FINAL VISUAL IMPACT ASSESSMENT

PROPOSED PHOTOVOLTAIC SOLAR ENERGY FACILITIES ON DU PLESSIS DAM FARM NEAR DE AAR, NORTHERN CAPE

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Prepared for:
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LIST OF ACRONYMS

APHP	Association of Professional Heritage Practitioners
BLM	Bureau of Land Management (United States)
BPEO	Best Practicable Environmental Option
CALP	Collaborative for Advanced Landscape Planning
CSP	Concentrated Solar Power
CPV	Concentrated Photovoltaic
DEA&DP	Department of Environmental Affairs and Development Planning (South Africa)
DEM	Digital Elevation Model
DoC	Degree of Contrast
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Geographic Information System
I&APs	Interested and Affected Parties
IDP	Infrastructure Development Plan
IEMA	Institute of Environmental Management and Assessment (United Kingdom)
IEMP	Integrated Environmental Management Plan

KOP	Key Observation Point
MAMSL	Metres above mean sea level
NELPAG	New England Light Pollution Advisory Group
PSDF	Provincial Spatial Development Framework
ROD	Record of Decision
SAIEA	Southern African Institute for Environmental Assessment
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
SEMP	Strategic Environmental Management Plan
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
VRM	Visual Resource Management
ZVI	Zone of Visual Influence

GLOSSARY

Best Practicable Environmental Option (BPEO)
This is the option that provides the most benefit, or causes the least damage, to the environment as a whole, at a cost acceptable to society, in the long, as well as the short, term.

Cumulative Impact
The impact on the environment which results from the incremental impact of the 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.

Impact (visual)
A description of the effect of an aspect of a development on a specified component of the visual, aesthetic or scenic environment, within a defined time and space.

Key Observation Points (KOPs)
KOPs refer to receptors (people affected by the visual influence of a project) located in the most critical locations surrounding the landscape modification, who make consistent use of the views associated with the site where the landscape modifications are proposed. KOPs can either be a single point of view that an observer/evaluator uses to rate an area or panorama, or a linear view along a roadway, trail or river corridor.

Management Actions
Actions that enhance the benefits of a proposed development, or avoid, mitigate, restore or compensate for, negative impacts.

Receptors
Individuals, groups or communities who would be subject to the visual influence of a particular project.

Sense of Place
The unique quality or character of a place, whether natural, rural or urban.

Scenic Corridor
A linear geographic area that contains scenic resources, usually, but not necessarily, defined by a route.

Scoping
The process of determining the key issues, and the space and time boundaries, to be addressed in an environmental assessment.

Viewshed
The outer boundary defining a view catchment area, usually along crests and ridgelines. Similar to a watershed. This reflects the area in which, or the extent to which, the landscape modification is likely to be seen.

Zone of Visual Influence (ZVI)
The ZVI is defined as 'the area within which a proposed development may have an influence or effect on visual amenity.'

1 EXECUTIVE SUMMARY

VRM Africa was appointed by Aurecon South Africa Pty (Ltd) to undertake a Visual Impact Assessment (VIA) for Mulilo Renewable Energy (Pty) Ltd (Mulilo). The proposed project would take place on the Du Plessis Dam Farm (Remainder of Farm 179), near De Aar in the Northern Cape.

The scope of the VIA covers the entire affected project area. This includes an inspection of the full site extent and a brief assessment, including the following:

- Quantifying and assessing the existing scenic resources/ visual characteristics on, and around, the proposed site.
- Evaluating and classifying the landscape in terms of sensitivity to a changing land use.
- Reviewing the legal framework that may have implications for visual scenic resources.

The Northern Cape region's most predominant features are the uniform nature of the flat Nama Karoo plains, with typical semi-desert and desert climatic conditions. The site is situated close to the town of De Aar in the Northern Cape where the dominant landscape feature is the open plains of the Karoo scrub and the Nama Karoo. Surrounding land use is agricultural, predominantly sheep farming. Vegetation variety is limited to one or two vegetation types, but is fairly iconic as a representation of the Nama Karoo landscape, which is strongly associated with South African cultural heritage. De Aar was established in 1903 and has a population of around 46 000 people. It was a main junction for the first railway line from Cape Town to Kimberley in 1881. De Aar has excellent transport infrastructure and is renowned for its central location on the main railway line and highway between Johannesburg, Cape Town, Port Elizabeth and Namibia.

A viewshed analysis of the existing landscape revealed that there would be very little difference between the visual envelopes of the two alternatives. The viewshed would be large and extend in a wide area around the site. Key Observation Points were defined:

- R48 southbound
- Happy Valley residents

A site landscape character assessment was undertaken at two locations to assess the scenic quality, receptor sensitivity to landscape change and receptor distance to the proposed landscape modifications. It was found that the scenic quality of the site is moderate, due to the close proximity of the site to the northern, and more industrial, section of the town. Receptor sensitivity was defined as moderate to low as the view to the site would include the Siemens Photovoltaic project adjacent the proposed site, which increases the visual absorption capacity (VAC) of the area.

The proposed landscape modification is large and will generate strong levels of visual contrast. The Class III visual objectives, to retain the existing rural landscape character, will not be met, and a change in the landscape character will take place to the site and the immediate surrounds. It must be noted that there are other energy-related projects proposed in the immediate surrounds which would significantly alter the surrounding landscape character.

De Aar has some of the highest renewable energy resource levels in the world, with good existing road infrastructure and accessibility to the national grid. There are 10 proposed renewable energy projects in the area surrounding De Aar as can be seen in the Department of Environmental Affairs Map in Figure 3. Of these 4 projects are situated to the south east of De Aar and 1 large area to the north east are pending. 3 projects have been approved and 1 has a preferred bidder status.

Already under construction is the 50MW De Aar Solar PV Project (Siemens/Globeleq/ Mainstream consortium) which is located 6 km outside the town of De Aar on land owned by the Emthanjeni Municipality in the Northern Cape. The project will cover an estimated 100 hectares and use 167 580 PV panels that will be fed directly into the Eskom 132 KV distribution system (*http://www.futuregrowth.co.za)*. The proposed Solar Capital De Aar Solar Farm is located on a 2 300 hectare farm outside De Aar, which will have 1 000 000 solar panels erected in the initial phase.

Should all these proposed projects be constructed, the change in landscape brought about by the proposed projects would significantly reduce its visual intrusion. The local landscape, in the outskirts of De Aar, may therefore change in character from one which is residential, commercial and industrial, to one where there are isolated high-tech developments, i.e. wind turbines and solar arrays.

It is the recommendation of this study that Alternative 1 could proceed without causing a significant change to the surrounding landscape character. Motivation for this decision is based on the following:

- The presence of the existing Siemens PV project under construction to the east of the site, which increases the eastern visual absorption capacity;
- the generally lower scenic quality of the western section of the site, which is strongly associated with the Eskom transmission lines;
- the Mulilo PV project located on this site that has already been granted environmental authorisation;
- Alternative 2 extends further to the south and abuts onto the Happy Valley residents' area and generates high levels of visual intrusion, which is not recommended; and
- De Aar already has a significant number of wind and solar energy farms under construction or as proposals therefore the potential of cumulative impacts caused by attracting other similar PV projects, is reduced.

An Environmental Management Plan (EMP) should be implemented, and mitigation measures must be effectively undertaken relating to:

Construction Phase

- Contract time kept to the minimum;
- Implementing traffic control measures;
- Disposal of surplus materials;
- Location of lay-down areas;
- Dust control measures; and
- Exclusion of rocky outcrops and river washes.

Operational Phase

- Height, location and finishes of building(s ;
- Use of non-reflective materials and receding colours; and
- Discussions with local community.

Closure Phase

- Removal of all PV structures, associated structures and infrastructure; and
- Rehabilitation and restoration.

2 INTRODUCTION

VRM Africa was appointed by Aurecon South Africa Pty (Ltd) (Aurecon) to undertake a Visual Impact Assessment (VIA) for Mulilo Renewable Energy (Pty) Ltd (Mulilo). The proposed project would take place on the Du Plessis Dam Farm (Remainder of Farm 179), near De Aar in the Northern Cape, as can be seen in the regional map below. The proposed site area is approximately 300km south-west of Kimberley. De Aar lies within the Emthanjeni Local Municipality, which is situated within the broader Pixley ka Seme District Municipality.

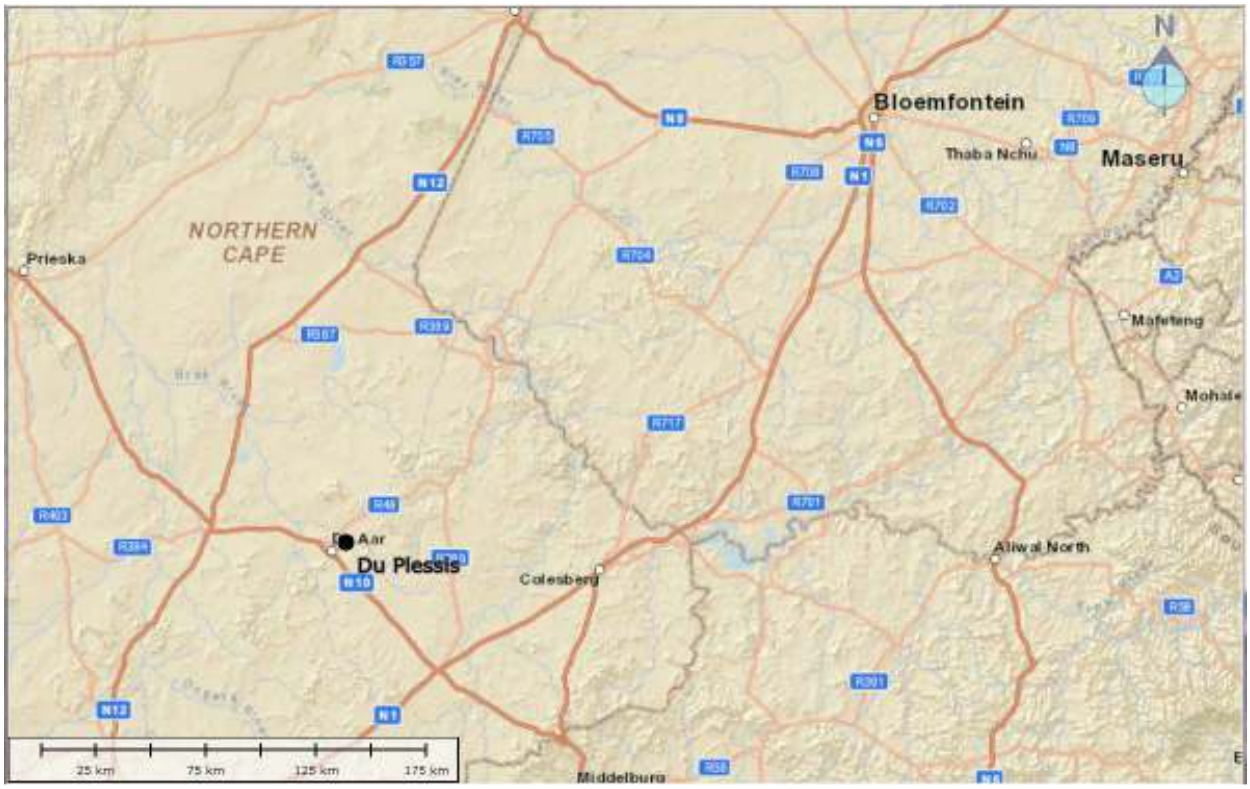

Figure 1: Regional location map

3 APPROACH TO STUDY

3.1 Terms of Reference

The scope of the study is to cover the entire affected project area. This includes a site visit, where the full extent of the site was investigated, as well as a general assessment of the surrounding area as potential impacts, such as cumulative impacts, may occur beyond the site boundaries.

- All available secondary data relevant to the affected project area was collated and analysed.
- Information was sourced from the following previous studies of the area:
  - Aurecon. 2013. Proposed Photovoltaic Energy Facilities on Du Plessis Dam Farm near De Aar, northern Cape: Draft Scoping Report. Report no. 7586.
  - Proposed Photo-Voltaic Facilities near De Aar, Northern Cape: Farms Paarde Valley, Badenhorst Dam and Annex du Plessis. Level 3 Visual Impact Assessment. Dec 2011. DEA REF NRs: 12/12/20/2500; 2/12/20/2499 and 12/12/20/2498. Karen Hansen Landscape Architect for Aurecon Environmental Services.
- Cumulative effects were considered in all impact reports.
- Specific attention was given to the following. To:
  - quantify and assess existing scenic resources/visual characteristics on, and around, the proposed site;
  - evaluate and classify the landscape in terms of sensitivity to a changing land use;

- determine viewsheds, view corridors and important viewpoints in order to assess the visual impacts of the proposed project;
- determine visual issues, including those identified in the public participation process;
- review the legal framework that may have implications for visual/scenic resources;
- assess the significance of potential visual impacts resulting from the proposed project for the construction, operational and decommissioning phases of the project; and
- identify possible mitigation measures to reduce negative visual impacts for inclusion into the project design, including input into the Environmental Management Plan (EMP).

3.2 Summary of Visual Impact Assessment Methodology

The process that VRM Africa follows when undertaking a VIA is based on the United States Bureau of Land Management's (BLM) Visual Resource Management method. This mapping and GIS-based method of assessing landscape modifications allows for increased objectivity and consistency by using a standard assessment criteria and involves the measurement of contrast in the form, line, texture and colour of the proposed landscape modification brought about by a project, against the same elements found in the existing natural landscape *(BLM. USDI. 2004).*

The first step in the VIA process is determining the existing landscape context. A regional landscape survey is undertaken, which identifies defining landscape features that surround the site of a proposed development, and sets the scene for the VIA process to follow. These features, also referred to as visual issues, are assessed for their scenic quality/worth. A VIA also assesses to what degree people who make use of these locations (e.g. a nearby holiday resort) would be sensitive to change(s) in their views, brought about by a proposed project (e.g. a mine). *(Assessment undertaken up to this point falls within the ambit of the Field Study.)*

These people are referred to as receptors and are identified early on in the VIA process. Only those sensitive receptors who qualify as Key Observation Points (KOPs) by applying certain criteria, are used to measure the amount of contrast generated by changes caused by project activities, against the existing landscape (i.e. visual impact).

The landscape character of the proposed project site is then surveyed to identify areas of similar land use and landscape character. These areas are evaluated in terms of scenic quality (landscape significance) and receptor sensitivity to landscape change (of the site) in order to define the visual objective for the project site. The overall objective is to maintain a landscape's integrity, but this can be achieved at varying levels, called VRM Classes, depending on various factors, including the visual absorption capacity of a site (i.e., how much of the project would be "absorbed" or "disappear", into the landscape). The areas identified on site are categorised into these Classes by using a matrix developed by BLM Visual Resource Management, which is then represented in a visual sensitivity map.

Landscapes are sub-divided into three distance zones based on relative visibility from travel routes or observation points. Proximity to surrounding receptors is evaluated in terms of these distance buffers: foreground zone is less than 7km, background zone is from 7 to 24km and "seldom seen" has no receptors. Viewshed maps are generated that indicate the overall area where the project activities would be visible, and in which distance buffer zone the receptors fall. *(Assessment undertaken up to this point falls within the ambit of the Baseline Study. What follows after this point comprises the Impact Assessment Study.)*

The proposed project activities are then finally assessed from the KOPs around the site to see whether the visual objectives (VRM Classes) defined for the site, are met in terms of measuring the potential change to the site's form, line, colour and texture visual elements, as a result of the proposed project (i.e. are the expected changes within acceptable parameters to ensure that the visual character of the landscape is kept intact and, if not, what can be done by the project to ensure that it is).Photo montages are generated to represent the expected change in the views, as seen from each KOP and, if class objectives are not met, to also show how proposed mitigation measures could improve the same views.

Using the impact assessment method provided by the environmental consultant, each project activity is then assessed for its visual impact. This is based on the contrast rating which was undertaken from each of the surrounding receptors to determine whether the proposed activities meet the recommended visual objectives defined, in order to protect the landscape character of the area. Recommendations are made and mitigations are provided.

Refer to Annexure 2 for a detailed description of the applied VIA and Aurecon's Impact Assessment methodology.

In terms of VIA best practice, the following guidelines were referred to:

- Internationally, the U.K. Institute of Environmental Management and Assessment's (IEMA) 'Guidelines for Landscape and Visual Impact Assessment'; (U.K Institute of Environmental Management and Assessment *(IEMA. 2002);*
- International Finance Corporation's (IFC) performance standards (PS) on environmental and social sustainability *(IFC. 2012);* and
- 'Guideline for Involving Visual and Aesthetic Specialists in EIA Processes' generated by South Africa's Provincial Government of the Western Cape, Department of Environmental Affairs and Development Planning *(Oberholzer, B. 2005);* 'Principles that influences (development) within a receiving environment include the following: The need to maintain the overall integrity (or intactness) of the particular landscape or townscape; the need to preserve the special character or 'sense of place' of a particular area; the need to minimize visual intrusion or obstruction of views within a particular area.' (Oberholzer.2005).

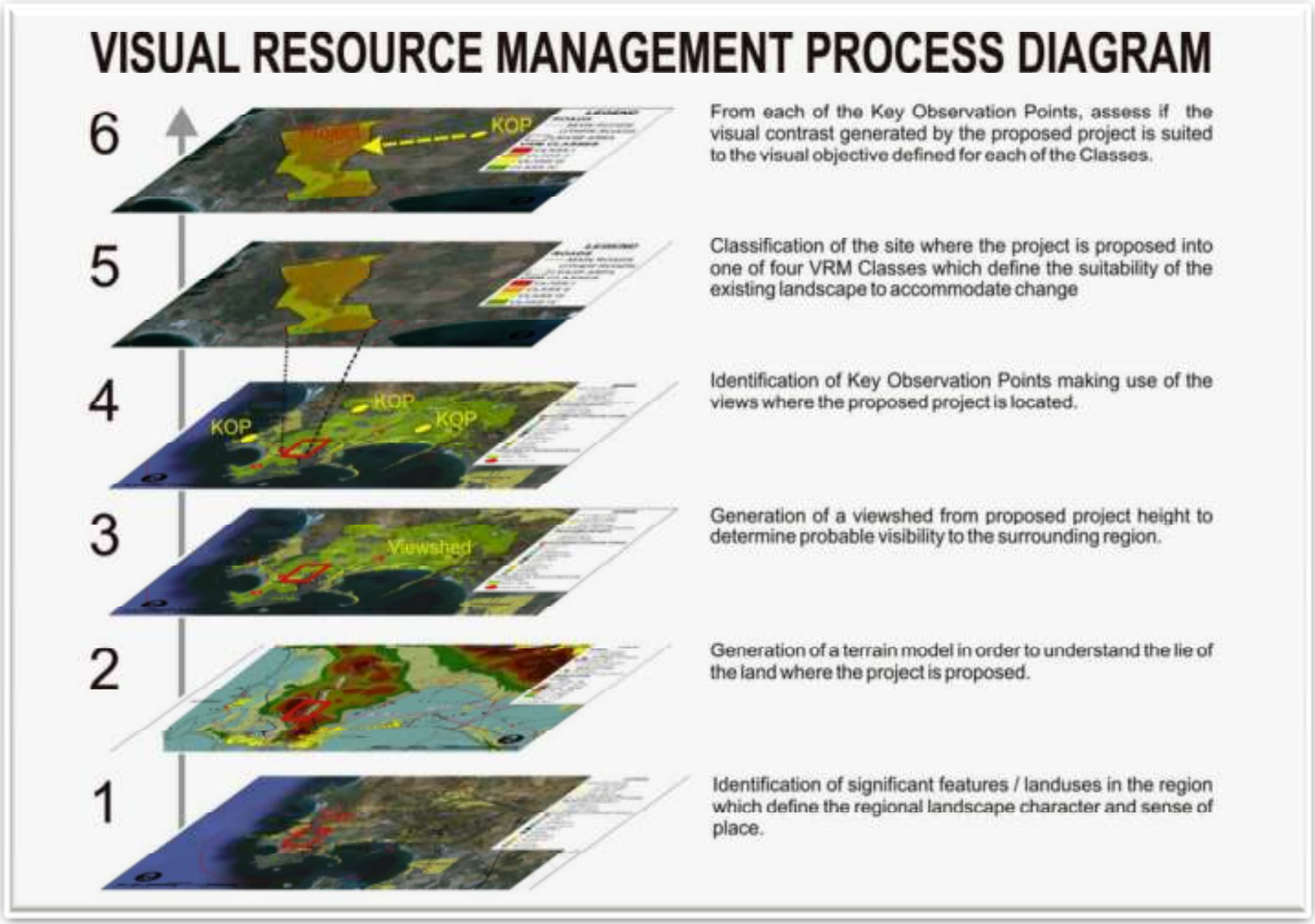

Figure 2: VRM Process Diagram

4 LIMITATIONS AND ASSUMPTIONS

The following limitations and assumptions were identified:

- Although every effort to maintain accuracy was undertaken, as a result of the Digital Elevation Model (DEM) being generated from satellite imagery and not being a true representation of the earth's surface, the viewshed mapping is approximate and may not represent an exact visibility incidence.
- The mapping in this document was created using Bing Maps (previously *Live Search Maps*, *Windows Live Maps*, *Windows Live Local*, and *MSN Virtual Earth*) and powered by the Bing Maps for Enterprise framework.
- The information for the terrain used in the 3D computer model on which the visibility analysis is based on is:
    - ASTGTM_S2 3E014 and ASTGTM_S24E014 data set (ASTER GDEM is a product of METI and NASA (ASTER, Source: https://lpdaac.usgs.gov)
- Determining visual resources is a subjective process where absolute terms are not achievable. Evaluating a landscape's visual quality is complex, as assessment of the visual landscape applies mainly qualitative standards. Therefore, subjectivity cannot be excluded in the assessment procedure *(Lange 1994)*. The project deliverables, including electronic copies of reports, maps, data, shape files and photographs, are based on the author's professional knowledge, as well as available information. The study is based on assessment techniques and investigations that are limited by time and budgetary constraints applicable to the type and level of assessment undertaken. VRM Africa reserves the right to modify aspects of the project deliverables if, and when, new/additional information may become available from research or further work in the applicable field of practice, or pertaining to this study.

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5 LEGISLATIVE CONTEXT

5.1 Applicable planning policies and standards

In order to comply with the Visual Resource Management requirements, it is necessary to clarify which planning policies govern the property area to ensure that the scale, density and nature of activities or developments are harmonious, and in keeping, with the sense of place and character of the area. The proposed landscape modifications must be assessed, taking the following planning policies into consideration:

- Northern Cape Provincial Spatial Development Framework (SDF) (2012)
- Emthanjeni Spatial Development Framework (SDF) (2007)

Northern Cape Provincial SDF

- Aesthetically prominent natural features or areas should be declared Protected Natural Environments if such declaration would promote natural scenic beauty or biodiversity. No development must be allowed in proclaimed Protected Natural Environments.
- Promote the development of renewable energy supply schemes. Large-scale renewable energy supply schemes are strategically important for increasing the diversity of domestic energy supplies and avoiding energy imports while minimizing detrimental environmental impacts.
- The construction of energy infrastructure must be strictly regulated in terms of the spatial plans and guidelines put forward in the Provincial SDF (PSDF). They must be carefully placed to avoid visual impacts on landscapes of significant symbolic, aesthetic, cultural or historic value and should blend in with the surrounding environment to the extent possible. *(C8.3.3 Energy Policy, Pg 141).*

Emthanjeni SDF

- It is proposed that the industrial development must continue in a northerly direction, alongside the railway lines.
- It is proposed that the area north of the N10 route be used for residential development, but that the area south of the N10 route still keeps its agricultural character *(Macroplan, 2007).*

5.2 Relevant standards to comply with

The International Finance Corporation (IFC) prescribes eight performance standards (PS) on environmental and social sustainability. The first is to identify and evaluate the environmental and social risks and impacts of a project, as well as to avoid, minimise or compensate for any such impacts. Under Performance Standard 6, ecosystem services are organized into four categories, with visual/aesthetic benefits falling into the category of cultural services, which are the non-material benefits people obtain from ecosystem. *(IFC. 2012).* This emotional enrichment that people experience and obtain from cultural ecosystems services is described by The Millennium Ecosystem Assessment, 2005, Ecosystems and Human Well-being: Synthesis report as follows: “Cultural ecosystems services: the non-material benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.” *(Millennium Ecosystem Assessment. 2005).*

The above includes the following, amongst others:

- Inspiration: Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising;
- Aesthetic values: Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, scenic drives, and the selection of housing locations;
- Sense of place: Many people value the “sense of place” that is associated with recognised features of their environment, including aspects of the ecosystem;
- Cultural heritage Many societies place high value on the maintenance of either

values:	historically important landscapes ("cultural landscapes") or culturally significant species; and
• Recreation and ecotourism:	People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.

The visual experience is not limited to the visual senses, but is a multisensory emotional involvement experienced by people when they perceive a specific scene, landmark, landscape, etc. The assessment subject of VIA is in itself a result of human perception.

Other Proposed and Approved Projects

According Renewables Map generated by the Department of Environmental Affairs, there are 10 proposed renewable energy projects in the area surrounding. This map cannot be displayed in the document due to defined restriction. The map can be viewed or download via the following link:

http://www.csir.co.za/nationalwindsolarsea/contact_reg.php

There are 10 proposed renewable energy projects in the area surrounding De Aar as can be seen in the Department of Environmental Affairs Map above. Of these 4 projects are situated to the south east of De Aar and 1 large area to the north east are pending. 3 projects have been approved and 1 has a preferred bidder status.

6 PROJECT DESCRIPTION

The objective of this section is to describe the character of the project activities and define the extent to which it will be visible to the surrounding areas.

The need and desirability of the proposed activity is based on the well-documented reasons for the desirability of renewable energy such as solar energy, which include:

- Utilising resources available to South Africa;
- Meeting nationally appropriate emission targets in line with global climate change commitments;
- Enhancing energy security by diversifying generation; and
- Creating a more sustainable economy *(Aurecon. 2013).*

Aurecon, on behalf of Mulilo, previously investigated a proposed PV facility at Du Plessis Dam Farm. After completion of the Basic Assessment Process (DEA Reference Number: 12/12/20/2498, NEAS Reference Number: DEAT/EIA/0000609/2011), the Department of Environmental Affairs (DEA) authorised a PV facility with 19.9 MW capacity (Environmental Authorisation (EA) dated 28 September 2012).

The previously approved PV facility will herein after be referred to as Du Plessis PV1. A 132 kV overhead transmission line (6.1km) connecting the approved site to the existing Eskom infrastructure was also approved in the EA dated 28 September 2012. Mulilo is currently investigating an additional three PV facilities on Du Plessis Dam farm. The area previously approved for PV 1 (approximately 64 ha) will be included in the proposed layouts for the additional PV facilities *(Aurecon. 2013).* The advantage of developing Du Plessis Dam Farm is that this site has already been subjected to intensive EIA investigations, and environmentally sensitive areas have been identified. These sensitive areas have thus informed the project's design phase to ensure that sensitive areas are avoided to limit the disturbance of ecosystems. *(Aurecon. 2012).*

6.1 Proposed Layout Alternatives

The proposed sites are well studied, suitable for the proposed development, located close to existing and proposed Eskom infrastructure and no fatal flaws have been identified. Mulilo are proposing to group similar developments together so that there can be a sharing of infrastructure and a minimising of potential impacts on the environment due to combining infrastructure and footprints.

Mulilo proposes to develop one of the following photovoltaic alternatives on this site:

- Alternative 1 (Alt 1): 3 PV plants of 75 MW each on Du Plessis Dam farm, with a combined footprint of approximately 859ha.
- Alternative 2 (Alt 2): 1 PV plant of 400 MW, with a footprint of approximately 1 000Ha.

Layout Plan: Alternative 1

This alternative consists of three proposed 75 MW PV facilities, and associated infrastructure, (referred to as PV 2, PV 3 and PV 4). These layouts take cognisance of the 75 MW limit determined by the Department of Energy, and the environmentally sensitive areas as identified by Aurecon (2012). The total extent of the three proposed facilities would be approximately 859 ha.

Plant	Footprint (Ha)	Capacity (MW)
PV 2	273	75
PV 3	212	75
PV 4	374	75

Layout Plan: Alternative 2

This alternative consists of one 400 MW PV facility. The layout for this alternative was developed by extending and combining the proposed 7 5MW facilities. This alternative is thus not limited to the Department of Energy's 75 MW cap per project. By increasing the capacity, it has the benefit of utilising industries at scale, thereby reducing associated development and construction costs, which reduces lending rates and essentially lowers the tariff of electricity sold *(Aurecon. 2013).*

Plant	Footprint (Ha)	Capacity (MW)
Extended PV 2	1 000	400

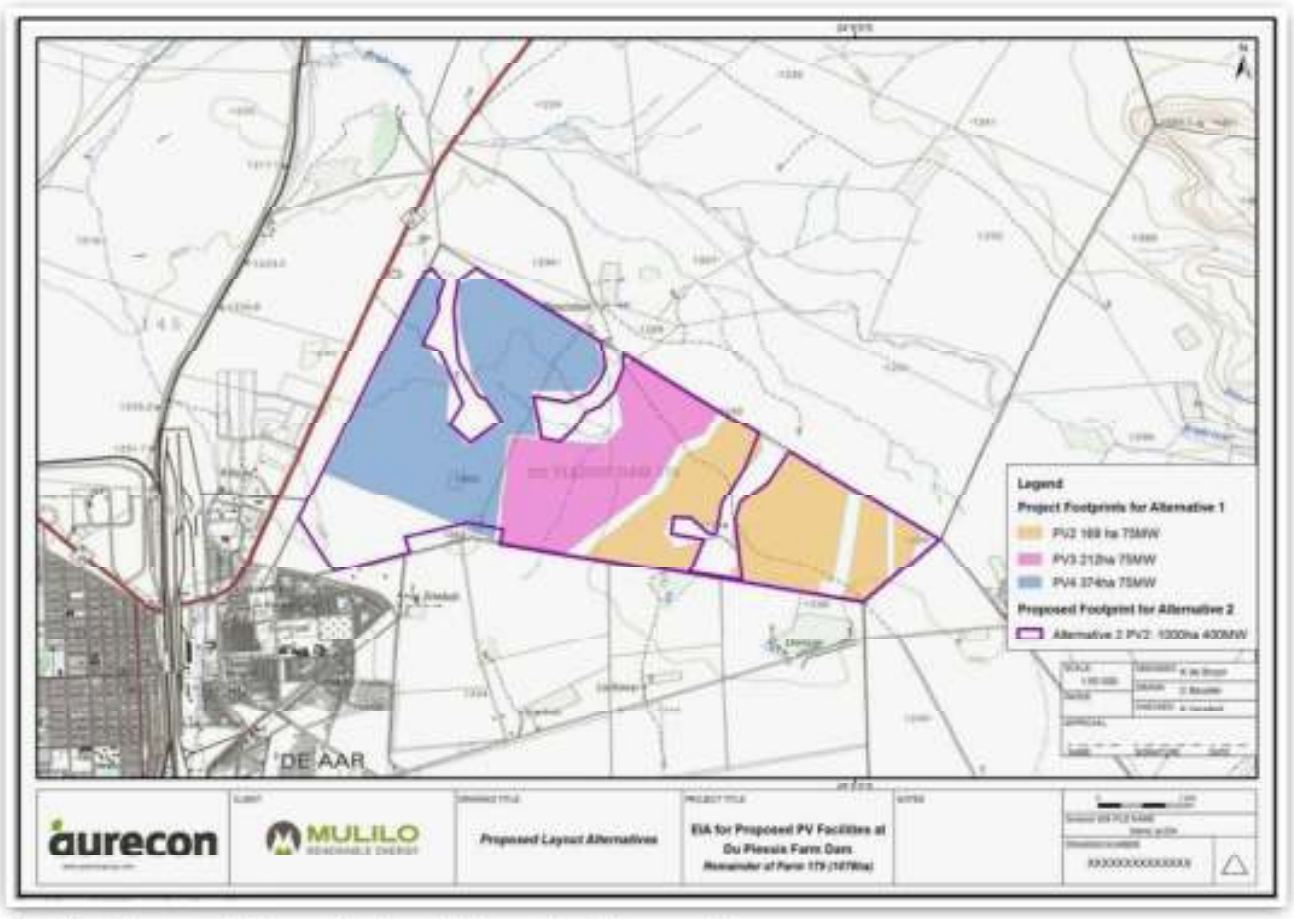

Figure 3: Proposed Alternative 1 and Alternative 2 Layout Map

No-Go alternative
The "No-Go" option is a baseline against which all other alternatives must be measured. The No-Go option in this case would include the existing approved PV facility (PV 1).

6.2 Proposed Activities

Each of the proposed PV plants would consist of the following:

- Solar energy plant: A photovoltaic component comprising of numerous arrays of PV panels and associated PV module mountings to generate up to 75 MW Alternating Current (AC) per plant, through the photovoltaic effect.
- Transmission lines: 132 kV overhead transmission lines to connect each facility to the central onsite substation and to the existing Eskom substation.
- Substations: A 3-bay substation on each site and one central 132 kV substation connecting the PV facilities with Eskom's Hydra substation via either an existing overhead 132 kV Eskom line or the previously authorised 132 kV overhead transmission line directly to De Aar substation.
- Boundary fence: Each 75 MW AC facility will have an electrical fence for safety and security reasons.

The project comprises the following additional infrastructure which can be shared between the three facilities:

- Access road from the R48 (6 m x 6.8 km long) and internal access roads for servicing and maintenance of the site.
- Onsite buildings, including a connection building, control building, guard cabin, and solar resource measuring substation.
- Laydown area to store equipment and material, and for construction camp.
- Water supply and storm water infrastructure.

6.2.1 *Proposed Solar Panel Alternatives*

Three solar panel types were highlighted for the proposed plant:

- Concentrated photovoltaic (CPV), using lenses or curved mirrors to concentrate sunlight onto a small area of solar PV cells to generate electricity. This is considered to be more cost effective than conventional PV solar cells although, to be most effective, it requires solar tracking.
- Conventional PV solar cells do not use mirrors or lenses and generate electricity by converting solar radiation energy into a DC current which then needs to be converted to an AC current to connect to the grid. These proposed PV panels are approximately 2m wide and 1m long and are arranged into modules.
- Concentrated solar power (CSP), using mirrors or lenses to concentrate thermal energy on a small surface area using a heat engine. Due to the large volume of water required, this alternative will not be studied further.

Example of solar plant *(Source: www.hawaiirenewableenergy.org/Villamesias2)*

Example of conventional large-scale type solar panels *(Source: www globalnvcorp com)*

Example of CPV-type solar panels *(Source: www ecofriend com)*

Figure 4: Photographs of examples of similar solar panel alternatives

Two mounting alternatives are assessed: Fixed axis tracking system and single axis tracking system. In a single-axis tracking system, the panels follow the sun to ensure maximum exposure to sunlight. They have the highest efficiency level, the smallest footprint and the lowest development costs. The dimensions of a tracker block ranges between 88m and 113m in an east-west direction, and 35m to 38m in a north-south direction (*Aurecon, 2013).*

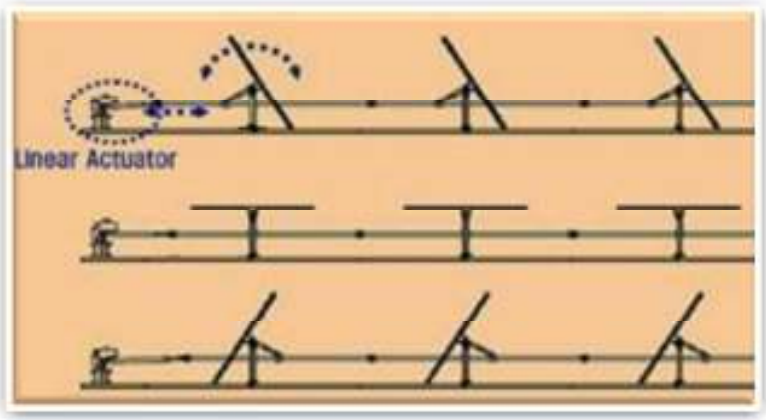

Figure 5: Photograph of mounting example *(www. environmental-expert.com)*

6.2.2 *Transmission Lines and Substation*

Each PV facility would require a substation onsite. This would then be linked via 132 kV transmission lines to one central onsite substation. Two transmission corridors are proposed:

Alternative 1 transmission corridor

The proposed transmission corridor (Alternative 1) would be approximately 10km in length. The width of the first section of the corridor is 31m and the second section is 160m. The first section of the corridor is from the De Aar substation, travelling north for approximately 1.7km, before turning south-east, crossing the R48, and then entering Du Plessis Dam Farm. The second section of the corridor would follow the southern boundary of the farm. The proposed corridor would house overhead transmission lines and substations to connect the proposed PV facilities to existing Eskom infrastructures *(Aurecon. 2013).*

Alternative 2 transmission corridor

The proposed transmission corridor (Alternative 2) would be approximately 8km in length. The width of the entire alternative 2 corridor is 31m. The first section of Alternative 1 and Alternative 2 transmission lines corridors overlap. The second section of the corridor would follow the layout of the approved transmission line as indicated in Figure 8. The proposed corridor would house overhead transmission lines and substations to connect the proposed PV facilities to existing Eskom infrastructures *(Aurecon. 2013).*

Substation with transformers at Sugarloaf Hill *(Source:www grocotts co za)*

Example of an existing 132 kV transmission line *(Source: Aurecon. 2013)*

Figure 6: Photographs of examples of additional infrastructure

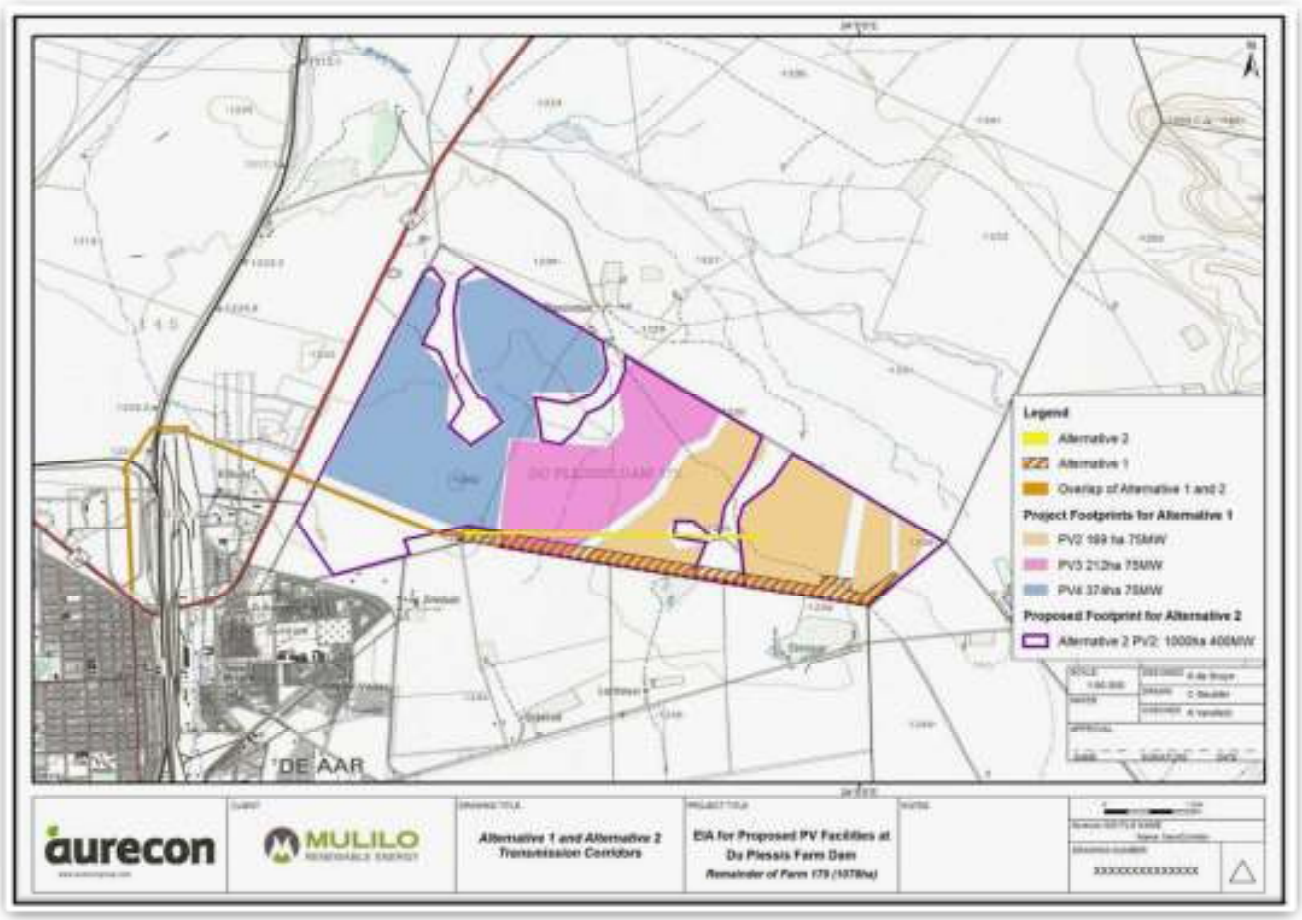

Figure 7: Transmission line corridors Alternatives 1 & 2

7 NATURE OF THE RECEIVING ENVIRONMENT

Landscape character is defined by the U.K. Institute of Environmental Management and Assessment (IEMA) as the 'distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, land form, soils, vegetation, land use and human settlement.' It creates the specific sense of place or essential character and 'spirit of the place' *(Spon Press, 2002).* The first step in the VIA process is determining the existing landscape context of the region and of the site(s) where the project is proposed.

Within the local context, the property is located within the Emthanjeni Local Municipality which falls under the Pixley ka Seme District Municipality. The existing landscape character has been shaped historically by the uniform nature of the flat Nama Karoo plains with typical semi-desert and desert climatic conditions. The site is situated close to De Aar in the Northern Cape, where the dominant landscape feature is the open plains of the Karoo scrub and the Nama Karoo. Surrounding land use is agricultural, predominantly sheep farming. Vegetation variety is limited to one or two vegetation types, but is fairly iconic as a representation of the Nama Karoo landscape, which is strongly associated with South African cultural heritage.

De Aar was established in 1903 and has a population of approximately 46 000 people *(www.deaar.co.za)*. It was a main junction for the first railway line from Cape Town to Kimberley, opened in 1881. De Aar has excellent transport infrastructure and is renowned for its central location on the main railway line and highway between Johannesburg, Cape Town, Port Elizabeth and Namibia. There are also two airfields used by civil aviation in De Aar. De Aar has the largest Central Business District (CBD) in the Emthanjeni Municipality due to the rich history of the railroad network that was once the economic drive of the area *(Emthanjeni Spatial Development Framework. 2007).* De Aar is also a primary commercial distribution centre for a large area of the central Great Karoo. Major production activities of the area include wool production and livestock farming *(http://www.deaar.co.za/).* De Aar is a visually contained town in that it is bound on its western edge by a line of very low hills, its residential character changes abruptly north of the R48 to industrial and the town is bound to the south by the N10 *(Hansen. 2011).*

Figure 8: View of grassy Nama Karoo biome
(Source: www.colinpatersonjones.co.za)

Location and Routes

The N10 is the main highway between the Cape and Johannesburg. The N10 is situated 5km to the south of the proposed site. The R48 is a regional road that runs to the north, adjacent to the proposed site. The railway line runs approximately 2 km from the site, to the north-west. The De Aar Aerodrome lies 6 km south of the site.

Figure 9: View towards De Aar from R48 showing local sense of place

Figure 10: View from N10 southbound showing local sense of place

Topography

The Northern Cape is characterised by wide open plains, sparse settlements and open spaces. The topography of the area is relatively flat, although there are a few ridge-shaped hills and larger flatter plateaus. The site for the proposed PV facilities is located on the open plains and the entire site is gently sloping with no particular topographical features of note. There is a slightly raised area in the south-western quadrant of the site. The elevation on site varies from 1 231 m to 1 260 m above sea level *(Aurecon. 2013).*

River

The study area falls within the arid region of South Africa and within the Lower Orange Water Management Area. Two perennial rivers are located near De Aar, with the Elandsfontein River running west of De Aar and the Brak River passing De Aar to the north. The Brak River has been identified as having conservation status**.** The other tributaries are smaller, ephemeral streams and only discernible as slightly shallow depressions with no clear associated vegetation, and slightly clayey soils. Small shallow instream dams have been constructed within some of these drainage channels *(Aurecon. 2013).* The ephemeral streams on the farm have been modified to some extent due to surrounding farming activities (livestock grazing). The assessment indicated that both the riparian and instream habitat integrity are considered to be moderately modified (B/C category) *(Aurecon. 2013).*

Vegetation

The study area falls within the Nama-Karoo Biome and there is one vegetation type occurring within the study site, namely Northern Upper Karoo. This vegetation type occurs in the northern parts of the Upper Karoo Plateau, with its southern extent ending near De Aar. It is shrubland, dominated by dwarf Karoo shrubs, grasses and some low trees. It is considered to be a *Least Threatened* vegetation type. The vegetation on site is in moderate to poor condition and appears to have been heavily grazed by domestic livestock. There were no trees found on the farm *(Hoare, 2012).*

In addition to the typical Northern Upper Karoo vegetation, the base of the ridge along the western boundary of the site also provides an important habitat for birds. The riverine vegetation along the Brak River, flowing north of the town of De Aar, approximately 15 km from the site, also creates important bird habitats. Environmentally sensitive areas were identified during the 2012 EIA for Du Plessis Dam farm *(Aurecon, 2012).* These onsite features include aquatic systems and sensitive heritage sites *(Aurecon. 2013).*

Example of rock outcrop found on site (Photo point 4)

Site grasslands

Figure 11: View of site vegetation

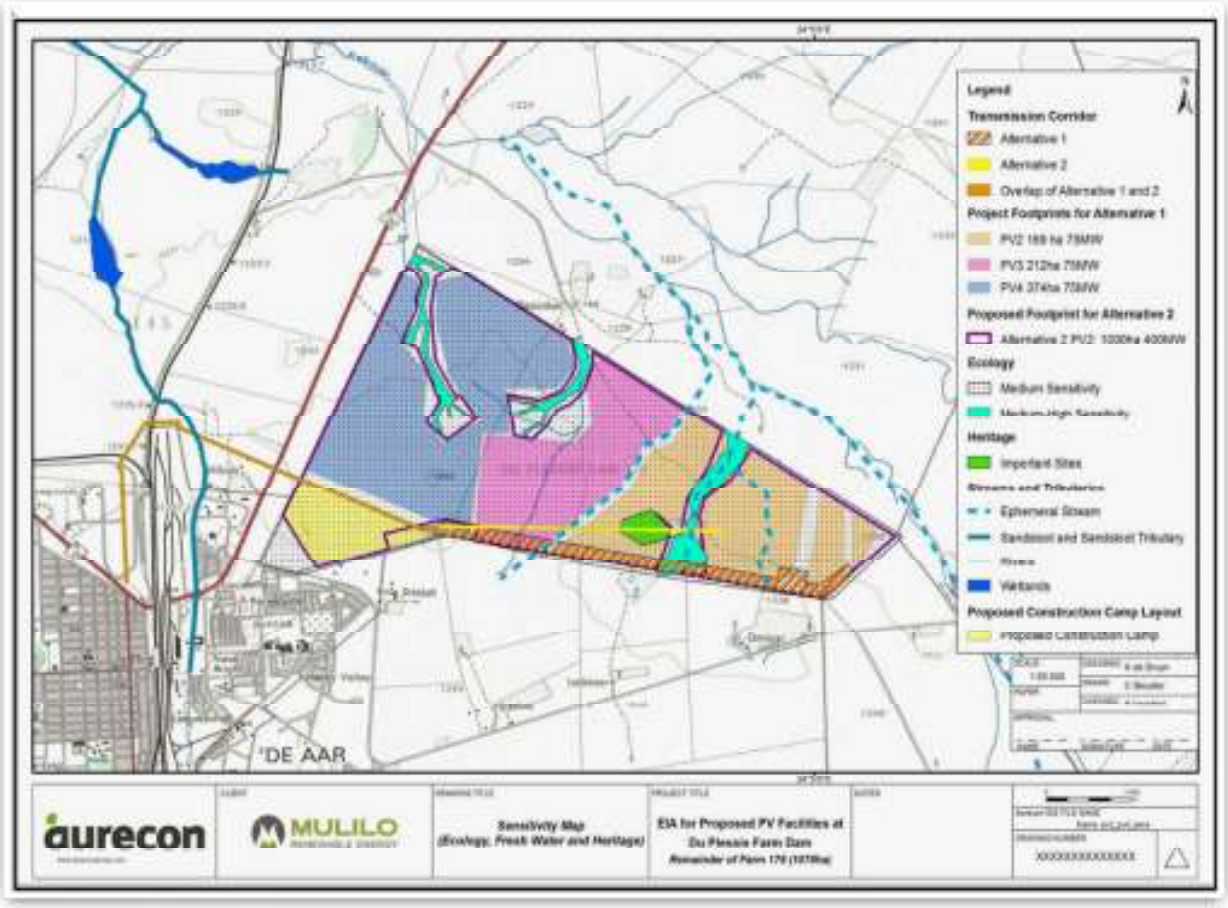

Figure 12: Sensitivity Map identified in 2012

Agriculture
The farm has a low agricultural potential. The farm consists of flat grassy plains which are used for grazing land. Water is the major limiting factor to local agricultural enterprises and the farm does not contain, nor does it directly border, a perennial river or freshwater impoundment which could be used as a source of irrigation water *(Aurecon. 2013).*

Industry
The Emthanjeni Local Municipality Spatial Development Framework (SDF) states that De Aar has the largest abattoir in the southern hemisphere. They supply all the major centres in South Africa with "Karoo" lamb and mutton. Sheep farms around De Aar are also major suppliers of wool (*Emthanjeni Spatial Development Framework. 2007).* De Aar is a declared industrial growth point in the Northern Cape as it is centrally located with excellent rail and road links**.** De Aar is the second most important railway junction in the country, as it is central to Gauteng, Cape Town, Port Elizabeth and Namibia. The industrial area of De Aar is located to the eastern side of the railway lines, north-east of the CBD of the town. This area was developed in this specific location, due to the development potential that the railway intersections in De Aar provided *(Emthanjeni Spatial Development Framework. 2007).*

Other solar projects in the area
De Aar has some of the highest renewable energy resource levels in the world, with good existing road infrastructure and accessibility to the national grid. The Solar Capital De Aar Solar Farm has a 2 300 hectare farm outside De Aar, which will have 1 000 000 solar panels erected in the initial phase. It will be one of the world's largest solar farms that will total 4 000 000 panels upon completion *(http://www.solarcapital.co.za).*

Figure 13: De Aar Solar Capital Energy Project *(www.solarcapital.co.za)*

Transmission Lines and Substation
The De Aar substation lies 8 km from the proposed site, with existing power lines that run through the area. It is therefore highly accessible to the national grid.

Other Land Uses
The surrounding land use is dominated by agricultural activities, consisting mostly of sheep and cattle grazing. The project site is currently also used for agriculture (grazing). It should be noted that there

are a number of environmental applications for renewable energy generation projects that are being undertaken within the De Aar area. The surrounding land use and landscape of De Aar will potentially change in the future if these projects come to fruition *(Aurecon. 2013)*.

The town is also home to a major military ammunition dump. The Department of Defence Ammunition Sub Depot De Aar is located about 2 km west of the town. The existing tourist industry is also growing, with farms alongside the N1, the N10 and the N12 opening guesthouses for tourists in order to provide an overnight facility for people travelling from the north to the south and vice versa *(Emthanjeni Spatial Development Framework. 2007).*

Landscape Value
The existing landscape character has been shaped historically by the uniform nature of the flat Nama Karoo plains which is strongly associated with South African cultural heritage. Cultural modifications are typically Karoo farming and are limited to the occasional farmstead, which adds to the sense of open space. Receptor sensitivity to these landscapes would be moderate, as the wide open plains do add value to the vista and are a core element in the area's sense of place. The landscape has agricultural and cultural value. However, the site does not have a specific sense of place. There are no landscape modifications and its open vista and remote scenic quality also adds value.

The overall visual impression of the site is one of undulating lowland landscapes, offering medium to long views. These sites have some value for agriculture, but do not have a strong or identifiable sense of place. Measured by lack of accessibility and the relative absence of settlement, they would be valued as an undeveloped edge to the urban area *(Hansen. 2011).*

8 PROJECT VISIBILITY

8.1 Project Visibility and Exposure

Making use of the ASTGTM survey data, a terrain model was generated for the area around the proposed project. A viewshed was generated from each of the project sites, making use of the height values as metres above point ground level as indicated in the table below:

Photovoltaic panels and mountings	± 4.5 m
Transmission lines	± 15 – 20 m
Substations	± 15 – 20 m
Boundary fence	± 2 m

8.1.1 *Viewshed: All PV Sites*

As indicated below, the viewshed generated from a landscape modification would be moderate to high and the visual absorption capacity (VAC) of the land is *moderate to low*. Even though modifications would be prominent within the flat landscape and low-lying scrub nature of the existing vegetation, there are existing landscape modifications, including transmission lines and low cost housing. Views of greatest significance are those from the following local places of habitation and work:

- The development site.
- Similar lands and farmsteads to the north-east and south of the proposed site.
- Portions of the eastern edges of Happy Valley and Nonzwakazi, to the east of De Aar.
- Southbound traffic on the R48 would have a view of the site for a short period.

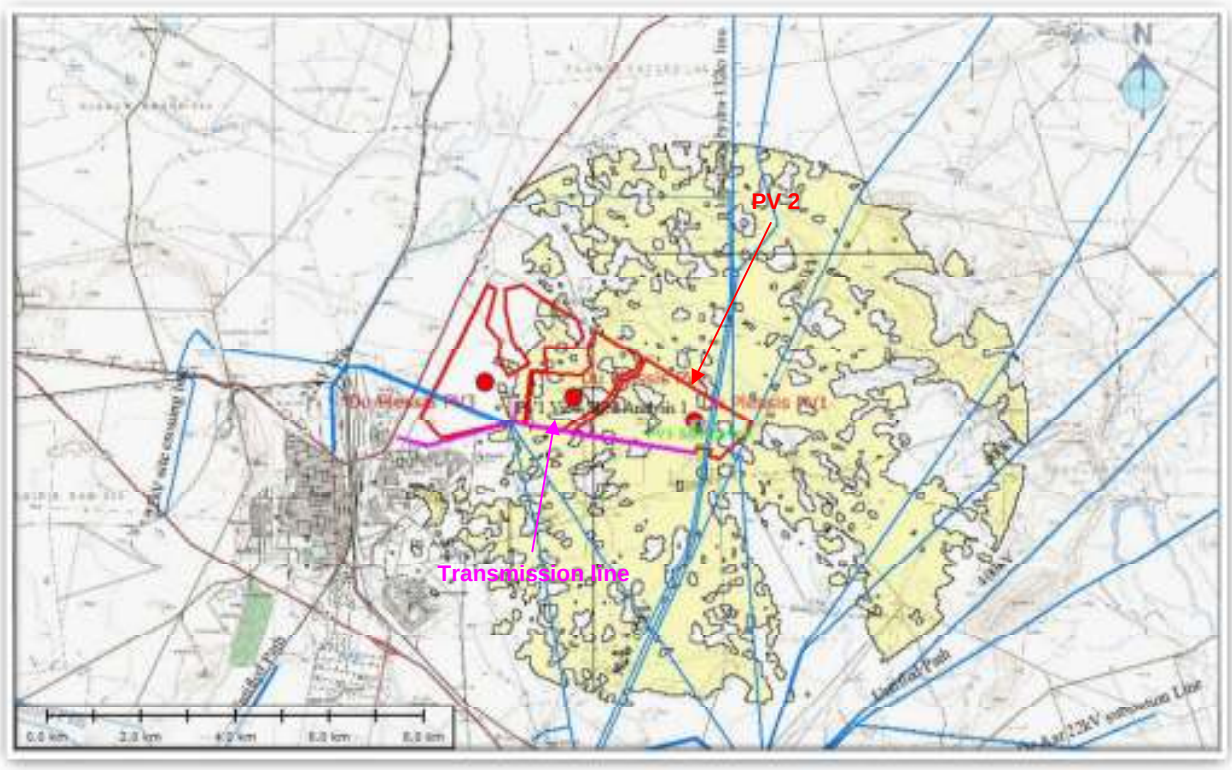

Figure 14: Viewshed: PV2

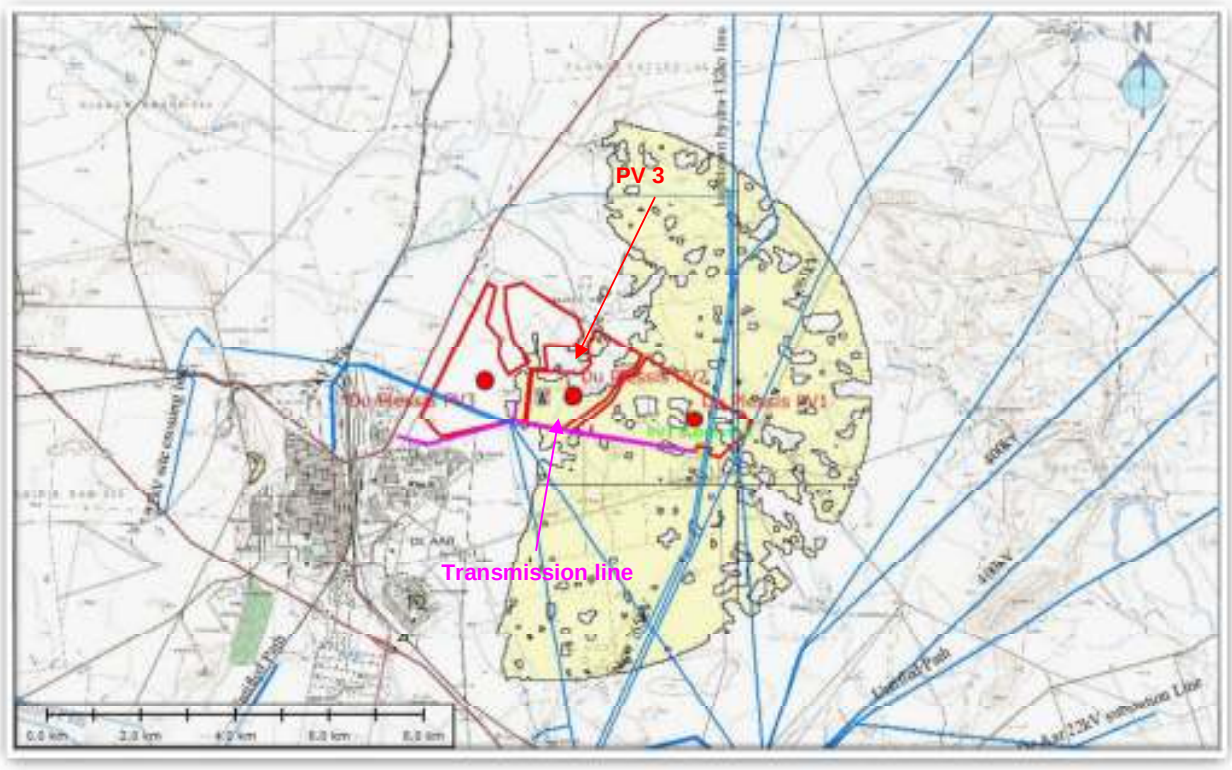

Figure 15: Viewshed: PV3

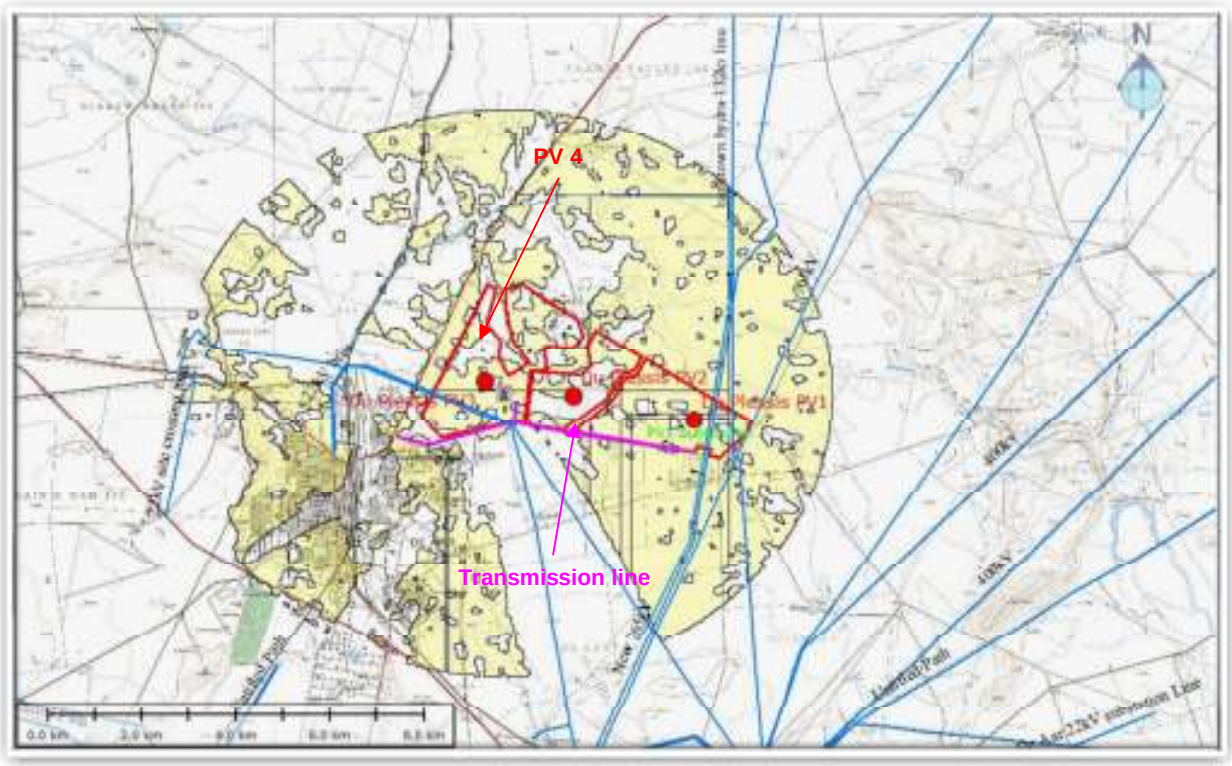

Figure 16: Viewshed: PV4

8.1.2 *Viewshed: Site PV Transmission Lines*

As indicated below, the viewshed generated from a landscape modification with an offset height of approximately 15 – 20 m would be *moderate* due to the flat Karoo landscape and low scrub. The zone of visual influence would be reduced, as the proposed transmission line is routed adjacent to an existing transmission line to the west and the railway line infrastructure to the east. The VAC level of the site is high and the Zone of Visual Influence (ZVI) is low.

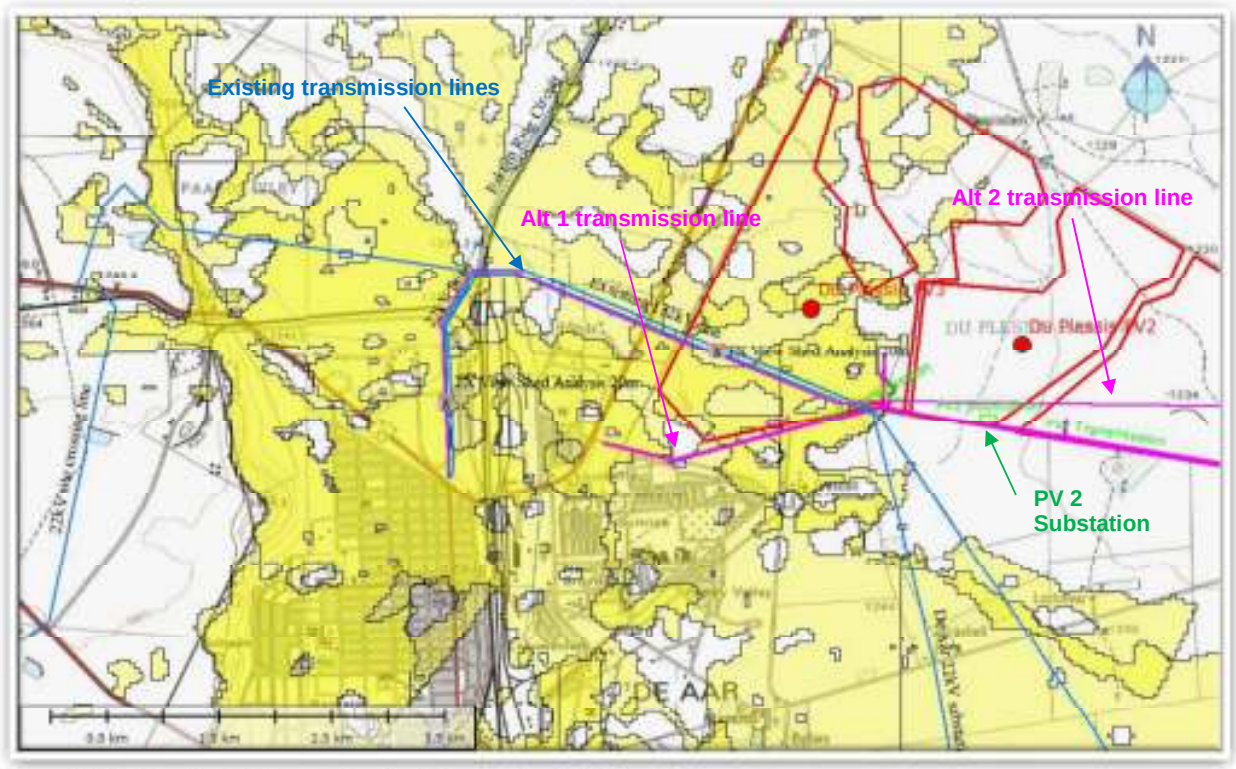

Figure 17: Viewshed: Transmission lines at a height of 20 m

9 SITE LANDSCAPE CHARACTER

The proposed project would take place on the farm Du Plessis Dam (Remainder of Farm 179) near De Aar in the Northern Cape (see Plate 1 in the Colour Plates-Annexure 1). Du Plessis Dam farm is approximately 1078 ha in extent and is zoned as agricultural land. The farm is currently used for small stock grazing *(Aurecon. 2013).*

The proposed site was selected based on the following criteria:

- High solar radiation levels based on historic satellite data;
- Grid connectivity and close proximity to strong grid access points and good existing road infrastructure;
- Availability of flat, level and open land with moderate altitude;
- Few environmentally and socially sensitive areas; and
- Non-arable or low arable potential of the land *(Aurecon. 2013).*

In terms of the VRM methodology, landscape character is derived from a combination of scenic quality, receptor sensitivity to landscape change, and the distance of the proposed landscape modification from key receptor points.

The scenic quality is determined using seven key factors:

- **Land Form:** Topography becomes more interesting as it gets steeper, or more massive, or more severely or universally sculptured.
- **Vegetation:** Primary consideration given to the variety of patterns, forms, and textures created by plant life.
- **Water:** That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration.
- **Colour:** The overall colour(s) of the basic components of the landscape (e.g. soil, rock, vegetation, etc.) are considered as they appear during seasons or periods of high use.
- **Scarcity:** This factor provides an opportunity to give added importance to one, or all, of the scenic features that appear to be relatively unique or rare within one physiographic region.
- **Adjacent Land Use:** Degree to which scenery and distance enhance, or start to influence, the overall impression of the scenery within the rating unit.
- **Cultural Modifications:** Cultural modifications should be considered, and may detract from the scenery or complement or improve the scenic quality of a unit.

Sensitivity levels are a measure of public concern for scenic quality. Receptor sensitivity to landscape change is determined using the following factors:

- **Type of Users:** Visual sensitivity will vary with the type of users, e.g. recreational sightseers may be highly sensitive to any changes in visual quality, whereas workers who pass through the area on a regular basis may not be as sensitive to change.
- **Amount of Use:** Areas seen and used by large numbers of people are potentially more sensitive.
- **Public Interest:** The visual quality of an area may be of concern to local, or regional, groups. Indicators of this concern are usually expressed via public controversy created in response to proposed activities.
- **Adjacent Land Uses:** The interrelationship with land uses in adjacent lands. For example, an area within the viewshed of a residential area may be very sensitive, whereas an area surrounded by commercially developed lands may not be as visually sensitive.
- **Special Areas:** Management objectives for special areas such as Natural Areas, Wilderness Areas or Wilderness Study Areas, Wild and Scenic Rivers, Scenic Areas, Scenic Roads or Trails, and Critical Biodiversity Areas frequently require special consideration for the protection of their visual values.
- **Other Factors:** Consider any other information such as research or studies that include indicators of visual sensitivity.

The table below is utilised to define the VRM Classes that represent the relative value of the visual resources of an area:

i. **Classes I and II** are the most valued
ii. **Class III** represent a moderate value
iii. **Class IV** is of least value

Evaluation of the suitability of a proposed landscape modification is undertaken by means of assessing the proposed modification against a predefined management objective assigned to each class. The VRM class objectives are defined as follows:

1. The **Class I** objective is to preserve the existing character of the landscape, where the level of change to the characteristic landscape should be very low, and must not attract attention. **Class I** is assigned to those areas where a ***specialist decision*** has been made to maintain a natural landscape.
2. The **Class II** objective is to retain the existing character of the landscape and the level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer, and should repeat the basic elements of form, line, colour and texture found in the predominant natural features of the characteristic landscape.
3. The **Class III** objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
4. The **Class IV** objective is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the landscape can be high, and these management activities may dominate the view and be the major focus of the viewer's (s') attention.

This is undertaken making use of the matrix below, developed by BLM Visual Resource Management method as seen below, which is then represented in a visual sensitivity map.

		VISUAL SENSITIVITY LEVELS								
		High			Medium			Low		
SCENIC QUALITY	A (High)	II	II	II	II	II	II	II	II	II
	B (Medium)	II	III	III/ IV *	III	IV	IV	IV	IV	IV
	C (Low)	III	IV	IV	IV	IV	IV	IV	IV	IV
DISTANCE ZONES		fore/middle ground	Backgroud	seldom seen	fore/middle ground	background	seldom seen	fore/middle ground	background	seldom seen

(A= scenic quality rating of ≥19; B = rating of 12 – 18, C= rating of ≤11)
* If adjacent areas are **Class III** or lower, assign **Class III**.
If higher, assign **Class IV**.

The site landscape character of the area was assessed from photographs taken from three survey points, as can be seen in the Site Layout Plan in Figure 19. The photographs can be seen in Figures 21 – 23.

The following locations, which are associated with the various proposed project activities, were surveyed during the field study to determine scenic quality, receptor sensitivity to landscape change and distance from nearest receptors:

- Photo site 1: to the north-east of PV4;
- Photo site 4: on PV1 site; and
- Photo site 6: remote district road to the south of the proposed site.

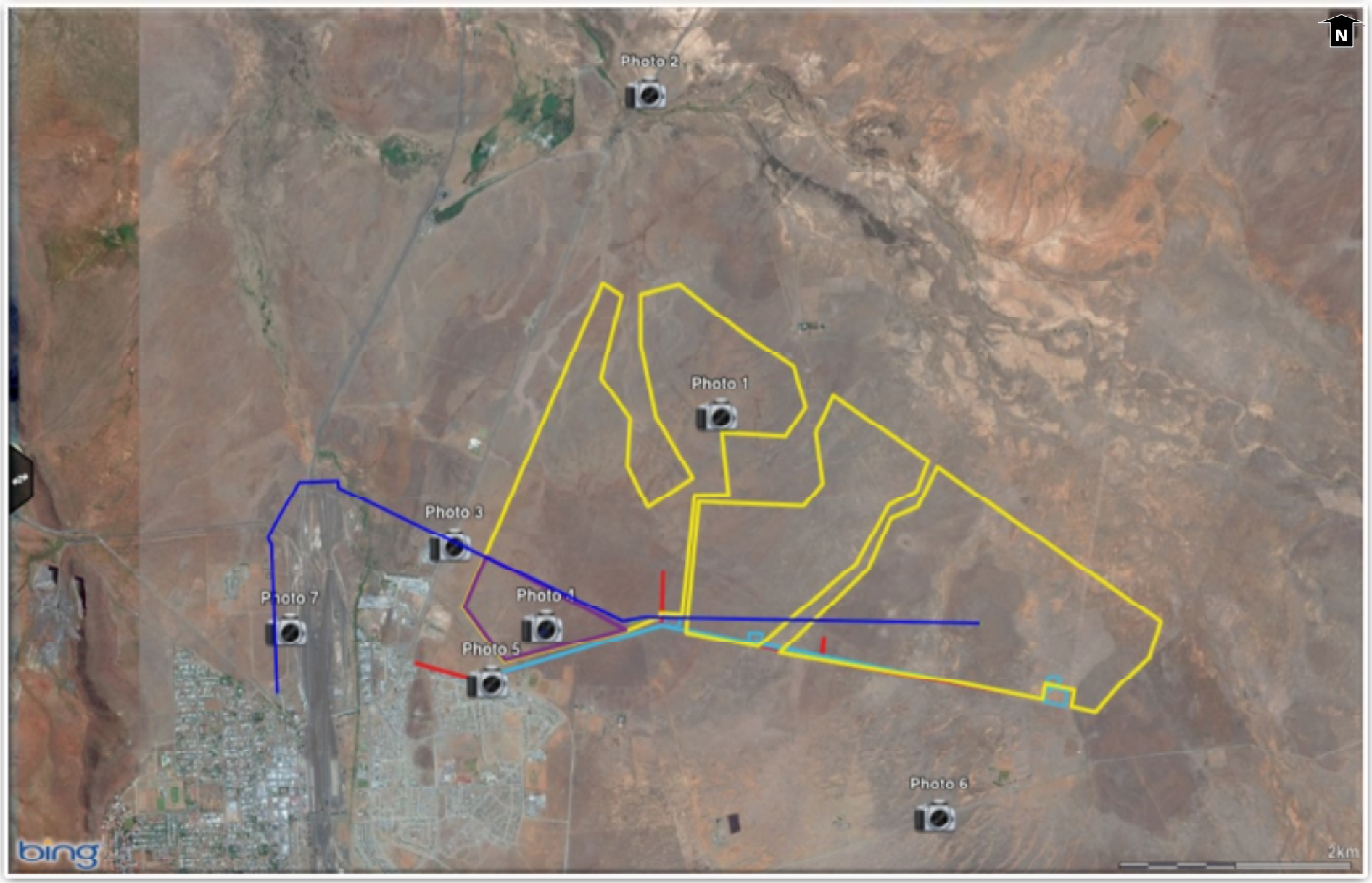

Figure 18: Site Layout plan with photo points

9.1.1 *Site Landscape Character Summary Table*

Survey Points				
Name	Photo point 1	Photo point 4	Photo point 6	Photo points 3 and 7
Features visible from photo point	PV4	PV4	PV2 & 3	Transmission line
VAC	Low	Moderate	Low	High
Viewshed	High	Moderate	Moderate High	Moderate

Scenic Quality				
Land form	2	1	1	1
Vegetation	1	1	1	1
Water	0	0	0	0
Colour	2	2	2	2
Adjacent scenery	2	1	1	1
Scarcity	1	1	1	1
Cultural modifications	0	-2	-2	-2
Score	8	4	4	4
Category	C	C	C	C

(A= scenic quality rating of ≥19; B = rating of 12 – 18, C= rating of ≤11)

Sensitivity				
Type of user	L	M	L	M
Amount of use	M	H	L	H
Public interest	L	M	L	M
Adjacent land users	L	M	L	M
Special areas	L	N	L	N
Score	L	M	L	M

(H = High, M = Moderate, L = Low Sensitivity)

Distance zone	FG	FG	FG	FG

(FG = Foreground, BG = Background, SS = Seldom Seen)

VRM Class	IV (III)	IV (III)	IV (III)	IV (III)

Site Landscape Character: PV 2 & 3 (Refer to Figure 21 of Colour Plates)

The sites of PV 2 and PV 3 lie in the south of the proposed footprint area and would be in the foreground zone of potential receptors. The existing land use is agricultural. The viewshed is *moderate to high* for PV 2 and PV 3 and the VAC is *low* due to the flat Karoo landscape and low scrub, so that any landscape modification would be prominent. There is an existing contrast from transmission lines on site. The landscape has a *low* scenic quality, as it is level and horizontal without any slope, even and smooth and consistent in line and form, and even-textured with no visible water features. Cultural modifications include transmission lines, which create some vertical lines against the horizon line.

Receptors for PV 2 and PV 3 would be agricultural but, as the area is agricultural, the amount of use would be low. The adjacent land users are also agricultural in nature, but there are no special areas and public interest is *low* as there is an existing context of transmission lines in the area.

The sites would fall into a Class IV. However, as the sites are agricultural, this would therefore become a Class III (standard set by VRM). *(USA Bureau of Land Management, 2004)*. The Class III objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

Site Landscape Character: PV 4 (Refer to Figure 22 of Colour Plates)
The PV4 site is in the foreground zone of potential receptors, which includes the R48 that lies to the north-west of the site. The existing land use is agricultural. The viewshed is *moderate to high* due to the flat, rolling Karoo landscape and low scrub, so that any landscape modification would be prominent. However, the existing contrast created by the housing development and transmission lines increases the VAC. The landscape has a *low* scenic quality, as it is level and horizontal without any slope, even and smooth and consistent in line and form, and even-textured with no visible water features. Cultural modifications include transmission lines, which create some vertical lines against the horizon line.

Receptors in the area would be agricultural, residential (housing settlement to the west) and transport related. The amount of use would be *moderate* due to the close proximity of the R48. The adjacent land users are also agricultural, as well as transport, in nature, with no special areas. Public interest is *low* as there is an existing context of residential housing and transmission lines with little tourism in the area. The sites would fall into a Class IV category. However, as the sites are agricultural, this would therefore become a Class III. The Class III objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate.

Site Landscape Character: PV Transmission lines (Refer to Figure 23 of Colour Plates)
The proposed transmission lines would run from the proposed sites to the local substation. The site falls into the foreground view of potential receptors. The existing land use is agricultural and transport related. The viewshed is *moderate* and would be prominent due to the flat Karoo landscape. However, the VAC of the area is *high* due to the increased contrast created by existing transmission lines and railway line infrastructure. The landscape has a *low* scenic quality as it is level and horizontal without any slope, even and smooth and consistent in line and form and even-textured with no visible water features, with an existing context of transmission lines and substation.

Receptors in the area would be agricultural, residential and transport related. However, the degree of receptor sensitivity would be *moderate to low*. The adjacent land users have a *low* rating as there is little tourism in the area and there are existing transmission lines and residential housing in the area. There are no special areas and public interest is *low*. The sites would fall into a Class IV and is suitable for development.

10 KEY OBSERVATION POINTS

The assessment of the Degree of Contrast (DoC) is a systematic process undertaken from Key Observation Points (KOPs) surrounding the project site, and is used to evaluate the potential visual impacts associated with the proposed landscape modifications. Key Observation Points (KOPs) are defined by the Bureau of Land Management as the people (receptors) located in strategic locations surrounding the property that make consistent use of the views associated with the site where the landscape modifications are proposed. These locations are important in terms of the VRM methodology, which requires that the DoC that the proposed landscape modifications will make to the existing landscape is measured from these most critical locations, or receptors, surrounding the property. The DoC generated by the proposed landscape modifications is measured against the existing landscape context in terms of the elements of form, line, colour and texture. Each alternative

activity is then assessed in terms of whether it meets the objectives of the established class category, and whether mitigation is possible. *(USA Bureau of Land Management, 2004)*

To define the KOPs, potential receptor locations were identified in the viewshed analysis, and screened, based on the following criteria:

- Angle of observation;
- Number of viewers;
- Length of time the project is in view;
- Relative project size;
- Season of use;
- Critical viewpoints, e.g. views from communities, road crossings; and
- Distance from property.

Making use of the above criteria, the following receptor locations were identified, as indicated in Figure 19:

- R48 southbound (Photo 2);
- Happy Valley (Photo 5); and
- Ebenezer Farm/ District Road (Photo 6).

11 CONTRAST RATING FROM KEY OBSERVATION POINTS

The contrast rating, or impacts assessment phase, is undertaken after the inventory process has been completed. The suitability of landscape modification is assessed by measuring the Degree of Contrast (DoC) of the proposed landscape modification to the existing contrast created by the existing landscape. This is done by evaluating the level of change to the existing landscape in terms of the line, colour, texture and form, in relation to the visual objectives defined for the area. The following criteria are utilised in defining the DoC:

- **None** :The element contrast is not visible or perceived.
- **Weak** :The element contrast can be seen but does not attract attention.
- **Moderate** :The element contrast begins to attract attention and begins to dominate the characteristic landscape.
- **Strong** :The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

As an example, in a Class I area, the visual objective is to preserve the existing character of the landscape, and the resultant contrast to the existing landscape should not be notable to the casual observer and cannot attract attention. In a Class IV area example, the objective is to provide for management activities which require major modifications of the existing character of the landscape. Based on whether the VRM objectives are met, mitigations, if required, are defined to avoid, reduce or mitigate the proposed landscape modifications so that the visual impact does not detract from the surrounding landscape sense of place.

KOP 1: R48 Southbound

The view from the R48 southbound can be seen in Figure 24 in Annexure 1: Colour Plates. The construction and operational phases would have a *strong* degree of contrast and would not meet the visual objectives to maintain the existing rural landscape character, due to the strong and moderate-strong contrast created by the line, colour and texture of the proposed PV facilities. The PV will read as a 2D form and will follow the topographical form of the site. There would be a precedent created by existing development, which would reduce the visual intrusion, but there will be a change to the landscape character with the construction of the proposed PV facilities. Closure phase would create no contrast and would meet the visual objectives of the site. This would require the removal of all structures and a return to agricultural land.

Table 1: Contrast Rating Table: R48 southbound

Visual Objective: Class III			
Landscape Modifications	**Construction**	**Operation**	**Closure**
Line	Strong	Strong	None
Colour	Moderate Strong	Moderate Strong	None
Texture	Strong	Strong	None
Form	Moderate	Moderate	None
Predicted contrast	Strong	Strong	None
Visual Objectives Met?	N	N	Y

Key: Y = Yes, N = No, Y (M) = Yes with mitigation, x = Not visible

KOP 2: Happy Valley/ Kareenville Residential Area

The view from Happy Valley can be seen in Figure 25 in Annexure 1: Colour Plates. The construction and operational phases would have a *strong* degree of contrast and would not meet the visual objectives to maintain the existing rural landscape character, due to the strong and moderate-strong contrast created by the line, colour and texture of the proposed PV facilities. The PV will read as a 2D form and will follow the topographical form of the site. There would be a precedent created by existing development, which would reduce the visual intrusion, but there will be a change to the landscape character with the construction of the proposed PV facilities. Closure phase would create no contrast and would meet the visual objectives of the site. This would require the removal of all structures and a return to agricultural land.

Table 2: Contrast Rating Table: Happy Valley residential area

Visual Objective			
Landscape Modifications	**Construction**	**Operation**	**Closure**
Line	Strong	Strong	None
Colour	Strong	Strong	Weak
Texture	Strong	Strong	Weak
Form	Moderate	Moderate	Weak
Predicted contrast	Strong	Strong	Weak
Visual Objectives Met?	N	N	Y (M)

Key: Y = Yes, N = No, Y (M) = Yes with mitigation, x = Not visible

KOP 3: Ebenezer Farm

The view from Happy Valley can be seen in Figure 26 in Annexure 1: Colour Plates. The construction and operational phases would have a *moderate* degree of contrast and would meet the visual objectives of the site, with mitigation, as the distance from the site in conjunction with the degraded landscapes, with a background view of the Eskom power lines, would reduce the visual contrasts generated by the project. The black colour would be seen as similar to the dark grey vegetation at a distance. To limit the potential of sunlight reflecting off the panels creating glint and glare impacts, it is recommended that the fixed tilt structure is utilised. The texture is in shadow (north-facing PV viewed from the south) and the line follows the horizon line. Closure phase would create no contrast and would meet the visual objectives of the site. Closure phase would include the removal of all structures, rehabilitation, and restoring the site to agricultural land.

Table 3: Contrast Rating Table: Ebenezer Farm

Visual Objective			
Landscape Modifications	**Construction**	**Operation**	**Closure**
Line	Moderate	Moderate	None
Colour	Moderate	Moderate	None
Texture	Moderate	Moderate	None
Form	Weak	Weak	None

Predicted contrast	Moderate	Moderate	None
Visual Objectives Met?	Y(M)	Y(M)	Y(M)

Key: Y = Yes, N = No, Y (M) = Yes with mitigation, x = Not visible

12 IMPACT ASSESSMENT

Impact, as defined by South Africa's Department of Environmental Affairs and Development Planning's (DEA&DP) Guideline for involving Visual and Aesthetic Specialists in EIA processes (2005), is: 'A description of the effect of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space' *(Oberholzer. 2005)*.

Based on the contrast rating, which was undertaken from each of the surrounding KOP receptors, an assessment was made of the visual significance of the following visual issues.

12.1 Construction phase

Potential Impacts: Dust caused by materials haulage to and from the site, site development works.

Recommended mitigations:

- Access roads are to be kept clean, and measures taken to minimise dust from construction traffic on gravel roads.
- Surface material should be scraped off, conserved and used for rehabilitation. The remainder could be used for site development, and any surplus disposed of in a manner that appears natural.
- Lay-down area is suitable as it screened from R48 receptors by the existing Siemens PV project to the west and has a 200m buffer from the nearest residential areas to the south. The laydown should be screened with shade cloth and dust prevention mitigations needs to be implemented during use to prevent wind blown dust.
- Site offices and structures should be limited to single-storey and they should be sited carefully to reduce visual intrusion. Colours should reflect hues of the surrounding vegetation and/or the ground. Roofs should be grey and non-reflective. Door and window frame colour should reference either the roof or wall colours.
- Litter is to be regarded as a serious offence and no contaminants are to be allowed to enter the environment by any means. An EMP would be drawn up and must be adhered to.
- Road construction and management must take run-off into consideration in order to prevent soil erosion.
- The top 50 - 100mm of naturally occurring substrate should be separated and then spread over finished levels.
- The developer will be required to ensure that the footprint areas of all impact sites utilised in the construction phase, are rehabilitated and restored as near as possible to previous natural vegetation during that phase, and not in the operational phase.
- The fencing should be grey in colour and located as close as possible around the PV site. If possible, natural waterways and drainage lines indicated as sensitive should not be fenced in.
- To limit the potential of sunlight reflecting off the panels creating glint and glare impacts, it is recommended that the Fixed Tilt structure option is utilised. With the tilt access aligned north-south, the panels will always be facing towards the sun which reduces the potential for impacts of reflection and glint. Due to the closer proximity of the site to the town of De Aar, the conventional PV type technology is preferred for the fixed tilt structures as the mirror reflecting the suns light onto a smaller PV panel increases the potential of glint and glare.

12.2 Operation phase

Potential Impacts: Lights at night and movement of maintenance vehicles. The visual impact of lighting will be significant because it can give a project a far greater zone of visual influence at night than the structures have during the day.

Recommended mitigations:

- All lighting is to be kept to a minimum, within the requirements of safety and efficiency.
- Where such lighting is deemed necessary, low-level lighting, which is shielded to reduce light spillage and pollution, should be used.
- No naked light sources are to be directly visible from a distance. Only reflected light should be visible from outside the site.
- Any necessary aircraft warning lights are to be installed as per the relevant authority requirements.
- External lighting must use down-lighters shielded in such a way as to minimise light spillage and pollution beyond the extent of the area that needs to be lit.
- Security and perimeter lighting must also be shielded so that no light falls outside the area needing to be lit. Unnecessarily tall light poles are to be avoided.

12.3 Closure phase

Potential Impacts: Removal of all PV structures, associated structures and fencing. Ripping of all internal roads and rehabilitation to natural state.

- All PV structures, associated structures and fencing should be removed and recycled.
- Internal roads should be ripped and then rehabilitated.
- All impacted footprint areas should be rehabilitated and restored to indigenous, endemic vegetation.

12.4 Cumulative Visual Impacts

Visual Impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
The proposed project setting a precedent for other similar renewable energy projects in the area resulting in possible landuse conflicts related to rapid and large scale landscape change	Without mitigation	Regional (north of De Aar)	Moderate	Long term	MODERATE	Possible	Moderate	Rever-sible
	With mitigation				LOW			

The visual impact of this proposed development must also be assessed in the context of the other renewable energy projects within the De Aar area that are in various stages of approval. De Aar has some of the highest renewable energy resource levels in the world, with good existing road infrastructure and accessible to the national grid.

A WEF project is approved for south of the town, on the Kasamberge/ Maanhaarberge plateau and the Swartkoppies ridge. This 100 MW WEF would include 67 turbines, with those nearest De Aar on Swartkoppies, about 7 km from the town, and those on the plateau about 15 km away. The development would be shielded by the built form of the town and therefore the visual impact on De Aar would be limited. However, there would be a visual impact experienced by users of the N10 travelling in either direction.

Another WEF project was approved recently for two sites on the Eastern Plateau, about 23km away from De Aar to the north-east and east. The site lies between the towns of De Aar and Philipstown, in similar rural uplands. This project has two sub-projects, the North project providing for 145 turbines distributed over the plateau and adjacent hills, and the South Project comprising 105 turbines. Cumulatively, the 250 turbines would have a lesser impact on the N10 and fringes of De Aar and a greater impact on local receptors. Consideration must be given to local residents in De Aar, the people who work there, people who live locally on the farmsteads, and people who drive through the area. To what degree would the proliferation of these developments visually impact upon these receptors and how would they be experienced.

Consideration must be given to local residents in De Aar, the people who work there, people who live locally on the farmsteads, and people who drive through the area. To what degree would the proliferation of these developments visually impact upon these receptors and how would they be experienced.

Cumulative impacts would be generated by new transmission lines, substations and new access roads associated with the new developments. The construction periods may not run concurrently, with a consequential increased visual impact on local roads. The construction periods could also have an increased impact due to longer timeframes, road access junctions will be more impacted-upon and lay-down areas may be more visible.

Should all the proposed PV facilities be constructed, De Aar will have a more industrial (security fenced), and a more contemporary (hi-tech developments), appearance. Once operational, these facilities would probably not promote noticeable additional traffic movements, but they may begin to influence the character of the town. In a very populated area, with complex landscape patterns, the number of proposed developments could result in a high visual impact. In this context, the long views, exposed sites, roads with little traffic, and small to medium sized towns, all combine to increase cumulative impacts. However, as the area has been identified as a solar energy hotspot, the cumulative impacts of this project (with mitigation) would be moderated as this solar project would be one of many. The surrounding areas around the town, and the town itself, are not necessarily a

tourist destination that is strongly associated with landscape and visual resources. This factor also mitigates the cumulative impacts of this project.

Mitigations would include encouraging the municipality to set up a planning committee which includes renewable developers, I&AP's and Local Authority which is tasked with addressing the issue of possible landuse conflicts related to rapid and large scale landscape change around De Aar.

12.5 No Development Option

The No-Go Option would retain the status quo which would include the development of PV 1 which has already been approved. Given that the landscape context of this development will change the sense of place, and the limited landscape value that the property holds for the surrounding areas, the landscape status quo could be changed without a significant visual impact to the surrounding areas. It is therefore recommended that Alternative 1 with mitigation can be implemented.

12.6 Impact Assessment Summary Table: Alternative 1

	Nature of the impact	Extent	Duration	Magnitude	Probability	Status	Confidence	Reversibility	Significance	Mitigation Measures	Significance after mitigation
CONSTRUCTION PHASE: ALT 1											
1	Hauling and delivery of PV parts	Regional	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	Good traffic management and keeping local people informed	
				Low	Probable						LOW
2	Hauling and delivery of construction materials	Regional	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	Good traffic management and keeping local people informed	
				Low							LOW
3	Location of access road off existing roads	Local	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	Upgrade road junctions as required and rehabilitate after works	
				Low							LOW
4	Visual disturbance of construction site and laydown area	Local	Constr	Medium	Definite	Negative	Certain	Reversible	Moderate	Screen site, operate within Construction Industry Management Guidelines, dust control	
				Low							LOW
5	Movement of construction vehicles with lights	Local	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	No night and weekend working	
				Low							LOW
6	Construction of trenches for cables	Local	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	Return ground to original state	
				Low							LOW
7	Construction of PV facilities and buildings	Local	Constr	High	Definite	Negative	Certain	Reversible	High	Use of local materials so that buildings blend in. Dust control measures	
				Medium							MODERATE
8	Construction of transmission lines	Local	Constr	Low	Definite	Negative	Certain	Reversible	Low	None. Already aligned along transmission line corridor	
											LOW
9	Completion of site works and fencing	Local	Constr	Medium	Definite	Negative	Certain	Reversible	Moderate	Good site management, avoidance of litter etc	
				Low							LOW

Note: Blank mitigation cells retain the rating for 'without mitigation' rating

	Nature of the impact	Extent	Duration	Magnitude	Probability	Status	Confidence	Reversibility	Significance	Mitigation Measures	Significance after mitigation
OPERATION PHASE: ALT 1											
1	Maintenance visits using existing road access	Local	Long term	Low	Definite	Negative	Certain	Reversible	Low	Good management practices Carry out repairs promptly and keep tidy	
											LOW
2	Site buildings and perimeter fence	Local	Long term	Medium	Definite	Negative	Certain	Reversible	Moderate	Light management Good management practices. Buffer from road (Alt 1)	
				Low							LOW
3	Impact of the development on receptors	Local	Long term	High	Definite	Negative	Certain	Reversible	High	Carry out repairs promptly and keep tidy	
				Medium							MODERATE

Note: Blank mitigation cells retain the rating for 'without mitigation' rating

	Nature of the impact	Extent	Duration	Magnitude	Probability	Status	Confidence	Reversibility	Significance	Mitigation Measures	Significance after mitigation
CLOSURE PHASE: ALT 1											
1	Removal of existing road access	Local	Short term	Medium	Definite	Negative	Certain	Reversible	Moderate	Ripping of roads and rehabilitation, restoration	
				Low							LOW
2	Removal of PV structures	Local	Long term	High	Definite	Negative	Certain	Reversible	High	Removal, rehabilitation and restoration	
			Short term	Low							LOW
3	Removal of site buildings and perimeter fence	Local	Long term	Medium	Definite	Negative	Certain	Reversible	Moderate	Ripping of roads and rehabilitation, restoration	
			Short term	Low							LOW
4	Removal of transmission line from site to adjacent Eskom line	Local	Long term	Medium	Definite	Negative	Certain	Reversible	Moderate	Ripping of roads and rehabilitation, restoration	
			Short term	Low							LOW

Note: Blank mitigation cells retain the rating for 'without mitigation' rating

12.7 Impact Assessment Summary Table: Alternative 2

	Nature of the impact	Extent	Duration	Magnitude	Probability	Status	Confidence	Reversibility	Significance	Mitigation Measures	Significance after mitigation
CONSTRUCTION PHASE: ALT 2											
1	Hauling and delivery of PV parts	Regional	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	Good traffic management and keeping local people informed	
				Low	Probable						LOW
2	Hauling and delivery of construction materials	Regional	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	Good traffic management and keeping local people informed	
				Low							LOW
3	Location of access road off existing roads	Local	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	Upgrade road junctions as required and rehabilitate after works	
				Low							LOW
4	Visual disturbance of construction site and laydown area	Local	Constr	Medium	Definite	Negative	Certain	Reversible	Moderate	Screen site, operate within Construction Industry Management Guidelines, dust control	
				Low							LOW
5	Movement of construction vehicles with lights	Local	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	No night and weekend working	
				Low							LOW
6	Construction of trenches for cables	Local	Constr	Medium	Definite	Negative	Sure	Reversible	Moderate	Return ground to original state	
				Low							LOW
7	Construction of PV facilities and buildings	Local	Constr	High	Definite	Negative	Certain	Reversible	High	Use of local materials so that buildings blend in. Dust control measures. No Go option for environmentally sensitive areas	
				Medium							MODERATE HIGH
8	Construction of transmission lines	Local	Constr	Low	Definite	Negative	Certain	Reversible	Low	None. Already aligned along transmission line corridor.	
											MODERATE
9	Completion of site works and fencing	Local	Constr	Medium	Definite	Negative	Certain	Reversible	Moderate	Good site management, avoidance of litter etc	
				Low							LOW

Note: Blank mitigation cells retain the rating for 'without mitigation' rating

	Nature of the impact	Extent	Duration	Magnitude	Probability	Status	Confidence	Reversibility	Significance	Mitigation Measures	Significance after mitigation
OPERATIONAL PHASE: ALT 2											
1	Maintenance visits using existing road access	Local	Long term	Low	Definite	Negative	Certain	Reversible	Low	Good management practices Carry out repairs promptly and keep tidy	
											LOW
2	Site buildings and perimeter fence	Local	Long term	Medium	Definite	Negative	Certain	Reversible	Moderate	Light management Good management practices. Buffer from road (Alt 1)	
				Low							LOW
3	Impact of the development on receptors	Local	Long term	High	Definite	Negative	Certain	Reversible	High	Carry out repairs promptly and keep tidy. Exclusion zone and buffers (Alt 1)	
				Medium							MODERATE

Note: Blank mitigation cells retain the rating for 'without mitigation' rating

	Nature of the impact	Extent	Duration	Magnitude	Probability	Status	Confidence	Reversibility	Significance	Mitigation Measures	Significance after mitigation
CLOSURE PHASE: ALT 2											
1	Removal of existing road access	Local	Short term	Medium	Definite	Negative	Certain	Reversible	Moderate	Ripping of roads and rehabilitation, restoration	
				Low							LOW
2	Removal of PV structures	Local	Long term	High	Definite	Negative	Certain	Reversible	High	Removal, rehabilitation and restoration	
			Short term	Low							LOW
3	Removal of site buildings and perimeter fence	Local	Long term	Medium	Definite	Negative	Certain	Reversible	Moderate	Ripping of roads and rehabilitation, restoration	
			Short term	Low							LOW
4	Removal of transmission line from site to adjacent Eskom line	Local	Long term	Medium	Definite	Negative	Certain	Reversible	Moderate	Ripping of roads and rehabilitation, restoration	
			Short term	Low							LOW

Note: Blank mitigation cells retain the rating for 'without mitigation' rating

13 CONCLUSION

The proposed landscape modification is large and will generate strong levels of visual contrast. The Class III visual objectives to retain the existing rural landscape character will not be met and a change in the landscape character will take place to the site and the immediate surrounds. It must be noted that there are other energy-related projects proposed in the immediate surrounds which would significantly alter the surrounding landscape character.

De Aar has some of the highest renewable energy resource levels in the world, with good existing road infrastructure and accessibility to the national grid. There are therefore a number of solar and wind energy projects in the area. Already under construction is the 50MW De Aar Solar (PV) and the proposed Solar Capital De Aar Solar Farm, which is located on a 2 300 hectare farm 6 km outside De Aar and will have 1 000 000 solar panels erected in the initial phase. A 100MW WEF project with 67 turbines is approved for south of the town, at a distance of about 7km. Another Wind Energy Facility project is being assessed for two sites on the Eastern Plateau, about 23 km away from De Aar, to the north-east and east, with a total of 250 turbines.

Should all the proposed renewable energy facilities be constructed, De Aar will have a more industrial (security fenced), and a more contemporary (hi-tech developments), appearance. Once operational, these facilities would probably not promote noticeable additional traffic movements, but they may begin to influence the character of the town. In a very populated area, with complex landscape patterns, the number of proposed developments could result in a high visual impact. In this context, the long views, exposed sites, roads with little traffic, and small to medium sized towns, all combine to increase cumulative impacts. However, as the area has been identified as a solar energy hotspot, the cumulative impacts of this project (with mitigation) would be moderated as this solar project would be one of many. The surrounding areas around the town, and the town itself, are not necessarily a tourist destination that is strongly associated with landscape and visual resources. This factor also mitigates the cumulative impacts of this project.

Due to the location of the site, and to the small number of potential receptors, the visual recommendation is that Alternative 1 (the preferred layout) could proceed. The conventional PV solar technology with tilt panel structure is preferred as the PV panel type will generate less potential for glint and glare than the Concentrated PV type which uses a reflective mirror to concentrate the sun. The presence of the existing Siemens PV project, under construction to the east of the site, increases the eastern visual absorption capacity and the generally lower scenic quality of the western section of the site, is strongly associated with the Eskom transmission lines. The Mulilo PV project has already been granted environmental authorisation and De Aar is already being recognised as an energy hub and, as such, the potential of further cumulative impacts caused by attracting similar PV projects is reduced. Alternative 2 is not recommended as it extends further to the south and abuts onto the Happy Valley residents' area. This generates high levels of visual intrusion which is not recommended.

The conventional PV solar with tilt panel technology option is preferred as this panel will generate less glint and reflection due the panels following the sun. An EMP should be implemented, and mitigation measures must be effectively undertaken, relating to:

Construction Phase

- Contract time kept to the minimum;
- Implementing traffic control measures;
- Disposal of surplus materials;
- Location of lay-down areas;
- Dust control measures; and
- Exclusion of rocky outcrops and river washes.

Operational Phase

- Height, location and finishes of building(s);
- Use of non-reflective materials and receding colours; and

- Discussions with local community.

Closure Phase

- Removal of all PV structures, associated structures and infrastructure; and
- Rehabilitation and restoration.

14 REFERENCES

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15 ANNEXURE 1: COLOUR PLATES

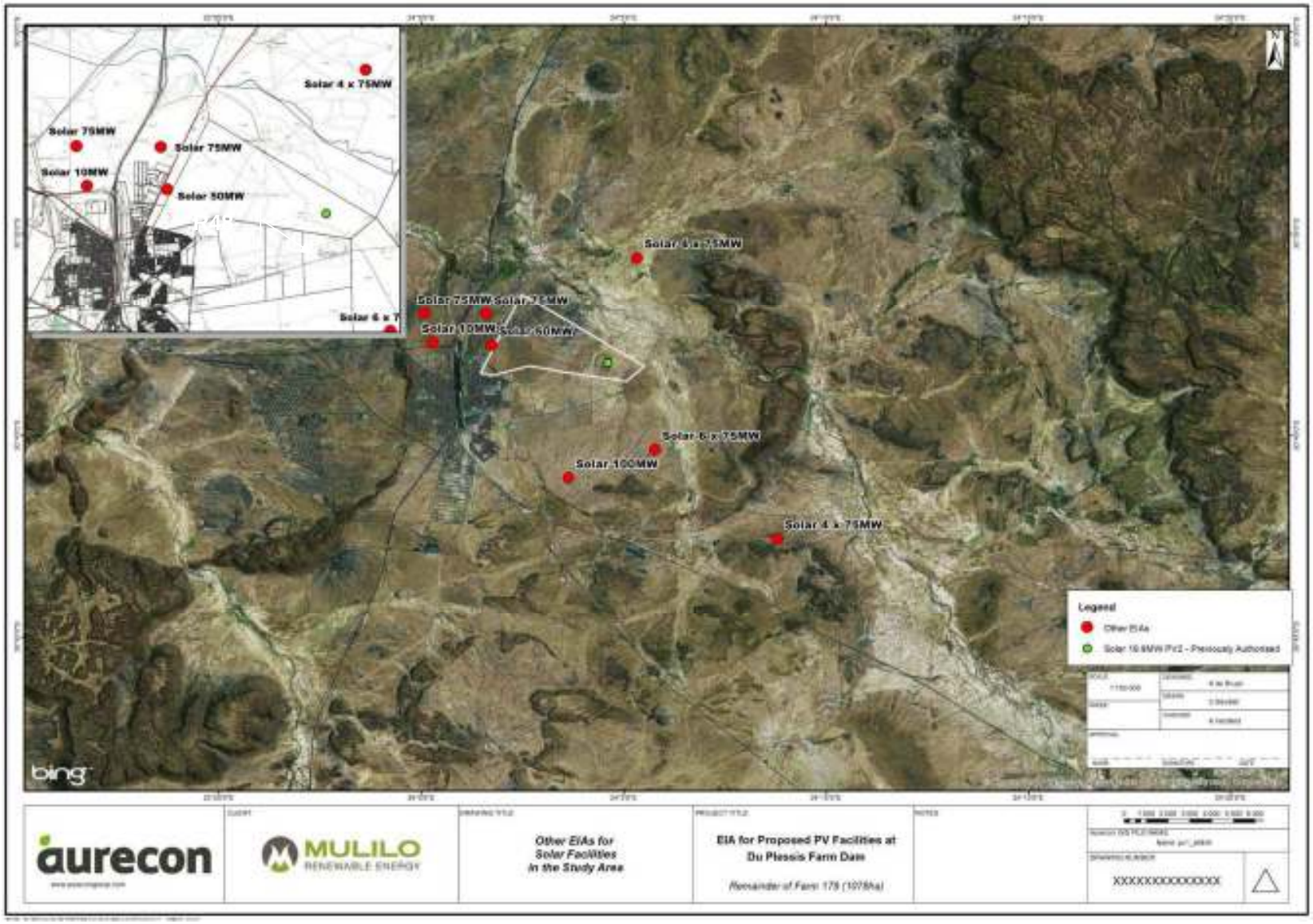


Figure 19: Other proposed wind and solar energy projects in the area *(Source: Aurecon. 2013)*

View North

View East

View South

View West

Figure 20: Views from **photo point 1**: Proposed PV site

View North

View East

View South

View West

Figure 21: Views from **photo point 4**: Proposed PV site

View North

View East

View South

View West

Figure 22: Views from **photo point 7**: transmission lines

View south from R48 southbound towards proposed sites as seen from photo point 2 with the approximate location of the project indicated in black

Figure 23: Receptor view: R48 southbound

View east from Happy Valley towards proposed site with the approximate extent of the proposed project indicated in black

View west showing local sense of place of photo point 5

Figure 24: Receptor view: Happy Valley/ Kareenville

View north west from Ebenezer Farm towards proposed site indicating approximate extent of the PV panels

View east showing local sense of place of photo point 6

Figure 25: Receptor view: Ebenezer Farm/ District road

16 ANNEXURE 3: METHODOLOGY

Visual impact is defined as 'the effect of an aspect of the development on a specified component of the visual, aesthetic or scenic environment within a defined time and space.' *(Oberholzer, B., 2005)*. As identified in this definition, 'landscapes are considerably more than just the visual perception of a combination of landform, vegetation cover and buildings, as they embody the history, landuse, human culture, wildlife and seasonal changes to an area.' *(U.K IEMA, 2002)*. These elements combine to produce distinctive local character that will affect the way in which the landscape is valued and perceived.

VRM Africa's objective is to provide Interested and Affected Parties (I&APs) and decision-makers with sufficient information to take "early opportunities for avoidance of negative visual effects." This is based on the U.K. Institute of Environmental Management and Assessment's (IEMA), and South Africa's Western Cape Department of Environmental Affairs and Development Planning's (DEA&DP), guidelines:

- "The ideal strategy for each identifiable, negative effect is one of avoidance. If this is not possible, alternative strategies of reduction, remediation and compensation may be explored. If the consideration of mitigation measures is left to the later stages of scheme design, this can result in increased mitigation costs because early opportunities for avoidance of negative visual effects are missed."*(U.K IEMA, 2002)*.
- "In order to retain the visual quality and landscape character, management actions must become an essential part of the guidelines throughout construction and operation...Proper management actions ensure that the lowest possible impact is created by the project...
- Ongoing monitoring programmes, with regard to the control of aesthetic aspects, for all stages of the project, are a vital component, ensuring that the long-term visual management objectives are met."*(Oberholzer, B., 2005)*.

The impact assessment methodology that VRM Africa uses is based on the VRM methodology developed by the United States Bureau of Land Management (BLM) in that the study involves the measurement of contrast in the form, line, texture and colour of the proposed landscape modification, against the same elements found in the natural landscape. The contrast rating is a systematic process undertaken from KOPs surrounding the project site, and the assessment of the degree of contrast (DoC) is used to evaluate the potential visual impacts associated with the proposed landscape modifications. The method is based on the premise that the degree to which a proposed landscape modification affects the visual quality of a landscape depends on the visual contrast created between a project and the existing landscape *(USA Bureau of Land Management, 2004)*.

Landscape Significance

Landscape significance is assessed in order to highlight the nature and degree of significance of the landscape context by differentiating between those landscapes of recognized or potential significance or sensitivity to modification to those landscape contexts that have low sensitivity and scenic value. 'Different levels of scenic values require different levels of management. For example, management of an area with high scenic value might be focused on preserving the existing character of the landscape, and management of an area with little scenic value might allow for major modifications to the landscape. Determining how an area should be managed first requires an assessment of the area's scenic values. Assessing scenic values and determining visual impacts can be a subjective process. Objectivity and consistency can be greatly increased by using standard assessment criteria to describe and evaluate landscapes, and to also describe proposed projects.' *(USA Bureau of Land Management. 2004)*.

Viewshed Analysis

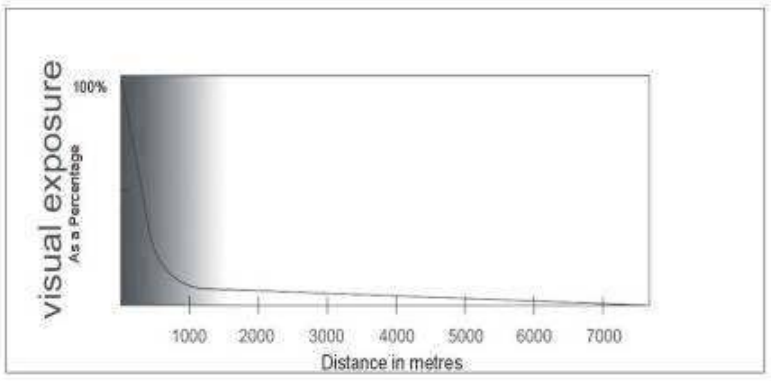
A viewshed is 'the outer boundary defining a view catchment area, usually along crests and ridgelines' *(Oberholzer, B., 2005)*. This reflects the area within which, or the extent to which, the landscape modification is likely to be seen. It is important to assess the extent to which the proposed landscape modifications are visible in the surrounding landscape, as a point of departure for defining the shared landscape context, and to identify the receptors making use of the common views. Viewshed analyses are not absolute indicators of the level of significance, but an indication of

potential visibility*(Centre for Advanced Spatial Analysis, 2002)*. Once the sites and heights of the proposed activities have been finalised, the viewshed analysis will be undertaken.

Receptor Exposure

The area where a landscape modification starts to influence the landscape character is termed the Zone of Visual Influence (ZVI) and is defined by the U.K. Institute of Environmental Management and Assessment's (IEMA) *'Guidelines for Landscape and Visual Impact Assessment'* as 'the area within which a proposed development may have an influence or effect on visual amenity (of the surrounding areas).'

The inverse relationship of distance and visual impact is well recognised in visual analysis literature *(Hull, R.B. and Bishop, I.E., 1988)*. According to Hull and Bishop, exposure, or visual impact, tends to diminish exponentially with distance. The areas where most landscape modifications would be visible are located within 2 km from the site of the landscape modification. Thus the potential visual impact of an object diminishes at an exponential rate as the distance between the observer and the object increases due to atmospheric conditions prevalent at a location, which causes the air to appear greyer, thereby diminishing detail. For example, viewed from 1000 m from a landscape modification, the impact would be 25% of the impact as viewed from 500 m from a landscape modification. At 2000m it would be 10% of the impact at 500 m. The relationship is indicated in the following graph generated by Hull and Bishop.



16.1 Distance Zones

The VRM methodology also takes distance from a landscape modification into consideration in terms of understanding visual resource. Three distance categories are defined by the Bureau of Land Management. The distance zones are:

1. ***Foreground / Middle ground***, up to approximately 6km, which is where there is potential for the sense of place to change;
2. ***Background areas***, from 6km to 24km, where there is some potential for change in the sense of place, but where change would only occur in the case of very large landscape modifications; and
3. ***Seldom seen areas***, which fall within the Foreground / Middle ground area but, as a result of no receptors, are not viewed or are seldom viewed.

16.2 Scenic Quality

In the VRM methodology, scenic quality is a measure of the visual appeal of a tract of land. In the visual resource inventory process, public lands are given a rating based on the apparent scenic quality, which is determined using seven key factors. During the rating process, each of these factors is ranked on a comparative basis with similar features in the region *(USA Bureau of Land Management, 2004)*. These seven elements are:

1. **Landform:** Topography becomes more interesting as it gets steeper, or more massive, or more severely or universally sculptured.
2. **Vegetation:** Give primary consideration to the variety of patterns, forms, and textures created by plant life. Consider short-lived displays when they are known to be recurring or spectacular. Also consider smaller-scale vegetation features which add striking and intriguing detail elements to the land.

3. **Water:** That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration.
4. **Colour:** Consider the overall colour(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) as they appear during seasons or periods of high use. Key factors to use when rating "colour" are variety, contrast and harmony.
5. **Scarcity:** This factor provides an opportunity to give added importance to one, or all, of the scenic features that appear to be relatively unique or rare within one physiographic region.
6. **Adjacent Land Use:** Degree to which scenery, outside the scenery unit being rated, enhances the overall impression of the scenery within the rating unit. The distance at which adjacent scenery will start to influence scenery within the rating unit ranges, depending upon the characteristics of the topography, the vegetative cover, and other such factors.
7. **Cultural Modifications:** Cultural modifications in the landform, water, and vegetation, and addition of structures, should be considered, and may detract from the scenery in the form of a negative intrusion, or complement or improve the scenic quality of a unit.

Receptor Sensitivity Rating Criteria
A= scenic quality rating of ≥19;
B = rating of 12 – 18,
C= rating of ≤11

Scenic Quality Rating Questionnaire

KEY FACTORS	**RATING CRITERIA AND SCORE**		
SCORE	**5**	**3**	**1**
Land Form	High vertical relief as expressed in prominent cliffs, spires or massive rock outcrops, or severe surface variation or highly eroded formations including dune systems: or detail features that are dominating and exceptionally striking and intriguing.	Steep-sided river valleys, or interesting erosion patterns or variety in size and shape of landforms; or detail features that are interesting, though not dominant or exceptional.	Low rolling hills, foothills or flat valley bottoms; few or no interesting landscape features.
Vegetation	A variety of vegetative types as expressed in interesting forms, textures and patterns.	Some variety of vegetation, but only one or two major types.	Little or no variety or contrast in vegetation.
Water	Clear and clean appearing, still or cascading white water, any of which are a dominant factor in the landscape.	Flowing, or still, but not dominant in the landscape.	Absent, or present but not noticeable.
Colour	Rich colour combinations, variety or vivid colour: or pleasing contrasts in the soil, rock, vegetation, water.	Some intensity or variety in colours and contrast of the soil, rock and vegetation, but not a dominant scenic element.	Subtle colour variations contrast or interest: generally mute tones.
Adjacent Scenery	Adjacent scenery greatly enhances visual quality.	Adjacent scenery moderately enhances overall visual quality.	Adjacent scenery has little or no influence on overall visual quality.

Scarcity	One of a kind: unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing etc.	Distinctive, though somewhat similar to others within the region.	Interesting within its setting, but fairly common within the region.
SCORE	**2**	**0**	**-4**
Cultural Modification	Modifications add favourably to visual variety, while promoting visual harmony.	Modifications add little or no visual variety to the area, and introduce no discordant elements.	Modifications add variety but are very discordant and promote strong disharmony.

16.3 Receptor Sensitivity

Sensitivity levels are a measure of public concern for scenic quality. Public lands are assigned high, medium or low sensitivity levels by analysing the various indicators of public concern. The following criteria were used to assess the sensitivity of each of the communities:

- **Public Interest:** The visual quality of an area may be of concern to local, state, or national groups. Indicators of this concern are usually expressed in public meetings, letters, newspaper or magazine articles, newsletters, landuse plans, etc. Public controversy, created in response to proposed activities that would change the landscape character, should also be considered.
- **Special Areas:** Management objectives for special areas such as natural areas, wilderness areas or wilderness study areas, wild and scenic rivers, scenic areas, scenic roads or trails, and Areas of Critical Environmental Concern (ACEC), frequently require special consideration for the protection of visual values. This does not necessarily mean that these areas are scenic, but rather that one of the management objectives may be to preserve the natural landscape setting. The management objectives for these areas may be used as a basis for assigning sensitivity levels.
- **Adjacent Land Uses:** The interrelationship with land uses in adjacent land can affect the visual sensitivity of an area. For example, an area within the viewshed of a residential area may be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive.
- **Type of User:** Visual sensitivity will vary with the type of users. Recreational sightseers may be highly sensitive to any changes in visual quality, whereas workers who pass through the area on a regular basis may not be as sensitive to change.
- **Amount of Use:** Areas seen and used by large numbers of people are potentially more sensitive. Protection of visual values usually becomes more important as the number of viewers increase *(USA Bureau of Land Management, 2004)*.

Receptor Sensitivity Rating Criteria

The level of visual impact considered acceptable is dependent on the types of receptors.

- *High sensitivity : e.g. residential areas, nature reserves and scenic routes or trails*
- *Moderate sensitivity : e.g. sporting or recreational areas, or places of work*
- *Low sensitivity : e.g. industrial, mining or degraded areas*

Sensitivity Level Rating Questionnaire

FACTORS	**QUESTIONS**	
Type of Users	**Maintenance of visual quality is:**	
	A major concern for most users	High
	A moderate concern for most users	Moderate
	A low concern for most users	Low

Amount of use	**Maintenance of visual quality becomes more important as the level of use increases:**	
	A high level of use	High
	Moderately level of use	Moderate
	Low level of use	Low
Public interest	**Maintenance of visual quality:**	
	A major concern for most users	High
	A moderate concern for most users	Moderate
	A low concern for most users	Low
Adjacent land Users	**Maintenance of visual quality to sustain adjacent land use objectives is:**	
	Very important	High
	Moderately important	Moderate
	Slightly important	Low
Special Areas	**Maintenance of visual quality to sustain Special Area management objectives is:**	
	Very important	High
	Moderately important	Moderate
	Slightly important	Low

16.4 Key Observation Points (KOPs)

KOPs are defined by the BLM Visual Resource Management as the people located in strategic locations surrounding the property that make consistent use of the views associated with the site where the landscape modifications are proposed. These locations are used to assess the suitability of the proposed landscape modifications by means of assessing the degree of contrast of the proposed landscape modifications to the existing landscape, taking into consideration the visual management objectives defined for the area. The following selection criteria were utilised in defining the KOPs:

- Angle of observation
- Number of viewers
- Length of time the project is in view
- Relative project size
- Season of use
- Critical viewpoints, e.g. views from communities, road crossings
- Distance from property

16.5 VRM Classes

The landscape character of the proposed project site is surveyed to identify areas of common landuse and landscape character. These areas are then evaluated in terms of scenic quality (landscape significance) and receptor sensitivity to landscape change (of the site) in order to define the visual objective for the project site. The overall objective is to maintain a landscape's integrity, but this can be achieved at varying levels, called VRM Classes, depending on various factors, including the visual absorption capacity of a site (i.e., how much of the project would be "absorbed" or "disappear" into the landscape). The areas identified on site are categorised into these Classes by using a matrix from the BLM Visual Resource Management method as seen below, which is then represented in a visual sensitivity map

The BLM has defined four Classes that represent the relative value of the visual resources of an area:

iv. **Classes I and II**are the most valued
v. **Class III** represent a moderate value

vi. **Class IV**is of least value

		VISUAL SENSITIVITY LEVELS								
		High			Medium			Low		
SCENIC QUALITY	A (High)	II	II	II	II	II	II	II	II	II
	B (Medium)	II	III	III/ IV *	III	IV	IV	IV	IV	IV
	C (Low)	III	IV	IV	IV	IV	IV	IV	IV	IV
DISTANCE ZONES		fore/middle ground	Background	seldom seen	fore/middle ground	background	seldom seen	fore/middle ground	background	seldom seen

(A= scenic quality rating of ≥19; B = rating of 12 – 18, C= rating of ≤11)

* If adjacent areas are **Class III** or lower, assign **Class III**, if higher, assign **Class IV**

Evaluation of the suitability of a proposed landscape modification is undertaken by means of assessing the proposed modification against a predefined management objective assigned to each class. The VRM class objectives are defined as follows:

5. The **Class I** objective is to preserve the existing character of the landscape, where the level of change to the characteristic landscape should be very low, and must not attract attention. **Class I** is assigned to those areas where a ***specialist decision*** has been made to maintain a natural landscape.
6. The **Class II** objective is to retain the existing character of the landscape and the level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer, and should repeat the basic elements of form, line, colour and texture found in the predominant natural features of the characteristic landscape.
7. The **Class III** objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
8. The **Class IV** objective is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the landscape can be high, and these management activities may dominate the view and be the major focus of the viewer's (s') attention.

16.6 Photo Montages and 3D Visualisation

As a component in this contrast rating process, visual representation, such as photo montages are vital in large-scale modifications, as this serves to inform I&APs and decision-making authorities of the nature and extent of the impact associated with the proposed project/development. There is an ethical obligation in this process, as visualisation can be misleading if not undertaken ethically. In terms of adhering to standards for ethical representation of landscape modifications, VRM Africa subscribes to the Proposed Interim Code of Ethics for Landscape Visualisation developed by the Collaborative for Advanced Landscape Planning (CALP) (July 2003)*(Sheppard, S.R.J., 2005)*. This code states that professional presenters of realistic landscape visualisations are responsible for promoting full understanding of proposed landscape changes, providing an honest and neutral visual representation of the expected landscape, by seeking to avoid bias in responses and demonstrating the legitimacy of the visualisation process. Presenters of landscape visualisations should adhere to the principles of:

- Access to Information
- Accuracy
- Legitimacy
- Representativeness
- Visual Clarity
- Interest

The Code of Ethical Conduct states that the presenter should:

- Demonstrate an appropriate level of qualification and experience.
- Use visualisation tools and media that are appropriate to the purpose.
- Choose the appropriate level of realism.
- Identify, collect and document supporting visual data available for, or used in, the visualisation process.
- Conduct an on-site visual analysis to determine important issues and views.
- Seek community input on viewpoints and landscape issues to address in the visualisations.
- Provide the viewer with a reasonable choice of viewpoints, view directions, view angles, viewing conditions and timeframes appropriate to the area being visualised.
- Estimate and disclose the expected degree of uncertainty, indicating areas and possible visual consequences of the uncertainties.
- Use more than one appropriate presentation mode and means of access for the affected public.
- Present important non-visual information at the same time as the visual presentation, using a neutral delivery.
- Avoid the use, or the appearance of, 'sales' techniques or special effects.
- Avoid seeking a particular response from the audience.
- Provide information describing how the visualisation process was conducted and how key decisions were taken*(Sheppard, S.R.J., 2005)*.

16.7 Contrast Rating Stage

The contrast rating, or impacts assessment phase, is undertaken after the inventory process has been completed and the proposed landscape modification is assessed from the Key Observation Point. The suitability of landscape modification is assessed by measuring the Degree of Contrast (DoC) of the proposed landscape modification to the existing contrast created by the existing landscape. This is done by evaluating the level of change to the existing landscape in terms of the line, colour, texture and form, in relation to the visual objectives defined for the area. The following criteria are utilised in defining the DoC:

- **None** :The element contrast is not visible or perceived.
- **Weak** :The element contrast can be seen but does not attract attention.
- **Moderate** :The element contrast begins to attract attention and begins to dominate the characteristic landscape.
- **Strong** :The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

As an example, in a Class I area, the visual objective is to preserve the existing character of the landscape, and the resultant contrast to the existing landscape should not be notable to the casual observer and cannot attract attention. In a Class IV area example, the objective is to provide for management activities which require major modifications of the existing character of the landscape. Based on whether the VRM objectives are met, mitigations, if required, are defined to avoid, reduce or mitigate the proposed landscape modifications so that the visual impact does not detract from the surrounding landscape sense of place.

16.8 VRM Terminology

The following terms were used in the Contrast Rating Tables to help define Form, Line, Colour, and Texture. The definitions were a combination of Microsoft Word Dictionary and simple description.

FORM	LINE	COLOUR	TEXTURE
Simple	Horizontal		Smooth
Weak	Vertical		Rough
Strong	Geometric		Fine
Dominant	Angular		Coarse
Flat	Acute		Patchy
Rolling	Parallel		Even
Undulating	Curved	Dark	Uneven
Complex	Wavy	Light	Complex
Plateau	Strong	Mottled	Simple
Ridge	Weak		Stark
Valley	Crisp		Clustered
Plain	Feathered		Diffuse
Steep	Indistinct		Dense
Shallow	Clean		Scattered
Organic	Prominent		Sporadic
Structured	Solid		Consistent

Simple	Basic, composed of few elements	**Organic**	Derived from nature; occurring or developing gradually and naturally
Complex	Complicated; made up of many interrelated parts	**Structure**	Organised; planned and controlled; with definite shape, form, or pattern
Weak	Lacking strength of character	**Regular**	Repeatedly occurring in an ordered fashion
Strong	Bold, definite, having prominence	**Horizontal**	Parallel to the horizon
Dominant	Controlling, influencing the surrounding environment	**Vertical**	Perpendicular to the horizon; upright
Flat	Level and horizontal without any slope; even and smooth without any bumps or hollows	**Geometric**	Consisting of straight lines and simple shapes
Rolling	Progressive and consistent in form, usually rounded	**Angular**	Sharply defined; used to describe an object identified by angles
Undulating	Moving sinuously like waves; wavy in appearance	**Acute**	Less than 90°; used to describe a sharp angle
Plateau	Uniformly elevated flat to gently undulating land bounded on one or more sides by steep slopes	**Parallel**	Relating to or being lines, planes, or curved surfaces that are always the same distance apart and therefore never meet
Ridge	A narrow landform typical of a highpoint or apex; a long narrow hilltop or range of hills	**Curved**	Rounded or bending in shape
Valley	Low-lying area; a long low area of land, often with a river or stream running through it, that is surrounded by higher ground	**Wavy**	Repeatedly curving forming a series of smooth curves that go in one direction and then another
Plain	A flat expanse of land; fairly flat dry land, usually with few trees	**Feathered**	Layered; consisting of many fine parallel strands
Steep	Sloping sharply often to the extent of being almost vertical	**Indistinct**	Vague; lacking clarity or form
Prominent	Noticeable; distinguished, eminent, or well-known	**Patchy**	Irregular and inconsistent;
Solid	Unadulterated or unmixed; made of the same material throughout; uninterrupted	**Even**	Consistent and equal; lacking slope, roughness, and irregularity
Broken	Lacking continuity; having an uneven surface	**Uneven**	Inconsistent and unequal in measurement irregular
Smooth	Consistent in line and form; even textured	**Stark**	Bare and plain; lacking ornament or relieving features
Rough	Bumpy; knobbly; or uneven, coarse in texture	**Clustered**	Densely grouped
Fine	Intricate and refined in nature	**Diffuse**	Spread through; scattered over an area
Coarse	Harsh or rough to the touch; lacking detail	**Diffuse**	To make something less bright or intense

Photo Montages and 3D Visualisation

As a component in this contrast rating process, visual representation, such as photo montages, are vital in large-scale modifications, as this serves to inform I&APs and decision-making authorities of

the nature and extent of the impact associated with the proposed project/development. There is an ethical obligation in this process, as visualisation can be misleading if not undertaken ethically. In terms of adhering to standards for ethical representation of landscape modifications, VRM Africa subscribes to the Proposed Interim Code of Ethics for Landscape Visualisation developed by the Collaborative for Advanced Landscape Planning (CALP) (July 2003) (Sheppard, S.R.J., 2005). This code states that professional presenters of realistic landscape visualisations are responsible for promoting full understanding of proposed landscape changes, providing an honest and neutral visual representation of the expected landscape, by seeking to avoid bias in responses and demonstrating the legitimacy of the visualisation process. Presenters of landscape visualisations should adhere to the principles of:

- Access to Information
- Accuracy
- Legitimacy
- Representativeness
- Visual Clarity
- Interest

16.9 Aurecon Impact Assessment Methodology

A standardised and internationally recognised methodology (Government of SA, 2004) has been applied to assess the significance of the potential environmental impacts of Rössing Uranium's project, outlined as follows:

For each impact, the EXTENT (spatial scale), MAGNITUDE (size or degree scale) and DURATION (time scale) will be described. These criteria are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the SEIA Report will represent the full range of plausible and pragmatic measures but does not necessarily imply that they should or will all be implemented. The decision as to which combination of alternatives and mitigation measures to apply for will lie with RU as the proponent, and their acceptance and approval ultimately with MET:DEA and MME. The SEIA Report will explicitly describe RU's commitments in this regard. The tables on the following pages show the scales used to assess these variables and define each of the rating categories.

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**National**	Within Namibia
	Regional	Within the Erongo Region
	Local	On site or within 100 m of the impact site
Magnitude of impact (at the indicated spatial scale)	**High**	Social and/or natural functions and/ or processes are *severely* altered
	Medium	Social and/or natural functions and/ or processes are *notably* altered
	Low	Social and/or natural functions and/ or processes are *slightly* altered
	Very Low	Social and/or natural functions and/ or processes are *negligibly* altered
	Zero	Social and/or natural functions and/ or processes remain *unaltered*
Duration of impact	**Short term**	Up to 4 years
	Medium Term	4 to 10 years after construction
	Long Term	More than 10 years after construction

Table 4: Assessment criteria for the evaluation of impacts

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in the following table, developed by Ninham Shand in 1995 as a means of minimising subjectivity in such evaluations, i.e. to allow for standardisation in the determination of significance.

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Table 5: Definition of significance ratings

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact would be determined using the rating systems outlined in the following two tables. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring.

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95% chance of the impact occurring.
Probable	Estimated 5 to 95% chance of the impact occurring.
Unlikely	Estimated less than 5% chance of the impact occurring.

Table 6: Definition of probability ratings

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 7: Definition of confidence ratings

Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined in the following table.

REVERSIBILITY RATINGS	CRITERIA
Irreversible	***THE ACTIVITY WILL LEAD TO AN IMPACT THAT IS PERMANENT.***
Reversible	***THE IMPACT IS REVERSIBLE, WITHIN A PERIOD OF 10 YEARS.***

Table 8: Definition of reversibility ratings

17 ANNEXURE 4: GENERAL MITIGATIONS

17.1 Lights at Night

Mitigation:

- Effective light management needs to be incorporated into the design of the lighting to ensure that the visual influence is limited to the mine, without jeopardising mine operational safety and security (See lighting mitigations by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corp in 14.2).
- Utilisation of specific frequency LED lighting with a green hue on perimeter security fencing.
- Directional lighting on the more exposed areas of operation, where point light source is an issue.
- No use of overhead lighting and, if possible, locate the light source closer to the operation.
- If possible, the existing overhead lighting method utilised at the mine should be phased out and replaced with an alternative lighting using closer to source, directed LED technology.

Mesopic Lighting

Mesopic vision is a combination of photopic vision and scotopic vision in low, but not quite dark, lighting situations. The traditional method of measuring light assumes photopic vision and is often a poor predictor of how a person sees at night. The light spectrum optimized for mesopic vision contains a relatively high amount of bluish light and is therefore effective for peripheral visual tasks at mesopic light levels. *(CIE, 2012)*

The Mesopic Street Lighting Demonstration and Evaluation Report by the Lighting Research Centre (LRC) in New York found that the 'replacement of white light sources (induction and ceramic metal halide) were tuned to optimize human vision under low light levels while remaining in the white light spectrum. Therefore, outdoor electric light sources that are tuned to how humans see under mesopic lighting conditions can be used to reduce the luminance of the road surface while providing the same, or better, visibility. Light sources with shorter wavelengths, which produce a "cooler" (more blue and green) light, are needed to produce better mesopic vision. Based on this understanding, the LRC developed a means of predicting visual performance under low light conditions. This system is called the unified photometry system. Responses to surveys conducted on new installations revealed that area residents perceived higher levels of visibility, safety, security, brightness, and colour rendering with the new lighting systems than with the standard High-Purity Standards (HPS) systems. The new lighting systems used 30% to 50% less energy than the HPS systems. These positive results were achieved through tuning the light source to optimize mesopic vision. Using less wattage and photopic luminance also reduces the reflectance of the light off the road surface. Light reflectance is a major contributor to light pollution (sky glow).' *(Lighting Research Center. New York. 2008)*

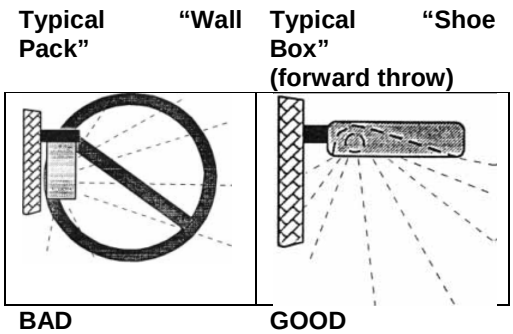
'Good Neighbour – Outdoor Lighting'

Presented by the New England Light Pollution Advisory Group (NELPAG) http://cfa/ www.harvard .edu /cfa/ps/nelpag.html) and Sky & Telescope http://SkyandTelescope.com/). NELPAG and Sky & Telescope support the International Dark-Sky Association (IDA) (http://www.darksky.org/).

What is good lighting? Good outdoor lights improve visibility, safety, and a sense of security, while minimizing energy use, operating costs, and ugly, dazzling glare.

Why should we be concerned? Many outdoor lights are poorly designed or improperly aimed. Such lights are costly, wasteful, and distractingly glary. They harm the night-time environment and neighbours' property values. Light directed uselessly above the horizon creates murky skyglow — the "light pollution" that washes out our view of the stars.

Good and Bad Light Fixtures



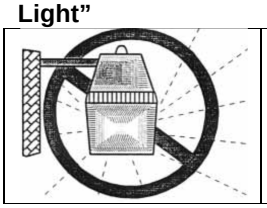
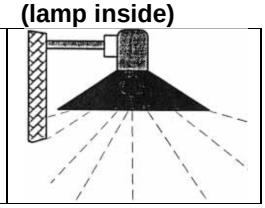
Glare Here's the basic rule of thumb: If you can see the bright bulb from a distance, it's a bad light. With a good light, you see lit ground instead of the dazzling bulb. "Glare" is light that beams directly from a bulb into your eye. It hampers the vision of pedestrians, cyclists, and drivers.

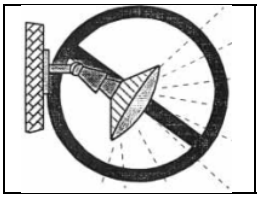
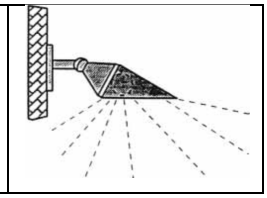
Light Trespass Poor outdoor lighting shines onto neighbours' properties and into bedroom windows, reducing privacy, hindering sleep, and giving the area an unattractive, trashy look.

Energy Waste Many outdoor lights waste energy by spilling much of their light where it is not needed, such as up into the sky. This waste results in high operating costs. Each year we waste more than a billion dollars in the United States needlessly lighting the night sky.

Excess Lighting Some homes and businesses are flooded with much stronger light than is necessary for safety or security.

Waste light goes up and sideways	Directs all light down

Typical "Yard Light"	**Opaque Reflector (lamp inside)**
	
BAD Waste light goes up and sideways	**GOOD** Directs all light down

Area Flood Light	**Area Flood Light with Hood**
	
BAD Waste light goes up and sideways	**GOOD** Directs all light down

How do I switch to good lighting?

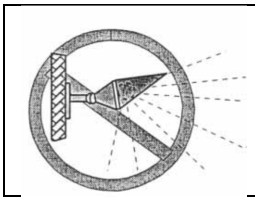
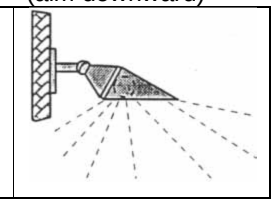
Provide only enough light for the task at hand; don't over-light, and don't spill light off your property. Specifying enough light for a job is sometimes hard to do on paper. Remember that a full Moon can make an area quite bright. Some lighting systems illuminate areas 100 times more brightly than the full Moon! More importantly, by choosing properly shielded lights, you can meet your needs without bothering neighbours or polluting the sky.

1. Aim lights down. Choose "full-cutoff shielded" fixtures that keep light from going uselessly up or sideways. Full-cutoff fixtures produce minimum glare. They create a pleasant-looking environment. They increase safety because you see illuminated people, cars, and terrain, not dazzling bulbs.

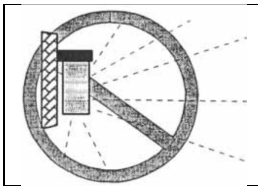
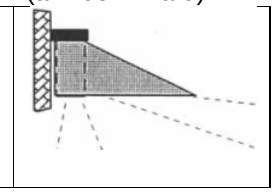
2. Install fixtures carefully to maximize their effectiveness on the targeted area and minimize their impact elsewhere. Proper aiming of fixtures is crucial. Most are aimed too high. Try to install them at night, when you can see where all the rays actually go. Properly aimed and shielded lights may cost more initially, but they save you far more in the long run. They can illuminate your target with a low-wattage bulb just as well as a wasteful light does with a high-wattage bulb.

3. If color discrimination is not important, choose energy-efficient fixtures utilising yellowish high-pressure sodium (HPS) bulbs. If "white" light is needed, fixtures using compact flourescent or metal-halide (MH) bulbs are more energy-efficient than those using incandescent, halogen, or mercury-vapor bulbs.

What You Can Do To Modify Existing Fixtures

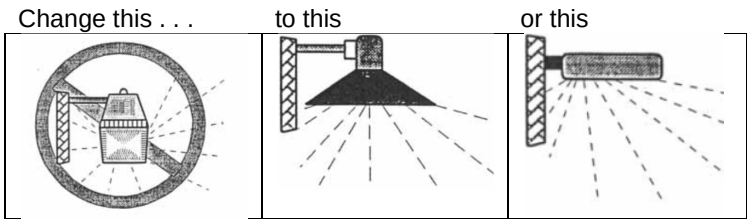
Change this . . .	to this (aim downward)
	

Floodlight:

Change this . . .	to this (aim downward)
	

Wall Pack

4. Where feasible, put lights on timers to turn them off each night after they are no longer needed. Put home security lights on a motion-detector switch, which turns them on only when someone enters the area; this provides a great deterrent effect!



Replace bad lights with good lights.
You'll save energy and money. You'll be a good neighbour. And you'll help preserve our view of the stars.