-economic Development Contributions. The project is anticipated to generate between R420 000 and R610 000 for Local Community Shareholders. In addition, between 405,000 and R525,000 per year would be contributed to enterprise development in the local community. The Table below also shows the likely present values of these flows of funds to the local community over 20 years. This is done by discounting future annual contributions using a range of discount rates from 0% (i.e. no discounting) to 3.5%. The results of discounting at 2.5% are recommended as the most realistic base case and reflect the recent real (i.e. after inflation) returns on 10-year government savings bonds.[17] They indicate that all future fund flows are likely to have a present value of between R30 million and R43 million (i.e. one would need to have this magnitude of funds available for investment today in order to be able to receive, as an annuity, the annual amounts of fund flows). This is a significant flow of funds and, assuming good fund management and project selection, it has the potential to result in the creation of significant economic opportunities in the local area.

Table 16: Potential funding flows to socio-economic and enterprise development initiatives

Contribution category	**Annual amount accruing to the local community smoothed over lifetime of project**		
	Threshold/minimum requirement	*Target*	*Average between threshold and target*
Socio-economic Development Contribution	R 900 000 - R 1 300 000	R 1 350 000 - R 1 950 000	R 1 125 000 - R 1 625 000
Local Community Shareholding	R 281 250 - R 406 250	R 562 500 - R 812 500	R 421 875 - R 609 375
Enterprise Development Contribution	R 270 000 - R 270 000	R 540 000 - R 780 000	R 405 000 - R 525 000
Total	**R 1 451 250 - R 1 976 250**	**R 2 452 500 - R 3 542 500**	**R 1 951 875 - R 2 759 375**

Discount rate	**Net Present Value of all annual funds accruing to the local community discounted over 20 years**		
	Threshold/minimum requirement	*Target*	*Average between threshold and target*
0%	R 29 025 000 - R 39 525 000	R 49 050 000 - R 70 850 000	R 39 037 500 - R 55 187 500
1.5%	R 24 915 987 - R 33 929 522	R 42 106 087 - R 60 819 903	R 33 511 037 - R 47 374 713
2.5%	**R 22 623 772 - R 30 808 082**	**R 38 232 421 - R 55 224 607**	**R 30 428 096 - R 43 016 345**
3.5%	R 20 625 750 - R 28 087 262	R 34 855 919 - R 50 347 439	R 27 740 835 - R 39 217 350

In order to predict the impacts resulting from socio-economic development contributions, enterprise development and shareholding it is instructive to consider the experience of the existing renewable energy facilities in the area. According to the General Manager of the KaXu Solar One facility, there is a working group in the area which is dedicated to a joint determination of how socio-economic

[17] Discounting is necessary as money received one year from now is worth less in today's terms due to positive real interest rates – e.g., one would need to invest less than R1000 today in order to have the equivalent of R1000 one year from now assuming positive real interest rates or investment returns (i.e. returns that exceed inflation).

development contributions should be used (T. Rauch, KaXu Solar One, pers com). Local municipal officials interviewed, however, felt that the municipality had not been adequately included in these discussions, and that information regarding this expenditure was not being shared with them (A. Green, I. Kolberg, Khâi-Ma Municipality, pers com). The Ward Councillor for Ward 1 had similar concerns (B. Josop, Ward 1 Councillor, pers com).

On the point of enterprise development, some challenges had been experienced. One such example is the experience of the Abengoa KaXu Solar One facility with transportation companies providing sub-standard services. After repeated attempts to rectify the situation, in some cases supplier development targets were not met. The company thus provided DoE with evidence that attempts had been made to support local suppliers as could be reasonably be expected of them before turning to service providers from outside the local area (T. Rauch, KaXu Solar One, pers com).

Mitigation

Mitigation measures inherent to the project design include (Z. Botha, Juwi, pers com):

- The applicant should seek to optimise the socio-economic development, enterprise development and shareholding impacts through an economic development policy, a BBEEE policy and an industrial relations policy. The latter should be expanded upon according to each project to create a service level agreement, which would be applied to sub-contractors in each project. These documents are intended to guide local procurement, socio-economic development, and shareholding-related processes to ensure that they are beneficial to all local stakeholders.
- The applicant will establish a communications committee early on in the project to ensure regular feedback from stakeholders.
- Community development will be guided by a Community Needs Analysis, drawn up by a 3rd party and based on local socio-economic conditions, a review of planning documents such as the IDP, and discussions with local government and community representatives. Interventions will then be guided by the Community Needs Analysis in collaboration with other energy developers in the area where possible.
- The Department of Energy (DoE) intends monitoring the compliance of Independent Power Producers with the commitments that they make to local socio-economic development as part of the bidding process. The environmental authorities should therefore liaise with the DoE in order to gather information regarding compliance with the applicant’s commitments.

Key mitigation measures proposed by the specialist include:

- Close liaison with local municipal managers, local councillors and other stakeholders involved in socio-economic development is required to ensure that any projects are integrated into wider strategies and plans with regard to socio-economic development. This is particularly important given that local government representatives have expressed concern on this point with regards to existing renewable energy facilities in the area.
- Other renewable energy producers and mineral extraction companies in the area already have a wide array of socio-economic development projects including an education trust, agricultural support projects and water and housing infrastructure development projects (T. Rauch, Abengoa, pers com). Of these projects, those which are in line with existing local government policies and plans, as outlined in the IDP and SDF, should be considered for support with the funds generated by the proposed project.

Significance of impacts

Based on the considerations outlined above, impacts during operations with mitigation are predicted to be of a moderate positive significance for each 100 MW project.

As discussed, although projected financial flows to socio-economic development are likely to be significant, actual outcomes will be highly dependent on the projects chosen for funding and their management.

The no-go alternative would not result in impacts as it would maintain the status quo.

Decommissioning would essentially result in the removal of funding along with its attendant benefits.

- **Impacts associated primarily with the influx of people**

The impacts assessed in this section would apply to the construction and operation of each of the three proposed 100 MW Solar PV facilities and their supporting infrastructure.

Community concerns are common especially in smaller communities regarding the negative impacts associated with an influx of outside workers particularly during the construction of large projects. These concerns include those associated with negative impacts on social structures and increased 'social ills' such as increased crime levels, increased alcohol and drug use, increased teenage and unwanted pregnancies, increased prostitution and increases in sexually transmitted diseases (STDs). These types of impacts are more commonly associated with the influx of people looking for work without success, but can also be associated with workers that do find work. Discussions with representatives of the local municipality revealed that there was some concern locally regarding increased drug use and prostitution, as well as the associated risks which this presents for family structures and the local community's social fabric following what has been observed so far with the influx of construction workers and other short-term contractors (I. Kolberg, A. Green, Khâi-Ma Municipality, pers com).

Potential impacts of this nature have been assessed in detail as part of the social specialist studies for other renewable energy projects in small communities the finding of which are drawn on here (see Barbour and van der Merwe, 2012 and van Zyl and Barbour, 2014 in particular). Barbour and van der Merwe note that while the presence of construction and other workers does not in itself constitute an impact, the manner in which workers conduct themselves can affect the local community and lead to increased social ills. They also make the observation that likely impacts are related to the number of employment opportunities that would go to non-locals and how the recruitment process is managed.

As previously mentioned, the applicants have indicated that they are committed to implementing a 'locals first' employment policy where possible and are indeed incentivized to do so under the REIPPPP. It is expected that a significant proportion of workers would be sourced locally especially low and medium skilled workers. These workers would already be part of the local community and its social structures thereby reducing the risk posed by influx.

Mitigation

Mitigation measures inherent to the project design include:
- A 'locals first' policy with regard to construction and operational labour needs.

- The community will be able to contact the site manager to report any issues which they may have. The site manager will be stationed within the area and will therefore be available on hand to deal with and address any concerns which may be raised.
- A complaints register will be available on site to any individual who may have a particular complaint with regards to the construction or operations processes.

Key mitigation measures proposed by the specialist include:[18]

- The applicant should establish a Monitoring Forum for the project. The Forum should be established before the construction phase commences and should include key stakeholders, including representatives from the local community, local municipal workers, local councillors, farmers, and the contractor. The role of the Forum would be to monitor the project and the implementation of the recommended mitigation measures.
- The applicant and the contractors should, in consultation with representatives from the Monitoring Forum, develop a Code of Conduct for the project. The code should identify what types of behaviour and activities by workers are not permitted in agreement with surrounding land owners. For example, access on land that is not part of the development will not be allowed (no short cuts by workers going from home to site over land that is not part of the project).
- The applicant and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase;
- The contractor should make the necessary arrangements for ensuring that all non-local construction workers are transported back to their place of residence once the construction phase is completed.
- Close coordination with the municipality is required, including regular meetings. The local community hold local government accountable for impacts resulting from the influx of people. Thus, as an existing focal point, it is important that local government plays a part in addressing these issues and efforts should be made by the applicant to involve the municipality in developing mitigation measures as needed and sharing information (including information about procedures surrounding employment and supplier involvement) with members of the public.

Significance of impacts

It is anticipated that with mitigation the threat posed to the community by influx would be manageable. This comes with the caveat that the impact on individuals affected community members has the potential to be high (for example, for an individual being affected by crime).

With the effective implementation of mitigation measures, the significance impacts for each of the 100MW projects is predicted to be of a low negative significance during construction and operations.

The no-go would have no impact relative to the status quo.

Decommissioning should increase the potential for an outflow of people from the local area in search of jobs elsewhere unless alternative opportunities are created locally or nearby.

[18] Partially drawing on Barbour and van der Merwe (2012) and van Zyl and Barbour (2014).

- **Impacts on surrounding land owners**

The impacts assessed in this section would apply to the construction and operation of each of the three proposed 100 MW Solar PV facilities and their supporting infrastructure.

As is often the case with large projects, concerns are usually raised by surrounding land owners that relate to potential negative impacts associated mainly with greater activity nearby and the presence of workers on the site particularly during construction. These concerns essentially include:

- Further deterioration of local roads
- Greater risk of increased dust levels
- Increased risk of crime such as stock theft and poaching
- Damage to farm infrastructure such as fences
- Increased littering
- Increased potential for veld fires

Discussions with local stakeholders revealed that there have been some issues in the past regarding gravel roads in the area not being adequately maintained with increased traffic resulting from the development of the three neighbouring renewable energy facilities (S. van der Colf, Konkoonsies 91; T. Rauch, Abengoa; F van den Heever, neighbouring landowner, pers com). Any increase in traffic on these and other roads that would be associated with the project thus has the potential to create a similar situation, particularly on the gravel road running north/south between the R358 and the N14. There are several homesteads in close proximity to this road. As impacts relating to increased traffic are covered by a traffic specialist report forming part of the EIA, they are not discussed further in this report.

Experiences with the influx of construction workers associated with the Eskom sub-stations and transmission lines in the area, as well as with the renewable energy facilities which have already been constructed, have also made land owners particularly wary of the risks that come with the introduction of a significant labour force into the area (F van den Heewer, FN Brand, M Brand, Klasie Brand, neighbouring landowners, pers com). More people in farming areas are seen as a risk factor for trespassing, theft, damages to farm infrastructure and equipment, littering along with veld fires. These types of concerns and potential impacts have been assessed in detail as part of the social impact assessments for other renewable energy and similar projects the findings of which are drawn on here (see Barbour and van der Merwe, 2012 and van Zyl and Barbour, 2014 in particular). In essence these studies have found that these issues are relatively common risks but that their significance can be reduced to low levels with adequate mitigation discussed below.

One of the neighbours (who would prefer not to be named in relation to this concern) mentioned that he believes that the geology of the area is such that when drilling to anchor foundations occurs as part of construction, the vibrations can travel far enough to cause damage to houses in the area. The applicant does not foresee this as being a problem, given their understanding of the geology, the kind of construction being undertaken and the distances between the project site and surrounding houses. As a precautionary measure, mitigation is proposed below for this potential impact focussed on conducting the necessary engineering assessment prior to construction.

Mitigation

Mitigation measures inherent to the project design include:

- No construction workers, with the exception of security personnel, will be allowed to stay on the site overnight.
- The community will be able to contact the site manager to report any issues which they may have. The site manager will be stationed within the area and will therefore be available on hand to deal with and address any concerns which may be raised.
- A complaints register will be available on site to any individual who may have a particular complaint with regards to the construction or operations processes.

Mitigation measures proposed by the specialist include:[19]

- As mentioned previously, the applicant and Monitoring Forum should develop a Code of Conduct for the project. The Code should identify what types of behaviour and activities by workers are not permitted in agreement with surrounding land owners.
- The movement of workers on and off the site should be closely managed and monitored by the contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting workers to and from site on a daily basis.
- The applicant should implement measures to assist and, if needed, fairly compensate potentially affected surrounding landowners whereby damages to farm property, stock theft or significant disruptions to farming activities can be minimized or reduced. Measures should be agreed on before construction commences. For these to be fairly dealt with, it will be necessary to set up a Monitoring Programme in collaboration with neighbouring land owners that is specifically designed to provide clarity on impacts and risks. Aspects or risks that should be monitored need to be agreed on with neighbouring land owners. The applicant should formally commit to mitigation and potential compensation actions that may arise from the Monitoring Programme.
- A fire management plan should be drawn up prior to construction in agreement with neighbouring land owners. This plan should clearly specify what types of behaviour would not be acceptable with appropriate sanction for transgressions. The applicants should also ensure that they join the local fire protection agency. Fire breaks around the site should be constructed as a first order of business before any other construction works begin.
- The EMPr must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested.
- Project engineers should determine whether the construction phase of the project will involve drilling which is capable of causing damage to surrounding structures and, if so, the applicant should seek to resolve this impact through an agreement with any affected landowners.

Significance of Impacts

All of the risks discussed above are considered manageable. Based on these findings, impacts on surrounding landowners have been rated as low for all three 100MW phases, provided that the above mitigation measures are implemented.

The no-go would have no impact relative to the status quo.

Decommissioning would entail the end of project-associated activity in the area, and thus a cease to all impacts on surrounding landowners.

[19] Partially drawing on Barbour and van der Merwe (2012) and van Zyl and Barbour (2014).

- **Impacts on tourism**

The impacts assessed in this section would apply to the construction and operation of each of the three proposed 100 MW Solar PV facilities and their supporting infrastructure.

As was outlined in the economic context section, tourism is not the most important economic sector in the local economy. It is, however, recognised as important in economic and spatial development planning and has the potential to play an increasingly prominent role as a driver of economic development. It is thus important to consider the potential impacts of the proposed development on this sector. Tourism impacts are often driven by changes in the sense of place in an area. The proposed development thus has the potential to impact on tourism as its nature dictates that it is likely to change the character of the area.

In order to assess tourism impacts, information on current tourism use and potential future use focusing on the area surrounding the site was gathered using planning documents for the district and local municipalities, accommodation search websites including SafariNow, AirBnB, Google Maps as well as the Discover Namakwa Travel Directory. In order to further explore the existence of tourism issues, pertinent information from other specialist studies was examined and an assessment of impacts made. In this regard the visual specialist study was most relevant.

Direct tourism use does not occur within the boundaries of the site. The site is nevertheless part of the tourism package of the area, and it could possibly be seen from some vantage points on routes which may be used by tourists (primarily the N14 and R358, although the closest points to the site along both these routes are roughly 20km away). There do not appear to be any tourist accommodation options within a 10km radius of the proposed site. The closest tourist accommodation facilities are the Oranjedal Guesthouse and the Red Rock River Camp, both in Onseepkans, followed by the facilities in Pofadder. There are some attractions in the wider area including angling and rafting on the Orange River (the closest points along the river being roughly 20 km to the West and to the North-West of the site), 4X4 and hiking eco trails in the Pella-Aggeneys area, as well as the Pilgrimage Trail and the Historic Copper Mining Trail, both of which extend from the town of Pella towards the coast in the west (Discover South Africa, 2017). The NDM IDP also categorises the wider area as forming part of the "*River and Grapes Cluster including areas around Upington, Groblershoop, Keimoes, Kakamas, Augrabies National Park for wine tourism in a desert setting, farming community lifestyle and rural culture, natural wonder in the Organe River and Augrabies falls, etc." (NDM, 2017: 58). It can be seen that the description of the River and Grapes Cluster does not give specific mention to the immediate area surrounding the project site. Likewise, the KMM SDF does not mention this area specifically in its description of the tourism character of the municipal area: "The Khai Ma environment is characterised by vast open land, unique topographical features (i.e., mountain ranges, Bushmanland, Inselberg, wilderness areas along the Orange River, etc.) and rich heritage of the Khoi San/Nama people as well as the cathedral at Pella provides ample eco-tourism, adventure tourism and cultural tourism opportunities.*" (KMM, 2010: 115)

There does not seem to be potential for the project to have any significantly negative impacts on tourism in the surrounding area and region. All of the tourism facilities and activities identified are far enough from the site that it is hard to see how they would be impacted. Furthermore, the visual impact assessment study did not identify any potentially sensitive tourism visual receptors in the area or designated scenic routes nearby. It predicts an overall visual impact of a low to medium significance with mitigation during the operational phase and points out that, although the surrounding area is renowned for its expansiveness and wilderness quality, it has already been altered to some extent by the neighbouring solar energy facility and powerlines (Lawson and Oberholzer, 2018).

The three proposed projects have the potential to result in a slight boost in tourism to the project area through its facilitation of increased business tourism. The positive impacts resulting from this will have been included in the estimates of the expenditure which will result from the proposed project, some of which will go towards accommodation and other expenses incurred by the company for contractors and employees visiting the project site. Other positive impacts would be more indirect as trips for work purposes can lead to an extended stay or lead to return visits for leisure when project personnel are exposed to the attractions of the area and the wider country. Personnel may also recommend the area to others as a tourist destination. This study will not quantify these impacts, but they are expected to be of low positive significance.

Mitigation

Impacts on tourism are dependent on how the site is developed and managed to minimise negative biophysical impacts. The measures recommended in other specialist reports to these impacts (primarily the minimisation of visual and ecological impacts) would thus also minimise tourism impacts.

Significance of impacts

It seems most reasonable to conclude that neither of the projects make a significant change to the current sense of place of the site and surrounds and would not introduce significant tourism risks. They have been rated as having a very low significance with mitigation during the construction and operational phase for all three 100 MW phases.

The no-go would have no impact relative to the status quo with regard to tourism.

Decommissioning would essentially result in the removal of tourism risks with adequate rehabilitation of the site.

8.7. ASSESSMENT OF CUMULATIVE IMPACTS

Cumulative impacts are defined as those which result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (CEQ, 1997). Bear in mind also that the distinction between cumulative and other impacts is often extremely difficult to make. The assessment of cumulative impacts is also generally more difficult primarily as they often require more onerous assumptions regarding the likely actions of others.

Cumulative impact assessment considered two distinct scenarios:

- The construction and operation of 1 x 100MW solar PV facility and associated infrastructure, as well as all other renewable energy projects approved or under environmental assessment process within 100km of the project site.
- The construction and operation of 3 x 100MW solar PV facility and associated infrastructure, as well as all other renewable energy projects approved or under environmental assessment process within 100km of the project site.

The list of projects which were considered in addition to the Paulputs project include four wind energy projects (of which all are currently undergoing scoping and EIA), 45 solar PV energy projects (of which 37 have been approved and 8 are currently undergoing either scoping and EIA or basic assessment), as well as 19 other renewable energy projects including CSP (of which 18 have been approved and 1 is in the process of being considered for environmental authorisation) .

The following discussion will apply to both of the scenarios outlined above. This is because, in terms of cumulative impacts, there is relatively little difference between the two scenarios, and certainly not enough to cause a significant difference in the likelihood or overall significance of impacts resulting from either combination of projects.

Potential cumulative impacts include the following:

- Impacts linked to project expenditure
- Impacts associated with the funding of local socio-economic development initiatives
- Social impacts associated primarily with the influx of people
- Impacts on surrounding land owners
- Impacts on tourism

Impacts linked to project expenditure

Cumulative impacts would be associated with significantly greater expenditure on the projects in the wider area. For example, one 100MW project would provide approximately between 30 and 50 ongoing direct employment opportunities. An additional 68 somewhat similar projects should eventually provide thousands of operational jobs per annum. Positive cumulative impacts are also likely to stem from the fact that the project should set a positive precedent for further investment in the area. By committing to investment in large developments, the applicants would be casting a strong ‘vote of confidence’ in the local economy. This has the potential to influence other investors (including locals) to also act with similar confidence thereby resulting in cumulative impacts on overall investment levels.

Overall cumulative impacts should reach high significance levels given the size of the investments involved relative to the size of the local economy. In a sense the projects have the potential to lead to the ‘crowding in’ of further investment. As has been noted, if the renewable energy industry grows in size (aided by the proposed project) it should provide opportunities for manufacturing and servicing at scale and the additional, cumulative benefit that would flow from it.

Impacts associated with the funding of local socio-economic and enterprise development initiatives

Similar to the case of project expenditure, the total cumulative funding of local socio-economic and enterprise development associated with 68 additional projects would generate a substantial amount of economic activity and would have a highly significant impact.

Social impacts associated primarily with the influx of people

The cumulative impact associated with numerous projects going ahead would be a substantial increase in the likelihood of more significant influxes of people to the area whether they have jobs secured or are job seekers. This should result in a higher risk of social problems associated with influx particularly during construction. Risks would be greatest if all projects proceed in relatively quick succession and lower if they are introduced more gradually thereby allowing for a more orderly introduction of new people to the local area.

Impacts on surrounding land owners

The cumulative impact associated with numerous projects going ahead would be a substantial increase in the potential severity of impacts on surrounding land owners. There would be a greater number of projects which would result in greater risks with respect to potential negative impacts associated with changed land use, greater activity nearby and the presence of workers in the area particularly during construction. These concerns essentially include further deterioration of local gravel roads, increased risk of stock theft and poaching, damage to farm infrastructure such as fences, increased littering, increased potential for veld fires and visual impacts.

Risks would be highly significant if all projects proceed in relatively quick succession and lower if they are introduced more gradually thereby allowing for a more orderly introduction of projects and people to the local area. It is, however, anticipated that the projects will come on line in a staggered manner, as the REIPPPP process has thus far awarded on average around six projects at a time in each technology category.

Impacts on tourism

The cumulative impact associated with numerous projects going ahead would increase in the potential severity of tourism risks. The concern would be that if these projects all go ahead, the area would become visually dominated by solar installations with consequences for tourism. In addition, the overall character of the area may be impacted on in that it would become more industrial in nature.

Should all of the projects go ahead, these types of projects would certainly become a prominent feature of the local environment. Bear in mind, however, that there are also relatively few tourism assets or facilities in the area that could be at risk. Business tourism would receive a significant boost. Cumulative risks have thus been rated as having a low to moderate significance when considered for the wider area.

8.8. IMPACT ASSESSMENT SUMMARY

- **Construction Phase**

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Project expenditure	Expenditure related impacts on jobs etc.	Positive	Regional	Short-term	Substantial	Definite	Low	Low	As outlined in the EMPr inputs section below.	Moderate	Moderate	Moderate
Influx of workers	Social impact associated with an influx of people	Negative	Regional	Short-term	Moderate	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Moderate	Low	Low
Presence of facility and workers	Impacts on surrounding land owners	Negative	Local	Short-term	Moderate	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Moderate	Low	Low
Visual and other impacts	Impacts on tourism	Negative	Local	Short-term	Slight	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Low	Very low	Very low

- **Operation Phase**

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Project expenditure	Expenditure related impacts on jobs etc.	Positive	Regional	Long-term	Substantial	Definite	Low	Low	As outlined in the EMPr inputs section below.	Moderate	Moderate to high	Moderate to high
Socio-economic development contribution	Funding of socio-economic and enterprise development initiatives	Positive	Regional	Long-term	Substantial	Definite	Low	Low	As outlined in the EMPr inputs section below.	Moderate	Moderate	Moderate
Influx of workers	Social impact associated with an influx of people	Negative	Regional	Long-term	Moderate	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Low to moderate	Low	Low
Presence of facility and workers	Impacts on surrounding land owners	Negative	Local	Long-term	Moderate	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Moderate	Low	Low
Visual and other impacts	Impacts on tourism	Negative	Local	Short-term	Slight	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Low	Very low	Very low

- **Decommissioning Phase**

Impact source/ cause	Description of Impact	Nature of Impact (negative or positive)	Spatial Extent of Impact	Duration of Impact	Consequence/ effects of Impact	Probability of Impact	Reversibility of Impact	Irreplaceability of Impact	Potential Mitigation Measures	Significance of Impact		Residual Impact after mitigation
										Without Mitigation/ Management	With Mitigation/ Management	
Project expenditure	Expenditure related impacts on jobs etc.	Negative	Regional	Long-term	Substantial	Definite	Low	Low	As outlined in the EMPr inputs section below.	Moderate	Moderate to high	Moderate to high
Socio-economic development contribution	Funding of socio-economic and enterprise development initiatives	Negative	Regional	Long-term	Substantial	Definite	Low	Low	As outlined in the EMPr inputs section below.	Moderate	Moderate	Moderate
Influx of workers	Social impact associated with an influx of people	Positive	Regional	Long-term	Moderate	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Low to moderate	Low	Low
Presence of facility and workers	Impacts on surrounding land owners	Positive	Local	Long-term	Moderate	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Moderate	Low	Low
Visual and other impacts	Impacts on tourism	Positive	Local	Short-term	Slight	Highly probable	High	Low	As outlined in the EMPr inputs section below.	Low	Very low	Very low

*Note that the impacts assessed for the decommissioning phase were assessed relative to the baseline of the operational phase. Thus, while there are impacts which result from the process of decommissioning itself (eg. Expenditure on equipment and employment to aid in the removal of physical capital, temporary influx of workers, impacts on surrounding land owners and tourism – somewhat similar to those experienced during construction, although expenditure would be less), the overall impacts resulting from the decommissioning phase will be influenced to a far larger degree by the reversal of impacts which had previously resulted from the operational phase. Impacts resulting from the decommissioning phase are thus similar in magnitude, but opposite in nature, to the impacts resulting from the operational phase.

8.9. MITIGATION MEASURES AND MANAGEMENT ACTIONS

Impact Management Outcome: Economic impacts associated with expenditure during the construction and operation phases of the project are maximised				
Impact Management Actions	**Time period for implementation of the impact management actions**	**Monitoring**		
		Method	**Frequency**	**Responsible person**
Set targets for use of local labour, based on REIPPP thresholds and targets outlined in DOE, 2014 (eg. RSA-based employees who are citizens and from local communities should make up at least between 12% and 20% of the workforce).	**CONSTRUCTION PHASE** **OPERATION PHASE**	• Employee profiles should be compiled by project owner and assessed by ECO annually to determine whether local labour sourcing targets have been met. • Where targets have not been met, project owner should be required to demonstrate to ECO that actions have been taken to try to ensure a greater proportion of local labour.	Quarterly auditing of achievement of socio-economic benefit goals with corrective actions, if needed, during construction phase. Yearly auditing of achievement of socio-economic benefit goals with corrective actions if needed, during operation phase.	Project Owner Facility Manager ECO
Maximise the use of local sub-contractors where possible through tendering and procurement.	**CONSTRUCTION PHASE** **OPERATION PHASE**	• Records of spending on procurement should be compiled by project owner and assessed by ECO annually to determine whether local content spending targets have been met. • Where targets have not been met, project owner should be required to demonstrate to ECO that actions have been taken to	Quarterly auditing of achievement of socio-economic benefit goals with corrective actions, if needed, during construction phase. Annual auditing of achievement of socio-economic benefit goals with corrective actions if needed, during operation phase.	Project Owner Facility Manager ECO

		try to source a greater proportion of supplies from the local area.		

Impact Management Outcome: Impacts associated with project's contribution to socio-economic and enterprise development initiatives are maximised				
Impact Management Actions	**Time period for implementation of the impact management actions**	**Monitoring**		
		Method	**Frequency**	**Responsible person**
Close liaison with local municipal and other stakeholders involved in socio-economic development in order to ensure that any projects are integrated into wider strategies and plans with regard to socio-economic development.	**OPERATION PHASE**	• Consultations with municipal representatives will reveal whether the project's socio-economic development spending is aligned with wider strategies and plans. • In the event that municipal representatives are not satisfied with the project's socio-economic development alignment, discussions should be facilitated to ensure correction.	Annual auditing of achievement of socio-economic benefit goals with corrective actions if needed, during operation phase.	ECO

Impact Management Outcome: Social impacts associated with an influx of people are minimised and controlled.				
Impact Management Actions	**Time period for implementation of the impact management actions**	**Monitoring**		
		Method	**Frequency**	**Responsible person**
The Project Owner should establish a Monitoring Forum for the project. The Forum should be established before the construction phase	**CONSTRUCTION PHASE**	• Record consultation with stakeholders, decisions on protocols, and mechanisms established with the Monitoring Forum to monitor the project	Monthly external audit by ECO	ECO

commences and should include key stakeholders, including representatives from the local community, local councillors and the contractor. The role of the Forum would be to monitor the project and the implementation of the recommended mitigation measures.		activities and implementation of mitigation measures. • Record and file minutes of Forum discussions for the external audits		
The Project Owner and the contractors should, in consultation with representatives from the Monitoring Forum, develop a Code of Conduct for the project. The Code of Conduct should identify what types of behaviour and activities by workers are not permitted in agreement with surrounding land owners and residents. All staff, contractor and member of the workforce must be made aware of the Code of Conduct during the recruitment process. Awareness training must be provided during their induction onsite and prior to	**CONSTRUCTION PHASE** **OPERATION PHASE**	• ECO to review and file the Code of Conduct. • Control that all staff, contractor and member of the workforce has received basic training on the Code of Conduct during their induction onsite. • Ensure that the Code of Conduct requirements are well understood and respected by all staff, contractor and member of the workforce. • Monitor the behaviour of any staff, contractor and member of the workforce onsite during the construction phase. • Record complaints and incidents in the environmental incident log.	Monthly external audit by ECO	ECO

commencement of work duties on site. Display the Code of Conduct in the operation and maintenance buildings and construction areas.				
The Project Owner and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase.	**CONSTRUCTION PHASE**	• Record and file attendance registers and material presented during the HIV/AIDS awareness programme for all construction workers • ECO to review and file the attendance registers and training material for the external audits • Attendance registers and copy of training material is kept on site and included in internal audit reports. • Record complaints and incidents in the environmental incident log.	Monthly external audit by ECO	ECO

Impact Management Outcome: Socio-Economic impacts on surrounding land owners are minimised and controlled.				
Impact Management Actions	**Time period for implementation of the impact management actions**	**Monitoring**		
		Method	**Frequency**	**Responsible person**
Apply the Code of Conduct established with assistance from the stakeholder Monitoring Forum for the	**CONSTRUCTION PHASE** **OPERATION PHASE**	• Same as those outlined above surrounding implementation of Code of Conduct	Monthly external audit by ECO	ECO

project. Continue with the Monitoring Programme set up prior to the commencement of construction and respond to its findings.				
The movement of workers on and off the site should be closely managed and monitored by the contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting workers to and from site on a daily basis.	**CONSTRUCTION PHASE**	• The ECO should conduct randomized interviews with workers of contractors to monitor the provision of transport. • Where transport can be confirmed not to have been provided (through discussions with the contractors), this should be recorded in the environmental incident log.	Monthly external audit by ECO	ECO
The Project Owner should implement measures to assist and, if needed, fairly compensate potentially affected surrounding landowners whereby damages to farm property, stock theft or significant disruptions to farming activities can be minimized or reduced. Measures should be agreed on before construction commences. For these to be	**CONSTRUCTION PHASE**	• Surrounding landowners can raise any incidents of damages to farm property, stock theft and other disruptions to their operations, which can be shown to have resulted due to the presence of the project, through the monitoring forum. • If the incidents can be shown to be the result of the project, and where the project owners fail to resolve the matter with affected parties, the incident can be recorded in	Monthly external audit by ECO	ECO

fairly dealt with, it will be necessary to set up a Monitoring Programme in collaboration with neighbouring land owners that is specifically designed to provide clarity on impacts and risks. Aspects or risks that should be monitored need to be agreed on with neighbouring land owners. The Project Owner should formally commit to mitigation and potential compensation actions that may arise from the Monitoring Programme.		the environmental incident log and further action be considered.		
A fire management plan should be drawn up prior to construction in agreement with neighbouring land owners. This plan should clearly specify what types of behaviour would not be acceptable with appropriate sanction for transgressions. The Project Owner should also ensure that they join the local fire protection agency. Fire breaks around the site should be constructed as a first order	**CONSTRUCTION PHASE**	• Control that the fire management plan is compiled and approved by the ECO prior to the commencement of construction activities. • Ensure that onsite Fire Control Officer is appointed prior to commencement of construction activities and that a collaboration is set up with the local fire protection agency. • Control that the staff who have specific responsibilities in case of fire are trained to implement the emergency	Monthly external audit by ECO	ECO

of business before any other construction works begin.		plan for dealing with a fire situation (audit of the training session attendance registers and material used for the training).		
The EMPr must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested.	**CONSTRUCTION PHASE**	• Audits of waste segregation/disposal methods on a monthly basis. • Monitor that wastes are correctly separated into recyclable and non-recyclable waste on weekly basis during construction phase. • Inspect that all refuse bins have a lid secured to prevent animal scavenging and scattering on weekly basis during construction phase. • Inspect condition and integrity of skips and waste collection bins, particularly after rainfall events. • Record and report non-conformance to the ECO for external audits.	Monthly external audits by ECO Weekly inspections by Environmental Manager during construction phase and decommissioning phase. Weekly inspections by Facility Manager during operation phase.	ECO Environmental Manager Facility Manager

8.10. CONCLUSIONS AND RECOMMENDATIONS

Given the findings presented herein, it seems most likely that the overall positive impacts of each 100 MW project would outweigh negative impacts with adequate mitigation. Benefits would be particularly prominent for the project applicants, land owners on the site, beneficiaries of local socio-economic development projects and in the achievement of national and regional energy policy goals. The project would also help to diversify the local economy and result in significant positive economic spin-offs primarily because of the expenditure injection and jobs associated with it.

Risks and negative impacts would primarily arise at a local scale and include risks associated with ‘social ills’ that may arise from an influx of workers and work-seekers along with risk to surrounding land owners. On the whole, these risks are considered manageable with adequate mitigation. Limited tourism facilities, the nature or surrounding land-uses and visual impacts indicates that risks to tourism would remain very low overall with mitigation.

If one of the individual 100 MW projects goes ahead, or if all three of the individual projects go ahead along with the numerous other renewable energy project approved or planned for the wider area, there would be a significant amplification of impacts. Positive impact associated with project expenditure and the funding of local socio-economic development initiatives would increase to a cumulative high significance. Cumulative social impacts associated with the influx of people and impacts on surrounding land owners should increase to a cumulative moderate significance given their intensity. Cumulative tourism impacts should increase to a similar degree.

Mitigation measures have been outlined in the report and the following measures are considered particularly important:

- Setting targets for the use of local labour and for training opportunities.
- Enhancing local community benefits with a focus on broad-based BEE and preferential procurement, etc.
- Establishing a Monitoring Forum for the project to monitor the project and the implementation of the recommended mitigation measures.
- Developing and enforcing a Code of Conduct for project workers.

8.11. APPENDIX A: REFERENCES

Barbour, T, 2007. Guideline for undertaken Social Impact Assessment in the EIA process: Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

Barbour, T. and van der Merwe, S. 2012. EIA of the SAGIT Wind Energy Facility near Wolseley, Western Cape: Social Impact Assessment. Report to GIBB, Cape Town.

Council on Environmental Quality (CEQ). 1997. Considering Cumulative Effects under the National Environmental Policy Act. Council on Environmental Quality. Executive Office of the President, Washington, D.C.

Department of Cooperative Governance, Human Settlements and Traditional Affairs (DCGHSTA). 2012. Northern Cape Provincial Development and Resource Management Plan / Provincial Spatial Development Framework (PSDF). DCGHSTA, Office of the Premier of the Northern Cape, Kimberly.

Department of Energy (DOE). 2014. The REIPP Procurement Programme Part B : Qualification criteria. Republic of South Africa.

Department of Environmental Affairs (DEA). 2015. Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa. CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B. Stellenbosch.

Department of Rural Development and Land Reform (DRDLR). 2017. Rural Development Plan: Namakwa District Municipality. Maswana JV, Bloemfontein.

Discover South Africa. 2017. Discover Namakwa (Online). Available: http://www.namakwa-dm.gov.za/wp-content/uploads/2017/07/Discover-Namakwa.pdf [Accessed 16-05-2018].

Lawson, Q. and Oberholzer, B. 2018. Visual Impact Assessment Report: Scoping and Environmental Impact Assessment for the Proposed Development of the 300 MW Paulputs Solar PV Energy Facility and Powerline Grid Connection. Prepared for Gaea Enviro (Pty) Ltd, Clanwilliam.

Maia, J., Giordano, T., Kelder, N., Bardien, G., Bodibe, M., du Plooy, P., Jafta, X., Jarvis, D., Kruger-Cloete, E., Kuhn, G., Lepelle, R., Makaulule, L., Mosoma, K., Neoh, S., Netshitomboni, N., Ngozo, T., and Swanepoel, J. 2011. Green Jobs: An Estimate of the Direct Employment Potential of a Greening South African Economy. Industrial Development Corporation, Development Bank of Southern Africa and Trade and Industrial Policy Strategies, Johannesburg, Midrand and Pretoria.

Namakwa District Municipality (NDM). 2017. Integrated Development Plan 2017 – 2022. NDM, Springbok.

Namakwa District Municipality (NDM). 2018. Integrated Development Plan Revision 2018/2019. NDM, Springbok.

Khâi-Ma Municipality (KMM). 2010. Khâi-Ma Municipality Rural Spatial Development Framework / Land Development Plan. Umsebe Development Planners, Nelspruit.

Khâi-Ma Municipality (KMM). 2016. Khâi-Ma Municipality IDP 2012-2017 Final Review 2016-2017. Khâi-Ma Municipality, Pofadder.

Statistics SA. 2002. Census 2001. Stats SA, Pretoria.

Statistics SA. 2012. Census 2011. Stats SA, Pretoria.

Van Zyl, H.W., de Wit, M.P. & Leiman, A. 2005. Guideline for involving economists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 G. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

8.12. APPENDIX B: SPECIALIST IMPACT ASSESSMENT CRITERIA

The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of the predicted environmental impacts and risks is described in Part 5 - Section 4 of the EIA report.

8.13. APPENDIX C: DISCLAIMER

The primary role of this study is to inform the decision-making processes being undertaken by the relevant environmental authorities with regards to the proposed project. Due care and diligence has been applied in the production of the study. However, ultimate responsibility for approving, denying or requiring changes to the proposed project application rests with the relevant environmental authorities (and other government bodies where relevant) who also bear responsibility for interrogating and determining how assessment information from this economic specialist study along with other information is to be used to reach their decisions. Independent Economic Researchers and Dr Hugo van Zyl can therefore not be held responsibility or liable for any consequences of the decisions made by the relevant environmental authorities with regard to the proposed project. This includes any financial, reputational or other consequences that such decisions may have for the applicant, the Environmental Assessment Practitioner responsible for conducting the Environmental Impact Assessment process or for the environmental authorities themselves.

8.14. APPENDIX D: SPECIALIST DECLARATION

I, Dr Hugo van Zyl, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

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

Signature of the specialist:

Name of Specialist: Dr Hugo van Zyl

Date: 15/11/2018

8.15. APPENDIX E: SPECIALIST CURRICULUM VITAE

Dr Hugo van Zyl

Profile and Key Expertise

Economist with a PhD and nineteen years' experience focusing on the analysis of projects and policies with significant environmental and development implications. Has conducted over 60 economic appraisals of infrastructure projects, industrial developments, mixed use developments, mining, energy projects, conservation projects and eco-tourism initiatives. The majority of these appraisals have involved the use of socio-economic impact assessment tools and cost-benefit analysis in order to inform decision-making. Has lead, participated in and co-ordinated research in environmental resource economics (incl. ecosystem services assessment and valuation, biodiversity finance and offsets, payments for ecosystem services, policy reform), socio-economic impact assessment, strategic assessment and protected area financing. Has provided economic inputs and guidance to national water tariff, air pollution, biodiversity conservation, biofuels, mine closure funding and climate change policy. Has had broad exposure to options for local economic development and their successful implementation. Country experience includes: South Africa, Namibia, Ethiopia, Russia, Seychelles, Georgia, Kazakhstan and Nigeria.

Selected relevant experience:

Economic and socio-economic impact assessments forming part of Environmental Impact Assessments (EIAs)

- **Renewable energy**:
  Wind – SWE near Vleesbaai, Western Cape (2013); SAGIT Energy Ventures near Bot River and Wolesley, Western Cape (2012). Windcurrent near Jeffrey's Bay, Eastern Cape (2011); InnoWind near Mossel Bay, Western Cape (2011); Mainstream near Jeffrey's Bay, Eastern Cape (2010).
  Solar – Mainstream Kentani near Dealesville, Free State (2014); Mainstream near Douglas and Keimoes, Northern Cape (2012); Thupela Energy near Vaalwater, Limpopo (2011).
- ***Roads***:
  N2 bypasses at Butterworth and iDutywa (2016); R44 upgrading between Stellenbosch and Somerset West (2014); Musina Ring Road, Limpopo (2011); Bloubos local road in Somerset West, Western Cape (2010); N1/N9 intersection upgrade at Colesberg, Free State (2009); tolling of the N1, N2 and R300 roads in the vicinity of Cape Town (2005); Changing road configurations on Hospital Bend in Cape Town (2001)
- ***Infrastructure and agricultural development***:
  Farm dams and production expansion for Habata Agri in the Robertson area, Western Cape (2017); Desalination plants for Umgeni Water, Kwa-zulu Natal (2015); Kleinberg Dam in the Hex River Valley, Western Cape (2014); Desalination plant for West Coast District Municipality, Western Cape (2012); Green Point World Cup Stadium, Cape Town (2008); Petroline petrol pipeline between Maputo and Gauteng (2008); Muldersvlei water treatment plant and reservoir near Klapmuts, Western Cape (2007); Iron ore terminal expansion at Saldanha port, Western Cape (2000); Wastewater treatment plan for East London, Eastern Cape (1996); Vissershok landfill expansion, Cape Town (2002); Regional landfill to service Cape Town (2006 and 2012); Helderberg waste transfer station in Somerset West, Western Cape (2008).
- ***Industrial developments and mining***:
  Upgrade and expansion of the Tsumeb copper smelter, Namibia (2017); Kamiesberg mineral sands mine, Northern Cape (2015); Burgan Oil fuel storage and distribution facility at Cape Town Harbour, Western Cape (2015), Frankfort Kraft Paper Mill, Free State (2015); Saldanha

Regional Marine Outfall Project in Danger Bay near Saldanha Bay, Western Cape (2014), AfriSam limestone mine and plant at Saldanha Bay, Western Cape (2012); Vedanta zinc mine near Aggeneys, Northern Cape (2013); Expansion of the PPC cement plant at Riebeek West, Western Cape (2009); Burnstone gold mine expansion (2009); Valencia uranium mine in Namibia (2008); Tata Steel ferrochrome smelter in Richards Bay, KZN (2003); Conversion of the Sasol Chemical Industries plant in Sasolburg from a coal based to a natural gas based plant, Free State (2002).

- ***Mixed-use and residential developments***:
  Granger Bay extension of V&A Waterfront, Cape Town (2014); Ladysmith mixed-use development, Kwa-Zulu Natal (2014); Barinor and Richmond park developments in greater Cape Town (2011); De Plaat residential estate near Velddrif, Western Cape (2009); Langezandt leisure development in Struisbaai, Western Cape (2011); Garden Route Dam mixed use development in George, Western Cape (2008); Anandale mixed use development in Cape Town (2008); Schalkenbosch Golf Estate, Le Grand Golf Estate and Ceres Golf Estates (2006); Carpe Diem Eco Estate near Port Alfred, Eastern Cape (2006); Altona mixed use development in Worcester, Western Cape (2007).

- Lead author of the Western Cape Provincial Government guidelines on economic specialist inputs into Environmental Impact Assessments. (2005)

Inputs to Strategic Environmental Assessments (SEAs)

- Lead economic specialist making inputs to the Strategic Environmental Assessment for shale gas development (fracking) in South Africa (2016).
- Economic specialist inputs to form part of the Strategic Environmental Assessment for the roll-out of electricity transmission infrastructure throughout South Africa. (2015)
- Environmental resource economic and socio-economic specialist study to form part of the Strategic Environmental Assessment and accompanying management plan for the Port of Saldanha, Western Cape. (2013)
- Lead author of a Strategic Environmental Assessment (SEA) of the potential production of biofuels based on Jatropha in the Kavango and Caprivi regions of Namibia. (2010)
- Environmental resource economics specialist study to form part of the Strategic Environmental Assessment and accompanying Environmental Management Framework for the Pixley ka Seme municipality in Mpumalanga. (2010)
- Environmental resource economics specialist study to form part of the Strategic Environmental Assessment and accompanying Environmental Management Framework for the Albert Luthuli and Msukaligwa municipalities in Mpumalanga. (2008)

Other selected recent projects

- Lead international consultant tasked with drawing up a Biodiversity Finance Plan to form part of the Georgian Biodiversity Finance (BIOFIN) project being undertaken by the Ministry of Environmental Protection and Agriculture (current).
- Lead consultant tasked with drawing up a Biodiversity Finance Plan to form part of the South African Biodiversity Finance (BIOFIN) project being undertaken by the Department of Environmental Affairs in partnership with the UNDP (2017).
- Assessment of the economic value associated with the Ethiopian protected areas system and the cost-benefit analysis of increased expenditure on protected areas development and management in Ethiopia. Conducted for the Ethiopian Wildlife Conservation Authority with UNDP funding. (2015)
- Financial sustainability modelling and economic impact assessment of biodiversity off-set options associated with the construction of the N2 Toll Highway in the Pondoland Region of the Eastern Cape Province (2014).

- Economic impact assessment component to form part of feasibility studies for six Special Economic Zones (SEZs) throughout the country commissioned by the Department of Trade and Industry (2014).
- Co-author and consultant to the formulation of the ValuES project initiated by GIZ focused on methods for integrating ecosystem services assessment and valuation into decision-making (2014).
- Second author of the guideline on conducting TEEB Country Studies focused on the value of ecosystem services. (2013)
- Socio-economic assessment of impacts on surrounding farmers associated with mine dewatering at Sishen iron ore mine, Northern Cape. (2012)
- Project leader and lead author of Financial Provisions for Rehabilitation and Closure in South African Mining: Discussion Document on Challenges and Recommended Improvements. (2011)

8.16. APPENDIX F: COMPLIANCE WITH THE REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF APRIL 2017

Requirements of Appendix 6 – GN R326 of NEMA EIA Regulations as amended (7 April 2017)	Please indicate where it is addressed in the Specialist Reports:
1. (1) A specialist report prepared in terms of these Regulations must contain- details of- the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix C
a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix D
an indication of the scope of, and the purpose for which, the report was prepared; (ca) an indication of the quality and age of base data used for the specialist report; (cb) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section4, Section7, Section 8
the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
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;	N/A
an identification of any areas to be avoided, including buffers;	N/A
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;	N/A
a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
any mitigation measures for inclusion in the EMPr;	N/A
any conditions for inclusion in the environmental authorisation;	N/A

any monitoring requirements for inclusion in the EMPr or environmental authorisation;	N/A
a reasoned opinion- whether the proposed activity, activities or portions thereof should be authorised; (ia) regarding the acceptability of the proposed activity or activities; and if the opinion is that the proposed activity 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;	N/A
a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 4
a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
any other information requested by the competent authority.	TBD
(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.	N/A

8.17. APPENDIX G: REIPPPP Economic Development Scorecard for evaluation of solar PV project bids

Element	Measurement	Threshold Level	Target Level	Weighting	Allocation of Points
1: Job Creation				25.00%	7.50
100-SR-01 RSA Based Employees who are Citizens	Number of RSA Based Employees who are Citizens *100 / Number of RSA Based Employees	50.00%	80.00%	2.00%	0.60
100-SR-02 RSA Based Employees who are Black People	Number of Black People employed *100 / Number of RSA Based Employees	30.00%	50.00%	1.67%	0.50
100-SR-03 Skilled Employees who are Black People	Number of Skilled Employees who are Black People *100 / Skilled Employees	18.00%	30.00%	2.00%	0.60
100-SR-04 RSA Based Employees who are Citizens from Local Communities	Number of Employees resides in Local Communities employed *100 / Number of RSA Based Employees	12.00%	20.00%	2.67%	0.80
Jobs for RSA Based Citizens per MW of Contracted Capacity	Number of RSA Based Employees who are Citizens / 12 / MW Contracted Capacity of Facility	NA	NA	16.67%	5.00
2: Local Content				25.00%	7.50
200-SR-01 Value of Local Content Spend	Value of Local Content spend / Total Project Value	45.00%	65.00%	25.00%	7.50
3: Ownership				15.00%	4.50
300-PC-01 Shareholding by Black People in the Seller	Shareholding by Black People in the Seller	12.00%	30.00%	3.50%	1.05
300-PC-02 Shareholding by Local Communities in the Seller	Shareholding by Local Communities in the Seller	2.50%	5.00%	4.00%	1.20
300-CC-01 Shareholding by Black People in the Contractor responsible for Construction	Shareholding by Black People in the Contractor	8.00%	20.00%	4.00%	1.20
300-OM-01 Shareholding by Black People in the Operations Contractor	Shareholding by Black People in the Operations Contractor	8.00%	20.00%	3.50%	1.05
4: Management Control				5.00%	1.50
400-SR-01 Black Top Management	Number of Black People in Top Management using the Adjusted Recognition of Gender *100 / Number of People in Top Management	0.00%	40.00%	5.00%	1.50
5: Preferential Procurement				10.00%	3.00
500-SR-01 BBBEE Procurement	Amount of Procurement Spend on BBBEE Contributors recognised in terms of BBBEE Recognition Levels * 100 / Total Amount of Procurement Spend	0.00%	60.00%	5.00%	1.50
500-SR-02 QSEs and EMEs Procurement	Amount of Procurement Spend on QSEs and EMEs * 100 / Total Amount of Procurement Spend	0.00%	10.00%	2.50%	0.75
500-SR-03 Women Owned Vendor Procurement	Amount of Procurement Spend on Women Owned Vendors * 100 / Total Amount of Procurement Spend	0.00%	5.00%	2.50%	0.75
6: Enterprise Development				5.00%	1.50
600-SR-01 Enterprise Development Contributions	Enterprise Development Contributions * 100 / Revenue in the Operating Measurement Period	0.00%	0.60%	2.50%	0.75
600-SR-02 Adjusted Enterprise Development Contributions	Adjusted Enterprise Development Contributions * 100 / Revenue in the Operating Measurement Period	0.00%	0.60%	2.50%	0.75
7: Socio-economic Development				15.00%	4.50
700-SR-01 Socio-Economic Development Contributions	Socio-Economic Development Contributions * 100 / Revenue in the Operating Measurement Period	1.00%	1.50%	10.00%	3.00
700-SR-02 Adjusted Socio-Economic Development Contributions	Adjusted Socio-Economic Development Contributions * 100 / Revenue in the Operating Measurement Period	1.00%	1.50%	5.00%	1.50

9. OFFSET STUDY

9.1. Introduction

juwi Renewable Energies, is proposing to develop a 300 MW solar PV facility with associated electrical infrastructure near Pofadder in the Northern Cape Province. The development would consist of three 100 megawatt (MW) solar PV phases as well as a 132kV grid connection to the Eskom 220/132kV Paulputs MTS Substation approximately 10 km long. The Northern Cape Department of Environment & Nature Conservation (DENC) submitted comments on the Draft Scoping Report and recommended that an offset study be undertaken to inform the EIA process. The site falls within a CBA 2 and in terms of the Draft National Offset Policy (Government Notice 276 of 2017), medium to high residual impacts on CBAs warrants the consideration of an offset as a mechanism to offset the residual impact of the development biodiversity. In order to address this potential need, this study has been commissioned by juwi Renewable Energies to investigate the ecological and conservation planning context of the site and inform the need and desirability of an offset for the proposed development. This is in line with the 2014 EIA Regulations and offset guidelines which recommend that the need for an offset should be evaluated at the pre-application phase and the necessary steps taken to include the offset in the EIA process and provide opportunity for the issuing authority (DEA) and other stakeholders to comment on the proposed offset if required. This study forms part of the EIA process and should be read in conjunction with the ecological, freshwater and avifaunal specialist studies for the proposed development. The scope for the biodiversity offset study is provided below and is based on the suggested guidelines for such studies as provided by DENC.

Scope

The recommended outline for offset studies as provided by DENC is indicated below and is used to inform the content of the current study. However, it is important to note that the Scope as outlined below is contingent on an offset being required. The current study is focussed primarily on the question as to whether an offset is a required and desirable outcome for the proposed development and as such, the later offset-specific components of the scope are contingent on the prior assessment as to whether an offset is an appropriate outcome for the proposed development.

1. Introduction
2. Context
    a. Requirement for the Offset
    b. Scope of the study

3. Offset Policy framework
    a. Legal & policy framework
    b. Biodiversity Offset principles
    c. Client's approach to Offset principles

4. The nature of compensation and Offsets
    a. Acceptable Offsets (form & nature of what is regarded acceptable offsets,

Offset ratio & design,
Exhaustion of mitigation hierarchy towards offset options/alternatives)

5. Biodiversity context of development (impact)
    a. Description of Biodiversity

   b. Regional biodiversity significance (incl. conservation status, protected status, conservation targets)

6. Determining the Offset
   a. Assumptions, limitations, uncertainties
   b. Quantifying the Offset required
   c. Designing the Offset
      i. Define optimal set of areas
      ii. Define most practical (with reasons that can be supported by proof)
   d. Verify sufficiency of Offset identified and identify shortfalls (or whether it is regarded an up-trade)

7. Scope of the <u>(development name)</u> Offset
   a. Offset options & implementation success factors
   b. Alignment of Offset with local and regional plans

8. Establishment and Management of Offset area
   a. Management Authority
   b. Timeframes to targets

9. Financial implications and arrangements
   a. Uncertainties, data gaps, monitoring
10. References

9.2. Framework for Biodiversity Offsets

Habitat loss is recognized as the primary driver of biodiversity loss and biodiversity offsets are becoming an internationally accepted tool which can be used to ensure that development is ecologically sustainable by enhancing the conservation and sustainable use of priority ecosystems and fragile biodiversity-rich areas not under formal protection. The NBF (National Biodiversity Framework, 2009) states that "*In some cases, following avoidance and mitigation, there is still residual damage to biodiversity as a result of a development. In such cases, if the development is socially and economically sustainable, ecological sustainability may be achieved through a biodiversity offset. A biodiversity offset involves setting aside land in the same or a similar ecosystem elsewhere, at the cost of the applicant, to ensure no net loss of important biodiversity. Biodiversity offsets are particularly important in securing threatened ecosystems and critical biodiversity areas.*"

The desired outcome of biodiversity offsets is to ensure that:

1. The cumulative impact of development authorization and land use change does not:
   - result in the net loss of CBA's or jeopardize the ability to meet South Africa's targets for biodiversity conservation;
   - lead to ecosystems becoming more threatened than 'Endangered'; and/or
   - cause a decline in the conservation status of species and the presence of 'special habitats'.
2. Conservation efforts arising from the development application process and contributing to improved protection of South Africa's unique species and ecosystems in perpetuity, are focused in areas identified as priorities for biodiversity conservation. Particular emphasis is on consolidation of priority areas and securing effective ecological links between priority areas; and

3. Ecosystem services provided by affected biodiversity and on which local or vulnerable human communities - or society as a whole - are dependent for livelihoods, health and/or safety, are at minimum safeguarded, and preferably improved.

The basic principles and tenets that underlie offsets and their practical implementation required to achieve the above goals are outlined below. The majority of this is taken directly or synthesised from the draft 2017 offset guidelines.

Defining Biodiversity Offsets

Biodiversity Offsets are conservation measures designed to remedy the residual negative impacts of development on biodiversity and ecological infrastructure, once the first three groups of measures in the mitigation sequence have been adequately and explicitly considered (i.e. to avoid, minimize and rehabilitate/restore impacts). Offsets are the 'last resort' form of mitigation, only to be implemented if nothing else can mitigate the impact (Figure 1). It is important to note in this regard that the offset is therefore not a form of mitigation in itself and the implementation of an offset does not release the requirement or need to implement the full array of mitigation and avoidance options at the impacted site.

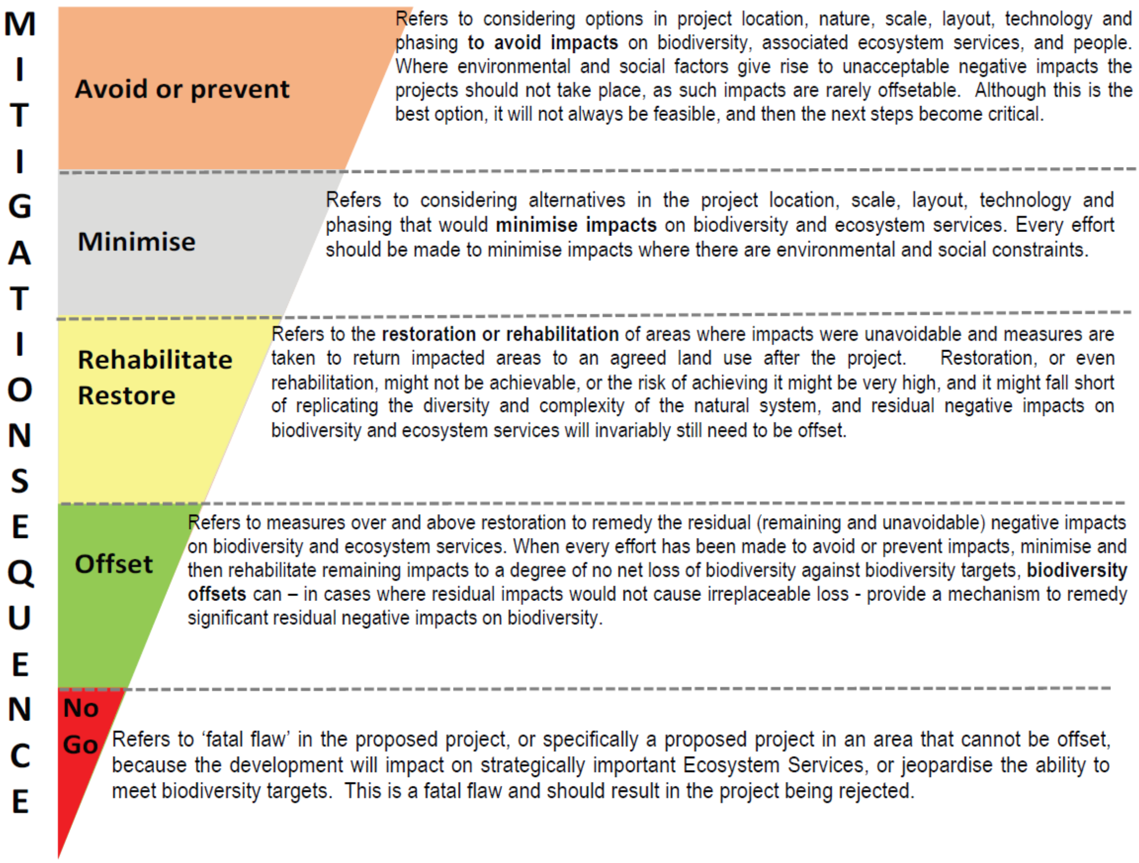


Figure 13. The mitigation hierarchy and the location of offsets within this context as the last resort for development.

There are limits to what can or should be offset

Biodiversity offsets are to be used in cases where the EIA process identifies negative residual impacts of 'medium' or 'high' significance on biodiversity. Activities resulting in impacts of 'low' significance may not require an offset. Impacts on biodiversity of 'very high' significance may not be able to be fully offset because of the conservation status, irreplaceability, or level of threat to affected biodiversity, or the risk of preventing scientific targets for conserving that biodiversity from being met. In these cases, given that the proposed activity would lead to irreversible impacts and irreplaceable loss of biodiversity, alternatives to the proposal should be sought; i.e. the proposed activity should not be authorized in its current form.

The principle of ecosystem protection

Biodiversity offsets should ensure the long-term protection of priority ecosystems on the ground and improve their condition and function, thereby resulting in measurable positive outcomes for biodiversity conservation 'on the ground'. These outcomes could contribute to improved ecosystem integrity and increased use and/ or cultural value of offset areas and the ecosystems of which they are part.

No Net Loss up to specified limits of acceptable change

Offsets should not be used to 'soften' a development proposal that would result in unacceptable loss of biodiversity. Biodiversity offsets should be designed in such a way that scientific targets for conserving ecosystems and other biodiversity features in the long term are attainable and not undermined as a consequence of the proposed activity. No biodiversity feature (species or ecosystem) should be at risk of being pushed beyond an Endangered threat status by a development.
Locating biodiversity offsets in the landscape
Biodiversity offsets should be located in the landscape in such a way that they help to secure priority areas for conservation, improve connectivity between these priority areas, and/ or consolidate or expand existing protected areas. Where priority ecosystem services are residually affected, biodiversity offsets should preferably be located in the landscape in such a way that they deliver equivalent services to affected parties; that failing, additional compensation measures would be needed for these parties.

Equivalence – 'like for like'

Biodiversity offsets should comprise - or benefit - the same biodiversity components as those components that would be negatively affected by development. In exceptional cases only, and only with support from the provincial conservation agency, could consideration be given to the biodiversity offset targeting a relatively more threatened ecosystem or habitat.

Additionality – new action required

Biodiversity offsets must result in conservation gains above and beyond measures that are already required by law or would have occurred had the offset not taken place.

Defensibility

The measure of residual negative impacts on biodiversity caused by a proposed development, as well as the design and implementation of biodiversity offsets, should be based on the best available biodiversity information and sound science, and should incorporate local traditional or conventional knowledge as appropriate. Offsets must consider all significant residual impacts on biodiversity: direct, indirect and/ or cumulative impacts. The scope of assessment must include due consideration of impacts on recognized priority areas for biodiversity conservation; impacts on biodiversity pattern (conservation status of ecosystem and species, importance to migratory species) and ecological and evolutionary processes (must look across scales and take into account connectivity, gradients and corridors); and impacts on ecosystems or species on which there is high dependence for health, livelihoods, and/ or wellbeing.

General procedures to be followed when considering offsets

The 2014 EIA Regulations as part of the introduction of the “One Environmental System” (where different application and authorisation processes are run concurrently), impose very tight timeframes on BAR and S&EIR processes. In order for the biodiversity impacts to be adequately assessed and evaluated, and the mitigation sequence applied, it is desirable to evaluate the probable need for – and design of - offsets in the pre-application phase. It is therefore important for the applicant and Environmental Assessment Practitioner (EAP) to work with the Competent Environmental Authority (CEA) in the pre-application phase to finalise as much of the biodiversity-related work as possible before the application is submitted. This should include:

a. Pre-application meeting with the CEA and EAP to determine the possibility of an offset being required. If an offset might be required, it becomes imperative for the applicant to investigate other project alternatives during the EIA process, particularly where impacts are likely to be of high or very high significance.
b. The biodiversity specialist(s), appointed by the applicant, should be fully appraised of the development proposal, including feasible location or siting alternatives, proposed layouts, operational activities, associated activities and infrastructure on which the development depends, likelihood of risks (amongst others) in order to perform specialist studies that can produce reliable and defensible significance ratings for negative impacts on biodiversity, as well as mitigation recommendations. Specialist studies should be done well in advance of the submission of the application.
c. Should there be potentially significant negative impacts on biodiversity, the environmental assessment should undertake a process to exhaust the mitigation sequence to reduce the impact on biodiversity through the investigation of alternatives. The study should clearly show how the mitigation sequence has been followed.
d. Should residual impacts of very high significance be probable, the applicant would effectively be pursuing his/ her application on risk.
e. If the biodiversity specialist(s) subsequently confirms that the residual negative impacts on biodiversity of medium/high significance would be unavoidable, offsets should be discussed with the CEA and, if deemed appropriate, offset investigation, planning and design would best commence pre-authorisation and be incorporated into all stages of the EIA process.
f. If an offset is required, the authorisation should state that development may only commence after the offset has been secured.

Requirements for a proposed offset as part of the EIA process

A CEA (Competent Environmental Authority i.e. DEA) may require that an Offset Report or an Offset Agreement be submitted as part of the final Basic Assessment or EIA Report, or that an Offset Agreement be concluded prior to the commencement of the listed activity. Where the applicant has secured and will manage (or contract a third party to manage) an offset, an Offsets Management Plan/ Programme may also be required to be submitted to the CEA.
Reporting on Offset performance and sufficiency should be included in the EMPr for any project.
Any Offset Report would be submitted as a specialist report with, and incorporated into, the BAR or EIR. At minimum, it should include the following information (see Appendix 3 of the 2014 EIA Regulations):

1. An evaluation of the adequacy of measures considered and adopted to avoid, minimize and rehabilitate potentially significant negative impacts on biodiversity. (That is, were these

measures sufficient; were reasonable and feasible alternative measures investigated, or could greater effort have been made particularly to avoid and minimize these impacts?).

2. A clear statement regarding the appropriateness of considering biodiversity offsets in this case. (That is, are there any residual impacts of 'very high' significance that could lead to irreplaceable loss of biodiversity and/ or priority ecosystem services?).
3. A reliable measure of residual negative impacts on significant biodiversity and ecosystem services requiring offsets.
4. It must take into account gaps in information or low levels of confidence in the predicted negative impacts.
5. It must give due consideration to uncertainties or low levels of confidence in the outcome of proposed measures to avoid, minimise and/ or rehabilitate negative impacts.
6. The duration of residual negative impacts of the proposed activity on biodiversity, taking a risk-averse approach, to determine the minimum duration of the biodiversity offset(s).
7. An explicit statement on the required size of the biodiversity offset to remedy these residual negative impacts, applying the basic offset ratio and adjustments as appropriate.
8. A description of the offset options considered (like for like habitat, trading up, or other), giving defensible reasons for arriving at the proposed offset type.
9. Where the proposed offset comprises land to be secured and managed:
   a) Evaluation of the probable availability of suitable offset site(s) in the surrounding landscape to meet offset requirements.
   b) Description of potential site(s) for biodiversity offset(s).
   c) Description of stakeholder engagement process in identifying and evaluating the adequacy and acceptability of the proposed offset site.
   d) Description of proposed approach to securing the offset site(s) (e.g. conservation servitude, protected area consolidation/ stewardship) and how it would be managed.
   e) Evaluation of probable adequacy of proposed offset site(s) by biodiversity specialist(s) and, where relevant, a social/ livelihood specialist:
      - *Is there a high level of confidence that offset site(s) would remedy residual impacts on a) biodiversity pattern (threatened ecosystems, threatened species and special habitats), b) biodiversity process, and c) on ecosystem services, while making a positive contribution to the long term conservation of biodiversity in the South Africa?)*
      - *Would the offset sites be located in recognised 'offset receiving areas'?*
      - *If relevant, is the motivation for a 'trading up' offset defensible in the specific context?*
      - *Would the offset site(s) be functionally viable in the long term?*
   f) A reliable estimate of the costs of acquiring or securing, rehabilitating and managing the necessary offset site(s) for the duration of residual negative impacts;
   g) Responsibility for managing, monitoring and auditing the biodiversity offset;
      - *Who would be responsible for implementing, managing and auditing the biodiversity offset?*
      - *Statement regarding the adequacy of capacity of the institution, organization or other party to meet obligations in terms of above responsibilities;*
   h) What measures would be taken to ensure that society as a whole, and affected communities in particular, would not be left more vulnerable or less resilient as a consequence of the proposed development [i.e. where offsets are to remedy loss of biodiversity underpinning valued ecosystem services, would the proposed offset(s) be affordable, accessible and acceptable to the main affected parties];
      - *Any negative impacts on local communities and/or society as a whole as a consequence of the proposed offset. If yes, how would these negative impacts be avoided;*
      - *Would the proposed use of the biodiversity offset site(s) be compatible with biodiversity conservation objectives? In particular, where an offset for residual*

negative impacts on biodiversity also provides offsets for residual impacts on ecosystem services, assurance must be provided that the latter would not compromise the biodiversity value of that offset (e.g. if biodiversity is to be a direct-use resource, then use could lead to degradation of that biodiversity / ecosystem).

i) What mechanism is to be used to provide sufficient funds for acquiring/ securing and managing the biodiversity offset site(s) for the duration of residual negative impacts of the proposed activity (i.e. Who will be the recipient of money? How will funds flow to the implementing agent?)

Paulputs PV – Ecological Baseline and Regional Context

In this section of the report, the ecological baseline for the Paulputs PV study area and the broader surrounding region are explored. The aim is to provide the ecological context of the site itself and then highlight the important biodiversity features and likely nature and direction of ecological processes operating in the area and the potential for the current development to impact on these features and processes, on its own and on a cumulative basis given the presence of several other existing solar energy developments in the area.

National Vegetation Types

The majority of the Paulputs PV site lies within the Bushmanland Arid Grassland vegetation type, with a small extent of Bushmanland Sandy Grassland in the south (Figure 14). Other vegetation types that occur in the wider area that would not be affected include Lower Gariep Broken Veld to the north and Eastern Gariep Plains Desert and Eastern Gariep Rocky Desert to the south.

The footprint is restricted to the Bushmanland Arid Grassland vegetation type. This vegetation unit is the second most extensive vegetation type in South Africa and occupies an area of 45478 km^2 and extends from around Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact and as a result it is classified as Least Threatened. Mucina & Rutherford (2006) list 6 endemic species for the vegetation type which is relatively few given the extensive nature of the vegetation type.

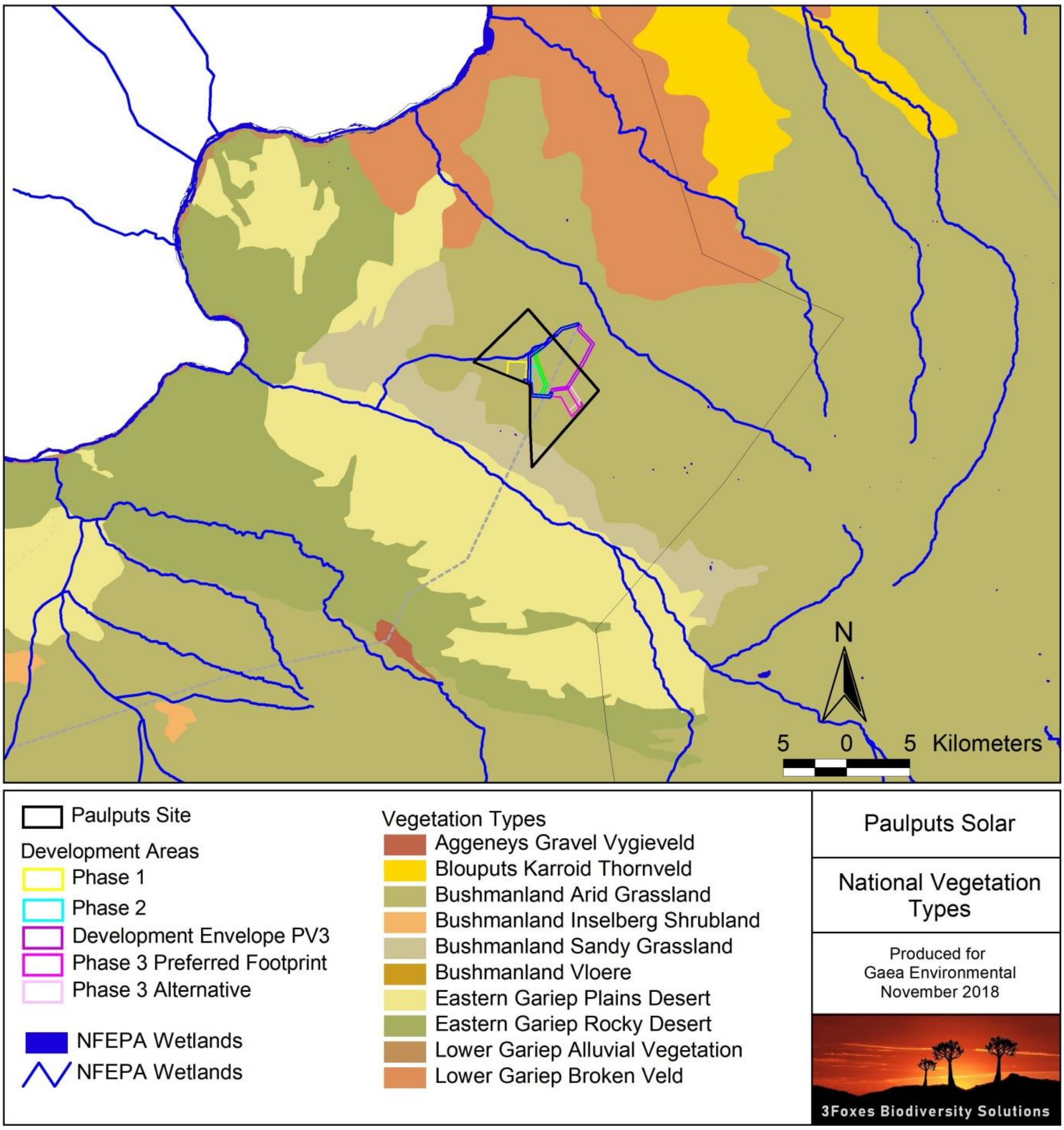


Figure 14. National Vegetation Types (Mucina & Rutherford 2006) for the wider area around the Paulputs Solar site, showing that the PV footprint areas are restricted to the Bushmanland Arid Grassland vegetation type.

Habitats and Plant Communities

The national vegetation types for the area are mapped at a very coarse scale and fail to adequately represent the variety of habitats and ecosystems present at the site. These are mapped (Figure 15) and described in more detail below. This section is drawn largely from the ecological specialist study but is repeated here due to its significance in determining the sensitivity of the site as well as informing the broader ecological context of the site.

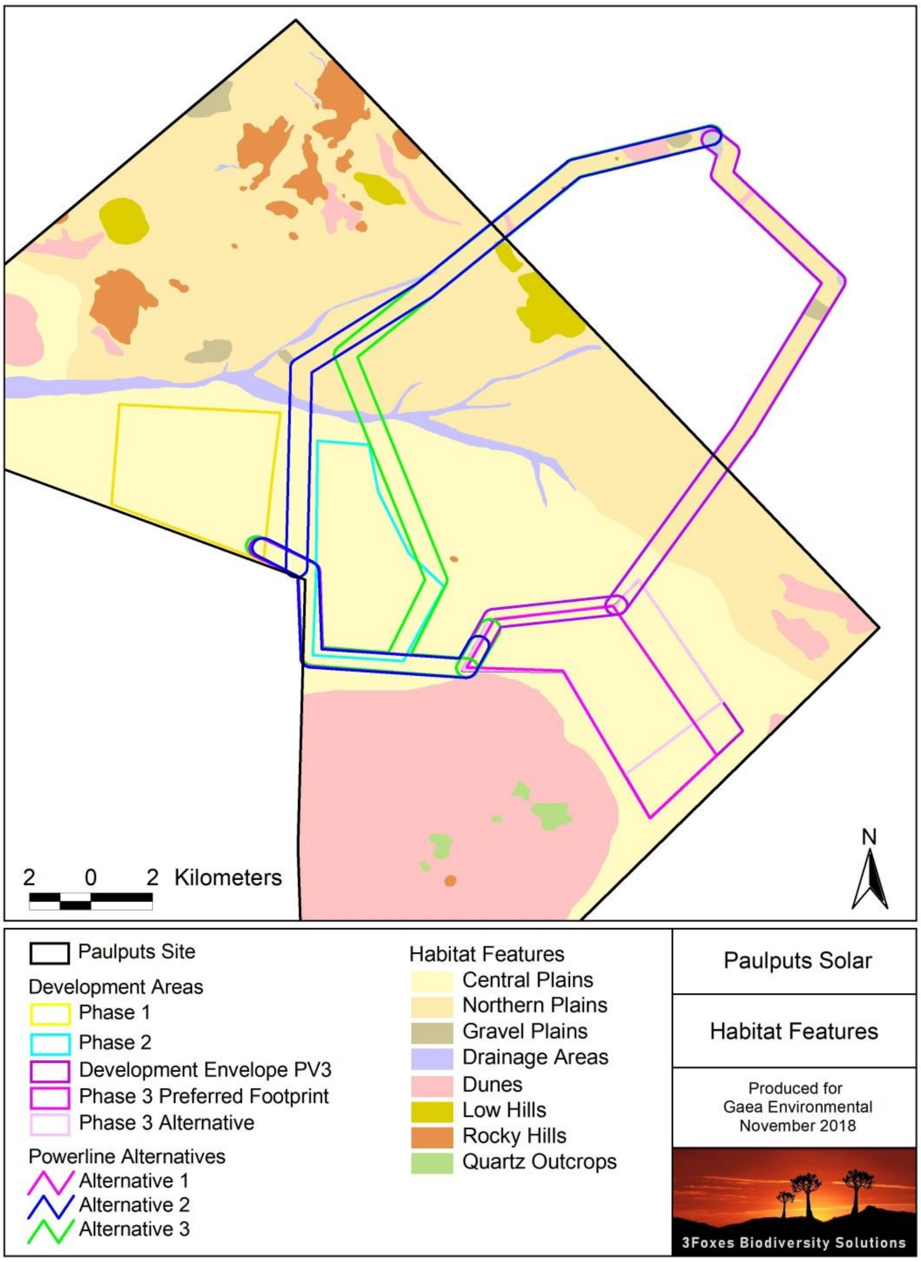


Figure 15. Habitat map for the wider Paulputs site and power line corridors. The different habitats mapped are described below.

Bushmanland Arid Grassland on Open Plains

The majority of the site including the footprint of the PV areas is located on the open plains of the site. These areas are classified as Bushmanland Arid Grassland and are reasonably representative of this vegetation unit although some areas are shrubbier than is typically characteristic for this unit. There is some variation in composition of this habitat across the site associated with changes in soil depth and texture, with grasses being dominant on more sandy soils and a larger proportion of shrubs in areas with shallow or gravelly soils. There are also a number of fairly extensive areas where there is clear evidence of degradation as a result of overgrazing. This habitat is considered low sensitivity as the abundance of species of conservation concern is relatively low, although some protected species including *Aloidendron dichotomum, Boscia foetida and Hoodia gordonii* occur within this habitat at low density. This is the dominant habitat across the majority of the study are as well as along the power line corridors. Characteristic and dominant species include grasses such as *Stipagrostis ciliata,* *Stipagrostis brevifolia, Stipagrostis anomala, Schmidtia kalahariensis and Enneapogon desvauxii; shrubs such as Rhigozum trichotomum, Lycium eenii, Phaeoptilum spinosum, Hermannia spinosa, Hermannia gariepina, Asparagus denudatus, Tetragonia arbuscular, Aptosimum marlothii, Aptosimum spinescens, Indigofera heterotricha and Eriocephalus microphyllus var. pubescens as well as low trees including Boscia foetida subsp. foetida and Parkinsonia africana.* Forbs were common at the time of the site visit and include species such as *Diascia engleri, Manulea nervosa, Lyperia tristis, Manulea schaeferi, Tribulus cristatus, Tribulus terrestris, Arctotis leiocarpa, Dicoma capensis, Felicia clavipilosa subsp. clavipilosa, Heliotropium curassavicum, Heliophila deserticola, Zygophyllum simplex and Kohautia cynanchica*.

Figure 16. Typical vegetation on the open plains within the PV development areas. The vegetation is dominated by Stipagrostis grasses with occasional scattered shrubs and low trees such as Rhigozum trichotomum and Boscia foetida.

Figure 17. Some parts of the site have shallow gravelly soils where the cover is lower but no specific associated species were observed with the result that these areas are not considered more sensitive than the more typical grassy areas.

Figure 18. Degraded vegetation within the Phase 3 PV area, dominated by Tribulis terrestris, Tribulis pterophorus, Schmidtia kalahariensis and Rhigozum trichotomum.

Rocky Hills

There are numerous rocky hills present in the wider site. These are considered sensitive features, especially for fauna. Although there are no rocky hills within the PV areas, the power line alternatives 2 and 3 go through or near several such hills. Species observed on the rocky outcrops include *Chascanum garipense*, *Tricholaena capensis subsp. capensis*, *Montinia caryophyllacea*, *Forsskaolea candida*, *Sericocoma avolans*, *Microloma incanum*, *Rogeria longiflora*, *Coccinia rehmannii*, *Codon royenii*, *Cissampelos capensis*, *Hermannia minutiflora*, *Enneapogon scaber*, Commiphora *gracilifrondosa* and *Aloidendron dichotomum*.

Figure 19. Typical rocky outcrop within the wider Paulputs site. These are considered especially important for fauna but also have a suite of associated plant species.

Dunes

There are several low dunes across the wider study area. In some areas such as in the far south of the site, these form small dune fields but in general these form isolated dunes or occur on the slopes of rocky outcrops where wind-blown sand has collected. Due to the vulnerability of these areas to disturbance, they are not considered suitable for development. Species present in the dunes include *Stipagrostis brevifolia*, *Stipagrostis anomala*, *Rhigozum trichotomum*, *Citrullus lanatus*, *Brachiaria glomerata*, *Cleome foliosa* var. *lutea*, *Limeum myosotis*, *Manulea schaeferi* and *Lycium bosciifolium*. The dunes are also important for fauna and provide a contrasting habitat to the surrounding plains, especially for species associated with loose sandy soils.

Figure 20. Dune vegetation in the foreground is usually dominated by species such as *Rhigozum trichotomum*, *Stipagrostis brevifolia* and *Brachiaria glomerata*.

Drainage Features

There are no well-developed drainage features within the site. The main feature of the site is a wash which runs in a westward direction from near the centre of the site. It is not well differentiated from the surrounding sandy plains, but has a higher proportion of larger woody species. Species present in the wash include *Stipagrostis brevifolia*, *Rhigozum trichotomum*, *Augea capensis*, *Lycium bosciifolium*, *Grielum humifusum* var. *parviflorum*, *Hypertelis salsoloides* var. *salsoloides*, *Parkinsonia africana*, *Arctotis leiocarpa* and *Citrullis lanatus*. As drainage lines are important from a hydrological perspective and also as faunal movement corridors and important habitat for fauna more generally, they are considered sensitive.

Figure 21. The drainage features of the site are not well developed but can be recognised as having a high abundance of tall woody shrubs as well as forbs and annuals.

Bedrock Pans

There are a few bedrock pans present in the wider study area. These are isolated features that occur where large areas of bedrock are exposed and where water may collect in depressions and pockets within the rock. Some of these appear to hold water for extended periods and represent small but important features of the landscape. These pans are used as habitat and breeding sites by temporary water organisms and amphibians but also as water sources by birds, insects, mammals and reptiles. As these are localised features, they are considered no-go areas. Two such areas were identified in the field study, one in the south of the site west of the PV Phase 1 area and another near to the power line Alternative 2 and 3 corridors. These features are not within the current footprint and would not be impacted by the development. The pans are generally not well vegetated and are not considered sensitive from a botanical perspective but represent important features in the landscape for fauna.

Figure 22. The bedrock pans consist of shallow depressions that are occasionally filled with water as well as deeper crevices in the bedrock which hold water for more extended periods.

Site Sensitivity Assessment

The sensitivity map for the site and the power line corridors is illustrated below in Figure 23. The three PV footprint areas are located within an area that is considered to be low sensitivity from an ecological, botanical, aquatic and avifauna perspective. Diversity of fauna and flora within the three PV phase footprint areas is relatively low and the affected habitat is not considered to be of broader ecological significance as it is typical of the area and is widely available. Although there are some protected plant species within the development footprint, most notably, *Hoodia gordonii*, *Aloidendron dichotomum* and *Boscia foetida*, the abundance of these species within the development footprint areas is low and their loss from these areas would not compromise the local populations of these species which have healthy populations in the immediate area outside of the development footprint.

Sensitive features that are present on or near the site, but which would not be affected by the development include the rocky outcrops which are located mostly to the north of the development areas, the bedrock pans which occur outside of the current study area, the drainage lines and some areas of quartz outcrops which are present to the south of the site. Within the context of the site, the PV footprint areas are considered to be well-delineated in terms of avoidance of sensitive features and represent the lowest sensitivity parts of the site and as such are considered well-mitigated in terms of planning-phase avoidance of sensitive features. This avoidance is a key factor in determining the low residual impacts on terrestrial ecology as assessed for the development.

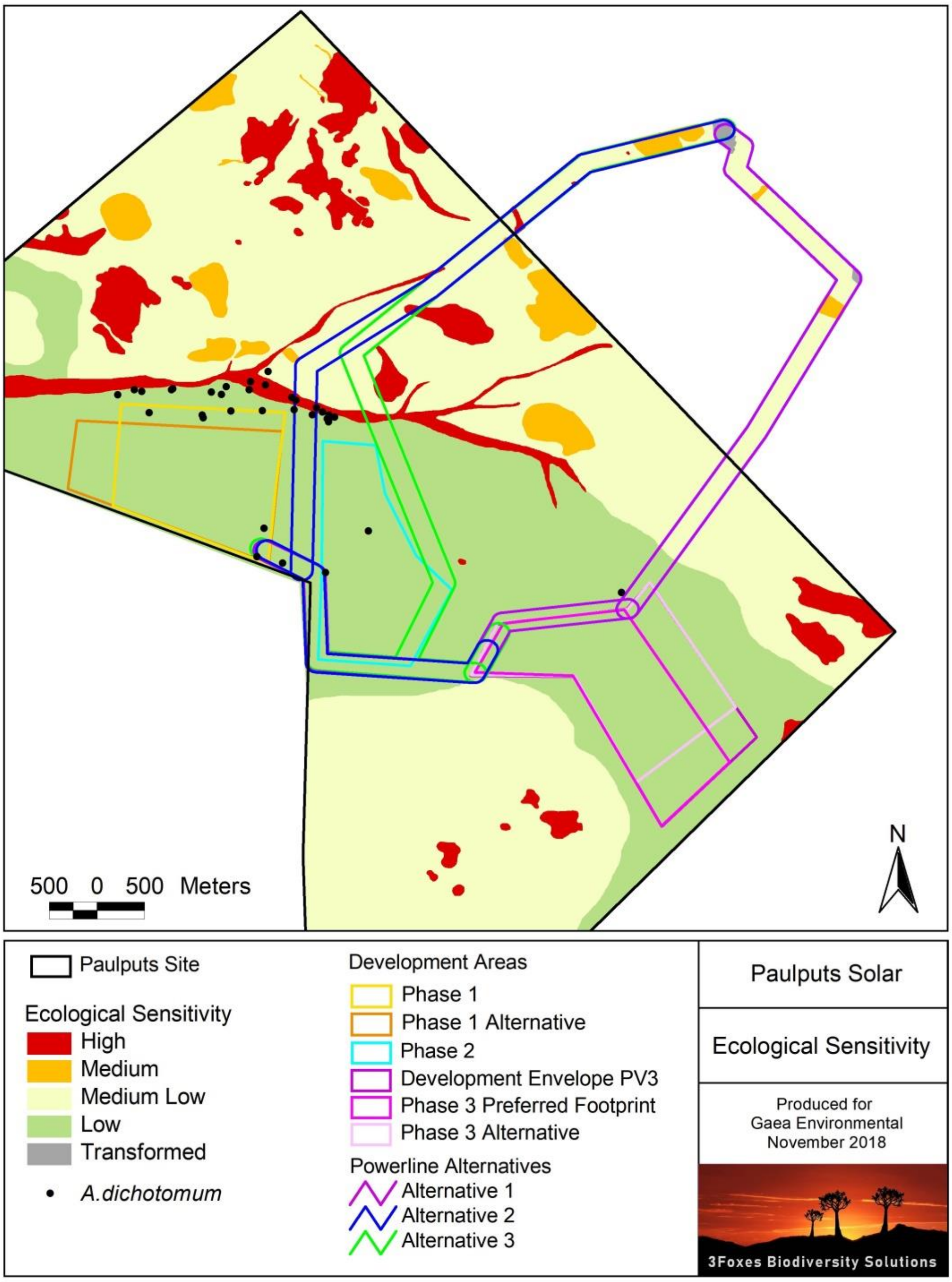


Figure 23. Ecological sensitivity map for the study area, showing revised, mitigated layout alternatives for Phase 1 and Phase 3 of the development, which includes additional avoidance of the Aloidendron dichotomum population to the north of the PV Phase 1 development area.

Critical Biodiversity Areas

An extract of the Northern Cape Critical Biodiversity Areas map for the study area is depicted below in Figure 24. The entire site as well as the power line corridor lies within an area classified as a CBA 2. As development within CBAs can have negative impacts on biodiversity pattern and process it is generally considered undesirable. Although the total footprint of the development, should all three PV phases be developed, would result in significant local habitat loss over ca. 600ha, based on the results of the field assessment, the affected areas are not considered to be very sensitive in terms of the biodiversity features that are within the development footprint. The CBA is related to the presence of an Important Bird Area (the Mattheus-Gat Conservation Area IBA) at the site and does not appear to be related to any other known terrestrial features of significance. The potential of the development to compromise ecological processes or the ability to meet conservation targets is not explored in this section, but is rather dealt with more explicitly in the following sections of the report.

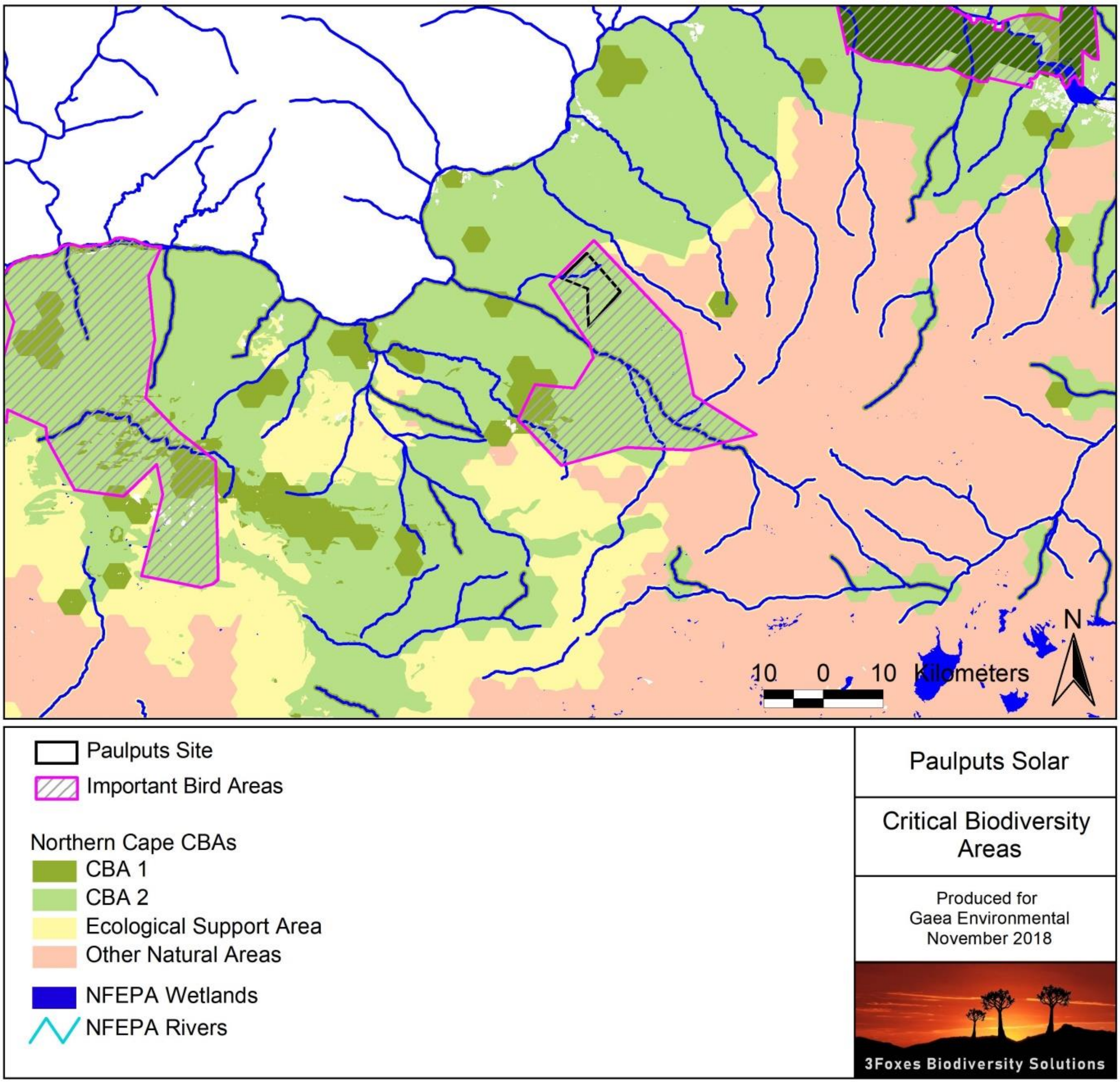


Figure 24. Extract of the Northern Cape Critical Biodiversity Areas map for the wider study area, showing that the site falls within a tier 2 CBA, which is related to the presence of an Important Bird Area at the site.

Since the CBA status of the site appears to be related to the IBA, the significance of the IBA for birds and especially the important habitats for birds within the IBA warrant more detailed investigation. According to the Birdlife SA IBA Handbook, the Mattheus-Gat Conservation Area has the following birds of significance "This IBA is one of a few sites protecting both the globally threatened Red Lark *Certhilauda burra*, which inhabits the red sand dunes and sandy plains with a mixed grassy dwarf shrub cover, and the near-threatened Sclater's Lark *Spizocorys sclateri*, which occurs erratically on gravel plains. The site potentially supports 16 of the 23 Namib-Karoo biome-restricted assemblage species and a host of other arid-zone birds. It is seasonally important for nomadic larks, such as Stark's Lark S. starki, and sparrow-larks, which are abundant after good rains. The number of known species for this IBA is 142. At the time of its categorisation, the IBA had been poorly atlased for SABAP2. Whereas 16 lark species were recorded during SABAP1, only seven have been recorded to date during SABAP2. It appears that the Red Lark population has declined in this IBA."

Globally threatened species are Red Lark, Sclater's Lark, Kori Bustard *Ardeotis kori*, Ludwig's Bustard *Neotis ludwigii* and Black Harrier *Circus maurus*, and Karoo Korhaan *Eupodotis vigorsii* is regionally threatened. There are also numerous biome-restricted species present, most of which nevertheless have a broad distribution within the country more generally. No parts of the IBA are currently formally conserved. Although parts of the IBA overlap with the 2010 National Protected Area Expansion Strategy Focus Areas, the area has not been identified as a protected area expansion strategy focus area under the more recent Northern Cape Protected Area Expansion Strategy, which is considered to represent the current best available knowledge on protected area expansion priorities in the Northern Cape.

The IBA is comprised predominantly of Bushmanland Arid Grassland, Bushmanland Sandy Grassland, Eastern Gariep Plains Desert, and Eastern Gariep Rocky Desert (Mucina & Rutherford, 2006). Aggeneys Gravel Vygieveld and Bushmanland Vloere are also represented in small areas. Most of the above mentioned bird species do not specialise in their habitat requirements beyond the need for arid zone conditions. One exception is the Red Lark, which prefers red dunes and closely associated sandy plains. Avifaunal monitoring has not recorded this species on site, and the site has been identified by a habitat modelling exercise as being of low to moderate significance for the species (Colyn per comm, see avifaunal report). The impact of habitat destruction during the construction of Paulputs Solar on this species is likely to be very limited then. The remaining bird species, which are more generalist in their requirements, cannot be considered to be significantly threatened by the loss of a portion of Bushmanland Arid Grassland when that vegetation type is so abundant nationally. The Martial Eagle pair which bred previously on site has not bred for two consecutive seasons, calling into question whether they will breed at this site again, and therefore diminishing the importance of destruction of habitat for this species. At a smaller spatial scale, within the above vegetation types sensitive habitats include: quartzite hills; gneiss granitic inselbergs; and dry riverbeds. None of these are impacted by the proposed project, having been avoided during the design phase.

Current Transformation Baseline & Cumulative Impact

There are several other existing solar energy developments in close proximity to the current site. This includes the Biotherm 10MW Konkoonsies PV plant north of the site as well as the two CSP plants northeast of the site. As these already existing and operational, they are considered to form part of the transformation baseline for the area. The footprint of these existing plants is approximately 800ha. There is also the larger 75MW PV plant on Konkoonsies II that is a preferred bidder and is currently under construction and would have a footprint of approximately 200ha. The total existing footprint of renewable energy in the area is thus approximately 1000ha. Although a node of solar energy development is starting to occur around the Paulputs substation the surrounding landscape is still overwhelmingly intact and has experienced little other transformation to date. Each phase of the current development would contribute approximately 200ha to transformation and habitat loss in the area. While the broader landscape is still little-impacted by transformation (Figure 25), the concentration of development around the substation is a potential concern. However, the location and spatial context of the current sites is seen as being important in moderating the potential cumulative impact of the development. The layout of the three PV plants is seen as being efficient as their close proximity to one another reduces edge effects and their position within the lower sensitivity gravelly and sandy plains of the area minimises their impacts on the more sensitive features of the area, in particular the dune systems, quartz areas and rocky hills. As a result, the cumulative impacts associated with the current development are considered acceptable, even if all three plants were ultimately to be built.

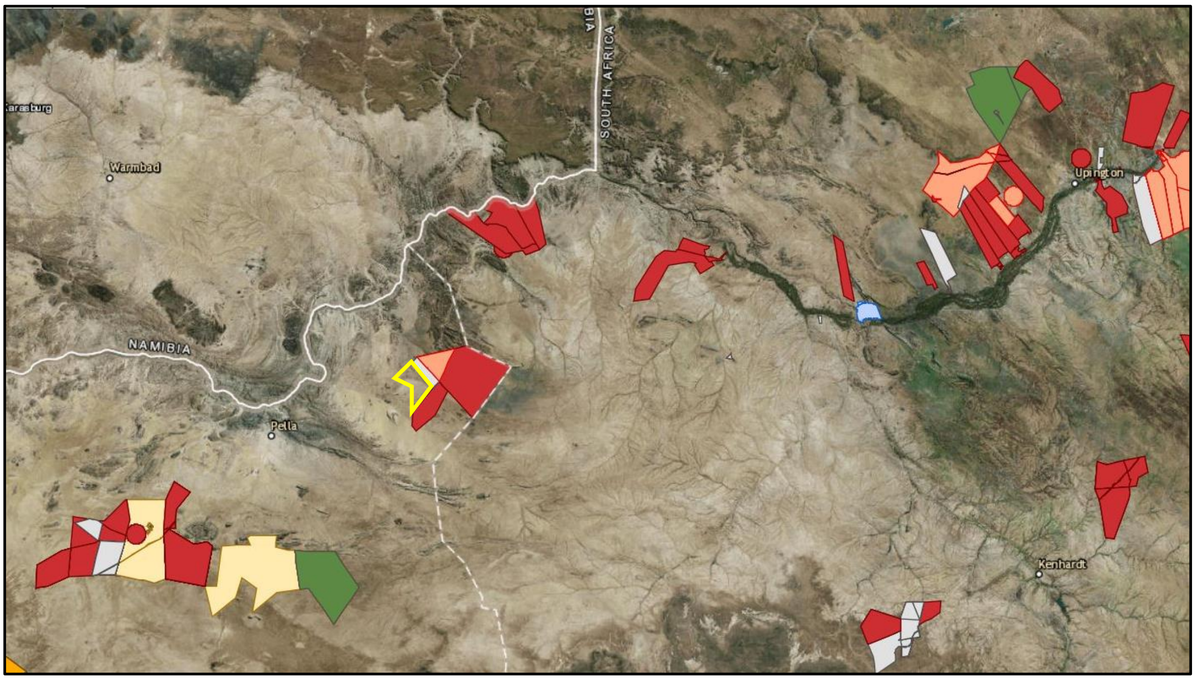


Figure 25. Map of DEA-registered renewable energy projects in the wider area around the Paulputs site, showing that there are several other projects in the immediate vicinity of the site as well as concentrations of projects in the Pofadder region as well as towards Upington.

Figure 26. Looking south from the hills along the road to Onseepkans over the CSP plant that is located east of the Paulputs substation. Existing impact in the area consists of the two CSP plants side by side at site and the Konkoonsies 10MW and the under construction 75MW PV plant south of the Paulputs substation.

9.3. Assessed Impacts & Significance

The assessed ecological impacts associated with the development of the 3 phases of the Paulputs Solar project are provided in Table 1 below. The majority of impacts were assessed as being of Moderate Significance before mitigation and of Low Significance with the implementation of the recommended mitigation measures. No impacts were assessed as High or Moderate post-mitigation impacts. It is however important to interrogate the reasons underlying the low post-mitigation impacts and any underlying uncertainties and assumptions.

Table 1. Summary assessment of impacts assessed as part of the fauna and flora specialist study for the Paulputs Solar development.

Impact	Pre-Mitigation Impacts	Post-Mitigation Impacts
Construction Phase		
Vegetation loss including protected species	Moderate	Low
Faunal impact due to construction activities	Moderate	Low
Operational Phase		
Operational impacts on fauna	Moderate	Low
Impact on CBAs	Moderate	Low
Decommissioning Phase		
Decommissioning will leave the site vulnerable to erosion	Moderate	Low
Decommissioning will leave the site vulnerable to alien plant invasion	Moderate	Low
Cumulative Impacts		
Cumulative impacts on broad scale ecological processes	Moderate	Low
Cumulative impacts on ability to meet conservation targets	Low	Low

As previously alluded to, the primary mitigation and avoidance measure that has been implemented with regards to the Paulputs Solar site is planning-phase avoidance of sensitive features. This is seen as the most important and effective mitigation measure that be implemented by a developer as all other mitigation measures are generally reactive to generated impacts and as such are less effective at reducing assessed impacts. Although construction phase disturbance intensity at the site is likely to be high, this is transient and given the homogenous nature of the site and the low density of fauna and flora of concern, the post-mitigation impacts during this phase of the development are still seen as being low. During the operational phase, there is limited scope for significant interaction between the plant and the adjacent environment with the result that operational phase impacts on fauna are likely to be low. This is also supported by observations from existing PV plants where a variety of fauna appear to co-habit within the PV array areas with no apparent ill-effect for either the fauna or the facility.

Impacts on the Bushmanland Arid Grassland vegetation type are seen as being minimal, given that this is one of the most extensive vegetation types in the country. Furthermore, the actual habitats affected are typical of the area and do not contain an abundance of species of concern. The affected CBA is a CBA 2 and does not appear to be in place specifically for terrestrial fauna and flora and the low sensitivity of the affected areas are well-supported by the field observations. Based on these considerations, the impacts on habitat loss within the CBA has been assessed as being of low post-mitigation significance. As suggested above, this is motivated by the apparent low irreplaceability of the affected habitats and plant communities and the large extent of the CBA in relation to the footprint of the development. In terms of the impacts on the development on broad-scale ecological processes, this is perhaps the most intangible impact to measure and is also likely to be the most important in terms of addressing the potential need and desirability for an offset at the site. Given the importance of this impact, this is dealt with explicitly and in detail in the next section.

In terms of uncertainties associated with the terrestrial ecology study, the vegetation of the site has been well-characterised as a result of the favourable conditions at the time of the main field assessment as well as a result of the numerous site visits the consultant has conducted to the broader study area for existing projects at the site. In terms of fauna, these have been less reliably characterised, largely as a result of the low density of most fauna at the site and the long time period that would be required to generate a comprehensive list of fauna present in the area. Again, the current assessment is well-informed by the previous work in the area and while there are likely numerous species present at the site that were not observed during any of the site visits, there are very few fauna of concern known to occur in the area with the result that this is not likely to significantly impact the assessment in any meaningful way. Overall, the results of the ecological study are seen as being comprehensive and reliable and there do not appear to be any significant gaps or uncertainties that are likely to have significant repercussions for the assessment.

From an avifaunal perspective, the habitat destruction residual impact after mitigation remains at Medium significance. However, we recommend that an offset is not required in this instance for the following reasons:

- The habitat on site is not unique or limited in the broader area.
- The key regionally Red-Listed lark species for which there is concern in this broader area and IBBA are not well represented on site, and habitat modelling has not identified the site as holding high value for these species.
- A relatively small amount of habitat is affected i.e. 600ha (from a total of 67 000ha in the IBA).
- We cannot envisage in this case how an appropriate offset could be implemented or what it would achieve. The vast majority of this habitat type is not transformed, nor does it face any threat of transformation in the broader area in any event. A fundamental challenge with an offset approach in this environment is that most of the key bird species are nomadic in response to environmental conditions (particularly rainfall) and cannot be guaranteed to even use and offset designated area.
- Given that the impact assessment methodology is categorical, we believe that such a motivation is acceptable in light of the fact that not all ‘Medium’ significance impacts are equal, and this particular one is towards the lower end of the Medium category.

Interpretation of Ecological Pattern & Process

In this section, the major ecological features of the wider study area are identified and mapped. These are then illustrated and discussed below before an overall interpretation of the associated ecological processes operating in the area are identified and discussed in reference to the site and the potential impact of the development on these features and processes.

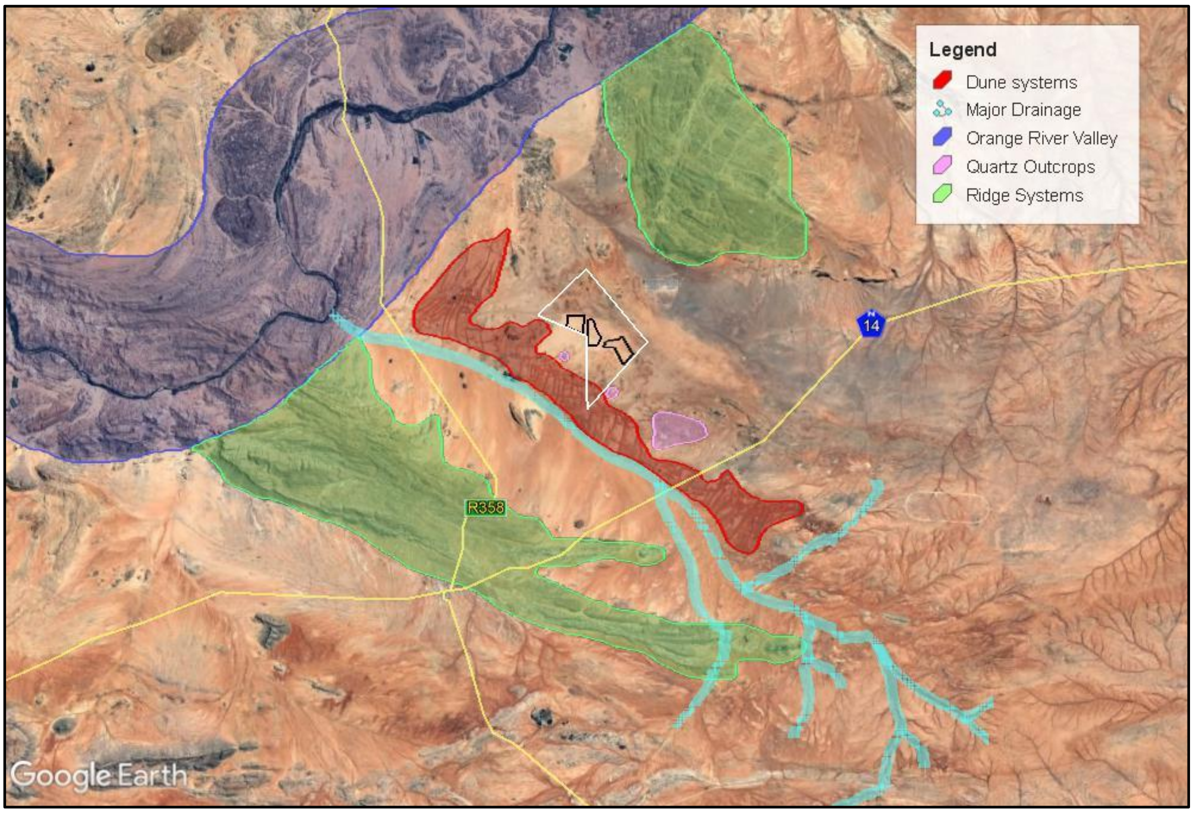


Figure 27. Major ecological process features of the wider area around the Paulputs Solar Site.

The map of the major ecological features of the area is illustrated above in Figure 15. The most significant feature of the wider area is the Orange River valley north of the site. This includes the river itself as well as the adjacent slopes, hills and plains. This is a well-defined environment that can easily be recognised in the field and has a specific associated climate as well as an array of characteristic indicator species. The Orange River valley forms a corridor that is still largely intact and would not be impacted by the current development as it does not encroach into the site. There are also several rocky ridge systems which link into the Orange River valley from the south and which occur both to the north and the south of the Paulputs Solar site. These provide continuity with the rocky, mountainous habitat along the Orange River and are seen as important ecological features of the area. In the valley to the south of the site is the Kaboep River. This is not a river in the typical sense as it very rarely if ever flows, except very briefly after large storms and usually only in sections. However, this system provides a linkage with the Orange River and also a corridor for species associated with the lowland sandy habitats typical of the Kaboep River valley. To the south of the site and north of the Kaboep River is a loose red dune system. This is an important area for the Red Lark as well as fauna associated with the loose sands of the dunes. The dune system is isolated from other such systems and is locally a fairly unique system that is not replicated until one gets to the dunes of the Koa River Valley near Aggeneys, approximately 80km to the southwest.

A meeting was organised with Birdlife South Africa (BLSA) on 28 February 2018 to confirm that BLSA does not have any objection to the proposed site location . During the meeting with BLSA, Mr Robin Colyn presented the results of a habitat suitability modelling exercise conducted for Red, Sclater's and Stark's Larks. The model output showed that the proposed Paulputs site was not in an area identified as being likely to have good habitat for these species. The specialist concluded that the Paulputs site is not in prime habitat for Red Lark. It is possible that the birds will use these dunes and associated habitat close to site at some point when conditions are favourable, but this is not a species known to move significantly at this stage. The specialist concluded that this species will not be at risk.

There are also some quartz hills along the northern edge of the dune field and these are seen as important features as they are usually home to a variety of specialised, associated flora and probably fauna as well.

Figure 28. Looking west along the road to Onseepkans, with the Orange River valley in the distance. The image shows the distant hills along the Orange River, with scattered hills, dunes and open plains in the foreground. There is very little existing development in this area and it is currently largely intact.

Figure 29. Typical habitat within the Orange River valley, with numerous rocky hills, some quartz outcrops and weathered quartz patches and plains dominated by Aloidendron dichotomum and Euphorbia gregaria. From an ecological point of view, this area is considered sensitive and of high biodiversity significance. It would not however be directly affected by the current development.

Figure 30. Looking south from within the Paulputs Solar site towards the Kaboep River, which is not visible below the hills in the middle distance. The image shows one of the quartz hills south of the site, which is seen as a locally significant feature. The rocky ridge in the distance is the large ridge system south of the site, illustrated in the Figure 15.

Figure 31. Looking south west across the plains south of the Paulputs Solar site into the Kaboep River valley, showing the open plains of the valley, some dunes visible in the middle distance and the rocky ridge system in the distance.

Figure 32. Looking north west across the open plains of the Kaboep River valley, with Namibia visible in the distance on the other side of the Orange River which is below the middle horizon.

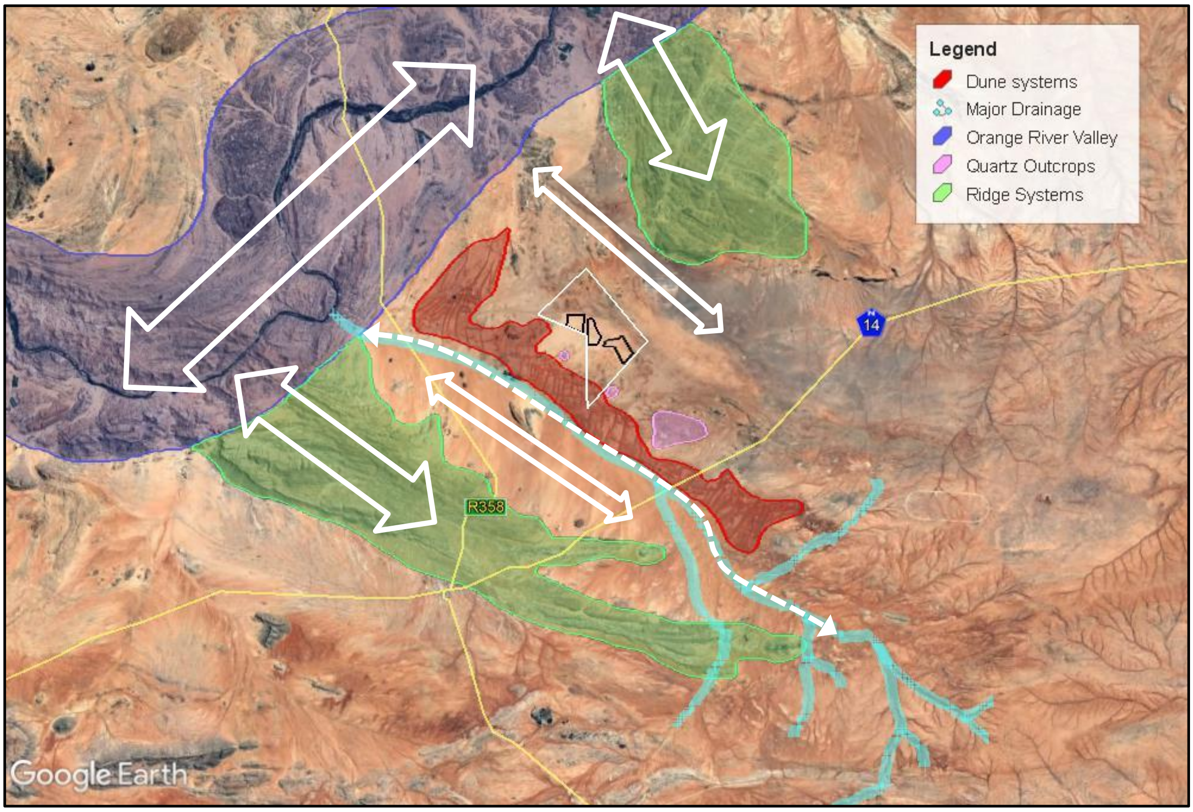


Figure 33. Broad summary of the ecological connections and likely faunal movement pathways within the broader Paulputs Solar study area.

A summary of the likely ecological process pathways and most important ecological connections operating in the area is illustrated above in the Figure 21. There is a clear and important habitat association and linkage between the large ridge systems in the area and the rocky areas along the Orange River. As there is a significant elevation gradient between the Orange River and the areas to the south, the ridge provides habitat continuity along a significant elevation gradient which is likely used seasonally by a variety of fauna and would be important over longer time scales for ecological resilience. Similarly, the Kaboep River system is an important feature of the area and provides a linkage to the Orange River and also represent a corridor for movement of fauna associated with lowland habitats. The open plains south of the river represents more typical habitat of the area but is likely to be used to some degree for movement to and from the Orange River Valley. To the north of the Kaboep River is the dune system which is a contained system and is not likely to be very important in terms of connectivity as it is isolated from other such areas. It is however of high significance as it is associated with the Red Lark. However as previously mentioned the avifauna specialist specifically surveyed all areas of red dunes and surrounds on or close to the proposed site for Red Lark (during the initial site visit and subsequent monitoring seasons) but did not record the species. BLSA also confirmed that the proposed Paulputs site is not in prime habitat for Red Lark. Between the site and the Kaboep River are also some occasional quartz outcrops. These are also contained systems and are seen as locally important habitats for a variety of associated species. As with the areas to the south of the Kaboep River, the open plains from the site northwards may also be of local significance for connectivity with the Orange River, but are seen as being of secondary significance to the Kaboep River valley itself.

Overall, given the scale at which these processes operate and the extent and location of the development, the scope for significant disruption of these broad-scale ecological processes is low. The footprint of the development at 600ha is not sufficient to represent a significant degree of habitat loss at the landscape scale (i.e. about 500 000 ha as mapped in Figure 21), to represent a significant obstacle or extent of habitat loss for the species prevalent in the area. Given these considerations, the contention of the fauna and flora specialist study that the development would have a low post-mitigation impact on broad-scale ecological processes is supported.

9.4. Need & Desirability for an Offset

In this section, the results of the study thus far are summarized and synthesised in order to evaluate the potential need and desirability of an offset for the development. As the development has other environmental impacts apart from those on terrestrial ecology, input was also sought from the freshwater specialist (Kate Snaddon) and the avifaunal specialist (Jon Smallie) on the need and desirability of an offset in terms of these components of biodiversity as well. The results of the current study are outlined as follows:

- The site falls within a Tier 2 CBA, which is related to the demarcation of the area as an Important Bird Area (Matteus-Gat Conservation Area). The IBA is however not formally protected in any way.
- The PV development footprint areas are seen as being well-located in context of the site and fall within the lowest sensitivity habitat available. This is seen as the most important mitigation measure that has been implemented by the developer and is the key factor which has resulted in the low post mitigation impacts associated with the development.
- The assessed terrestrial ecological impacts associated with the development have all been assessed as being low after mitigation in the fauna and flora specialist study. As there are no significant assumptions and limitations associated with this assessment, it is considered to be robust and well supported by the baseline data from the site.
- A detailed analysis of the broad-scale features and ecological processes operating in the landscape around the site was conducted as part of this study. This analysis identified a variety of important ecological features present in the wider area, but at the same time supports the low assessed sensitivity of the proposed development areas. The site is not located within any of the important features or ecological corridors and gradients operating in the area. As such, it is highly unlikely that the development would result in significant impact on these features or processes and the low assessed impact of the development on broad-scale ecological processes operating in the area is supported.

Input regarding the potential impact of the development on freshwater ecosystems, obtained from Kate Snaddon is as follows:

> "According to the current Biodiversity Offsets Policy, offsets should only be applied to remedy impacts that will have a residual moderate or high negative significance. In addition, the Wetlands Offset Policy states that "The goals of wetland offsets are to achieve 'No Net Loss' and preferably a net gain with respect to the full spectrum of functions and values provided by wetlands". This includes no net loss of wetland area or of wetland function, however it is important to note that there is no wetland on the proposed site. The same principles can be applied to watercourse habitat and function. The key is to identify whether the impacts associated with the proposed development(s) would lead to a loss of habitat / area or function. This is more critical than the CBA or FEPA status, as often this status can apply to a large area due to the size of the planning units (in the case of FEPA – these are whole sub-catchments).
>
> In the case of the impacts associated with Phases 1 to 3 at the Paulputs site, none of the impacts associated with the development itself were assessed as having a moderate or high significance, due to the sloping of the Phase 1 and Phase 3 sites away from the Kaboep River, and in all cases, mitigation measures recommended in the Scoping and EIA Reports will effectively avoid direct or indirect impacts on any of the inland aquatic ecosystems identified on the sites. It was concluded for the EIA, that there would be no significant residual impacts after mitigation, no loss of wetland or watercourse habitat, and no loss of ecosystem function. As such, there is no requirement for an offset."

In terms of the input obtained from Jon Smallie on the avifaunal impacts associated with the development, the following opinion was obtained:

> "The significance of bird habitat transformation at the Paulputs facility is Medium post mitigation (not High). However we do not recommend an offset approach since: the habitat on site is not particularly unique, nor limited; the more sensitive habitats within this vegetation type have been avoided; the facility will impact approximately 600ha of habitat of a total of approximately 67 000ha in the IBA; and the most important bird species for which the IBA is declared were not recorded on site, nor is the site likely to be highly suitable for them based on the BLSA habitat suitability modelling exercise conducted for Red, Sclater's and Stark's Larks presented by BLSA on 28 February 2018.

In terms of the ecological impacts, the following conclusion is reached with regards to the need and desirability for an offset for the development:

> Although the development is located within a Tier 2 CBA, the assessed terrestrial ecological impacts are all considered to be low after mitigation. A detailed analysis of the site context and ecological patterns and processes operating in the area supports the conclusion that the development will have low impacts on broad-scale ecological processes. As such, the conclusion reached in terms of terrestrial ecology is that the development will not have moderate or high post mitigation impacts and does not occur in an area of high biodiversity value where there will be significant residual impacts on terrestrial biodiversity. As such, it is not considered necessary or desirable to implement an offset for the development and the development should focus on mitigating impacts on-site.

9.5. Conclusion and Recommendations

Based on the analysis provided as part of this study as well as the conclusions reached in the associated specialist studies from the EIA process, an offset is not recommended as a necessary outcome for the development. The development will not have moderate or high post mitigation impacts on important biodiversity features and does not occur in an area of high biodiversity value where there will be significant residual impacts on terrestrial biodiversity. It is recommended that mitigation be restricted to the site and focused on the impacts that would be generated by the development. The appropriate avoidance has already been implemented by the developer in terms of the layout planning. With the appropriate mitigation during construction and operation, the impacts of the development on the receiving environment will be acceptable and no nett loss of biodiversity is likely to occur.

In terms of further steps regarding this study and findings contained herein, it is recommended that this study is circulated to DENC and DEA for comment and further input. Should any IAPs not concur with the result of the study, further input and comment on why this might be should be requested along with any supporting information. All comments and inputs should be addressed before the final draft is submitted along with the final EIA Report.

9.6. APPENDIX A: Specialist Declaration

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

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

Signature of the specialist: ______________________________

Name of Specialist: _____Simon Todd________________________________

Date: _____18 November 2018____

9.7. APPENDIX B: Peer-review report

Dr. Philip G. Desmet
84 Clearwater Road
Lynnwood Glen, 0081
tel: +27 012 348-0577
mobile: 082 850 8751
email: DrPhil@ecosolgis.com
VAT No. 4400284156
Tax No. 2759150143
SA ID: 7003145146087
Pr.Sci.Nat. 115310

January 16, 2019

Ms Nazley Towfie
Project Development Manager: Wind & Solar
juwi Renewable Energies (Pty) Ltd
24th Floor, Metropolitan Centre
7 Walter Sisulu Avenue
Cape Town
8001
South Africa

Project Title: Scoping and Environmental Impact Assessment for the Proposed Development of the 300 MW Paulputs Solar PV Energy Facility near Pofadder, in the Khaî-Ma Local Municipality (Northern Cape Province)

Review of the Requirement for a Biodiversity Offset

This document provides an independent expert opinion on the requirement for a biodiversity offset in relation to the proposed solar PV development at Paulputs near Pofadder in the Northern Cape Province.

Based on the information assessed and my personal knowledge of the area I agree with the findings of the biodiversity offset assessment report that an offset is not required for the presented development footprint.

This opinion is informed by the biodiversity offset report prepared as part of the development EIA study as well as the biodiversity specialist studies (bird, aquatic, fauna and flora). Additional spatial biodiversity planning information not discussed in the above studies was also considered, namely, the Namakwa District Bioregional Plan (2009) and the National Protected Area Expansion Strategy (2016).

The biodiversity information presented in the specialist studies paints a good picture of the diversity, extent and status of biodiversity present at the site. This description and assessment of the site is consistent with my personal knowledge of the Bushmanland biodiversity and ecosystems. The interpretation of the development impacts and weighting of these impacts (medium to low) is in my opinion justified given the biodiversity of the site, the location of the development footprint and the mitigation measures proposed. Biodiversity features of conservation concern such as quartz hills, koppies, rock banke with vernal pools, drainage lines and raptor nests are all avoided in the proposed development plan. Loss of habitat (approximately 600ha) will be confined to Least Threatened vegetation types that are not near a threatened ecosystem threshold.

In terms of the Draft National Biodiversity Offset Policy[1] the Paulsputs site is entirely located within a CBA2 area in the Northern Cape Conservation Plan 2016 and therefore should attract a biodiversity offset with a ratio of 20:1. However, as the biodiversity offset assessment report correctly argues, the areas being impacted do not contain biodiversity features listed in the draft national policy document as requiring offsets, namely:

- Areas of irreplaceable biodiversity
- Areas of composite biodiversity significance recognised in approved biodiversity policy, bioregional, biodiversity or spatial conservation plans
- Ecosystem status
- Species threat status
- Special habitats.
- Important ecological corridors
- Areas that provide ecological goods and services of high value to communities or society

A limitation of the specialist studies and the biodiversity offset assessment reports is that they do not consider other relevant spatial biodiversity informants such as the Namakwa District Bioregional Plan (2009) and the National Protected Area Expansion Strategy (2016) (Figure 1). These plans confirm the existing opinion regarding the regional ecological context of the site not being located within a feature identified as being important in a biodiversity plan.

Based on my review of the information presented the conclusions of the biodiversity offset assessment report are correct and no offset is required for the development provided (1) the final footprint is as presented; and (2) the mitigation measures are successfully implemented

For assessing future similar projects the following recommendations should be considered by DEA and DENC:

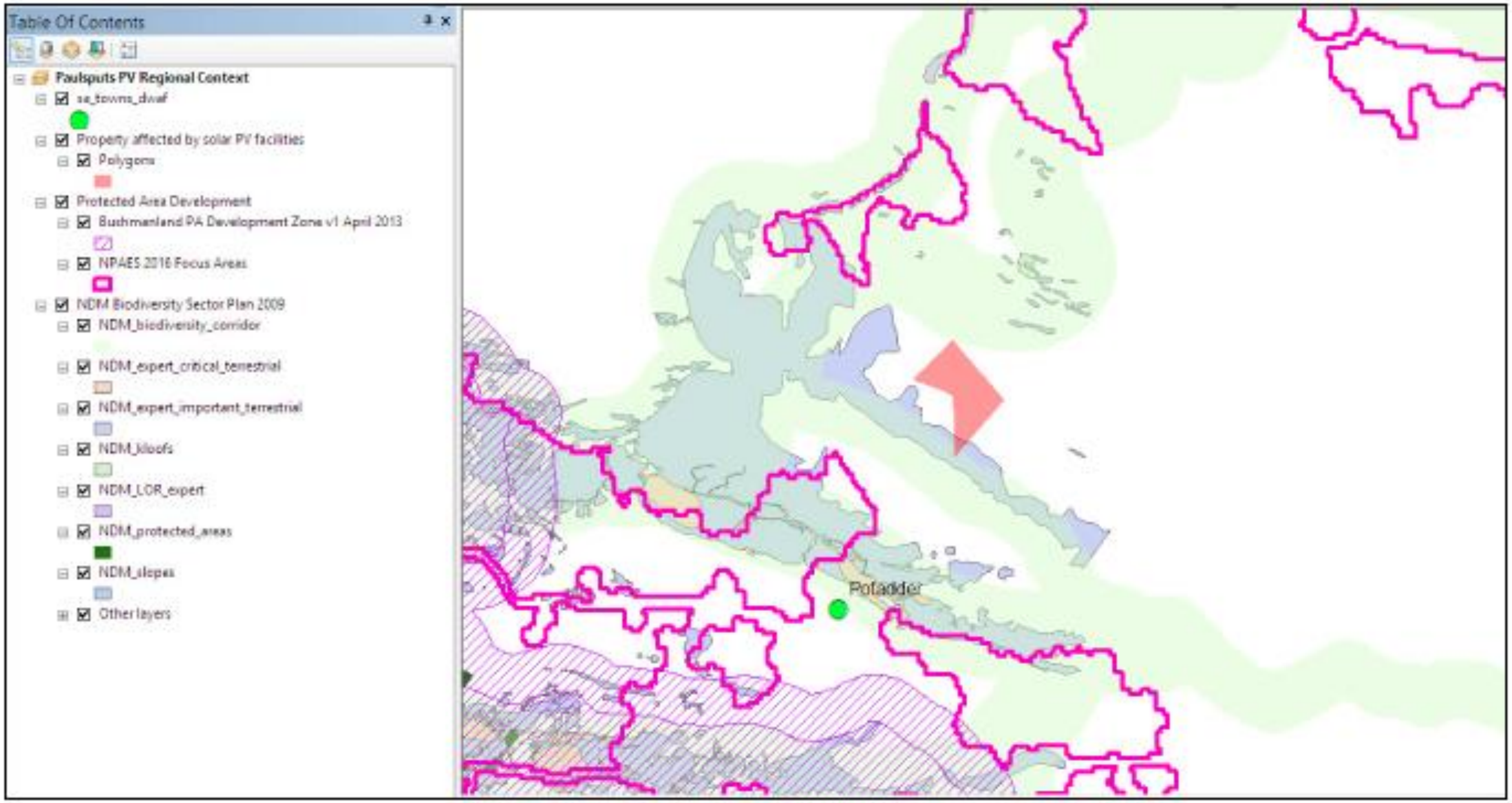
- As energy sites develop around sub-stations so the cumulative impact will grow to the point that biodiversity pattern and process targets will be compromised ultimately requiring the implementation of biodiversity offsets.

[1] Government Gazette, 31 March 2017, No. 40733. Department Of Environmental Affairs: National Environmental Management Act (107/1998): Draft National Biodiversity Offset Policy. Government Notice No. 276.

It is strongly recommended that DEA conduct Regional Context Studies or SEAs for each energy development node. This will improve the certainty of assessing the regional context and cumulative impacts of individual developments as well as the requirement for biodiversity offsets.

- The information contained in the Northern Cape Conservation Plan is not detailed enough to inform site-level decisions as considered in this report. It is necessary that the Northern Cape Conservation Plan be updated to (1) provide information detail at a relevant spatial scale (i.e. small planning units that can relate to the size of biodiversity features and development footprints); and, (2) as an immediate minimum measure a site by feature or biodiversity feature look-up table must be made available to better understand the features triggering the designation of CBA1 and CBA2 areas.

Figure 1 The location of the Paulsputs site in relation to the Namakwa District Bioregional Plan (2009) and the National Protected Area Expansion Strategy (2016).



1. SPECIALIST INFORMATION

Specialist Company Name:	Dr. Philip G. Desmet			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Dr. Philip G. Desmet			
Specialist Qualifications:	BSC Hons., MSc and PhD			
Professional affiliation/registration:	Pr.Sci.Nat. 115310			
Physical address:	84 Clearwater Road, Lynnwood Glen			
Postal address:	84 Clearwater Road, Lynnwood Glen			
Postal code:	0081	Cell:	082 850 8751	
Telephone:	012 348 0577	Fax:	n/a	
E-mail:	DrPhil@ecosolgis.com			

2. DECLARATION BY THE SPECIALIST

I, _____Philip George Desmet____________, 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

Dr Philip G. Desmet

Name of Company:

16 January 2019

Date