Visual Impact Assessment for the Shrike PV Facility within the Stilfontein PV Cluster, Stilfontein, North West Province

Stilfontein PV VIAs, Stilfontein , South Africa
South Africa Mainstream Renewable Power Developments (Pty) Ltd

SRK Consulting (South Africa) (Pty) Ltd ▪ 581877_42A ▪ February 2023

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Profile and Expertise of Specialists

SRK Consulting (South Africa) (Pty) Ltd (SRK) has been appointed by South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) to undertake the Basic Assessment (BA) processes required in terms of the National Environmental Management Act 107 of 1998 (NEMA). SRK Consulting has appointed a team of professionals to conduct the Visual Impact Assessment (VIA) specialist study as part of the BA process. SRK comprises over 1 600 professional staff worldwide, offering expertise in a wide range of environmental and engineering disciplines. SRK's Cape Town Environmental, Social and Governance (ESG) department has a distinguished track record of managing large environmental and engineering projects, extending back to 1979. SRK has rigorous quality assurance standards and is ISO 9001 accredited.

In accordance with the EIA Regulations, 2014 (as amended), the qualifications and experience of the key individual specialists involved in the study are detailed below.

Project Director and Reviewer: Christopher Dalgliesh, BBusSc (Hons); MPhil (EnvSci)
Registered Environmental Assessment Practitioner (EAP) No. 2019/413
Chris Dalgliesh is a Partner and Principal Environmental Consultant with over 36 years' experience, primarily in South Africa, Southern Africa, West Africa and South America (Suriname). Chris has worked on a wide range of projects, notably in the natural resources, Oil & Gas, waste, infrastructure (including rail and ports) and industrial sectors. He has managed and regularly reviews Visual Impact Assessments. He has directed and managed numerous Environmental and Social Impact Assessments (ESIAs) and associated management plans, in accordance with international standards. He regularly provides high level review of ESIAs, frequently directs Environmental and Social Due Diligence studies for lenders, and also has a depth of experience in Strategic Environmental Assessment (SEA), State of Environment Reporting and Resource Economics. He holds a BBusSci (Hons) and M Phil (Env).

Specialist Consultant: Kelly Armstrong, BSocSc (Hons) Environmental Science
Kelly Armstrong is an Environmental Consultant at SRK Consulting. She has five years' experience in managing Basic Assessment, Environmental Impact Assessment and Water Use Authorisation processes and acting as an Environmental Control Officer (ECO) in the renewable energy, residential, aquaculture, marine and mining sectors. She also manages and contributes to Visual Impact Assessments for infrastructure, renewable energy and mining projects. Kelly holds a BSocSc (Hons) in Environmental and Geographical Studies from the University of Cape Town.

Statement of SRK Independence

Neither SRK nor any of the authors of this report have any material present or contingent interest in the outcome of this assessment, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK. SRK has no beneficial interest in the outcome of the assessment capable to affect its independence.

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Acronyms and Abbreviations

amsl	Above Mean Sea Level
BA	Basic Assessment
BESS	Battery Energy Storage System
DEA&DP	Department of Environmental Affairs and Development Planning
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESG	Environmental, Social and Governance
Mainstream	Mainstream Renewable Power Developments South Africa (Pty) Ltd
MTS	Main Transmission Station
NEMA	National Environmental Management Act 107 of 1998
OP	Observation Points
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
SRK	SRK Consulting (South Africa) (Pty) Ltd
ToR	Terms of Reference
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment

Useful Definitions

This list contains definitions of symbols, units, abbreviations, and terminology that may be unfamiliar to the reader.

After-image	Visual illusion that refers to an image continuing to appear after exposure to the original image as ceased.
Azimuth Angle	Direction (in degrees) measures clockwise from true north.
Glint	A momentary flash of bright light caused by a reflection of light off a surface.
Glare	A continuous source of bright light.
Landscape Integrity	The compatibility of the development/visual intrusion with the existing landscape.
Sense of Place	The identity of a place related to uniqueness and/or distinctiveness. Sometimes referred to as genius loci meaning 'spirit of the place'.
Shadow Flicker	Sunlight flickering effect caused when rotating wind turbine blades periodically cast shadows over small openings such as windows.
Viewshed	The topographically defined area from which the project could be visible.
Visibility	The area from which the project components would actually be visible and which depends upon topography, vegetation cover, built structures and distance.
Visual Absorption Capacity	The potential for the area to conceal the proposed development.
Visual Character	The elements that make up the landscape including geology, vegetation and land-use of the area.
Visual Exposure	The zone of visual influence or viewshed. Visual exposure tends to diminish exponentially with distance.
Visual Impact	A change to the existing visual, aesthetic or scenic environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.
Visual Intrusion	The effect of the artificial insertion (construction) of an object on the visual quality of the environment resulting in its compatibility (absorbed into the landscape elements) or discord (contrasts with the landscape elements) with the landscape and surrounding land uses.
Visual Obtrusion (or Obstruction)	The effect of the artificial insertion (construction) of an object into a landscape, typically blocking and/or foreshortening views.
Visual Quality	The experience of the environment with its particular natural and cultural attributes.
Visual Receptors	Potential viewers (individuals or communities) who are subjected to the visual influence of a project.

1 Introduction

1.1 Background

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) propose to construct and operate nine Photovoltaic (PV) Facilities with maximum nameplate capacity of up to 150 MW, each with an on-site substation (IPP-Portion), battery energy storage systems (BESS) and associated infrastructure. The nine PV Facilities, grid connections and associated infrastructure (referred to as “projects”) are located on seven farms and are collectively referred to as the Stilfontein PV Cluster, with a total footprint of ~2 737 ha, extending ~7 km from north to south and ~5.5 km from west to east (see Figure 1-1).

In addition, each PV Facility will be connected to an on-site substation (Eskom-Portion). From the on-site substation (Eskom-Portion) the grid connection will route to the proposed Main Transmission Substation (MTS) which will step up the power from 132 kV to 400 kV. The MTS will be connected to the existing 400 kV powerlines on the project site. Each PV Facility and the grid connections will all be submitted as **separate environmental authorisation applications (i.e. there will be 19 separate applications**[1]**).**

The Stilfontein PV Cluster is located ~25 km south-west of Potchefstroom and ~6 km north-east of Stilfontein, in North West Province and within the Klerksdorp Renewable Energy Development Zone (REDZ).

SRK Consulting (South Africa) (Pty) Ltd (SRK) has been appointed by Mainstream to conduct 19 Basic Assessment (BA) processes for individual projects within the Stilfontein PV Cluster required in terms of the National Environmental Management Act 107 of 1998 (NEMA) and the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended).

A Visual Impact Assessment (VIA) of each project within the Stilfontein PV Cluster is one of the specialist studies commissioned for each BA process. The VIA describes the visual baseline and rates the significance of visual and sense of place impacts, utilising the standard impact rating methodology, prescribed in the Terms of Reference (ToR). **This VIA relates to the Shrike PV Facility (**Figure 1-2**).**

1.2 Terms of Reference

The primary aims of the study are to describe the visual baseline, assess the visual (including glint and glare) impacts of the project and identify effective and practicable mitigation measures. More specifically, the ToR for the study are as follows:

- Describe the baseline visual characteristics of the study area, including landform, visual character and sense of place, and place this in a regional context;
- Identify potential impacts of the project on the visual environment through analysis and synthesis of the following factors:
  - Visual exposure;
  - Visual absorption capacity;
  - Sensitivity of viewers (visual receptors);
  - Viewing distance and visibility;
  - Landscape integrity; and

[1] Nine PV Facility, nine Electrical Grid Infrastructure and one MTS.

- Solar radiation.

- Model glare generated by the proposed PV arrays;
- Assess potential visual and sense of place impacts of the project using SRK's impact assessment methodology (see Appendix C);
- Identify and assess the direct, indirect and cumulative impacts (pre- and post-mitigation) of the proposed project (and alternatives, if applicable) on visual resources in relation to other proposed and existing developments in the surrounding area; and
- Recommend practicable mitigation measures to avoid and/or minimise impacts and/or optimise benefits.

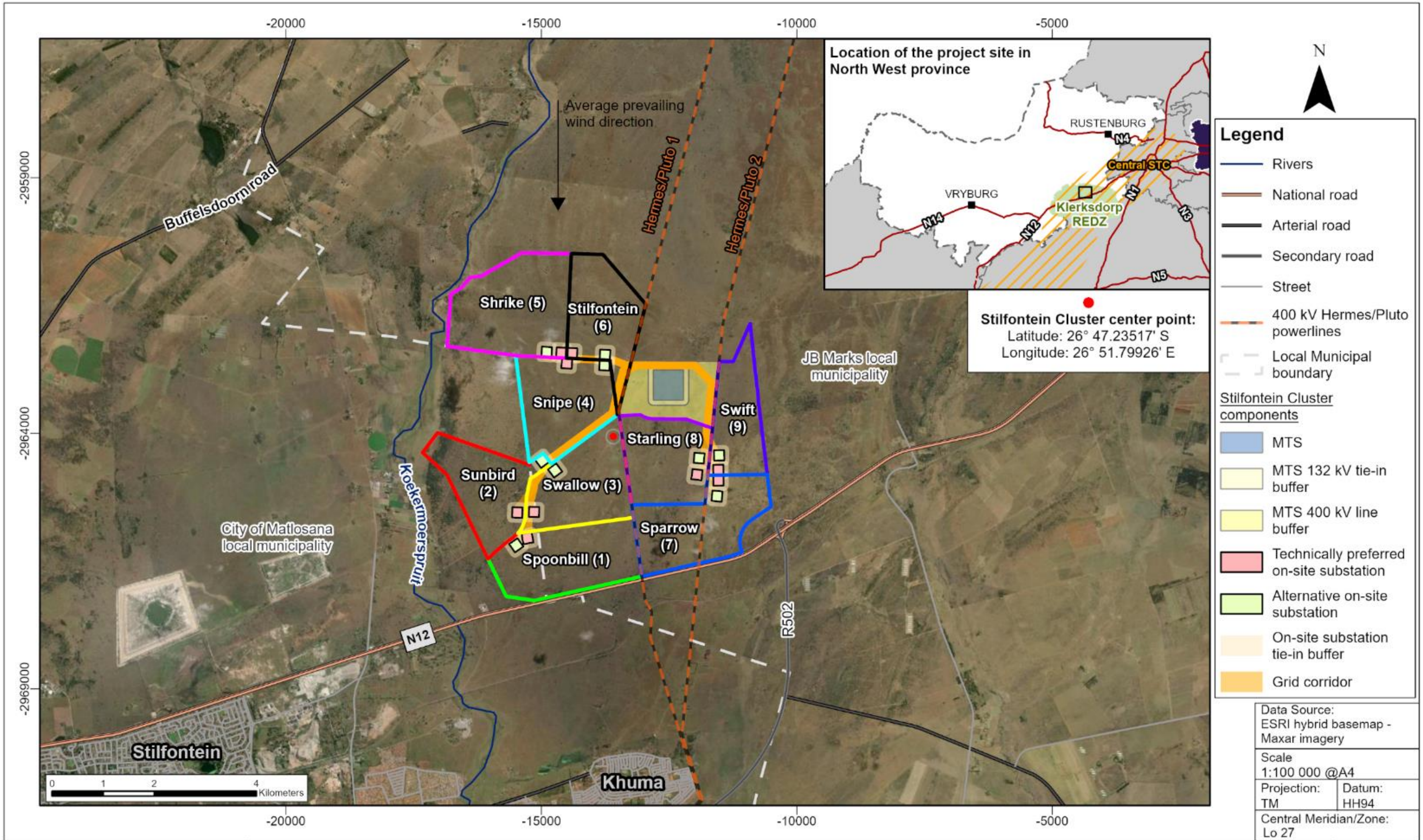
1.3 Content of the Report

The EIA Regulations, 2014 (R982 of 2014, as amended by R326 of 2017 and R517 of 2021), prescribe the required content of a specialist report prepared in terms of the EIA Regulations, 2014 (as amended). These requirements, and the sections of this VIA in which they are addressed, are summarised in Table 1-1.

Table 1-1: Required content of a specialist report

App 6	Item	Section
(a) (i)	Details of the specialist who prepared the report;	Page 3
(a) (ii)	Expertise of that specialist to compile a specialist report, including a curriculum vitae,	Page 3, Appendix A
(b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B
(c)	An indication of the scope of, and the purpose for which, the report was prepared;	1.2
(cA)	An indication of the quality and age of base data used for the specialist report;	2.4, 2.5
(cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	6
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	2.4
(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	2
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	5, 6
(g)	An identification of any areas to be avoided, including buffers;	5.7
(h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A (see above)
(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	2.5
(j)	A description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	6, 7
(k)	Any mitigation measures for inclusion in the EMPr;	6
(l)	Any conditions for inclusion in the environmental authorisation;	6
(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	6
(n) (i)	A reasoned opinion whether the proposed activity or portions thereof should be authorised;	7.2

App 6	Item	Section
(n) (iA)	A reasoned opinion regarding the acceptability of the proposed activity or activities;	7.2
(n) (ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	7
(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	None undertaken by the specialist
(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A (see above)
(q)	Any other information requested by the competent authority.	None was requested



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Date: 10/01/2023	Compiled by: BRCH
Project No. 581877	Fig No. 1-1

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STILFONTEIN PV CLUSTER VIA
LOCALITY MAP

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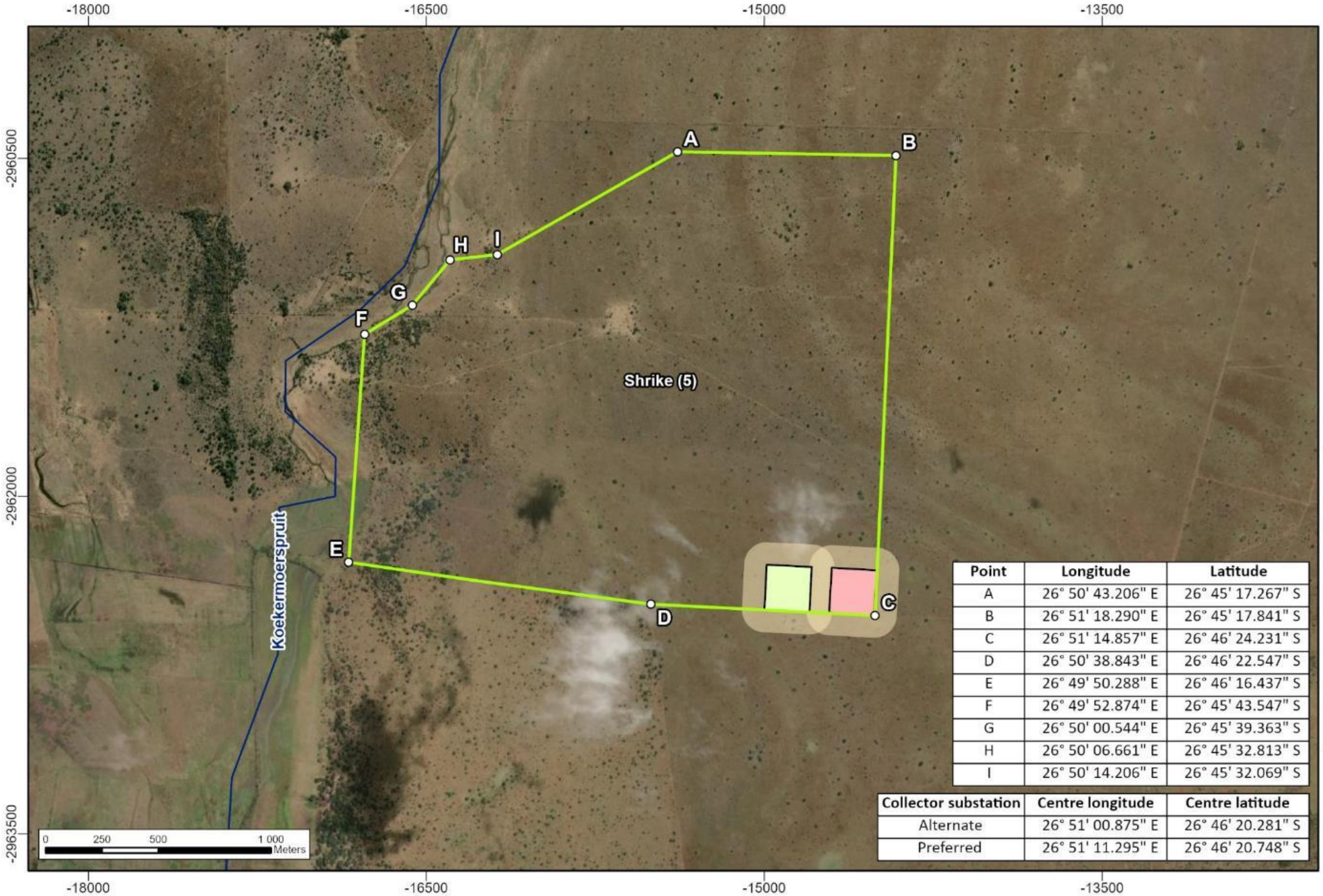
Revision: A Date: 14 02 2023



Point	Longitude	Latitude
A	26° 50' 43.206" E	26° 45' 17.267" S
B	26° 51' 18.290" E	26° 45' 17.841" S
C	26° 51' 14.857" E	26° 46' 24.231" S
D	26° 50' 38.843" E	26° 46' 22.547" S
E	26° 49' 50.288" E	26° 46' 16.437" S
F	26° 49' 52.874" E	26° 45' 43.547" S
G	26° 50' 00.544" E	26° 45' 39.363" S
H	26° 50' 06.661" E	26° 45' 32.813" S
I	26° 50' 14.206" E	26° 45' 32.069" S

Collector substation	Centre longitude	Centre latitude
Alternate	26° 51' 00.875" E	26° 46' 20.281" S
Preferred	26° 51' 11.295" E	26° 46' 20.748" S

Legend

- Boundary points
- Rivers

Project components

- Technically preferred on-site substation
- Alternative on-site substation
- On-site substation tie-in buffer
- Boundary fence

Data Source: ESRI hybrid basemap - Maxar imagery

Scale: 1:25 000 @A4

Projection: TM | Datum: HH94

Central Meridian/Zone: Lo 27

Date: 09/01/2023 | Compiled by: BRCH

Project No. 581877 | Fig No. 1-2

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STILFONTEIN PV CLUSTER BAs

SHRIKE PV PROJECT LAYOUT

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Revision: A Date: 13 02 2023

2 Methodology

Visual impacts are a function of the physical transformation of a landscape on account of the introduced object, and the experiential perceptions of viewers.

Given the subjective nature of visual issues, assessing the visual impacts of a project in absolute and objective terms is not achievable. Thus, qualitative as well as quantitative techniques are required.

In this VIA, emphasis has therefore been placed on ensuring that the methodology and rating criteria are clearly stated and transparent. The focus of the study is to determine the character and sensitivity of the visual environment, identify visual receptors and viewing corridors, model glare potential and identify and assess potential visual (including glint and glare) impacts and mitigation measures. Glint and glare are defined as follows:

- Glint: A momentary flash of bright light caused by a reflection of light off a surface; and
- Glare: A continuous source of bright light.

Glint cannot be meaningfully modelled but is described should it occur. Glare is the more likely and, arguably, more pertinent impact. Impact assessment ratings are motivated and, where possible, assessed against explicitly stated and objective criteria.

2.1 Guidelines

Relevant guidelines that provide direction for visual assessment include the Department of Environmental Affairs and Development Planning's (DEA&DP) "Guideline for Involving Visual and Aesthetic Specialists in EIA Processes" (DEA&DP, 2005), the Landscape Institute's "Guidelines for Landscape and Visual Impact Assessments" (2013), and Pager Power's "Solar Photovoltaic Development – Glint and Glare Guidance" (2018), which have been considered in this VIA.

DEA&DP's Guideline (2005) identifies typical components of a visual study:

- Identification of issues and values relating to visual, aesthetic and scenic resources through involvement of stakeholders;
- Identification of landscape types, landscape character and sense of place, generally based on geology, landforms, vegetation cover and land use patterns;
- Identification of viewsheds, view catchment area and the zone of visual influence, generally based on topography;
- Identification of important viewpoints and view corridors within the affected environment, including sensitive receptors;
- Indication of distance radii from the proposed project to the various viewpoints and receptors;
- Determination of the visual absorption capacity (VAC) of the landscape, usually based on topography, vegetation cover or urban fabric in the area;
- Determination of the relative visibility, or visual intrusion, of the proposed project;
- Determination of the relative compatibility or conflict of the project with the surroundings; and
- A comparison of the existing situation with the probable effect of the proposed project.

Projects that warrant a visual specialist study include those:

- Located in a receiving environment with:

- Protection status, such as national parks or nature reserves;
- Proclaimed heritage sites or scenic routes;
- Intact wilderness qualities, or pristine ecosystems;
- Intact or outstanding rural or townscape qualities;
- A recognized special character or sense of place;
- Outside a defined urban edge line;
- Sites of cultural or religious significance;
- Important tourism or recreation value;
- Important vistas or scenic corridors;
- Visually prominent ridgelines or skylines; and/or

- Where the project is:
  - High intensity, including large-scale infrastructure;
  - A change in land use from the prevailing use;
  - In conflict with an adopted plan or vision;
  - A significant change to the fabric and character of the area;
  - A significant change to the townscape or streetscape;
  - A possible visual intrusion in the landscape; or
  - Obstructing views of others in the area.

In terms of the guideline, the proposed PV Facilities and associated infrastructure can be classified as a Category 4 development, which includes medium-scale development generally 1 to 3-storey structures and usually more than 25% of the area retained as green open space. As the project is situated within an area of medium scenic, cultural, historical significance, with a number of Nature Reserves and tourist attractions within the region (Wikipedia, 2022) a high visual impact is expected (see Table 2-1), which introduces:

- Potential effects on protected landscapes and/or scenic resources;
- Some change in the visual character of the area; and
- New development or adds to existing development in the area.

Such a project typically warrants a Level 3 assessment (see Table 2-2), which includes the following generic steps:

- Identification of issues and site visit;
- Description of receiving environment and proposed project;
- Establishment of view catchment area, view corridors, viewpoints and receptors;
- Indication of potential visual impacts using established criteria;
- Inclusion of potential lighting impacts at night; and
- Description of alternatives, mitigation measures and monitoring programmes.

Table 2-1: Expected visual impact significance

Type of environment	Type of development				
	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5
Protected / wild areas	Moderate	High	High	Very high	Very high
High scenic, cultural, historical value	Minimal	Moderate	High	High	Very high
Medium scenic, cultural, historical value	Little or none	Minimal	Moderate	**High**	High
Low scenic, cultural, historical value / disturbed	Little or none Possible benefits	Little or none	Minimal	Moderate	High
Disturbed or degraded sites	Little or none Possible benefits	Little or none Possible benefits	Little or none	Minimal	Moderate

Table 2-2: Recommended approach for visual assessment

Approach	Type of issue expected				
	Little or no visual impact	Minimal visual impact	Moderate visual impact	High visual impact	Very high visual impact
Level of visual impact recommended	Level 1 visual input	Level 2 visual input	Level 3 visual assessment	Level 4 visual assessment	

Glint and glare (also referred to as solar reflection) analyses are required for projects that may cause visual discomfort to surrounding receptors (particularly aviation activity, motorists and residents). A glint and glare analysis was conducted due to the project's proximity to the N12 motorway and some residences, and for the Klerksdorp Airport (see Figure 5-6).

PV panels vary in their reflectivity with none absorbing 100% of the incoming light, thus leading to solar reflection which may be experienced by receptors. Glint and/or glare can only be experienced by receptors with a direct line of sight to the PV array. Whether a receptor experiences glint or glare depends on the receptor's location and movement in relation to the PV panels.

Several countries, including South Africa, require Glint and Glare Impact Assessments for certain projects, *inter alia*, PV projects located in close proximity to aircraft approach and take-off centrelines, an aerodrome or helistop[2]. However, no content requirements or associated guidelines have been released by the authorities.

Pager Power's "Solar Photovoltaic Development – Glint and Glare Guidance" (2018) considered and is based on a suite of international planning and aviation guidelines related to glint and glare originating specifically from PV projects. In the absence of established international glare thresholds (for solar), Pager Power considered the threshold durations of shadow flicker (from wind turbines) beyond which mitigation is required in some European countries. The threshold is 30 minutes per day or more and more than 30 hours per year within 500 m of the turbine. Considering, *inter alia*, that shadow flicker inherently flickers at a third of the frequency of the rotating blades (assuming three blades), the recommended threshold for glint and glare (which is continuous) beyond

[2] South African Civil Aviation Authority Obstacle Notice 3/2020: Additional Requirements for Solar Project Applications.

which mitigation is required, is 60 minutes per day, for three or more months of the year (see Section 5.6.1) (Pager Power, 2018).

In the absence of other authoritiative regulatory guidelines, the Pager Power Guideline has been used for the Glint and Glare analysis in this VIA.

2.2 Approach

The approach adopted for the VIA is intended to be as accurate and thorough as possible. Analytical techniques are selected to endorse the reliability and credibility of the assessment.

The approach to and reporting of the VIA study comprises three major, phased elements (as summarised in Figure 2-1 below):

- Description of the visual context;
- Identification and discussion of the potential visual (including glint and glare) impacts; and
- Assessment of those potential impacts.

Visual impacts are assessed as one of many interrelated effects on people (i.e. the viewers and the impact of an introduced object into a particular view or scene) (Young, 2000). In order to assess the visual impact the project has on the affected environment, the visual context (baseline) in which the project is located must be described. The inherent value of the visual landscape to viewers is informed by geology / topography, vegetation and land-use, and is expressed *as Visual Character* (overall impression of the landscape), *Visual Quality* (how the landscape is experienced) and *Sense of Place* (uniqueness and identity).

Visual impact is measured as the change to the existing visual environment caused by the project as perceived by the viewers (Young, 2000). The visual impact(s) may be negative, positive or neutral (i.e. the visual quality is maintained). The magnitude or intensity of the visual impacts is determined through analysis and synthesis of the VAC of the landscape (potential of the landscape to absorb the project), zone of visual influence or exposure, visibility (viewing distances), compatibility of the project with landscape integrity (congruence), the sensitivity of the viewers (receptors) and the duration and intensity of glare.

Sources of visual impacts are identified for the construction and operational phases of the project. The significance of those visual impacts is then assessed using the prescribed impact rating methodology, which includes the rating of:

- Impact consequence, determined by extent, duration and magnitude/intensity of impact (see above);
- Impact probability;
- Impact significance, determined by combining the ratings for consequence and probability; and
- Confidence in the significance rating.

The significance rating methodology is described in more detail in Appendix C.

Mitigation measures recommended to avoid and/or reduce the significance of negative impacts, or to optimise positive impacts, are identified for the project. Impact significance is re-assessed assuming the effective implementation of mitigation measures.

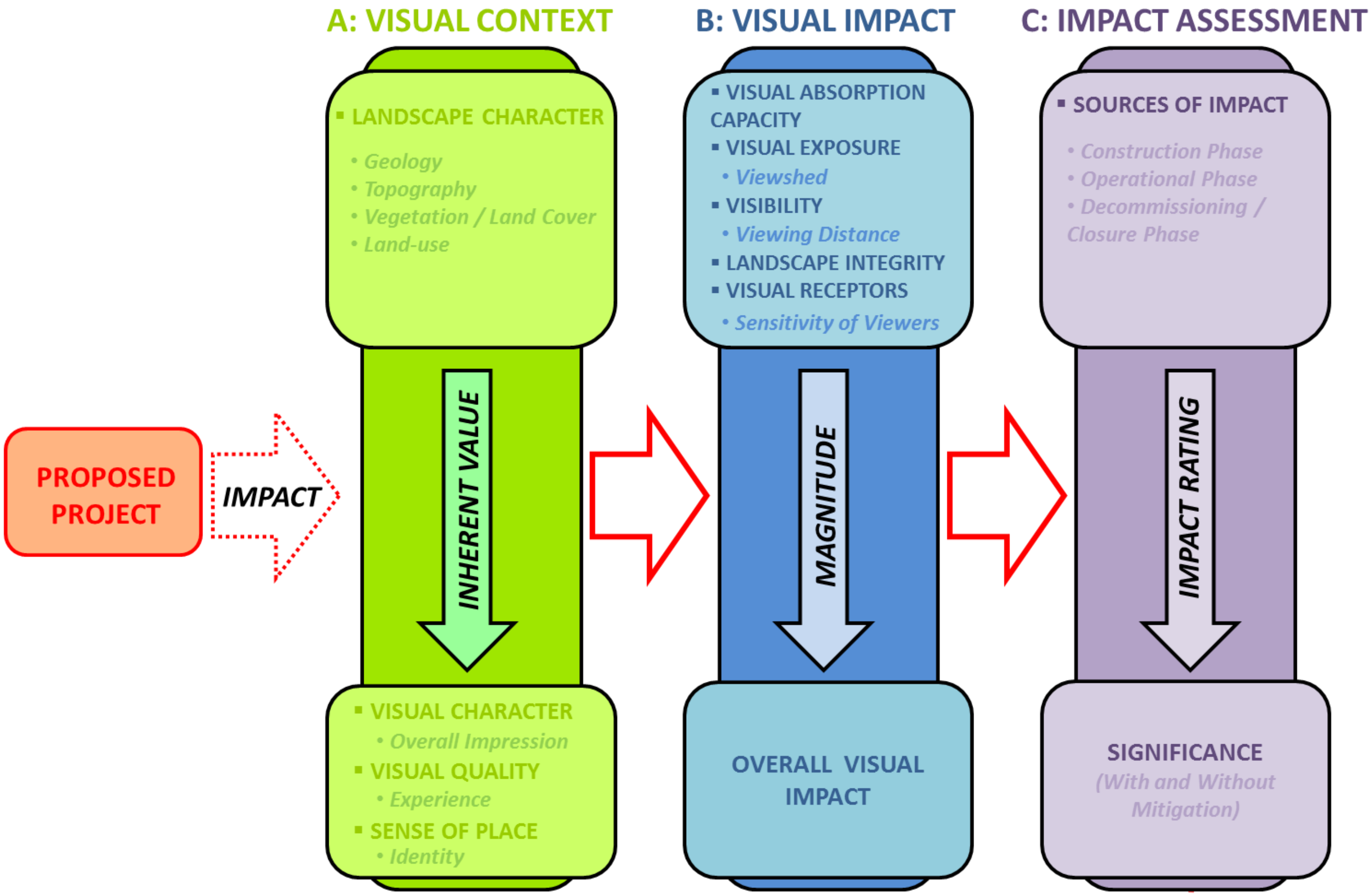


Figure 2-1: Approach to and method for the VIA

2.3 Method

The following method was used to assess the visual context (baseline) for the project:

1. Describe the project using information supplied by the proponent and BA team;
2. Collect and review visual data, including data on topography, vegetation cover, land-use and other background information;
3. Undertake fieldwork, comprising a reconnaissance of the study area, particularly the project site and key viewpoints. The objectives of the fieldwork were to:
   - Familiarise the specialist with the site and its surroundings;
   - Identify key viewpoints / corridors; and
   - Determine and groundtruth the existing visual character and quality in order to understand the sensitivity of the landscape.

   Visual 'sampling' using photography was undertaken to illustrate the likely zone of influence and visibility. The location of the viewpoints was recorded with a GPS.
4. Undertake a mapping exercise to define the visual character of the study area; and
5. Identify sensitive receptors.

The following method was used to assess the visual impact of the project:

1. Determine the visual zone of influence or exposure by superimposing the proposed upgrades on aerial imagery, and verified during the site visit;
2. Make field observations at key viewpoints to determine the likely distance at which visual impacts will become indistinguishable;
3. Conduct glare modelling to identify the potential glint and duration of glare from the PV panels experienced by receptors, if any;
4. Rate impacts on the visual environment and sense of place based on a professional opinion and the prescribed impact rating methodology;
5. Recommend practicable mitigation measures to avoid and/or minimise impacts; and
6. Provide environmental management measures to be included in the Environmental Management Programme for the project (EMPr).

2.3.1 Glare Analysis Methodology

Glare can be modelled geometrically to accurately predict whether reflection will be experienced by receptors using the following parameters:

- The earth's orbit around the sun;
- The earth's rotation and orientation;
- The location of the PV array;
- The orientation of the PV panels and the azimuth angle[3]; and
- Local topography including (comparative) receptor and PV array heights above mean sea level (amsl).

[3] Direction (in degrees) measures clockwise from true north.

The glare model provides a quantified assessment of:

- When and where glare will occur throughout the year for a prescribed PV installation; and
- Intensity of the effects on the human eye at those locations where glare occurs.

ForgeSolar's GlareGauge modelling software was used to model the anticipated intensity and duration of glare from the PV array. The results of the glare analysis are detailed in Section **Error! Reference source not found.**.

2.4 Site Visit and Data Acquisition

A site visit was undertaken on 2 February 2022. The duration and timing of the site visit were adequate to provide the specialist with a representative impression of the site and surroundings.

The following additional information sources were used:

- Maps indicating the location and layout of the project;
- Topographic data, including spatial files with 5 m contours obtained from the Department of Rural Development and Land Reform;
- Biodiversity data from SANBI Biodiversity GIS;
- Aerial images; and
- Other available data on geology, vegetation, land use, receptors, glare etc.

The information is sufficiently recent and detailed to provide appropriate inputs into the VIA.

2.5 Assumptions and Limitations

As is standard practice, the VIA is based on a number of assumptions and is subject to certain limitations, which should be borne in mind when considering information presented in this report. These assumptions and limitations include:

- VIA is not, by nature, a purely objective, quantitative process, and depends to some extent on subjective judgments. Where subjective judgments are required, appropriate criteria and motivations for these have been clearly stated;
- The study is based on technical information supplied to SRK, which is assumed to be accurate. This includes the proposed locations, dimensions and layouts of the project components;
- The glare analysis does not account for smaller physical obstructions between the PV panels and the receptors (e.g. buildings or tree cover);
- The glare analysis assumes clear, sunny skies year-round;
- The PV array tracking model assumes the modules move instantly when tracking the sun, and when reverting to the rest position of 0°;
- The study area is defined as the area within a 5 km radius of the site, as the visual impact beyond this distance is considered negligible due to the low vertical profile/dimensions of PV arrays which serve to limit visibility; and
- This study does not provide motivation for or against the project, but rather seeks to give insight into the visual character and quality of the area, its VAC and the potential visual (including glint and glare) impacts of the project.

The findings of the VIA are not expected to be affected by these assumptions and limitations.

3 Project Description and No Go Alternative

Mainstream proposes the construction and operation of the Shrike PV Facility PV Facility (Shrike) with up to 150 MW generation capacity, including grid connections, BESS and associated infrastructure ("the project"). The Shrike facility is located in the Dr Kenneth Kaunda District Municipality in the North West Province. The project site is located approximately 13 km east of the town of Stilfontein along the N12 and forms part of the larger proposed Stilfontein PV Cluster.

3.1 Stilfontein PV Cluster Overview

The project forms part of the larger proposed Stilfontein PV Cluster, which comprises up to nine 150 MW PV facilities, including grid connections, BESS and associated infrastructure. ***Separate EA applications will be submitted for the individual PV facilities and grid connections through separate BA processes*** (see Figure 3-1). The Stilfontein Cluster is briefly described here.

The Stilfontein Cluster is entirely located within the Klerksdorp REDZ and the Central Strategic Transmission Corridor (STC) (see Figure 1-1). Individual PV facilities will be submitted as part of the REIPPPP bidding process. At this stage it is not known which facilities (projects) may be awarded preferred bidder status, and thus which portion of the Stilfontein Cluster will be developed.

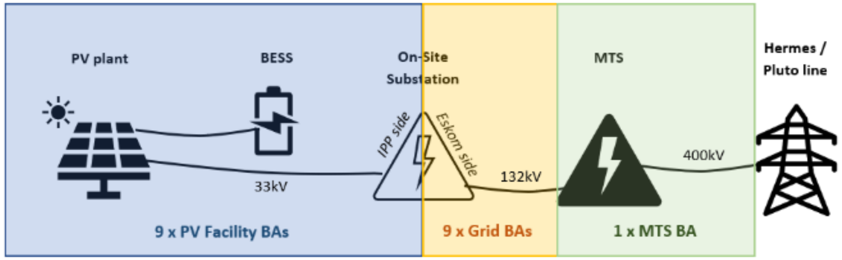


Figure 3-1: Components included in the individual BA processes for the Stilfontein Cluster

3.2 Shrike PV Project Description

This section provides a summary of the proposed project and focuses on elements that are relevant to the VIA. A more detailed project description is provided in the BA Reports for the project.

Mainstream proposes to develop the Stilfontein PV Cluster, comprising nine facilities each generating up to 150 MW PV Facilities, including associated infrastructure. The Cluster will have a combined development footprint of 2 737 ha (Figure 1-1).

The project comprises the following key components:

- PV single axis tracking arrays with a maximum export capacity of up to150 MW and a maximum height of 5 m. Panel technology will be either monofacial or bifacial;
- Internal gravel roads with a maximum width of up to 12 m;
- Power transformers;
- Fencing and lighting;
- Material laydown areas;
- Stormwater infrastructure;

- Water supply and water storage infrastructure;
- Offices, including ablutions with septic / conservancy tank sewage treatment infrastructure;
- Operational control centre and maintenance area;
- Lithium-Ion BESS;
- IPP-portion of the 11-33/132kV on-site substation, each serving one PV facility. The proposed step-up substation facility will have a development footprint of up to 4 ha, with a 100 m wide buffer around each on-site substation to accommodate powerline tie-ins at any point of the substation and other associated activities. Two alternative locations are identified for each substation; and
- Medium voltage 11-33kV underground cabling and / or overhead power lines between the PV facilities and on-site substation

3.3 Project Alternatives

3.3.1 Location Alternatives

PV Facilities

Mainstream conducted an internal constraint mapping exercise to identify the project buildable area for the Shrike PV facility (and the Stilfontein Cluster) which has the least environmental impact.

The identified available buildable area has been fully allocated to the nine proposed PV facilities and associated infrastructure that comprise the Stilfontein Cluster (see Figure 1-1). As such, no alternative sites are being assessed for the Shrike PV facility.

On-Site Substation (IPP-Portion)

Two on-site substation location alternatives were identified per project along with a corresponding grid corridor.

The location of the Shrike Substation is broadly determined by the location of the PV facilities. The location of the on-site substation and corresponding powerline corridor was optimised to:

- Optimally serve the relevant PV facilities;
- Minimise the required length of powerlines;
- Provide adequate accessibility;
- Provide adequate space for other infrastructure; and
- Take account of topographical and environmental characteristics.

Two alternative on-site substation locations were identified per project. A technically preferred substation location was indicated for each project (Figure 1-1).

3.3.2 Activity Alternatives

The proposal is to generate renewable power as part of the REIPPPP. The project lies within the Klerksdorp REDZ which was specifically identified for the deployment of large-scale PV facilities. As such, there are no reasonable activity alternatives.

3.3.3 Technology Alternatives

Cell Technology

Different solar cell and panel technologies are being considered; these do not meaningfully affect the significance of visual impacts.

Panel Technology

Two panel technologies are considered; monofacial panels or bifacial panels. Bifacial panels are technically preferred as they have a:

- Higher yield per module area unit;
- Lower light-induced degradation;
- Longer operational lifetime; and
- Comparable cost.

Mounting Technology

Mainstream considered various mounting technologies during the pre-feasibility stage which are described in detail in the BA Report.

The PV panels will be mounted on single-axis tracking structures, with multiple rows of supporting structures installed on a north-south axis, and will have a maximum height of 5 m above ground.

BESS Technology

Mainstream considered various BESS technologies during the pre-feasibility stage which are described in detail in the BA Report.

Solid state lithium-ion batteries will be used. Solid state battery cells are integrated into battery modules and installed into racks, that are then installed into specifically prepared shipping containers to function as an integrated battery system. Containers will be placed on raised concrete plinths and may be stacked on top of each other to a maximum height of ~ 15 m. Each container has a footprint of ~ 60 m^2 and is ~ 4 m high. Each BESS will have a footprint of up to 10 ha.

3.3.4 No-Go Alternative

The No-Go alternative will be considered in the study in accordance with the requirements of the EIA Regulations, 2014 (as amended). The No-Go alternative implies that the project will not be implemented, visual impacts will not occur, and additional renewable electricity will not be generated by this project.

4 Visual Context (Affected Environment)

The following description of the affected environment focuses on the *Visual Character* of the area surrounding and including the project (the study area), and discusses the *Visual Quality* and *Sense of Place*[4]. This baseline information provides the context for the visual analysis.

4.1 Landscape Character

Landscape character is the description of the pattern of the landscape, resulting from particular combinations of natural (physical and biological) and cultural (land use) characteristics. It focuses on the inherent nature of the land rather than the response of a viewer (Young, 2000).

4.1.1 Geology and Topography

The geology and topography of the area, together with the temperate highveld climate, provide the framework for the basic landscape features and visual elements of the study area.

The project falls within the western portion of the highveld, the elevated inland plateau that comprises roughly 30% of South Africa's land area.

[4] These terms are explained in the relevant sections below.

The highveld terrain is generally devoid of mountains and consists primarily of rolling plains. This region experiences summer rainfall, with substantial afternoon thunderstorms and frost in winter.

The project site comprises seven relatively flat properties in a uniform environment, at an elevation of ~1 380 (above mean sea level [amsl]) (in the north), gently falling over ~ 7 km to ~1 340 amsl (near the N12) and dropping to 1 300 m amsl over ~12 km to the Vaal River, south of the project site. Gently undulating topography to the northeast and northwest of the sites rises to ~1 500 m amsl (Figure 4-3).

The expansive and somewhat unspectacular landscape is further characterised by tailings dams and overburden stockpiles to the southwest, ranging from ~15 m to ~30 m in height, evidence past and present mining activity in the surrounding area (Figure 4-1).

Figure 4-1: Tailings dams to the south of the PV Facilities (photo taken from the N12)

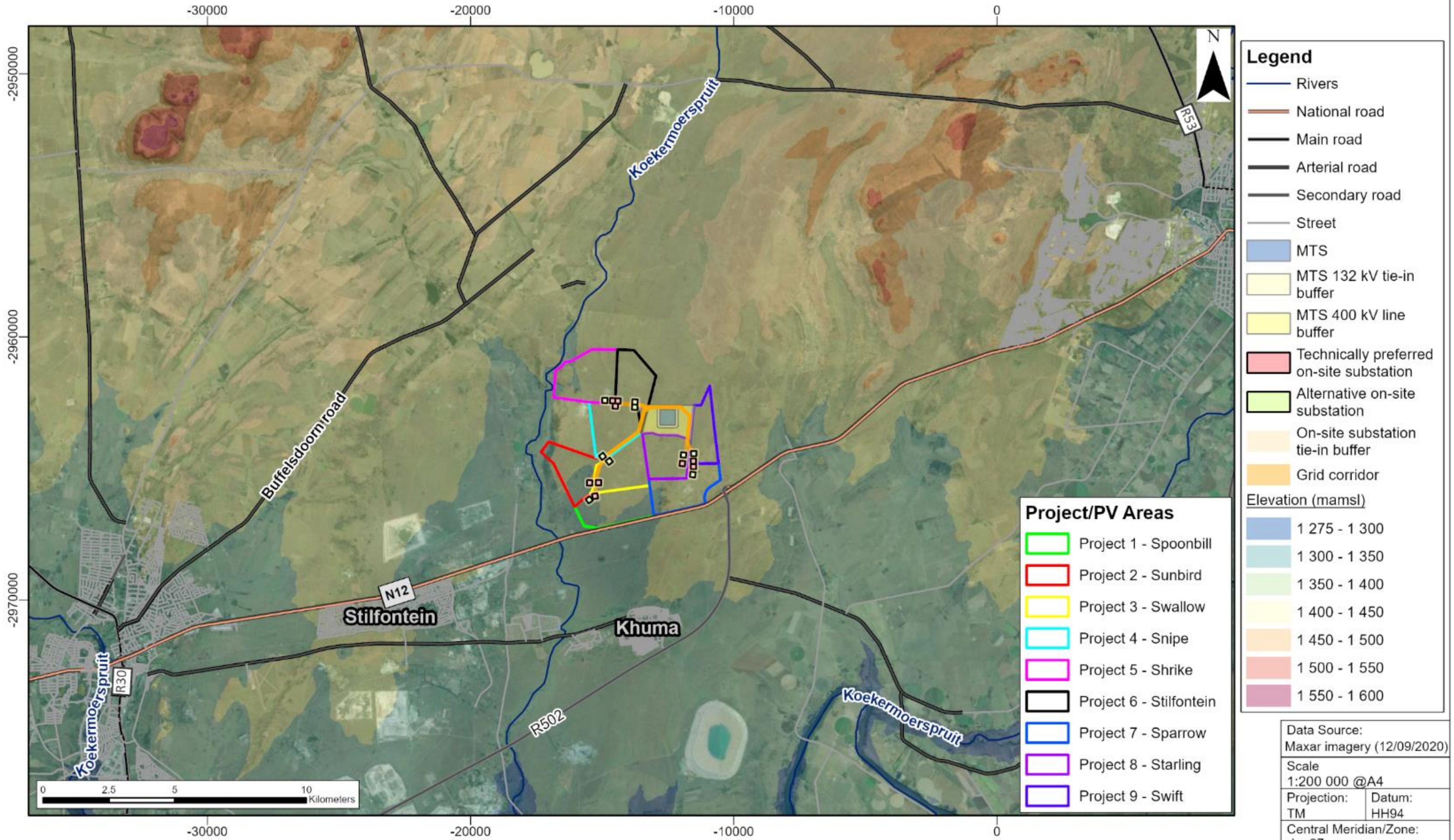
The project is underlain by dolomite and limestone of the Malmani Subgroup of the Chuniespoort Group. The Koekermoerspruit forms an informal boundary to the immediate west of the project site.

4.1.2 Vegetation

The project will be located across the Vaal Reefs Dolomite Sinkhole Woodland and Carlton Dolomite Grassland vegetation types of the Dry Highland Grassland Biome. The Dry Highland Grassland Biome occurs at mid-altitudes of 1 300 – 1 600 m amsl and undulating topography with small outcropping mountains and river valleys. The biome comprises grasses and low shrubby vegetation with small clusters of trees and bushes, reminiscent of African savannah landscapes (Figure 4-2). The proposed Highveld National Park is located ~13 km to the northeast of the Cluster site. The proposed Park would occupy ~ 10 200 ha and would cover ~0.3% of the endangered grassland biome, the vegetation type the Park aims to preserve (Daemane, Cilliers, & Bezuidenhout, 2010)[5].

Figure 4-2 : Vegetation type across the sites

[5] The National Park was proposed in 1984 (Daemane & Bezuidenhout, 2012), but the area has not and will not be declared a National Park (per comms. Bezuidenhout, 2023).



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Central Meridian/Zone: Lo 27	
Date: 22/03/2022	Compiled by: BRCH
Project No. 581877	Fig No. 4-3

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STILFONTEIN PV CLUSTER VIA
TOPOGRAPHIC MAP

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4.1.3 Land Use

The highveld is home to some of South Africa's most important commercial farming areas, as well as its largest concentration of metropolitan centres. Potchefstroom, ~ 25 km to the northeast of the site, is one of the largest urban centres in the North West Province with tertiary institutions, industry, services and agriculture being key economic sectors.

The area surrounding the site is predominantly characterised by agricultural and mining activities (tailings dam), urban development, infrastructure (roads and rail) and natural highveld grassland. Hartebeesfontein, Buffelsfontein and Stilfontein mines are located to the south of the site, while the mining towns of Klerksdorp, Stilfontein and Orkney, and the Khuma township are located to the southwest. Agriculture, mainly crop and cattle farming, is the predominant land use to the north, east and west of the sites. Farmsteads are dotted throughout the area, especially to the east and west. National, regional and provincial roads criss-cross the region. A railway line runs parallel to the N12 to the south of the site. The existing 400 kV Hermes/Pluto 1 and 2 powerlines traverse the site in a north-southerly direction (Figure 4-4).

Figure 4-4: Hermes/Pluto 400 kV powerline

In addition, land use in the surrounding the project area includes the following:

- Frontier Shooting Range;
- Frontier Metal Processing;
- Chubby Chick poultry farm;
- Club Louico; and
- Khora Lion Park.

The seven farms that constitute the Cluster site are undeveloped and used for agricultural purposes.

4.2 Visual Character

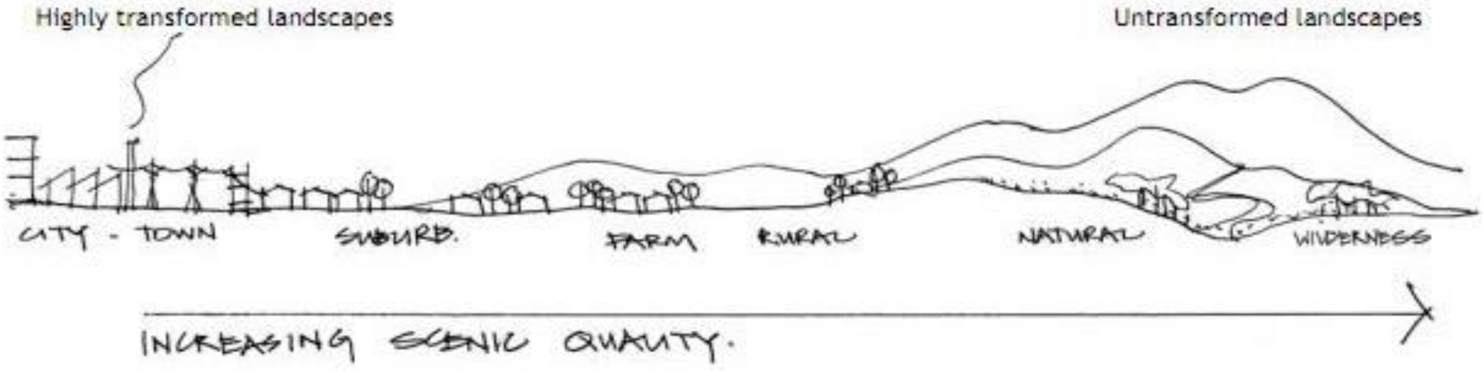
Visual character is descriptive and non-evaluative, which implies that it is based on defined attributes that are neither positive nor negative. It refers to the overall experience and impression of the landscape, such as natural or transformed.

A change in visual character cannot be described as having positive or negative attributes until the viewer's response to that change has been taken into consideration. The probable change caused by the project is assessed against the existing degree of change caused by previous development.

Typical character attributes, used to describe the visual character of the affected area and to give an indication of potential value to the viewer, are provided in Figure 4-5.

The basis for the visual character is provided by the topography, vegetation and land use of the area, which is predominantly a rural environment characterised by the undulating, vegetated landscape, albeit with large pockets of settlements and mining activity. Harsh, man-made structures and landforms introduced by mining dominate the landscape to the south-west of the sites. The rolling expanse of vegetated landscape to the north and east of the site further evokes the natural, rural environment. The project area can therefore be defined as a modified rural landscape as it is mostly rural but settlements, mining activities and busy roads and railway are visible in the landscape.

Highly Transformed Landscape – Urban/Industrial	Transition Landscape	Modified Rural Landscape	Natural Transition Landscape	Untransformed Landscape – Natural
Substantially developed landscape. High levels of visual impact associated with buildings, factories, roads and other related infrastructure (e.g. powerlines).	Transitional landscape associated with the interface between, rural, agricultural area and more developed suburban or urban zones.	Typical character is rural landscape, defined by field patterns, forestry plantations and agricultural areas and associated small-scale roads and buildings.	A changing landscape character associated with the interface between natural areas and modified rural / pastoral or agricultural zones.	No / minimal impact associated with the actions of man. National parks, coastlines, pristine forest areas.



Source: (CNDV, 2006)

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Figure 4-5: Typical visual character attributes

4.3 Visual Quality

Aesthetic value is an emotional response derived from our experience and perceptions. As such, it is subjective and difficult to quantify in absolute terms. Studies in perceptual psychology have shown that humans prefer landscapes with higher complexity (Crawford, 1994). Landscape quality can be said to increase when:

- Topographic ruggedness and relative relief increases;
- Water forms are present;
- Diverse patterns of grasslands, shrubs and trees occur;
- Natural landscape increases and man-made landscape decreases; and
- Where land use compatibility increases.

The visual quality of the area is largely experienced through rolling views of the undulating landscape, especially from and across the site (Figure 4-6).

The visual quality of the study area is defined by the fabric of developed settlements and infrastructure surrounded by agricultural and mining activity. The naturally undulating landscape is interrupted by exposed, unvegetated tailings dams and overburden stockpiles which detract from the visual quality of the surrounding area. Streams and rivers add to visual quality.

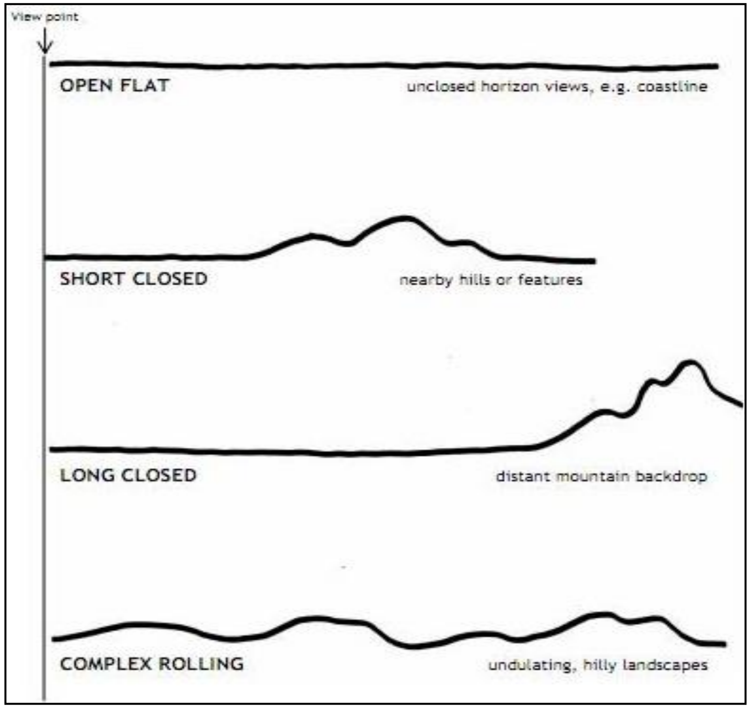


Figure 4-6: Typical views in the landscape

Sources: CNDV (2006)

4.4 Visual Receptors

The Stilfontein Cluster is located across seven farms that neighbour farms to the north, east and west, and abut the N12 national highway to the south (Figure 1-1). Beyond the N12 to the southeast is the town of Stilfontein and various industrial and mining areas.

Visual receptors have been identified based on surrounding land uses. The visual receptors are briefly described below and linked to viewpoints (VP) indicated in **Error! Reference source not found.**:

- **Residents** (VP2 – VP3, VP6 – VP8, VP11 – VP13): The residential areas of Stilfontein and Khuma are located to the southwest of the PV Facilities. Isolated farmsteads are interspersed throughout the area surrounding the PV Facilities in all directions, but especially to the east and west.
- **Recreational** (VP8 - VP10): The Frontier Shooting Range (VP 8), Camp Louico (VP9) and Khora Lion Park (VP10) are located to the west of the sites.
- **Motorists** (VP1 - VP5, VP7 – VP8, VP15 – VP18): Three roads are located in close proximity, to the east, south and west of the sites. To the east is an unnamed street (hereafter referred to as Road East). The N12 national dual-carriage way is situated to the south of the site. Vermaasdrift Road extends north - south, to the west of the project site.

Landowners and occupiers (tenants) of the seven farms are considered as receptors; however, they have reached a negotiated agreement with Mainstream and will receive financial renumeration in compensation for development on their properties. As such, they are not deemed to be sensitive receptors.

4.5 Sense of Place

Our sense of a place depends not only on spatial form and quality, but also on culture, temperament, status, experience and the current purpose of the observer (Lynch, 1992). Central to the idea of 'sense of place' or Genius Loci is identity. An area will have a stronger sense of place if it can easily be identified with, that is to say if it is unique and distinct from other places. Lynch defines 'sense of place' as "the extent to which a person can recognise or recall a place as being distinct from other places – as having a vivid or unique, or at least a particular, character of its own" (Lynch, 1992).

It is often the case that sense of place is linked directly to visual quality and that areas / spaces with high visual quality have a strong sense of place. However, this is not an inviolate relationship, and it is plausible that areas of low visual quality may have a strong sense of place or – more commonly – that areas of high visual quality have a weak sense of place. The defining feature of sense of place is uniqueness, generally real or biophysical (e.g. trees in an otherwise treeless expanse), but sometimes perceived (e.g. visible but unspectacular sacred sites and places which evoke defined responses in receptors). In this context Cross (2001) identified six categories of relationships with place: biographical, spiritual, ideological, narrative, cognitive and dependent (Table 4-1).

The region has scenic value in terms of its undulating natural landscape and views over large portions of agricultural land and – within the project site – fairly pristine if undramatic grasslands and treescapes, reminiscent of African savannah landscapes. The natural landscape and rustic character contrast with evidence of anthropogenic influence in the region, *viz*. mining, dense urban fabric and industry. To the north of the project site, visual-spatial quality is informed by the rural character of the area (farmsteads, smallholdings, rolling hills), while to the south it informed by industrial and peri-urban textures (residential areas, mines and industrial areas).

Table 4-1: Relationship to place

Type of Relationship	Process
Biographical (historical and familial)	Being born in and living in a place. Develops over time
Spiritual (emotional, intangible)	Feeling a sense of belonging
Ideological (moral and ethical)	Living according to moral guidelines for human responsibility to place Guidelines may be religious or secular

Type of Relationship	Process
Narrative (mythical)	Learning about a place through stories, family histories, political accounts and fictional accounts
Cognitive (based on choice and desirability)	Choosing a place based on a list of desirable traits and lifestyle preferences
Dependent (material)	Constrained by lack of choice, dependency on another person or economic opportunity

Sources: Adapted from Cross (2001)

The sense of place of the surrounding area is strongly influenced by the surrounding land use, which can generally be described as a rural mining area.

The relationship of receptors in the study area (Section 4.4) to place may be predominantly biographical and dependent. A family, for example, who has lived or worked in Klerksdorp or Stilfontein for a few generations will have a biographical and dependent attachment to the area.

5 Analysis of the Magnitude of the Visual Impact

The following section outlines the analysis that was undertaken to determine the **magnitude or intensity** of the overall visual impact resulting from the project. Various factors were considered in the assessment, including:

- Visual exposure;
- Visual absorption capacity;
- Sensitivity of visual receptors;
- Visibility and viewing distance;
- Integrity with existing landscape / townscape; and
- Glare analysis.

The analysis of the magnitude or intensity of the visual impact, as described in this section, is summarized and integrated in Table 5-8 and forms the basis for the assessment and rating of the impact as documented in Section 6.

5.1 Visual Exposure

Visual exposure is determined by the zone of visual influence or viewshed. The viewshed is the topographically defined area that includes all the major observation sites from which the project *could* be visible. The viewshed analysis assumes maximum visibility of the project, or part thereof, in an environment stripped bare of vegetation and structures. The viewshed indicates the visibility of the project accounting for the decrease in visibility as distance from the project increases (Figure 5-1).

It is anticipated that visibility of the combined Stilfontein Cluster with a footprint of 2 114 ha – if all projects are developed – will be high within the project area, and to receptors immediately south of the project site beyond the N12, as well as those to the immediate southwest and northwest of the sites (Figure 5-1). The project will be marginally visible in the background to receptors approximately 3 – 5 km from the project site.

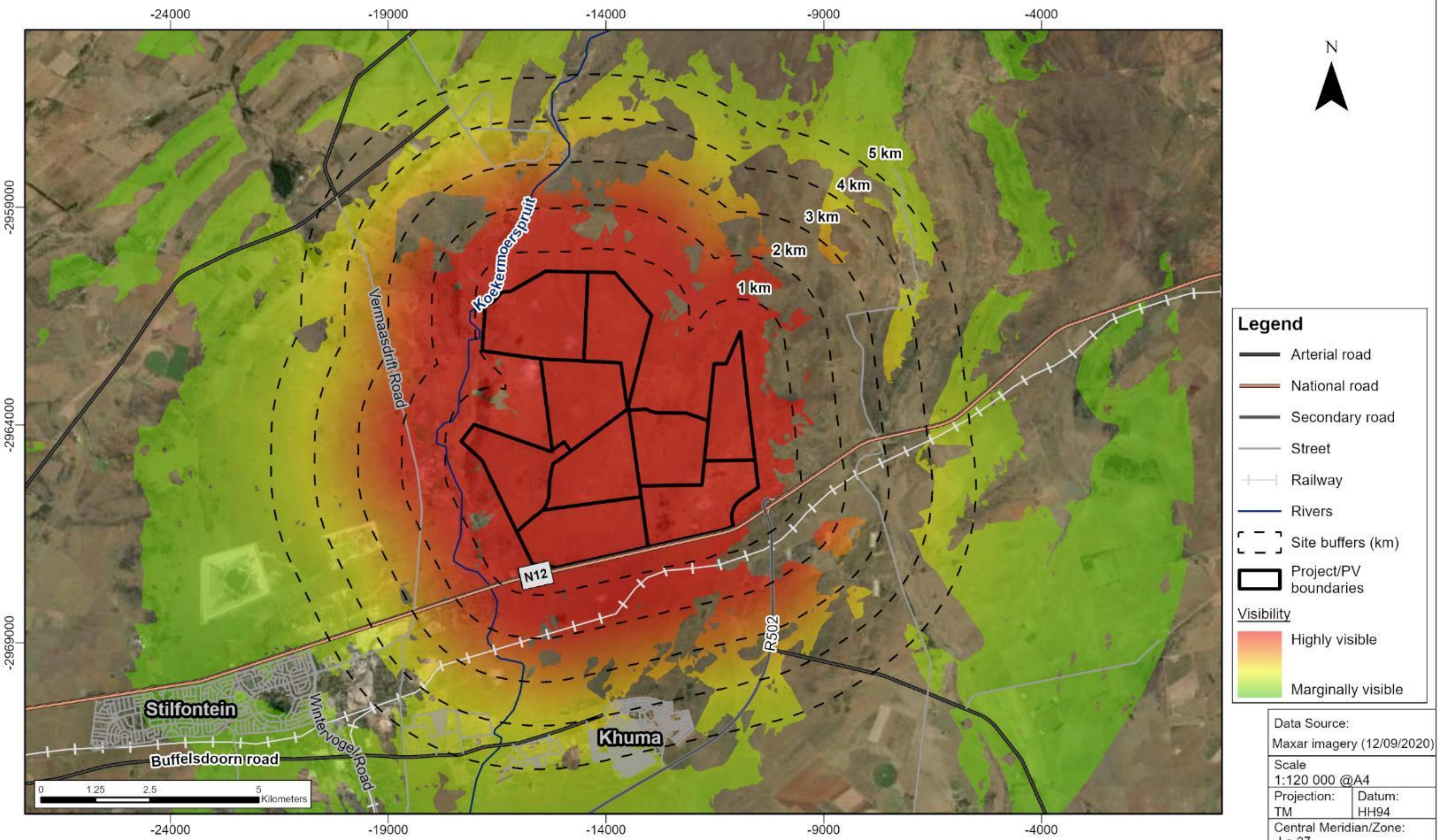
The overall visibility of the Stilfontein Cluster (in the region) is moderate due to the proximity of receptors to the project site, moderated by the undulating topography which screens the site from surrounding receptors. However, the project will be visible in the following areas:

- Farmsteads to the south of the N12. The viewshed indicates that the project will be visible from only a few farmsteads located 1 – 2 km to the south of the project site;

- Transient receptors on the N12 and railway located 1 – 5 km to the south and south-west of the project site;
- Industrial area adjacent to the N12, 1 – 4 km southwest of the project site;
- Stilfontein residential area over 5 km southwest of the project site. These residents, while sensitive receptors, are situated at a distance that renders the project marginally visible in the background;
- Residents located between 1-3 km west of the project site;
- Farmsteads north of the N12 and less than 2 km to the southwest of the project site;
- Motorists on Vermaasdrift Road will experience views of the project. Visibility ranges from high to moderate along this road with the project likely to be visible in the middleground - to background; and
- Farmsteads located 3.5 – 4.5 km northwest of the project site. These residents are considered sensitive receptors; however due to their distance from the project site, it will be visible in the background.

The viewshed for the Shrike PV Facility is included in Figure 5-2**.**

The visual exposure of proposed project is deemed ***high.***



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Central Meridian/Zone: Lo 27	
Date: 22/03/2022	Compiled by: BRCH
Project No. 581877	Fig No. 5-1

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STILFONTEIN PV CLUSTER VIA

COMBINED VIEWSHED

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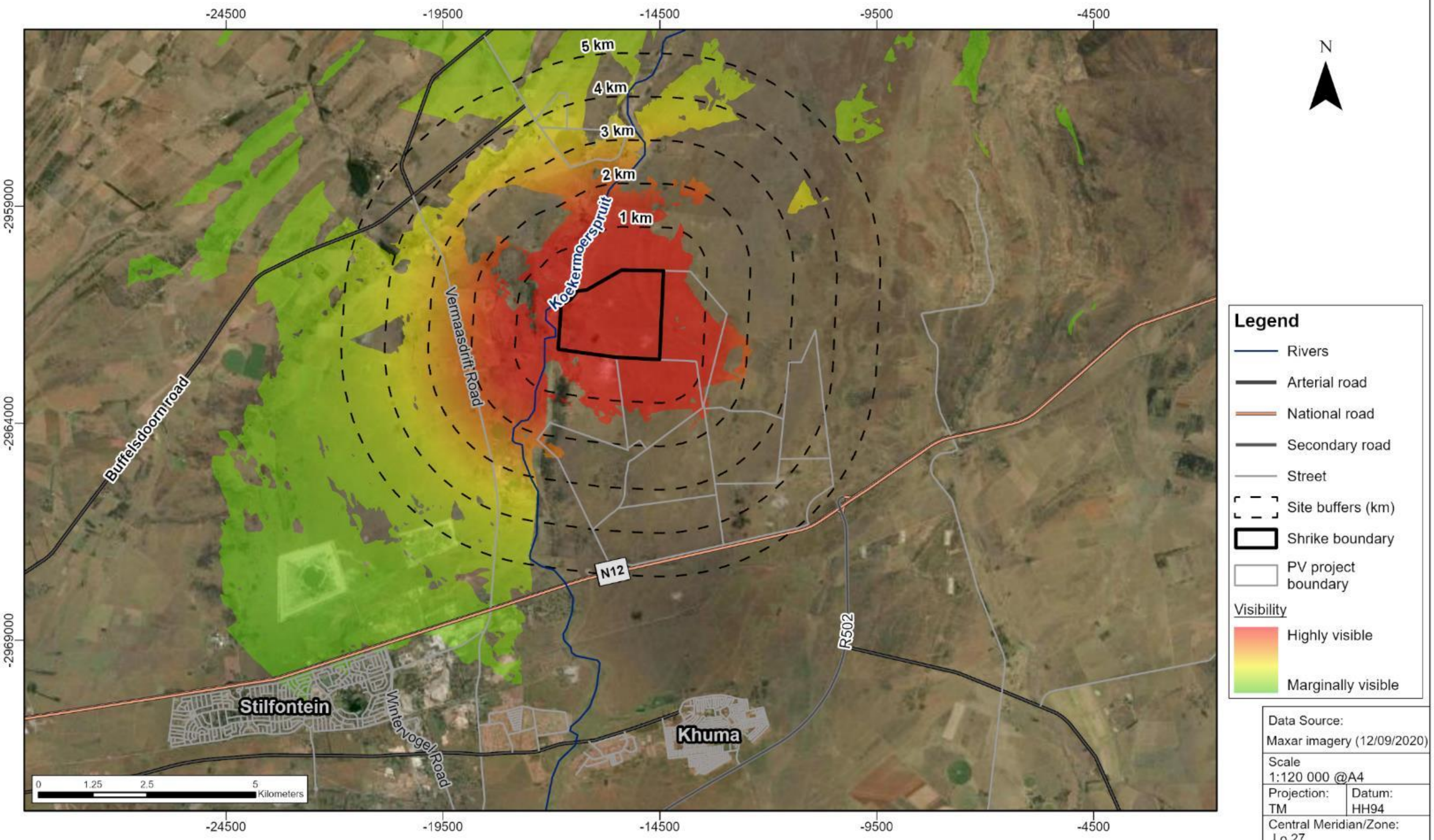

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Central Meridian/Zone: Lo 27

Date: 22/03/2022

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Project No. 581877

Fig No. 5-2

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STILFONTEIN PV CLUSTER VIA
SHRIKE VIEWSHED

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5.2 Visual Absorption Capacity

The VAC is the potential for an area to conceal and assimilate the proposed project. Criteria used to determine the VAC of the affected area are defined in Table 5-1. The VAC of an area is increased by:

1. Topography and vegetation that is able to provide screening and increase the VAC of a landscape;
2. The degree of urbanisation compared to open space. A highly urbanised landscape is better able to absorb the visual impacts of similar developments, whereas an undeveloped rural landscape will have a lower VAC; and
3. The scale and density of surrounding development.

These factors frequently apply at different scales, by influencing the VAC in the foreground (e.g. dense bush, existing roads and bridges, small structures), middleground and background (e.g. tall forests, hills, cityscapes).

The VAC of the Stilfontein Cluster project area is increased by undulating topography and - to a far more limited extent - by grassland and low trees, providing screening to the projects. The low vertical profile of the PV panels is anticipated to increase the screening potential of the vegetation and topography. However, vegetation is not able to provide screening to the associated infrastructure such as the on-site substations, MTS and pylons (associated with the powerlines). The undulating topography will marginally absorb the associated infrastructure.

Urban development can help to increase VAC, but is some distance from the project site, reducing this effect. In addition, the vast 2 114 ha footprint of the combined Stilfontein Cluster also reduces the VAC.

The project area has a ***low*** VAC.

Table 5-1: Visual absorption capacity criteria

High	Moderate	Low
The area is able to absorb the visual impact as it has: ▪ Undulating topography and relief ▪ Good screening vegetation (high and dense) ▪ Is highly urbanised in character (existing development is of a scale and density to absorb the visual impact).	The area is moderately able to absorb the visual impact, as it has: ▪ Moderately undulating topography and relief ▪ Some or partial screening vegetation ▪ A relatively urbanised character (existing development is of a scale and density to absorb the visual impact to some extent.	The area is not able to absorb the visual impact as it has: ▪ Flat topography ▪ Low growing or sparse vegetation ▪ Is not urbanised (existing development is not of a scale and density to absorb the visual impact to some extent.)
 http://www.franschhoek.co.za	 http://wikipedia.org	 http://www.butbn.cas.cz
 http://commons.wikimedia.org	 http://blogs.agu.org	 http://fortheinterim.com

5.3 Sensitivity of Visual Receptors

Receptors are important insofar as they inform visual sensitivity. The sensitivity of viewers is determined by the number and nature of viewers.

Viewers can be deemed to have:

1. High sensitivity if they view the project from e.g. residential areas, nature reserves and scenic routes or trails;
2. Moderate sensitivity if they view the project from e.g. sporting or recreational areas or places of work; and
3. Low sensitivity if they view the project from or within e.g. industrial, mining or degraded areas, or are transient viewers on roads.

The sensitivity of potential viewers identified in Section 4.4 is described below:

- **Residents:** The residential areas of Stilfontein, Khuma and farmsteads surrounding the site area are considered to have sensitivities ranging from low to high depending on proximity to the project site. Residents located further away will experience the site in the background, whereas those in close proximity (less than 1 km) will experience the project in the foreground (Figure 5-3).
- **Recreational:** The Frontier Shooting Range, Camp Louico and Khora Lion Park are located to the west of the site. Patrons at Frontier Shooting Range and Khora Lion Park are considered to have moderate sensitivity, whereas receptors at Camp Louico are considered to have high sensitivity. These recreational receptors are located between 1 km and 4 km from the project site so would view the project in the middleground to background depending on their distance from the project site.
- **Motorists:** Three roads are located in close proximity to the project site. The N12, a national highway, extends ~6 km along the southern boundary of the project site. Vermaasdrift Road, extending northwards from the N12 is located to the west of the project site and largely provides access to the agricultural areas to the west and north of the project site, Camp Louico, Khora Lion Park and Frontier Shooting Range. To the east of the project site, a road (Road East) extends north from the intersection with the N12 and provides access to agricultural areas and Matlwang Village.

  Motorists are considered to have relatively low sensitivity as their view of the project is transient and temporary.

5.4 Viewing Distance and Visibility

The distance of a viewer from an object is an important determinant of the magnitude of the visual impact. This is because the visual impact of an object diminishes / attenuates as the distance between the viewer and the object increases. Thus, the visual impact at 1 000 m would, nominally, be 25% of the impact as viewed from 500 m. At 2 000 m it would be 10% of the impact at 500 m (Hull and Bishop, 1988 in (Young, 2000)).

Three basic distance categories can be defined for a project of this scale (as discussed and represented in Table 5-2): foreground, middleground and background.

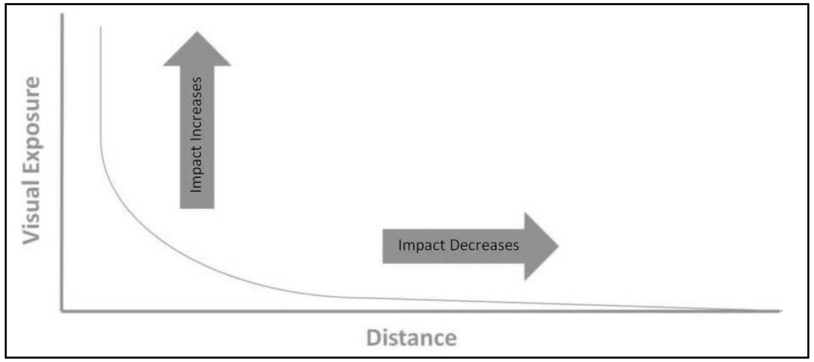


Figure 5-3: Visual exposure vis-à-vis distance

Sources: Adapted from Hull and Bishop, 2998 in (Young, 2000)

A number of viewpoints were selected to indicate locations from where receptors may view the PV Projects and / or associated infrastructure. The viewpoints are shown in Figure 5-4 and listed in Table 5-4. Current views from these points are shown in Appendix D.

The predicted visibility of portions of the project area from each viewpoint is described in Table 5-4, based on the visibility categories in Table 5-3.

Note that unlike visual exposure (Section 5.1) which describes areas from which the project may be visible without taking local screening into account (i.e. the viewshed), visibility describes predicted, actual visibility.

Table 5-2: Distance categories

FOREGROUND (0 – 1 km)	The zone where the proposed project will dominate the frame of view. The project will be *highly visible* unless obscured.
MIDDLEGROUND (1 - 2 km)	The zone where colour and line are still readily discernible. The project will be *moderately visible* but will still be easily recognisable.
BACKGROUND (2 -5 km)	This zone stretches from 2 km to 5 km. Objects in this zone can be classified as *marginally visible* to *not visible*.

The visibility of the project can be summarised as follows:

- The project will be visible in the middleground to motorists, campers and residents to the west (VP9, VP10 and VP11);
- The project will largely be screened by topography and vegetation, and, therefore, will be marginally visible to receptors located to the west (VP6, VP7, VP8), north (VP 12) and south (VP 15); and
- The project will not be visible from the east (VP1, VP2 and VP3), south (VP4, VP5, VP14, VP16, VP17, VP18), north (VP13) due to topography.

Overall, the visibility of the project is ***low*** due to its limited visibility to transient motorists on the N12 and to highly sensitive receptors (e.g. residents).

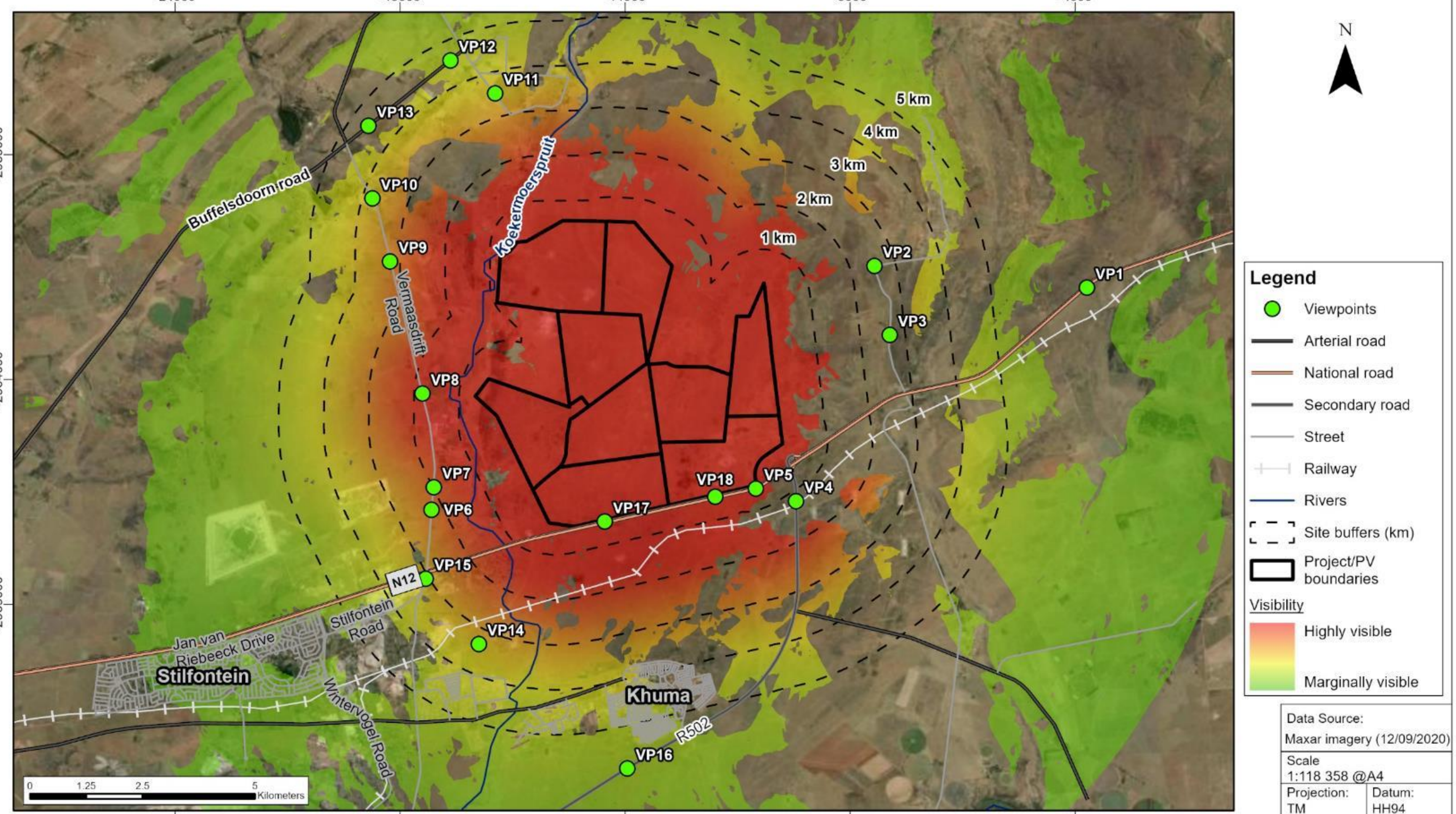
Table 5-3: Visibility criteria

NOT VISIBLE	Project cannot be seen	
MARGINALLY VISIBLE	Project is only just visible / partially visible (usually in the background zone)	
VISIBLE	Project is visible although parts may be partially obscured (usually in middleground zone)	
HIGHLY VISIBLE	Project is clearly visible (usually in foreground or middleground zone)	

Table 5-4: Visibility from viewpoints

Viewpoint #	Location	Co-ordinates	Direction of view	Potential Receptors	Visibility
VP1	N12 (East)	26° 45' 50.16" S 26° 54' 53.63" E	Looking west	Motorists travelling on N12	**Not Visible** Shrike PV will not be visible to motorists travelling west on the N12. The associated infrastructure will not be visible from this viewpoint.
VP2	Unnamed Road East	26° 45' 50.16" S 26° 54' 53.63" E	Looking west	Farmsteads and motorists travelling to and from Matlwang.	**Not Visible** The Shrike PV will not be visible from this viewpoint. The associated infrastructure may be visible from this viewpoint.
VP3	Unnamed Road East	26° 46' 40.13" S 26° 55' 6.00" E	Looking west	Farmsteads and motorists travelling along the unnamed road.	**Not Visible** The Shrike PV will not be visible from this viewpoint. The associated infrastructure may be visible from this viewpoint.
VP4	R502 Bridge	26° 48' 40.04" S 26° 53' 50.47" E	Looking north-west	Motorists and train	**Not Visible** Shrike PV will not be visible to the motorists on the R502 and trains. The associated infrastructure will not be visible from this viewpoint.
VP5	N12	26° 48' 30.99" S 26° 53' 18.10" E	Looking north / north-west	N12 Motorists	**Not Visible** The Shrike PV will not be visible to the motorists travelling on the N12.
VP6	Vermaasdrift Road Farmstead	26° 48' 45.86" S 26° 48' 57.42" E	Looking east	Farmsteads and motorists travelling along the Vermaasdrift Road.	**Marginally Visible** The Shrike PV and associated infrastructure will be marginally visible to the motorists and residents on Vermaasdrift Road.
VP7	Vermaasdrift Road North 1	26° 48' 29.67" S 26° 48' 59.19" E	Looking east	Farmsteads and motorists on Vermaasdrift Road.	**Marginally Visible** The Shrike PV and associated infrastructure will be marginally visible to the motorists and residents on Vermaasdrift Road.
VP8	Vermaasdrift Road Frontier Shooting Range	26° 47' 22.07" S 26° 48' 50.08" E	Looking east	Shooting Range patrons and motorists on Vermaasdrift Road	**Marginally Visible** The Shrike PV and associated infrastructure will be marginally visible to the motorists and Shooting Range patrons on Vermaasdrift Road.
VP9	Vermaasdrift Road Camp Louico	26° 45' 46.47" S 26° 48' 24.35" E	Looking east / south-east	Campers and motorists on Vermaasdrift Road	**Visible** The Shrike PV and associated infrastructure will be visible from this viewpoint. The associated infrastructure may be visible from this viewpoint.

Viewpoint #	Location	Co-ordinates	Direction of view	Potential Receptors	Visibility
VP10	Khora Lion Park	26° 45' 01.11"S 26° 48' 10.16"E	Looking east / south-east	Patrons of the Lion Park and surrounding farmsteads	**Visible** The Shrike PV and associated infrastructure will be visible from this viewpoint. The associated infrastructure may be visible from this viewpoint.
VP11	Northern Farmsteads	26° 43' 45.12"S 26° 49' 48.81"E	Looking south	Farmsteads	**Visible** The Shrike PV and associated infrastructure will be visible from this viewpoint. The associated infrastructure may be visible from this viewpoint.
VP12	Northern Farmsteads	26° 43' 21.35"S 26° 49' 13.01"E	Looking south	Farmsteads	**Marginally Visible** The Shrike PV and associated infrastructure will be marginally visible from this viewpoint.
VP13	Northern Farmsteads	26° 44' 08.68"S 26° 48' 07.00"E	Looking south	Farmsteads	**Not Visible** The Shrike PV and associated infrastructure will not be visible from this viewpoint due to distance.
VP14	Khuma Residential Area	26° 50' 23.01"S 26° 49' 35.30"E	Looking north	Residents of Khuma settlement	**Not Visible** The Shrike PV and associated infrastructure will not be visible from this viewpoint.
VP15	Intersection of Vermaasdrift and N12	26° 49' 35.85"S 26° 48' 52.61"E	Looking north-east	Motorists on Vermaasdrift Road and N12	**Marginally Visible** The Shrike PV and associated infrastructure may be marginally visible in the background from this viewpoint due to distance and screening by vegetation.
VP16	R502	26° 51' 53.19"S 26° 51' 34.63"E	Looking north	Motorists on the R502	**Not Visible** The Shrike PV and associated infrastructure will not be visible from this viewpoint.
VP17	N12	26° 48' 54.74"S 26° 51' 16.57"E	Looking north	Motorists on the N12	**Not Visible** The Shrike PV and associated infrastructure will not be visible from the motorists travelling on the N12.
VP18	N12	26° 48' 36.88"S 26° 52' 45.47"E	Looking north	Motorists on the N12	**Not Visible** The Shrike PV and associated infrastructure will not be visible from the motorists travelling on the N12.



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Central Meridian/Zone: Lo 27	
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Project No. 581877	Fig No. 5-4

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STILFONTEIN PV CLUSTER VIA
COMBINED VIEWSHED WITH VIEWPOINTS

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5.5 Compatibility with Landscape Integrity

Landscape (or townscape) integrity refers to the compatibility of the development / visual intrusion with the existing landscape. The landscape integrity of the project is rated based on the relevant criteria listed in Table 5-5.

Table 5-5: Landscape integrity criteria

Criterion	Landscape integrity		
	High	**Moderate**	**Low**
	The project is:		
Consistency with existing land use of the area	Consistent	Moderately consistent	Not consistent / very different
Sensitivity to natural environment	Highly sensitive	Moderately sensitive	Not sensitive
Consistency with urban texture and layout	Consistent	Moderately consistent	Not consistent / very different
Congruence of Buildings / structures with / sensitivity to existing architecture / buildings	Congruent / sensitive	Moderately congruent / sensitive	Not congruent / sensitive
Scale and size relative to nearby existing development	Similar	Moderately similar	Different

The proposed Stilfontein Cluster will be located in a peri-urban landscape that includes both anthropogenic and natural landscape elements, creating a mixed texture of land use patterns. The Stilfontein Cluster is moderately consistent with the patterned land use of the surrounding area (e.g. townscapes, industry and mining infrastructure/tailings dams). However, the layout, texture, scale and size of the Stilfontein Cluster are of low compatibility and considered incongruent with the existing landscape as the PV Facilities will comprise uniform, highly reflective and geometric, man-made structures across very large areas (~200 ha – 350 ha).

The BESS, on-site substations and the MTS will have development footprints of 10 ha, 4 ha and 36 ha respectively. While the form and use of these project components may be moderately consistent with the surrounding infrastructure (e.g. the two 400 kV Hermes/Pluto transmission lines traversing the site), the size and scale is considered different.

The powerlines (11-33 kV, 132 kV and 400 kV) will be moderately consistent and congruent with the use, texture, size and scale of the development in the surrounding areas.

The Stilfontein Cluster is deemed to have ***low*** integrity with the surrounding landscape, whereas the associated infrastructure is considered to have ***moderate*** integrity with the surrounding landscape.

5.6 Solar Reflection

The suite of visual receptors that may be impacted by glint and glare caused by any new development may include:

- Residents;
- Motorists;
- Train drivers; and
- Pilots and air traffic controllers.

Visual receptors potentially exposed to solar reflection by this project are residents, train users and motorists (see Section 5.3).

5.6.1 Glare Thresholds

The ocular (or visual) impact of glare has been categorised into the following three categories (Ho, Ghanbari, & Diver, 2011):

- Green: low potential to cause after-image;
- Yellow: potential to cause temporary after-image; and
- Red: potential to cause retinal burn (permanent eye damage)[6].

The Glare Hazard Plot (Figure 5-5) illustrates the ocular (or visual) impact of solar glare as a function of the intensity of the glare source on the retina (retinal irradiance) and the portion of a viewer's field of vision that the glare occupies (subtended source angle).

Although there are no South African thresholds to determine the significance of glare, recommended thresholds have been published by Pager Power (2018). Pager Power (2018) considers glare significant, and mitigation is required, when glare is anticipated to persist for longer than 60 minutes per day for three or more months per year within a residential area (Pager Power, 2018).

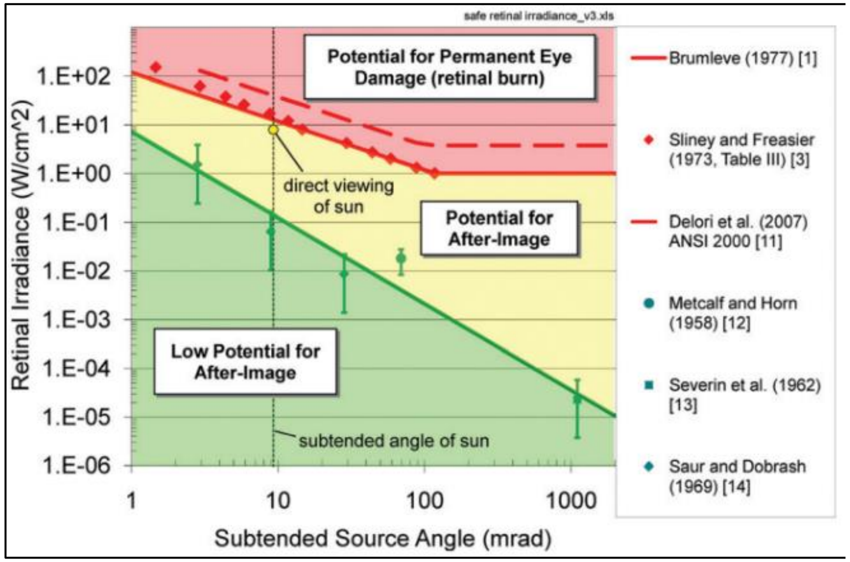


Figure 5-5: Potential impacts of retinal irradiance as a function of subtended source angle

Sources: (Ho, Ghanbari, & Diver, 2011)

Based on the two categories of glare applicable to PV Facilities (Green glare and Yellow glare) in the Glare Hazard Plot (Ho, Ghanbari, & Diver, 2011) and Pager Power (2018), SRK framework for assessing the magnitude of glare is presented in Table 5-6 below.

[6] Retinal burn is typically not possible from PV glare as the PV panels do not focus the reflected sunlight.

Table 5-6: Magnitude of glare impacts for PV Facilities

Impact	Category of Glare[7]	Duration of Glare
High	Yellow	> 60 minutes per day for ≥ 3 months
Medium	Yellow	≥ 30 minutes per day, but ≤ 60 minutes per day for any duration of months
Low	Yellow or Green	< 30 minutes per day for any duration of months

The impact of glint and glare originating from PV Facilities also depends on the sensitivity of the affected receptors. Generally, motorists are more sensitive to glint and/or glare than immobile receptors due to the potential consequences of momentary blindness, *viz*. increased risk of accidents.

5.6.2 Modelling Glare

Glare modelling was conducted for the proposed layout of the PV array using ForgeSolar's GlareGauge. The parameter inputs used to model glare for the proposed project are included in Table 5-7 and the GlareGauge report included in Appendix E.

Table 5-7: Solar reflection model parameters

Parameter	Input
Panel height (centroid)	1.53 m
Axis Tracking	Single (horizontal)
Tracking axis orientation	0°
Tracking axis tilt	0°
Tracking axis panel offset	0°
Maximum tracking angle[8]	60°
Resting angle	0°
Panel material	Smooth glass[9]
Receptor height – Residents[10]	1.5 m
Receptor height – Motorists	1 m

Thirty-three (33) Observation Points (OP) representative of the 'stationary' receptors such as the residential areas of Khuma, Stilfontein, farmsteads, Louico Camp, Khora Lion Park (Figure 5-6) were modelled to ascertain whether glare would be experienced by receptors at these points.

Glare experienced by motorists on the N12, Unnamed Road East and Vermaasdrift Road was modelled in both directions (two-way roads) (Figure 5-6).

The Klerksdorp Airport aircraft flight path was also modelled (Figure 5-6).

Based on the input parameters (Table 5-7) the glare analysis demonstrated that glare from the PV Facilities, will be experienced by visual receptors (residents, train users and motorists). However, none of the receptors will experience > 60 minutes of glare per day for three months or more.

Notable findings from the modelling of the glare are summarised below:

[7] Category of glare in terms of the Glare Hazard Plot; Red Glare, Yellow Glare and Green Glare (Ho, Ghanbari, & Diver, 2011).

[8] Maximum rotation (tracking) angle of PV modules in either direction relative to the mid-position on the torque tube.

[9] Conservative assumption that the PV modules will not have anti-glare coating.

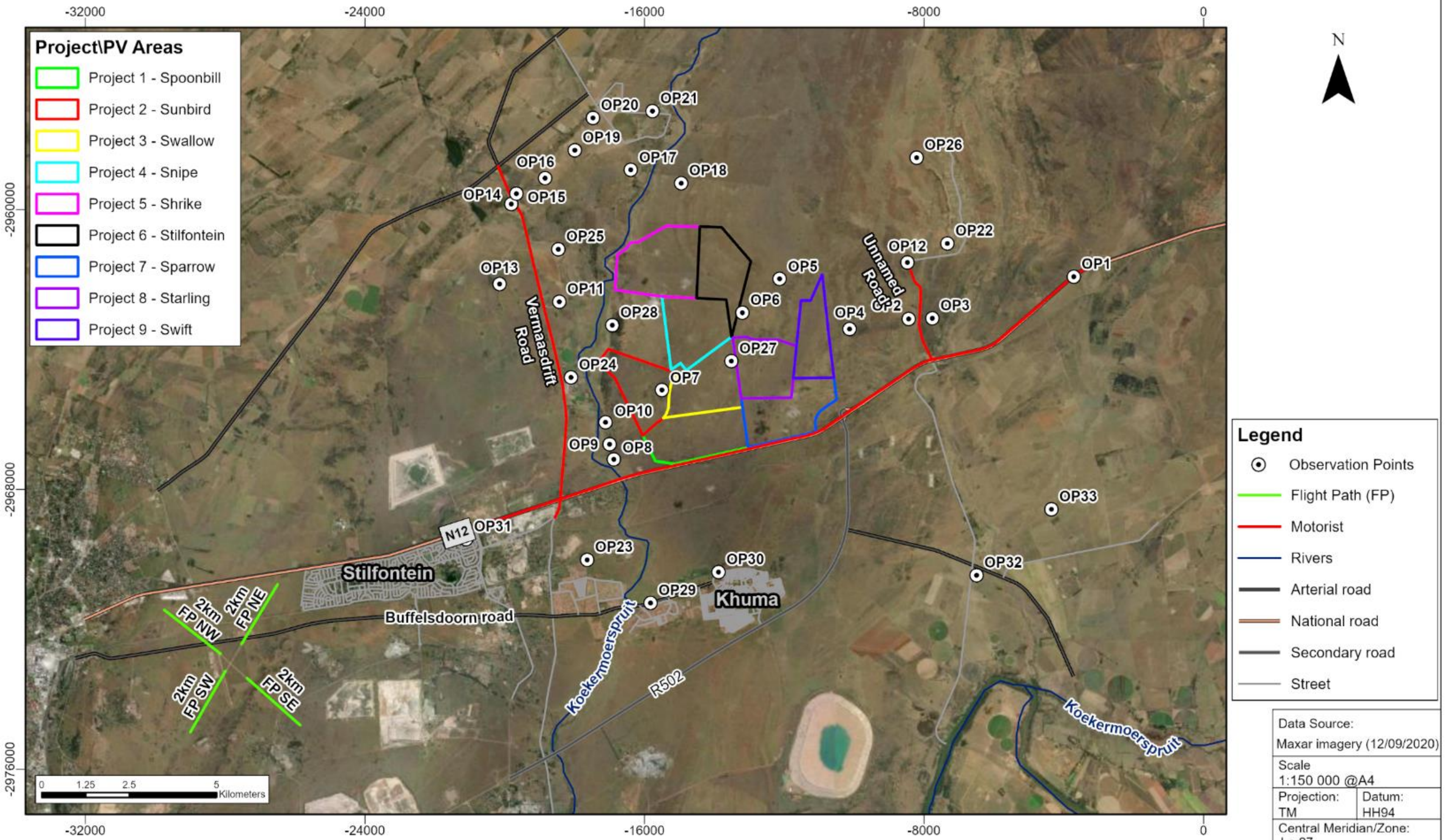
[10] Assumption that average eye level standing is 1.5m.

- Points to the north and south of the PV Facilities (OP 17, 18, 20, 21, 23, 29, 30 and 32) will not experience glare (Figure 5-5). This is expected as the panel support structures are aligned on a north-south axis;

Glint is not modelled. However, if the PV panels are visible to moving receptors, then glint and a pulse of after-image may be experienced.

Glare results relating to Shrike PV Facility are provided in Appendix G.

No receptors will be exposed to < 30 minutes per day, as such the glare modelled is anticipated to be ***low***.



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Central Meridian/Zone: Lo 27

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STILFONTEIN PV CLUSTER VIA
GLARE RECEPTORS

Date: 14/04/2022 | Compiled by: BRCH

Project No. 581877 | Fig No. 5-5

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Revision: A Date: 18 01 2023

5.7 Magnitude of the Overall Visual Impact

Based on the above criteria, the magnitude or intensity of the overall visual impact that is expected to result from the project has been rated. Table 5-8 provides a summary of the criteria, a descriptor summarising the status of the criteria and projected impact magnitude ratings.

The overall magnitude of the visual impact that is expected to result from the entire Stilfontein Cluster is rated as ***high***. The high visual exposure and visibility of the project by a high number of visual receptors, and the low VAC is only moderated by the low visual sensitivity of many of these viewers (i.e. motorists). No areas to be avoided were identified.

Table 5-8: Magnitude of overall visual impact

Criteria	Rating	Comments
Visual Exposure (Viewshed)	High	The project will largely be highly visible from within the project area and to receptors immediately south of the project area beyond the N12, as well as those immediately southwest and northwest of the project sites.
Visual Absorption Capacity	Low	The VAC of the project site is increased by the undulating topography and – to a far more limited extent - by grassland and low trees providing screening of the project area. The vegetation does not screen associated infrastructure such as the on-site substation, MTS and pylons (associated with the powerlines). The undulating topography will marginally absorb the associated infrastructure.
Viewer Sensitivity (Receptors)	Moderate	Visual receptors exposed to the project (motorists, recreational and residents) have varied visual sensitivity. Motorists have transient exposure to PV Facilities and associated infrastructure, while the residents surrounding the project area will have a high sensitivity. The receptors at the recreational areas such as Louico Camp, Khora Lion Park and the Frontier Shooting Range are considered to have a moderate sensitivity.
Viewing Distance and Visibility	Low	The project area is visible to transient motorists on the N12 and to highly sensitive receptors (e.g. residents).
Landscape Integrity	Low (PV Facilities and project) and Moderate (associated infrastructure)	The PV Facilities are moderately consistent with the patterned land use of the surrounding area; however, the layout, texture, scale and size of the PV Facilities is of low compatibility and considered incongruent with the existing landscape. The project (all nine PV Facilities) will be very different and incongruent with the land use, layout, texture, scale and size of the surrounding landscape. The associated infrastructure will be moderately consistent and congruent with the use, texture, size and scale of the development in the surrounding areas.
Solar Reflection	Low	The glare analysis indicates that glare caused by the project be low as receptors will experience < 30 minutes of glare per day for varying periods throughout the year. Glint is not modelled; but may be experienced by moving receptors that have line of sight of the PV panels.

6 Impact Assessment and Mitigation Measures

The following section describes the visual impacts anticipated during the construction and operations phases of the entire Stilfontein Cluster.

Possible measures to avoid, mitigate or compensate visual impacts will be considered and recommended, depending on the severity of impacts and the feasibility of measures. The mitigation hierarchy and sample measures are provided below (DEA&DP, 2005):

- Avoid, e.g. by re-examining the need for the proposed project, relocating the project or re-designing the project;
- Mitigate (reduce), e.g. through adjustments to the siting and design of the project, careful selection of finishes and colours, use of earthworks (such as berms) and planting to provide visual screening and dust control where required;
- Rehabilitate and restore, e.g. through on-site and off-site landscape rehabilitation of areas affected by the project, which may include re-instating landforms and natural vegetation, provision of landscaped open space etc.;
- Compensate and offset, where avoidance or mitigation cannot achieve the desired effect; and
- Enhance, where the proposed project is located in run-down areas or degraded landscapes.

The Shrike PV Facility relates to a greenfield development.

Direct visual and aesthetic impacts are likely to result from the Shrike PV Facility include the following:

- Earthworks and construction activities (including clearing of vegetation and associated generation of dust);
- Altered sense of place caused by the project;
- Glint and glare originating from the PV array causing visual discomfort and impairing visibility to receptors;
- Visual intrusion diminishing vistas across the project area; and
- Increased light pollution.

Potential visual impacts of the project are described and assessed in Appendix F, utilising the impact rating methodology presented in Appendix C.

In this VIA, most impacts (are taken to) manifest in the operational phase.

6.1 The No-Go Alternative

The No Go alternative entails no change to the status quo, in other words, the Stilfontein PV Cluster will not be developed (see Section 3.3).

Forgoing the development of the Stilfontein PV Cluster will mean that the sense of place will not be altered, no visual intrusion, glint or glare or light pollution will be experienced, i.e. the visual impacts of this project would not be realised. However, it would also mean that no renewable energy will be generated by this project.

6.2 Cumulative Impacts

6.2.1 Introduction

For the purposes of this report, cumulative impacts are defined as ‘direct and indirect impacts that act together with existing or future potential impacts of other activities or proposed activities in the area / region that affect the same resources and / or receptors’.

For the most part, cumulative effects or aspects thereof are too uncertain to be quantifiable, due mainly to a lack of data availability and accuracy. This is particularly true of cumulative effects arising from potential or future projects, the design or details of which may not be finalised or available and the direct and indirect impacts of which have not yet been assessed.

For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognised as important on the basis of scientific concerns and/or concerns of affected communities.

Figure 6-1 presents the matrix used to evaluate the cumulative visual impacts of the project on the sense of place of the study area. This matrix presents the relationship between two quantities; severity of impacts (importance and magnitude) and extent of impact (geographic size).

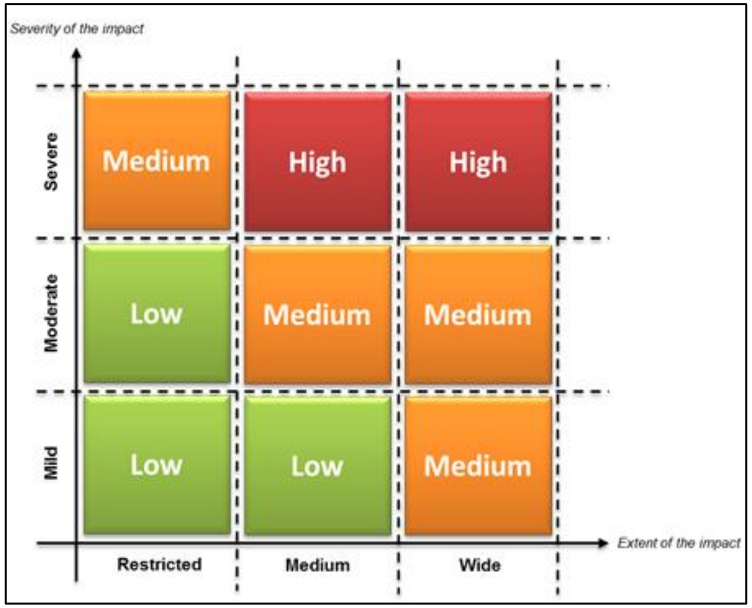


Figure 6-1: Cumulative impact evaluation matrix

The cumulative impact assessment considers the:

- Proposed nine PV facilities and associated on-site substations and infrastructure in the Stilfontein Cluster; and
- Other PV projects approved (but not yet constructed) or under consideration within a 30 km radius of the project area as listed on the Department of Forestry, Fisheries and the Environment (DFFE) South African Renewable Energy EIA Application Database (DFFE, 2022) (see Table 6-1).

Table 6-1: Approved projects within 30 km radius of the project site

Project	DFFE Reference	EA Status	Capacity
Kabi Vaalkop PV Facility	12/12/20/2513/4/AM1	Approved	N/A
Kabi Vaalkop PV Facility	12/12/20/2513/4	Approved	75 MW
Buffels Solar PV 1	14/12/16/3/3/2/777	Approved	75 MW
Buffels Solar PV 2	14/12/16/3/3/2/778	Approved	100 MW
YMS Mineral Resources PV Plant	12/12/20/2629/AM1	Approved	20 MW
Witkop Solar PV II	12/12/20/2507/2	In process	61 MW
Siyanda PV Facility	14/12/16/3/3/2/1/2369	Approved	150 MW

6.2.2 Cumulative Impact Assessment

Altered Sense of Place and Visual Intrusion caused by Proposed and Approved PV Facilities

The Stilfontein PV Cluster will introduce unique infrastructure into the visual landscape, comprising over 2 700 ha of PV panels, nine 4 ha on-site substations, a 36 ha MTS and various 11-33 kV, 132 kV and 400 kV powerlines. This infrastructure will be different in form, scale, size and texture to the surrounding infrastructure and will contrast with the largely rural and natural landscape of the surrounding area. As such, the project will alter the sense of place and diminish the scenic value of the project site and surrounding area.

As discussed in Section 5, the project will range in visibility to the residential, recreational and transient receptors in the area surrounding the project site. The man-made artefacts visible to receptors will present as a visual intrusion in the either in the foreground to motorists or middleground or background to residential and recreational receptors.

Furthermore, it is anticipated that each of the PV Facilities will require lighting along the perimeter or at the BESS and on-site substations. Consequently, the project will add to existing nightglow from surrounding residential areas. The extensive scale of the project will increase light pollution in the area, which will alter the sense of place.

The other approved PV projects listed in Table 6-1 are largely located to the southwest of the project area, adjacent to existing mines (Figure 6-2). As such, these proposed projects are likely to be less incongruent with land use, form and size than the Stilfontein PV Cluster which is some distance from mines in the area. Despite the comparatively small scale of those projects, they will also create visual impacts such as altered sense of place, visual intrusion and light pollution.

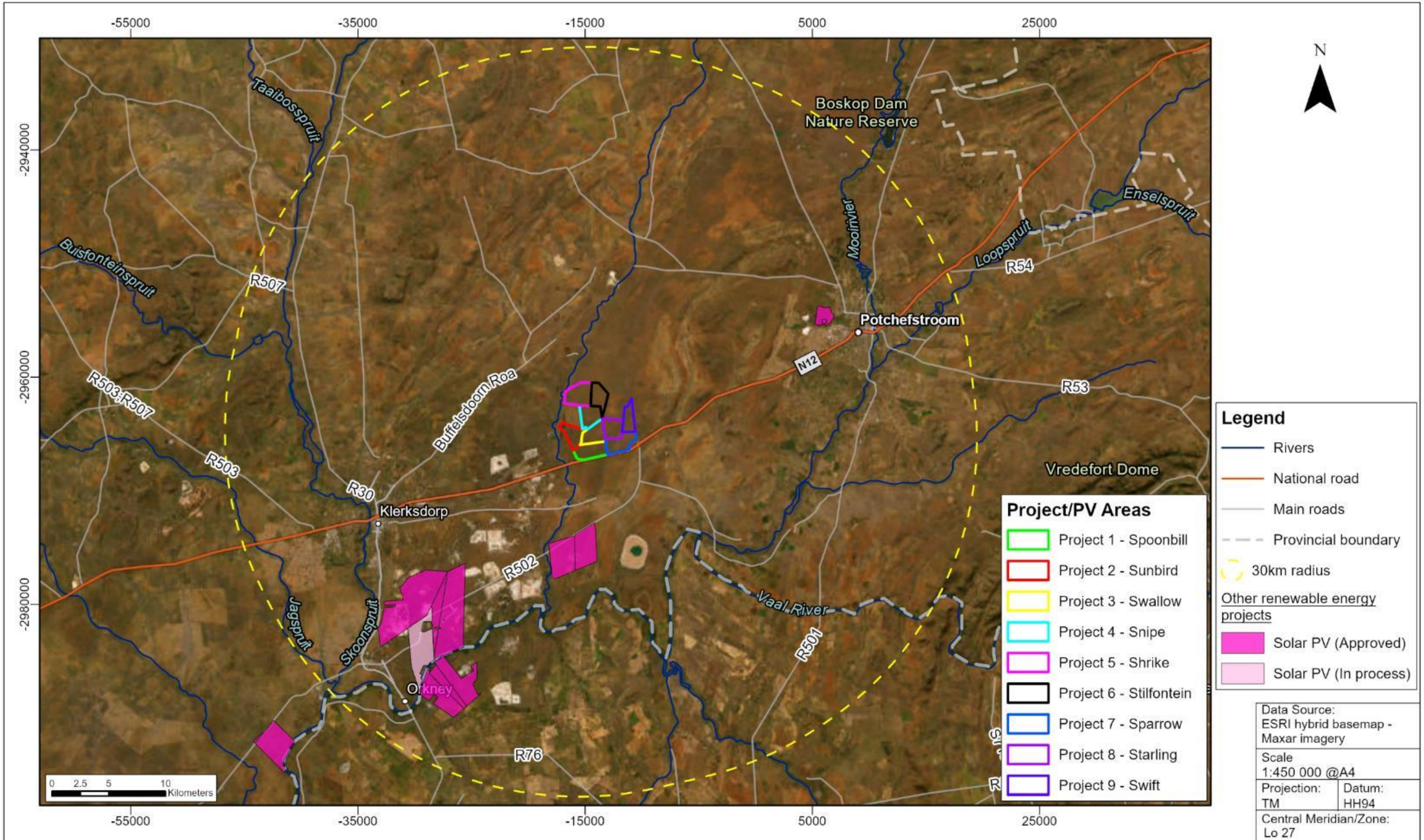
Visual Discomfort and Impaired Visibility caused by Glint and Glare

The introduction of a vast array of reflective surfaces will generate glare which is expected to impact surrounding receptors, mainly to the east and west, and motorists along the N12, Unnamed Road East and Vermaasdrift Road during certain times of the day in select periods of the year. Cumulatively, exposure to glare from the Stilfontein Cluster does not exceed 30 minutes per day at any one receptor, and as such is not considered to be high or a fatal flaw; however, is likely to be a nuisance to some receptors.

Cumulatively, the additional approved projects listed in Table 6-1 and the Stilfontein PV Cluster are expected to alter the sense of place, adding to anthropogenic transformation in the rural / peri-urban landscape environment. Cumulative light pollution is also expected to increase as this impact has a larger zone of influence than direct visual intrusion, for example.

It is relevant to note that, while the cumulative visual impact is considered significant, these projects fall within the Klerksdorp REDZ, a designated area where such projects are encouraged, *inter alia*, by streamlining of EA processes.

The *severity* of the cumulative visual impact of the project on the sense of place and visual intrusion is broadly rated as moderate and is assessed to be of a wide *extent*. The cumulative impact is thus assessed to be of ***medium*** significance.



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Central Meridian/Zone: Lo 27

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STILFONTEIN PV CLUSTER VIA
CUMULATIVE PROJECTS

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Revision: A Date: 25 01 2023

7 Findings and Recommendations

The VIA describes and interprets the visual context or affected environment in which the project is located: this provides a visual baseline or template, and aims to ascertain the aesthetic uniqueness of the project area. To better understand the magnitude or intensity of visual and sense of place impacts, the capacity of the project area and receptors to accommodate, attenuate and absorb impacts was analysed in considerable detail. To assess impact significance, the project was "introduced" into the baseline, taking account of the attenuating capacity of the project area.

Findings and recommendations for the Shrike PV Facility are provided in Appendix F.

7.1 Findings

The following findings are pertinent:

- The basis for the visual character of the region is provided by the geology / topography, vegetation and land use of the area, which is predominantly a rural / peri-urban environment. The project area falls within the western portion of the highveld. The highveld terrain is generally devoid of mountains, consists primarily of rolling plains and experiences a temperate highveld climate. The project site lies in a uniform environment, at an elevation of ~1 380 m amsl.
- Vegetation types in the project area are Vaal Reefs Dolomite Sinkhole Woodland and Carlton Dolomite Grassland. The Dry Highland Grassland Biome occurs on undulating topography with small outcropping mountains and river valleys. The vegetation on the site comprises grasses and low shrubby vegetation with small clusters of trees and bushes, reminiscent of African savannah landscape.
- The landscape quality and the visual quality of the project area is largely determined by the land use of the project area and surrounds. It is situated within an expansive and somewhat unspectacular landscape that is further characterised by tailings dams and overburden stockpiles from mining activities in the surrounding area. The area surrounding the site is predominantly characterised by agricultural and mining activities, urban development, infrastructure (roads and rail) and natural highveld grassland. Mines and mining towns are located to the south and southwest, while agriculture (mainly crop and cattle farming) is the predominant land use to the north, east and west of the project site. Farmsteads are dotted throughout the area. The National N12 Highway lies to the south. Two 400 kV Hermes/Pluto transmission lines traverse the area in a north-south direction. The project area can be defined as a modified rural landscape.
- The visual quality of the area is largely experienced through rolling views of the undulating landscape, especially from and across the site. The study area is defined by the fabric of developed settlements and infrastructure surrounded by agricultural and mining activity. Streams and rivers add to the visual quality.
- The visual exposure of the proposed project area is high due to the vast size of the (Cluster) project area as well as the receptors immediately to the south of the project site beyond the N12, as well as those to the immediate southwest and northwest of the (Cluster) site. The project will be marginally visible in the background to the receptors approximately 3 – 5 km from the project site. The overall visibility of the project is moderated by the distance of the receptors from the project site and the undulating topography. The visual exposure of the project is deemed moderate.
- The visual absorption capacity of the project area is increased by the undulating topography and – to a far more limited extent – by

grassland and low trees, providing partial screening to the project. The project area has a low VAC for the project.

- The project area has a large number of transient receptors that will be less sensitive to visual impacts. Residential and recreational receptors are considered to have a higher sensitivity. Potentially highly sensitive receptors are generally located at least 1 km away from the project.
- The visibility of the project is moderate due to its high visibility to transient motorists on the N12 and train passengers, and marginal visibility to the highly sensitivity receptors surrounding the site.
- Construction activities generate visual impacts related to stripping of vegetation, bulk earthworks (which can generate dust) and from construction infrastructure, plant, and materials on site (e.g. site camp, cranes, and stockpiles). Dust generated during construction will be visually unappealing and may detract from the visual quality (sense of place) of the area. The construction activities will be discordant with the landscape and surrounding land uses and therefore will be a temporary visual intrusion to surrounding receptors.
- The project is anticipated to be incongruent and incompatible with the current landscape and infrastructure and will result in a permanent change to the landscape, scenic value and sense of place.
- The project will involve various project components being developed on the project site. These project components are generally incongruent with the surrounding area and will be visible to receptors to varying degrees. As such, this project will result in visual intrusion.
- Lighting will be installed along the perimeter of the facilities to improve security. Introducing lighting into the vast project area is anticipated to result in a deterioration of visual quality.
- In addition to the nine PV facilities and nine substations and one Main Transmission Substation (MTS) comprising the Stilfontein Cluster, six approved PV projects are located within a 30 km radius of the project site and one PV project application in progress. While these projects are of a smaller scale in comparison to the Stilfontein PV Cluster, they are expected to impact on the sense of place and result in visual intrusion. The cumulative impact is assessed to be of ***medium*** significance.
- This project is located within the Klerksdorp REDZ, an area intentionally designated as suitable for renewable energy projects.

7.2 Conclusion

This project will be largely different and incongruent with the existing infrastructure and the natural landscape. As such, visual impacts include altered sense of place, visual intrusion, and light pollution. This VIA demonstrates that the project will generally result in a significant visual impact.

Potentially highly sensitive receptors are generally located more than 1 km from the project sites and, where the project is visible, it will be mostly visible in the middleground and background. Transient receptors, however, will experience visual intrusion in the foreground in some locations.

The project is somewhat consistent with the mixed land use patterns of the surrounding area, which already includes powerlines.

Construction and operation phase visual impacts are deemed to be acceptable on the assumption that the mitigation measures listed in Appendix F are implemented and noting the location of the project in a designated REDZ. Based on the assessment and the assumption that the mitigation measures will be implemented, the specialist is of the opinion that the visual impacts of the project are acceptable, and, from a visual perspective, there is no reason not to authorise the project.

Signatures

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

This report, Visual Impact Assessment for the Shrike PV Facility within the Stilfontein PV Cluster, Stilfontein, North West Province, was prepared and reviewed by the SRK personnel presented below.

Prepared by

Kelly Armstrong, Environmental Consultant

Project Partner

Chris Dalgliesh, Partner

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Appendix A Specialist CV

Kelly Armstrong

Environmental Consultant

Profession	Environmental Consultant
Education	BSocSc Hons (Environmental & Geographical Studies), University of Cape Town, 2017
Registrations/ Affiliations	Not Applicable
Awards	Not Applicable

Specialisation

Environmental Impact Assessment; Environmental Management Planning, Environmental Control Officer; Stakeholder Engagement; Water Use Authorisations; Atmospheric Emission Licences; Waste Management License audits; Visual Impact Assessment; Glare Modelling.

Expertise

Kelly has five years' experience in the ESG sector. Her core expertise includes:

- coordinating environmental impact assessment processes across a range of sectors;
- compiling environmental management programmes for projects;
- auditing compliance with environmental management programmes;
- managing stakeholder engagement processes; and
- managing visual impact assessments, and glint and glare modelling.

Employment

2019 - present	SRK Consulting (Pty) Ltd, Environmental Consultant
2018 - 2019	Terramanzi Group, Junior Environmental Consultant

Publications

1. Keeping an Eye on PV Glint and Glare. *Multiple publications.* August 2022.

Languages

English – read, write, speak (fluent)

Kelly Armstrong
Environmental Consultant

Environmental Impact Assessments (EIA)

- Mainstream Renewable Power South Africa (Pty) Ltd, Scoping and Environmental Impact Report for Hanover WEF and SEF Cluster, 2022 – ongoing, R3.3m.
- Oceana Group Limited, Basic Assessment (BA) for Oceana's 10 MW SPV Facility in St Helena Bay, Western Cape, 2021 – ongoing, R400 000.
- Transnet SOC Ltd, Scoping and EIA for the Increase of Manganese Handling and Storage at the Multi-purpose Terminal, Port of Saldanha, Western Cape, 2021 - 2022, R1 125 000.
- City of Cape Town, EIA for the proposed upgrades of Cape Flats Wastewater Treatment Works, Western Cape, 2019 – 2021, R400 000.
- Eskom Holdings SOC Ltd, Screening Study for 765 kV Kappa – Sterrekus Powerline, Western Cape, 2020 – 2022, R5 000 000.
- Nadeson Consulting Engineers, Middelpos Stormwater Upgrades EA Amendment, Saldanha Bay, Western Cape, 2020, R25 000.
- Eskom Holdings SOC Ltd, BA for the Single Circuit Powerline from Ceres to Witzenberg Substations, Witzenberg Local Municipality, Western Cape, 2020 – 2021, R435 000.
- Nadeson Consulting Engineers, Middelpos Stormwater Upgrades Basic Assessment (BA), Saldanha Bay, Western Cape, 2019 – 2020, R250 000.
- Human Settlements Holistic Services, Charlesville Low Cost Housing BA, Cape Town, Western Cape, 2019 – 2021, R150 000.
- Paarl Vallei Developments, BA for Paarl Valleij Residential Development, Western Cape, 2019.
- Copperton Wind Farm, Copperton Wind Energy Facility Environmental Management Programme (EMPr) Amendment, Northern Cape, 2019.
- Val de Vie Investments, Substantive Amendment of Pearl Valley Phase II Environmental Authorisation (EA), Western Cape, 2018 – 2019.
- Val de Vie Investments, Substantive Amendment of Levendal Development EA, Western Cape, 2018 - 2019
- Watchman Properties, BA for Vendome Estate Development, Western Cape, 2018 – 2019.
- Val de Vie Investments, BA for River Farm Estate Development, Western Cape, 2018 – 2019.
- G7 Renewable Energies, Substantive Amendment of Brandvalley Wind Energy Facility EA, Western Cape, 2018.
- Haga Haga Wind Farm, EIA for Haga Haga Wind Energy Facility, Eastern Cape, 2018.
- Haga Haga Wind Farm, BA for Haga Haga Overhead Powerline, Eastern Cape, 2018.

Environmental Management Programme (EMPr)

- Victoria & Alfred Waterfront (Pty) Ltd, Environmental Specification for V&A Revetment Upgrades Phase 2, Granger Bay, March 2021, R35 000
- Victoria & Alfred Waterfront (Pty) Ltd, Environmental Specification for V&A Revetment Upgrades Phase 1, Granger Bay, August 2020, R35 000
- Zutari (Pty) Ltd, Specification for the Environmental Management for the Decommissioning of the Athlone Power Station, 2020, R50 000.

- Water and Wastewater Engineering (Pty) Ltd, for the City of Cape Town, Cape Flats Aquifer Recharge Water Treatment Plant (WTP) Environmental Method Statement, Western Cape, 2020, R30 000.
- KSS Holdings (Pty) Ltd, EMPr for concrete batching for Karusa and Soetwater Wind Farms, December 2019, R10 000.
- Saint-Gobain Gyproc, Update Maskam Mine EMPr, Vanrhynsdorp, Western Cape, 2019, R200 000.

Environmental Control Officer (ECO)

- Victoria & Alfred Waterfront (Pty) Ltd, V&A Revetment Upgrades, ECO during phase two of the repair works on the Revetments, 2021, R35 000.
- Lions Hill Development Company, The Ridge Residential Development, ECO for Construction Phase, 2020 – 2022, R75 000.
- Project Assignments (Pty) Ltd, Reactor Refurbishments at the Cape Flats and Mitchells Plain WWTW, ECO during the refurbishment, 2020 - 2021, R145 000
- Victoria & Alfred Waterfront (Pty) Ltd, V&A Revetment Upgrades, ECO during repair works on the Revetments, 2020, R35 000.
- Water & Wastewater Engineering (Pty) Ltd, Athlone WWTW Blower House Complex Demolition ECO, ECO during the demolition works, 2020 – 2021, R220 000.
- Coega Development Corporation (on behalf of NDPW), St Helena Bay Fishing Harbour ECO during maintenance dredging. 2019 – 2021, R70 000.
- Coega Development Corporation (on behalf of NDPW), Hout Bay Fishing Harbour ECO during maintenance dredging. 2019 – 2020, R75 000.
- Coega Development Corporation (on behalf of NDPW), Gordon’s Bay Fishing Harbour ECO during maintenance dredging. 2019 – 2020, R75 000.
- Coega Development Corporation (on behalf of NDPW), Lambert’s Bay Fisheries Harbour ECO during maintenance dredging. 2019 – 2021, R70 000.
- Department of Agriculture, Forestry and Fisheries (DAFF), ECO for operational phase Aquaculture Development Zone, Saldanha Bay. 2019 – 2020, R200 000.
- Evergreen Developments, ECO for construction phase of Evergreen Lifestyle Estate, Paarl, 2018 – 2019.
- Val de Vie Investments, ECO for construction phase of River Club Residential Precinct, Paarl, 2018 – 2019.
- Val de Vie Investments, ECO for construction phase of Pearl Valley Phase II Estate, Paarl, 2018 – 2019.
- Copperton Wind Farm, ECO for construction phase of Copperton Wind Farm, Northern Cape, 2018 – 2019.

Environmental Compliance Audits

- Astron Energy (Pty) Ltd, Waste Management Licence External Compliance Audit: Astron Energy, Milnerton Refinery, 2022, R75 000.
- Tronox Mineral Sands (Pty) Ltd, Fines Dam 6 Environmental Compliance Audits, January 2020, R100 000.
- Astron Energy, EA Audits for Various Astron Energy Projects, Milnerton, Western Cape, 2019, R215 000.

Atmospheric Emission Licences (AEL)

- Transnet, AEL Variation for Iron Ore Terminal, Port of Saldanha, Western Cape, 2019, R40 000.

Kelly Armstrong
Environmental Consultant

Water Use Licences (WUL)

- Eskom Holdings SOC Ltd, BA for the Single Circuit Powerline from Ceres to Witzenberg Substations, Witzenberg Local Municipality, Western Cape, 2020 -2021, R435 000.
- Human Settlements Holistic Services, Charlesville Low Cost Housing General Authorisation, 2019 – ongoing, R150 000.

Visual Impact Assessments (VIA)

- SiVEST SA (Pty) Ltd, Visual Impact Assessment for Lesaka SPV Facility, Loeriesfontein, Northern Cape, 2022, R120 000.
- SiVEST SA (Pty) Ltd, Visual Impact Assessment for Hendrina North 132 kV Powerline and Substation, Hendrina, Mpumalanga Province, 2022, R60 000.
- SiVEST SA (Pty) Ltd, Visual Impact Assessment (including Glint and Glare) for Bonsmara PV and Associated Infrastructure, Kroonstad, Free State Province, 2022, R72 000.
- Mainstream Renewable Power South Africa (Pty) Ltd, Visual Impact Assessment for the Hanover PV and WEF Cluster, Hanover, Northern Cape, 2022 – ongoing, R141 000
- Mainstream Renewable Power South Africa (Pty) Ltd, Visual Impact Assessment for the Stilfontien SPV Cluster and Associated Infrastructure, Stilfontein, North West Province, 2022, R95 000.
- Oceana Group Limited, Visual Impact Assessment for Oceana's 10 MW SPV Facility in St Helena Bay, Western Cape, 2021 – ongoing, R70 000.
- The Environmental Partnership, VIA for the Wingfield Interchange Upgrade BA, Cape Town, Western Cape, 2021, R56 000.
- Mineral Sand Resources (Pty) Ltd, VIA for the Tormin Mine Expansion EIA, Matzikama Local Municipality, Western Cape, 2021, R131 166.
- Mineral Sand Resources (Pty) Ltd, Visual Specialist Study for the De Punt Baseline Study, Matzikama Local Municipality, Western Cape, 2021, R95 466

Appendix B Specialist Declaration of Independence

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Proposed development the Stilfontein Cluster, North West Province, with separate EA applications for:
- Nine Photovoltaic (PV) facilities and associated infrastructure: Spoonbill, Sunbird, Swallow, Snipe, Shrike, Stilfontein, Sparrow, Starling and Swift;
- Three collector substations and associated infrastructure: Voelnessie A, Voelnessie B, Voelnessie C; and
- One Main Transmission Substation and associated infrastructure.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	SRK Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	1	Percentage Procurement recognition	135%
Specialist name:	Kelly Armstrong			
Specialist Qualifications:	BSocSc (Hons) Environmental Science			
Professional affiliation/registration:	N/A			
Physical address:	Albion Spring, 183 Main Road, Rondebosch, 7700			
Postal address:	Postnet Suite #206, P Bag X18, Rondebosch, 7701			
Postal code:	7700	Cell:	076 114 9254	
Telephone:	021 659 3060	Fax:	086 530 7003	
E-mail:	karmstrong@srk.co.za			

2. DECLARATION BY THE SPECIALIST

I, ______Kelly Armstrong_______, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Armstrong

Signature of the Specialist

SRK Consulting

Name of Company:

~~15~~ 17 June 2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, ____Kelly Armstrong____________________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Armstrong

Signature of the Specialist

SRK Consulting

Name of Company

17 June 2022

Date

7235569-7

Signature of the Commissioner of Oaths

2022-06-17

Date

SUID-AFRIKAANSE POLISIEDIENS
STASIEBEVELVOERDER
17 -06- 2022
STATION COMMANDER
RONDEBOSCH, K.P/C.P.
SOUTH AFRICAN POLICE SERVICES

Appendix C Impact Assessment Methodology

Impact Rating Methodology

The assessment of impacts will be based on specialists' expertise, SRK's professional judgement, field observations and desk-top analysis.

The significance of potential impacts that may result from the proposed project will be determined in order to assist decision-makers (typically by a designated authority or state agency, but in some instances, the proponent).

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur.

The criteria used to determine impact consequence are presented in the table below.

Table 1: Criteria used to determine the consequence of the impact

Rating	Definition of Rating	Score
A. Extent – *the area over which the impact will be experienced*		
Local	Confined to project or study area or part thereof (e.g. project areas)	1
Regional	The region, which may be defined in various ways, e.g. cadastral, catchment, topographic	2
(Inter) national	Nationally or beyond	3
B. Intensity – *the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources*		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration – *the timeframe over which the impact will be experienced and its reversibility*		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Table 2: Method used to determine the consequence score

Combined Score (A+B+C)	3 – 4	5	6	7	8
Consequence Rating	Very Low	Low	Medium	High	Very High

Once the consequence will be derived, the probability of the impact occurring will be considered, using the probability classifications presented in the table below.

Table 3: Probability classification

Probability – the likelihood of the impact occurring	
Improbable	<40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	>70% - 90% chance of occurring
Definite	>90% chance of occurring

The overall **significance** of impacts will be determined by considering consequence and probability using the rating system prescribed in the table below.

Table 4: Impact significance ratings

		Probability			
		Improbable	**Possible**	**Probable**	**Definite**
Consequence	Very Low	**INSIGNIFICANT**	**INSIGNIFICANT**	**VERY LOW**	**VERY LOW**
	Low	**VERY LOW**	**VERY LOW**	**LOW**	**LOW**
	Medium	**LOW**	**LOW**	**MEDIUM**	**MEDIUM**
	High	**MEDIUM**	**MEDIUM**	**HIGH**	**HIGH**
	Very High	**HIGH**	**HIGH**	**VERY HIGH**	**VERY HIGH**

Finally, the impacts will be also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below.

Table 5: Impact status and confidence classification

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit') - ve (negative – a 'cost')
Confidence of assessment	
The degree of confidence in predictions based on available information, SRK's judgement and/or specialist knowledge.	Low Medium High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.
- **HIGH**: the potential impact **will** affect the decision regarding the proposed activity/development.
- **VERY HIGH**: The proposed activity should only be approved under special circumstances.

In the VIA, practicable mitigation and optimisation measures will be recommended and impacts will be rated in the prescribed way both without and with the assumed effective implementation of mitigation and optimisation measures. Mitigation and optimisation measures will either be:

- **Essential**: best practice measures which must be implemented and are non-negotiable; and
- **Best Practice**: recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the proponent if not implemented.

Negative impacts (with mitigation) rated high or very high will be shaded in red, while positive impacts (with optimisation) rated high or very high will be shaded green.

Appendix D Viewpoint Photographs

Viewpoint 1 (N12 East) looking west towards the Stilfontein PV Cluster in the background

Viewpoint 2 (Unnamed Road East) looking west towards the Stilfontein PV Cluster (not visible)

Note: The white line indicates the approximate location of the Stilfontein PV Cluster.

Viewpoint 3 (Unnamed Road East) looking west towards the Stilfontein PV Custer (not visible)

Viewpoint 4 (R502 Bridge) looking north-west towards the Stilfontein PV Cluster in the background

Viewpoint 5 (N12) looking north towards the Stilfontein PV Cluster in the middleground

Viewpoint 6 (Vermaasdrift Road Farmstead) looking east towards Stilfontein PV Cluster in the background

Viewpoint 7 (Vermaasdrift Road North 1) looking east towards the Stilfontein PV Cluster (not visible)

Viewpoint 8 (Vermaasdrift Road Frontier Shooting Range) looking east towards the Stilfontein PV Cluster (not visible)

Source: Google Earth Street View, verified by SRK site visit.

Viewpoint 9 (Vermaasdrift Road Camp Louico) looking south-east towards the Stilfontein PV Cluster in the background

Viewpoint 10 (Khora Lion Park) looking south-east towards the Stilfontein PV Cluster in the background

Viewpoint 11 (Northern Farmsteads) looking southeast towards the Stilfontein PV Cluster in the background

Viewpoint 12 (Northern Farmsteads) looking south towards the Stilfontein PV Cluster in the background

Viewpoint 13 (Northern Farmsteads) looking south towards the Stilfontein PV Cluster in the background

Viewpoint 14 (Khuma Residential Area) looking north towards the Stilfontein PV Cluster (not visible)

Viewpoint 15 (Intersection of Vermaasdrift and N12) looking north east towards the Stilfontein PV Cluster in the background

Viewpoint 16 (R502) looking north east towards the Stilfontein PV Cluster in the background

Viewpoint 17 (N12) looking northeast towards the Stilfontein PV Cluster in the middleground

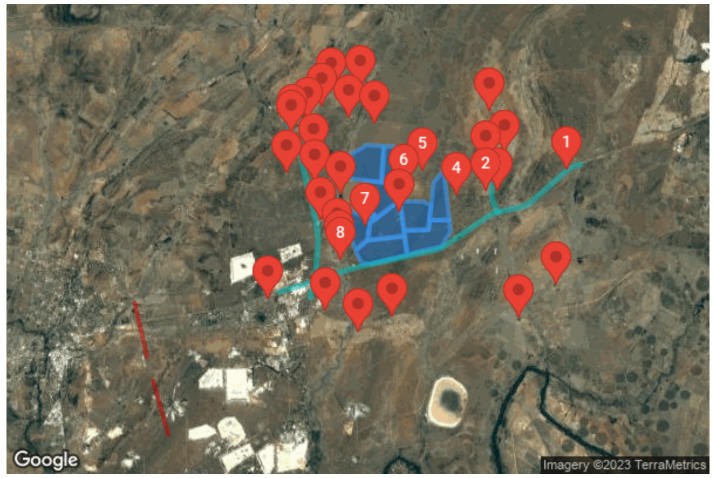
Viewpoint 18 (N12) looking north towards the Stilfontein PV Cluster in the middleground

Appendix E Glare Report

FORGESOLAR GLARE ANALYSIS

Project: **Mainstream Stilfontein PV Cluster**
Site configuration: **Stilfontein Cluster**

Created 13 Jan, 2023
Updated 16 Jan, 2023
Time-step 1 minute
Timezone offset UTC2
Site ID 82366.14583
Category 1 MW to 5 MW
DNI peaks at 2,200.0 W/m^2
Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Summary of Results Glare with potential for temporary after-image predicted

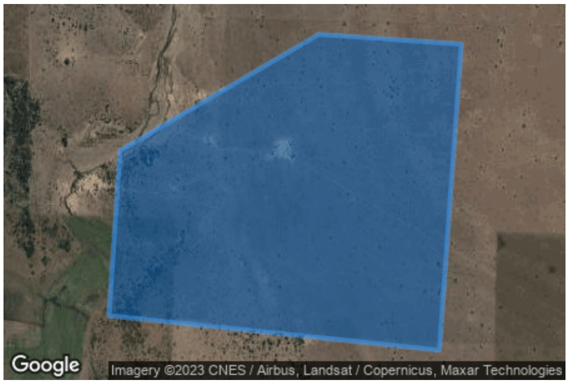
PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
1 - Spoonbill PV	SA tracking	SA tracking	2,154	35.9	3,715	61.9	-
2 - Sunbird PV	SA tracking	SA tracking	198,904	3,315.1	79,499	1,325.0	-
3 - Swallow PV	SA tracking	SA tracking	193,730	3,228.8	72,054	1,200.9	-
4 - Snipe	SA tracking	SA tracking	5,193	86.5	8,703	145.1	-
5 - Shrike PV	SA tracking	SA tracking	7,401	123.3	13,658	227.6	-
6 - Stilfontein PV	SA tracking	SA tracking	10,436	173.9	12,520	208.7	-
7 - Sparrow PV	SA tracking	SA tracking	9,486	158.1	18,106	301.8	-
8 - Starling PV	SA tracking	SA tracking	932	15.5	527	8.8	-
9 - Swift PV	SA tracking	SA tracking	19,079	318.0	7,421	123.7	-

Total annual glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
N12	7,811	130.2	17,063	284.4

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Road East	1,372	22.9	1,114	18.6
Road West	4,025	67.1	3,678	61.3
FP 1	0	0.0	0	0.0
FP 2	0	0.0	0	0.0
OP 1	802	13.4	167	2.8
OP 2	1,034	17.2	690	11.5
OP 3	1,027	17.1	522	8.7
OP 4	1,942	32.4	2,120	35.3
OP 5	2,491	41.5	5,602	93.4
OP 6	3,570	59.5	17,058	284.3
OP 7	195,222	3,253.7	73,277	1,221.3
OP 8	1,882	31.4	830	13.8
OP 9	2,039	34.0	2,083	34.7
OP 10	2,722	45.4	3,537	59.0
OP 11	3,681	61.4	1,826	30.4
OP 12	948	15.8	632	10.5
OP 13	4,961	82.7	1,554	25.9
OP 14	2,544	42.4	618	10.3
OP 15	1,828	30.5	788	13.1
OP 16	1,271	21.2	618	10.3
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	234	3.9	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	975	16.2	493	8.2
OP 23	0	0.0	0	0.0
OP 24	4,025	67.1	5,030	83.8
OP 25	3,162	52.7	1,139	19.0
OP 26	589	9.8	1,090	18.2
OP 27	190,833	3,180.6	70,607	1,176.8
OP 28	3,495	58.2	2,830	47.2
OP 29	0	0.0	0	0.0
OP 30	0	0.0	0	0.0
OP 31	2,340	39.0	1,237	20.6
OP 32	0	0.0	0	0.0
OP 33	490	8.2	0	0.0

Name: 5 - Shrike PV
Axis tracking: Single-axis rotation
Backtracking: Instant
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-26.773797	26.853468	1345.87	1.53	1347.40
2	-26.771689	26.830749	1391.25	1.53	1392.78
3	-26.761598	26.831514	1379.35	1.53	1380.88
4	-26.754477	26.845185	1352.64	1.53	1354.17
5	-26.755079	26.854981	1348.09	1.53	1349.62

Name: 6 - Stilfontein PV
Axis tracking: Single-axis rotation
Backtracking: Instant
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-26.774045	26.862604	1380.05	1.53	1381.58
2	-26.773802	26.853959	1367.10	1.53	1368.63
3	-26.755200	26.855414	1381.66	1.53	1383.19
4	-26.755291	26.861327	1388.44	1.53	1389.97
5	-26.764316	26.869669	1393.11	1.53	1394.64
6	-26.783602	26.864043	1383.37	1.53	1384.90

Route Receptors

Name: N12
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-26.764652	26.970264	1361.25	1.00	1362.25
2	-26.765917	26.965972	1362.08	1.00	1363.08
3	-26.767296	26.963140	1364.91	1.00	1365.91
4	-26.776454	26.951338	1370.20	1.00	1371.20
5	-26.784691	26.940781	1356.88	1.00	1357.88
6	-26.785687	26.939107	1354.75	1.00	1355.75
7	-26.786606	26.936618	1351.63	1.00	1352.63
8	-26.789901	26.920310	1343.12	1.00	1344.12
9	-26.790782	26.917864	1341.35	1.00	1342.35
10	-26.801929	26.899539	1372.72	1.00	1373.72
11	-26.807483	26.890398	1378.48	1.00	1379.48
12	-26.808326	26.888639	1376.64	1.00	1377.64
13	-26.809092	26.885892	1371.35	1.00	1372.35
14	-26.815373	26.854564	1343.62	1.00	1344.62
15	-26.818974	26.836325	1327.66	1.00	1328.66
16	-26.822957	26.822764	1331.47	1.00	1332.47
17	-26.827093	26.808945	1333.27	1.00	1334.27
18	-26.831229	26.794010	1351.30	1.00	1352.30

Name: Road East
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-26.763756	26.914708	1371.91	1.00	1372.91
2	-26.764944	26.915180	1368.52	1.00	1369.52
3	-26.766235	26.915664	1364.47	1.00	1365.47
4	-26.767585	26.916201	1360.22	1.00	1361.22
5	-26.768725	26.916662	1357.91	1.00	1358.91
6	-26.768898	26.916748	1357.77	1.00	1358.77
7	-26.769271	26.916995	1357.26	1.00	1358.26
8	-26.769626	26.917349	1357.11	1.00	1358.11
9	-26.769904	26.917746	1357.23	1.00	1358.23
10	-26.770210	26.918121	1356.69	1.00	1357.69
11	-26.770450	26.918314	1356.63	1.00	1357.63
12	-26.770727	26.918454	1356.45	1.00	1357.45
13	-26.771034	26.918540	1356.08	1.00	1357.08
14	-26.771484	26.918593	1355.66	1.00	1356.66
15	-26.771906	26.918625	1355.62	1.00	1356.62
16	-26.773103	26.918593	1355.02	1.00	1356.02
17	-26.774195	26.918604	1354.18	1.00	1355.18
18	-26.776446	26.918422	1353.12	1.00	1354.12
19	-26.779013	26.918239	1350.59	1.00	1351.59
20	-26.780440	26.918164	1349.13	1.00	1350.13
21	-26.784300	26.919130	1348.52	1.00	1349.52
22	-26.787575	26.920825	1346.80	1.00	1347.80
23	-26.789395	26.921758	1345.66	1.00	1346.66

Name: Road West
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-26.834067	26.812121	1344.71	1.00	1345.71
2	-26.832803	26.812207	1340.65	1.00	1341.65
3	-26.831386	26.812593	1340.09	1.00	1341.09
4	-26.829318	26.813709	1340.25	1.00	1341.25
5	-26.827863	26.814395	1337.51	1.00	1338.51
6	-26.826369	26.814781	1334.36	1.00	1335.36
7	-26.823804	26.814953	1333.26	1.00	1334.26
8	-26.815569	26.815640	1329.59	1.00	1330.59
9	-26.806836	26.816498	1331.46	1.00	1332.46
10	-26.804155	26.816713	1332.70	1.00	1333.70
11	-26.799329	26.816026	1333.75	1.00	1334.75
12	-26.795192	26.815511	1334.79	1.00	1335.79
13	-26.789139	26.813923	1339.23	1.00	1340.23
14	-26.780940	26.811692	1342.70	1.00	1343.70
15	-26.774121	26.809803	1345.32	1.00	1346.32
16	-26.766649	26.807829	1347.89	1.00	1348.89
17	-26.756725	26.805383	1349.05	1.00	1350.05
18	-26.751820	26.803881	1351.25	1.00	1352.25
19	-26.749980	26.802551	1356.24	1.00	1357.24
20	-26.746608	26.800405	1372.35	1.00	1373.35
21	-26.741894	26.798173	1381.24	1.00	1382.24
22	-26.739403	26.797014	1379.65	1.00	1380.65

Flight Path Receptors

Name: FP 1
Description:
Threshold height: 15 m
Direction: 166.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	-26.864883	26.716314	1348.25	15.24	1363.49
Two-mile	-26.836723	26.708960	1325.97	206.20	1532.17

Name: FP 2
Description:
Threshold height: 15 m
Direction: 344.2°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	-26.877553	26.719902	1358.17	15.24	1373.41
Two-mile	-26.905373	26.728738	1331.48	210.62	1542.10

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-26.767984	26.962695	1364.09	1.50
OP 2	2	-26.778815	26.915167	1354.65	1.50
OP 3	3	-26.778594	26.921980	1367.11	1.50
OP 4	4	-26.781350	26.898241	1392.67	1.50
OP 5	5	-26.768450	26.878030	1396.60	1.50
OP 6	6	-26.777102	26.867302	1391.70	1.50
OP 7	7	-26.796980	26.844102	1348.36	1.50
OP 8	8	-26.814934	26.830058	1330.14	1.50
OP 9	9	-26.811008	26.828964	1333.19	1.50
OP 10	10	-26.805157	26.827812	1334.25	1.50
OP 11	11	-26.774338	26.814591	1341.98	1.50
OP 12	12	-26.764316	26.914849	1370.64	1.50
OP 13	13	-26.769235	26.798132	1356.31	1.50
OP 14	14	-26.748873	26.801018	1363.01	1.50
OP 15	15	-26.745731	26.801672	1374.08	1.50
OP 16	16	-26.742174	26.810768	1365.99	1.50
OP 17	17	-26.740583	26.834983	1359.90	1.50
OP 18	18	-26.743515	26.849727	1369.08	1.50
OP 19	19	-26.734873	26.818749	1368.90	1.50
OP 20	20	-26.726853	26.824327	1374.70	1.50
OP 21	21	-26.725273	26.841657	1381.90	1.50
OP 22	22	-26.759334	26.926173	1388.33	1.50
OP 23	23	-26.841252	26.821340	1328.50	1.50
OP 24	24	-26.793852	26.818330	1336.02	1.50
OP 25	25	-26.760733	26.814519	1345.71	1.50
OP 26	26	-26.737136	26.917403	1408.18	1.50
OP 27	27	-26.789541	26.864312	1377.24	1.50
OP 28	28	-26.780485	26.829921	1347.61	1.50
OP 29	29	-26.852416	26.840317	1319.88	1.50
OP 30	30	-26.844127	26.860373	1327.58	1.50
OP 31	31	-26.835203	26.787427	1350.51	1.50
OP 32	32	-26.844886	26.934581	1316.32	1.50
OP 33	33	-26.827788	26.956168	1323.57	1.50

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
1 - Spoonbill PV	SA tracking	SA tracking	2,154	35.9	3,715	61.9	-
2 - Sunbird PV	SA tracking	SA tracking	198,904	3,315.1	79,499	1,325.0	-
3 - Swallow PV	SA tracking	SA tracking	193,730	3,228.8	72,054	1,200.9	-
4 - Snipe	SA tracking	SA tracking	5,193	86.5	8,703	145.1	-
5 - Shrike PV	SA tracking	SA tracking	7,401	123.3	13,658	227.6	-
6 - Stilfontein PV	SA tracking	SA tracking	10,436	173.9	12,520	208.7	-
7 - Sparrow PV	SA tracking	SA tracking	9,486	158.1	18,106	301.8	-
8 - Starling PV	SA tracking	SA tracking	932	15.5	527	8.8	-
9 - Swift PV	SA tracking	SA tracking	19,079	318.0	7,421	123.7	-

Total annual glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
N12	7,811	130.2	17,063	284.4
Road East	1,372	22.9	1,114	18.6
Road West	4,025	67.1	3,678	61.3
FP 1	0	0.0	0	0.0
FP 2	0	0.0	0	0.0
OP 1	802	13.4	167	2.8
OP 2	1,034	17.2	690	11.5
OP 3	1,027	17.1	522	8.7
OP 4	1,942	32.4	2,120	35.3
OP 5	2,491	41.5	5,602	93.4
OP 6	3,570	59.5	17,058	284.3
OP 7	195,222	3,253.7	73,277	1,221.3
OP 8	1,882	31.4	830	13.8
OP 9	2,039	34.0	2,083	34.7
OP 10	2,722	45.4	3,537	59.0
OP 11	3,681	61.4	1,826	30.4
OP 12	948	15.8	632	10.5

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 13	4,961	82.7	1,554	25.9
OP 14	2,544	42.4	618	10.3
OP 15	1,828	30.5	788	13.1
OP 16	1,271	21.2	618	10.3
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	234	3.9	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	975	16.2	493	8.2
OP 23	0	0.0	0	0.0
OP 24	4,025	67.1	5,030	83.8
OP 25	3,162	52.7	1,139	19.0
OP 26	589	9.8	1,090	18.2
OP 27	190,833	3,180.6	70,607	1,176.8
OP 28	3,495	58.2	2,830	47.2
OP 29	0	0.0	0	0.0
OP 30	0	0.0	0	0.0
OP 31	2,340	39.0	1,237	20.6
OP 32	0	0.0	0	0.0
OP 33	490	8.2	0	0.0

PV: 5 - Shrike PV potential temporary after-image

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
N12	765	12.8	1,468	24.5
Road East	1,083	18.1	1,110	18.5
Road West	14	0.2	0	0.0
FP 1	0	0.0	0	0.0
FP 2	0	0.0	0	0.0
OP 1	513	8.6	151	2.5
OP 2	750	12.5	601	10.0
OP 3	653	10.9	520	8.7
OP 4	343	5.7	1,614	26.9
OP 5	781	13.0	3,400	56.7
OP 6	389	6.5	2,341	39.0
OP 11	11	0.2	125	2.1
OP 12	540	9.0	605	10.1
OP 13	31	0.5	61	1.0
OP 22	554	9.2	493	8.2
OP 25	20	0.3	41	0.7
OP 26	430	7.2	1,090	18.2
OP 28	53	0.9	38	0.6
OP 14	11	0.2	0	0.0
OP 15	5	0.1	0	0.0
OP 33	455	7.6	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 29	0	0.0	0	0.0
OP 30	0	0.0	0	0.0

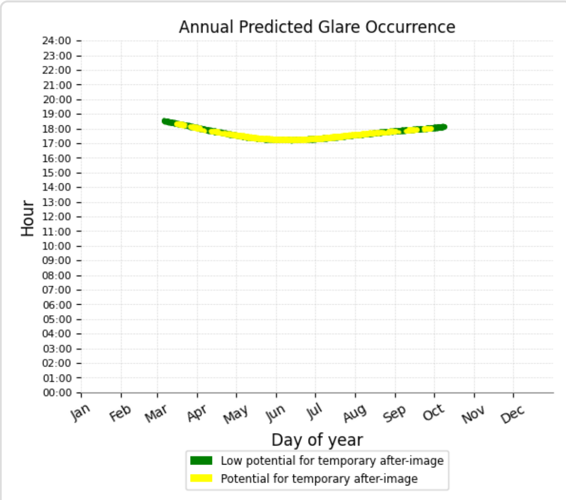
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 31	0	0.0	0	0.0
OP 32	0	0.0	0	0.0

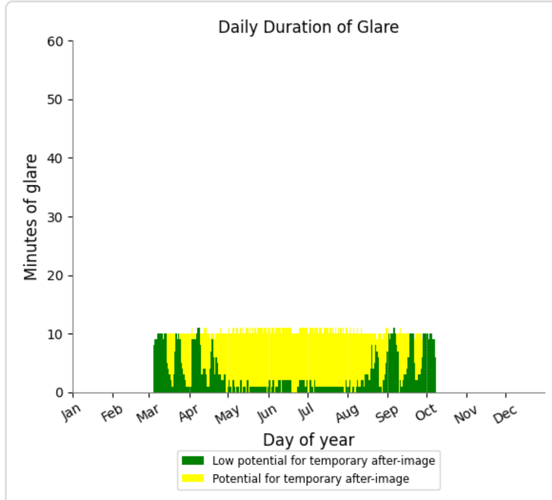
5 - Shrike PV and N12

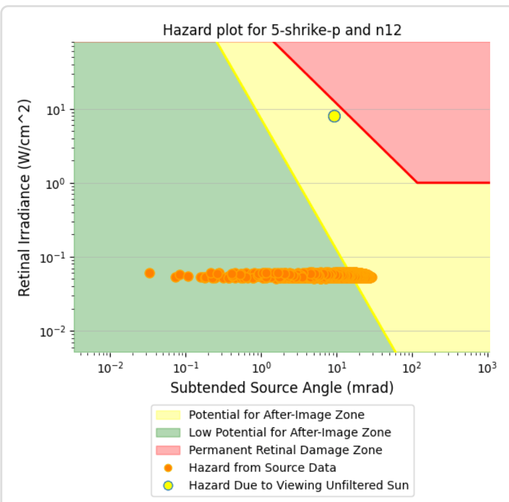
Receptor type: Route

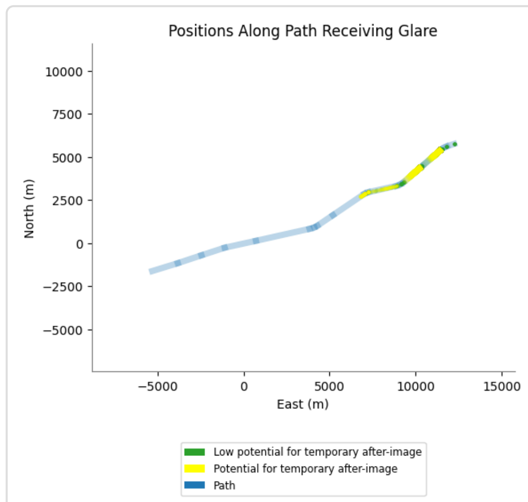
1,468 minutes of yellow glare

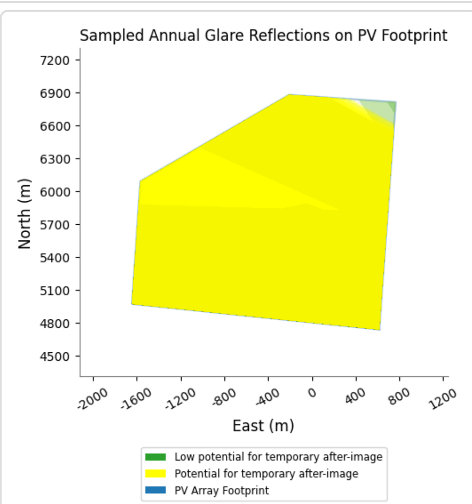
765 minutes of green glare









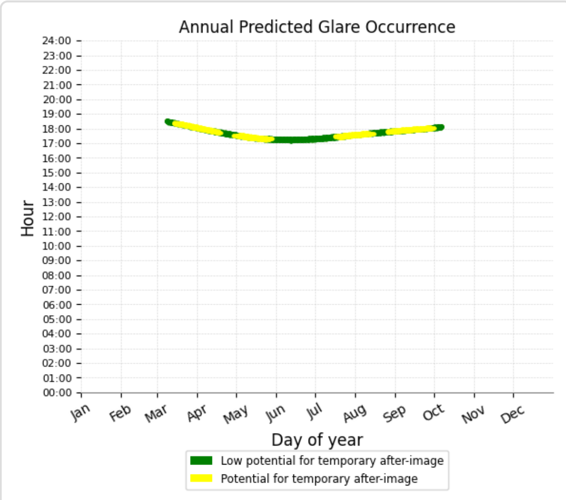


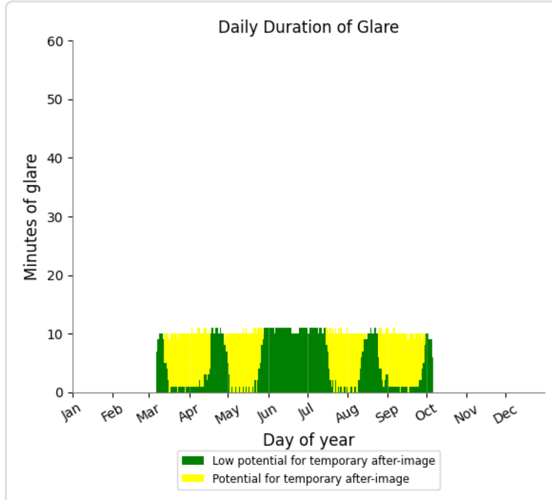
5 - Shrike PV and Road East

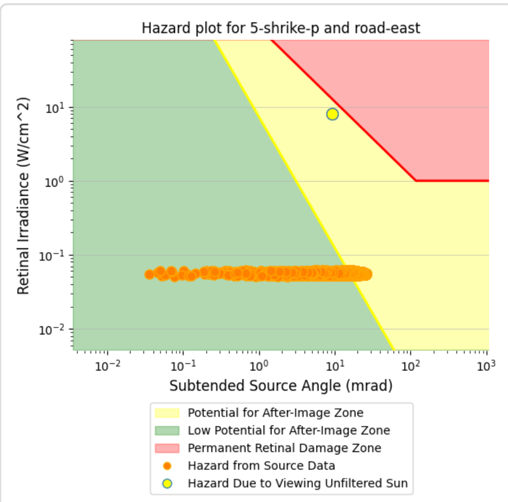
Receptor type: Route

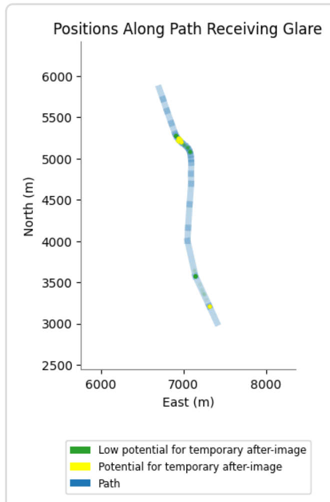
1,110 minutes of yellow glare

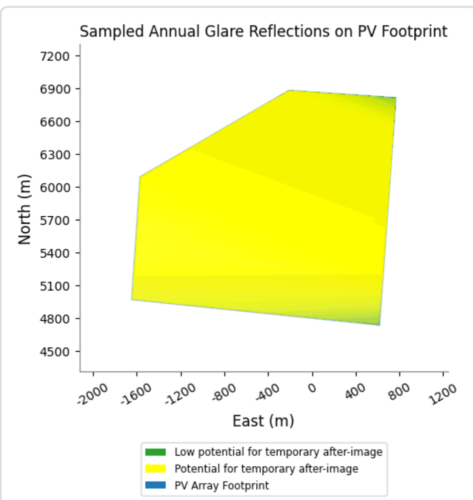
1,083 minutes of green glare









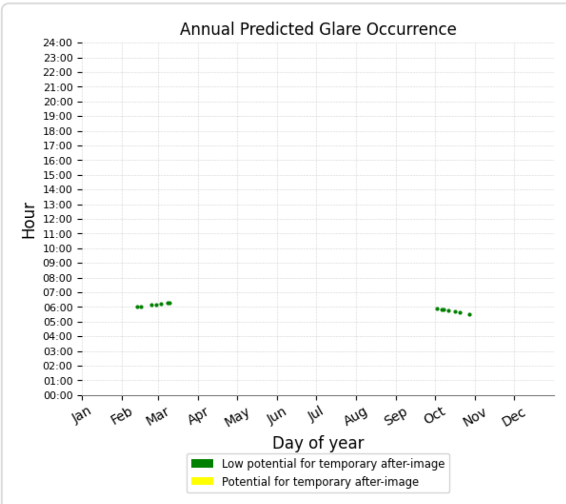


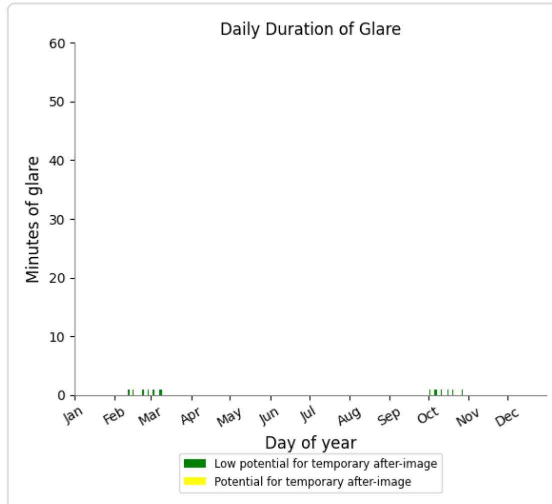
5 - Shrike PV and Road West

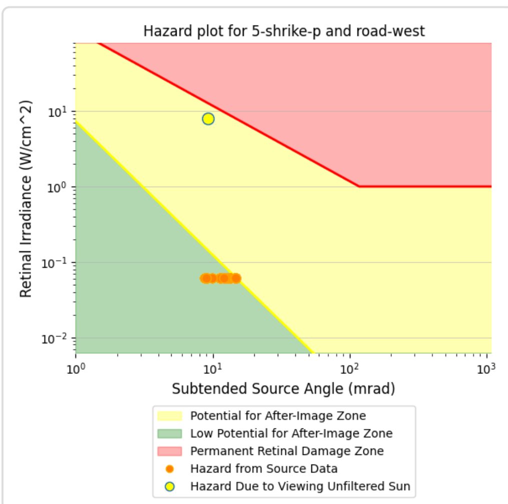
Receptor type: Route

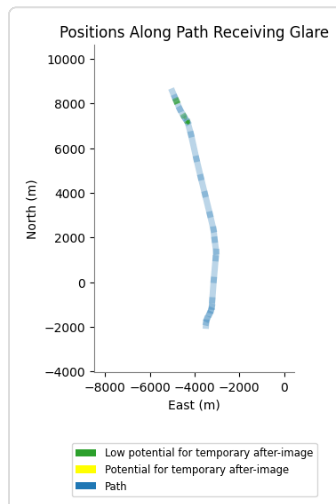
0 minutes of yellow glare

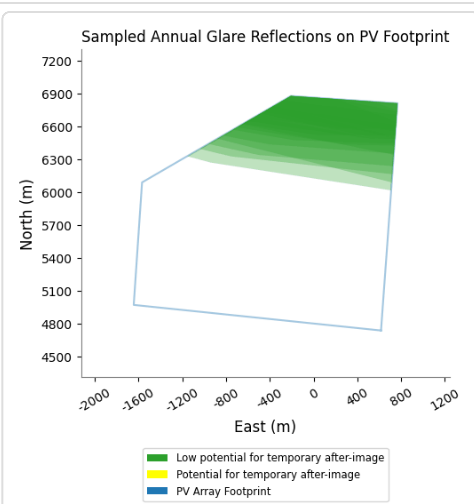
14 minutes of green glare











5 - Shrike PV and FP 1

Receptor type: 2-mile Flight Path

No glare found

5 - Shrike PV and FP 2

Receptor type: 2-mile Flight Path

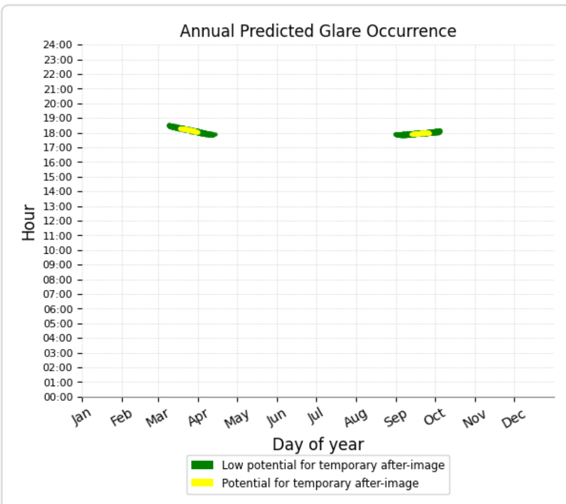
No glare found

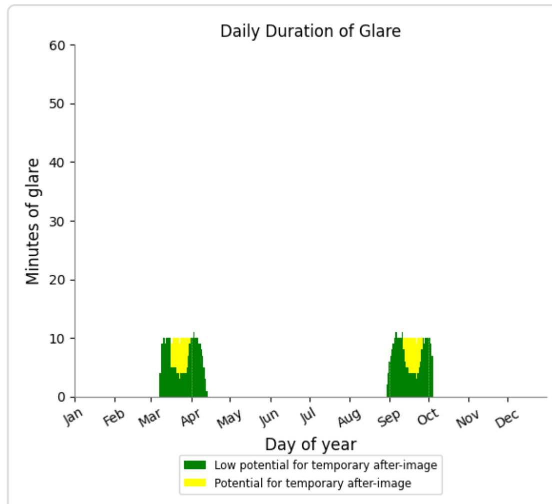
5 - Shrike PV and OP 1

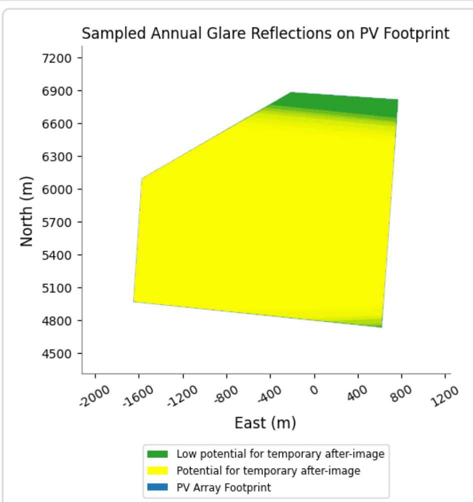
Receptor type: Observation Point

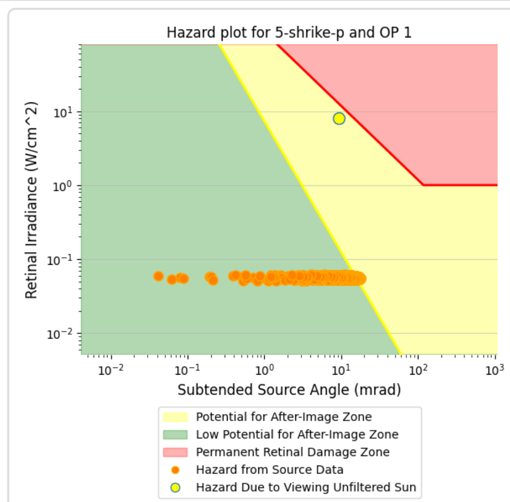
151 minutes of yellow glare

513 minutes of green glare







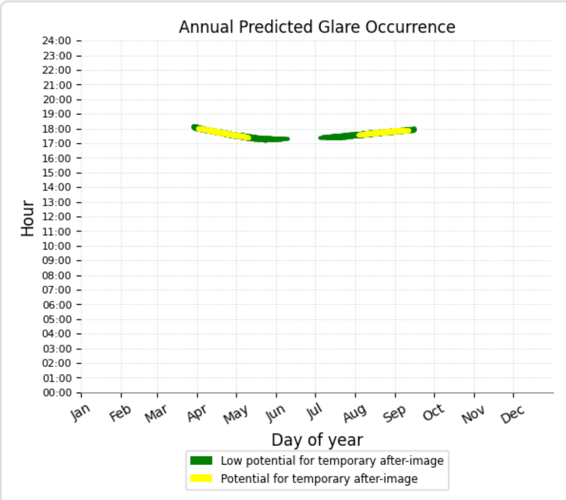


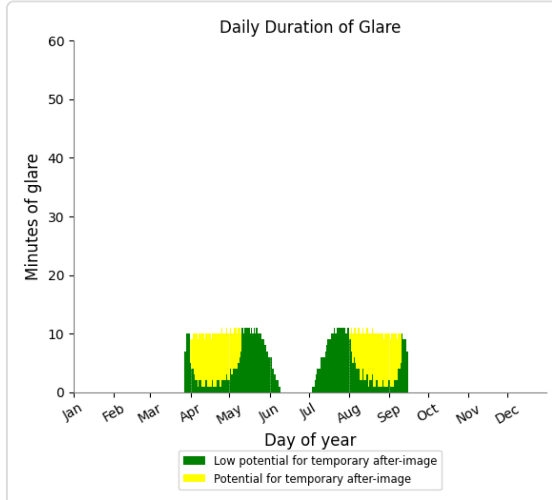
5 - Shrike PV and OP 2

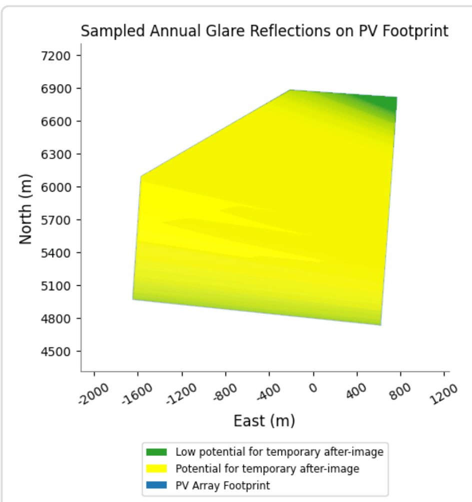
Receptor type: Observation Point

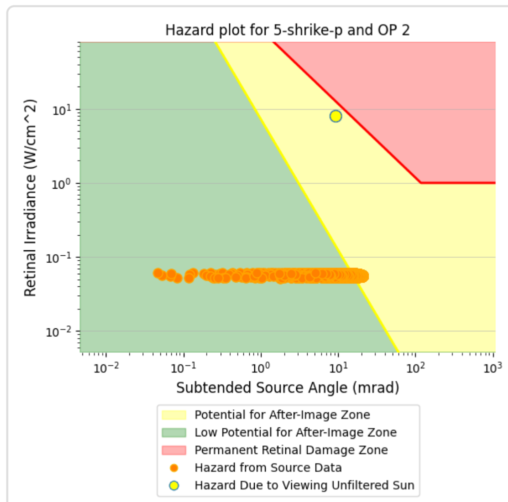
601 minutes of yellow glare

750 minutes of green glare



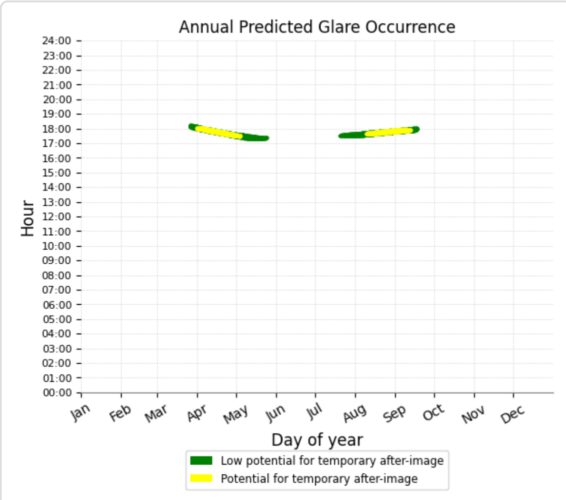


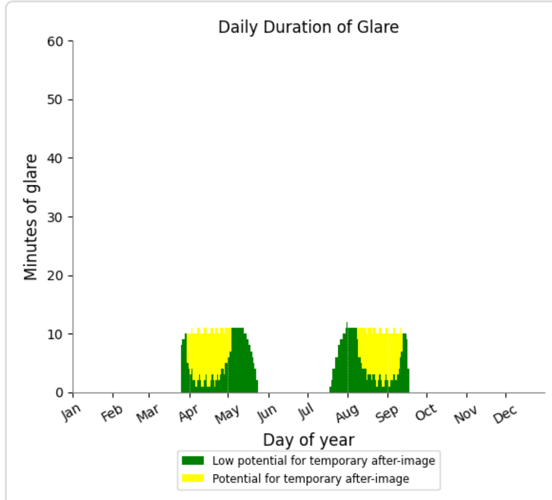


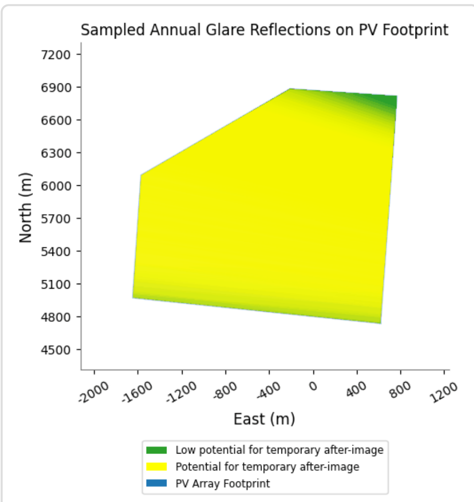


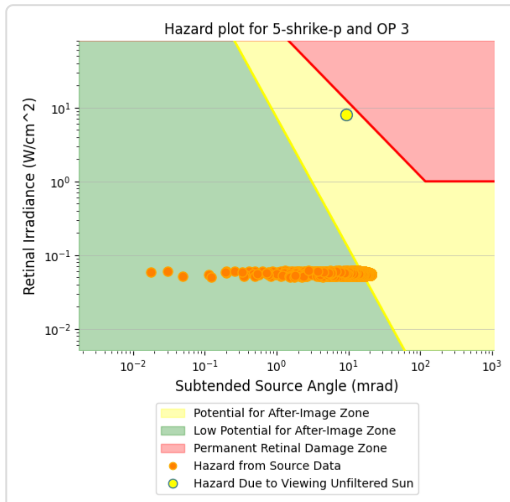
5 - Shrike PV and OP 3

Receptor type: Observation Point
520 minutes of yellow glare
653 minutes of green glare







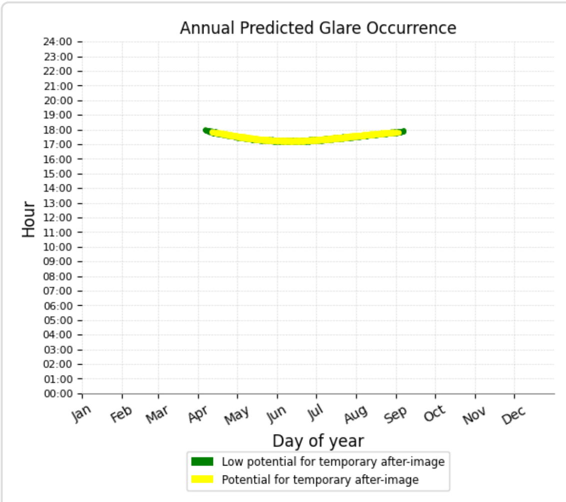


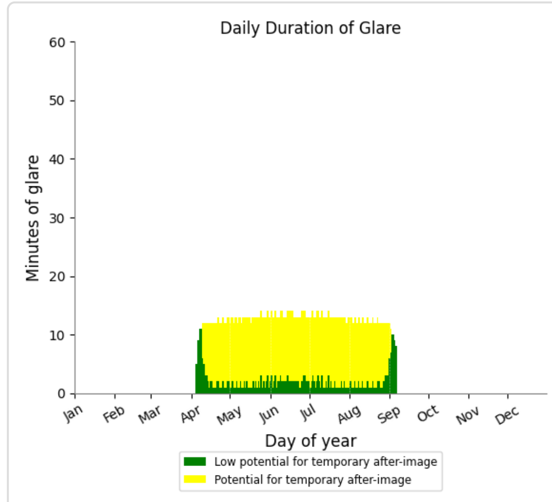
5 - Shrike PV and OP 4

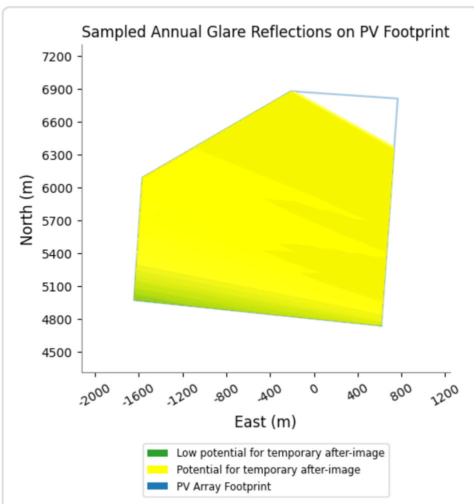
Receptor type: Observation Point

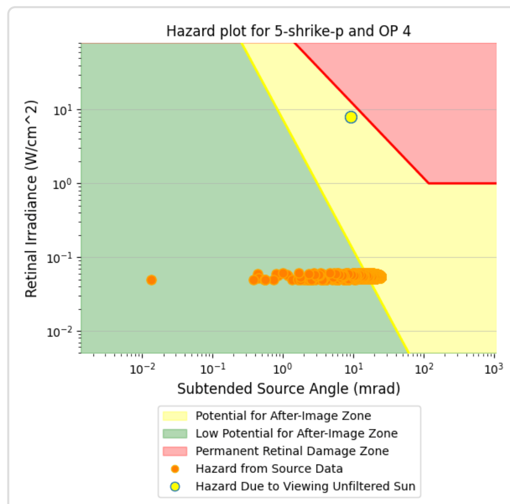
1,614 minutes of yellow glare

343 minutes of green glare







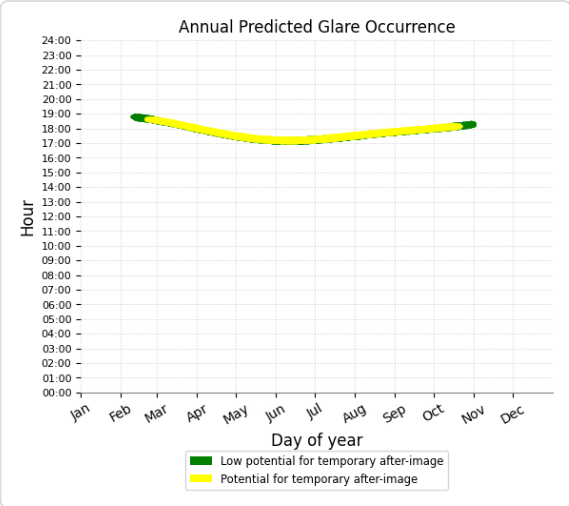


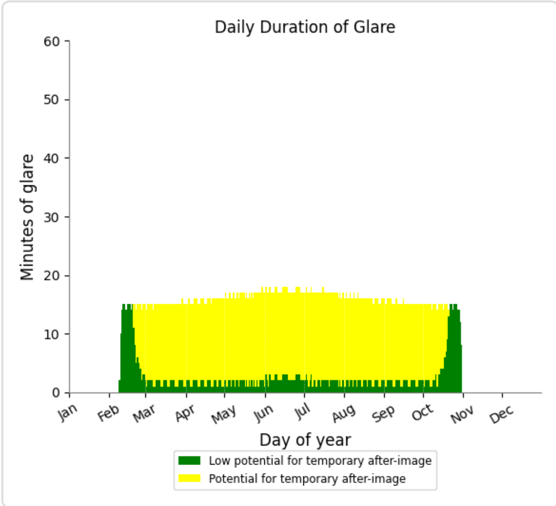
5 - Shrike PV and OP 5

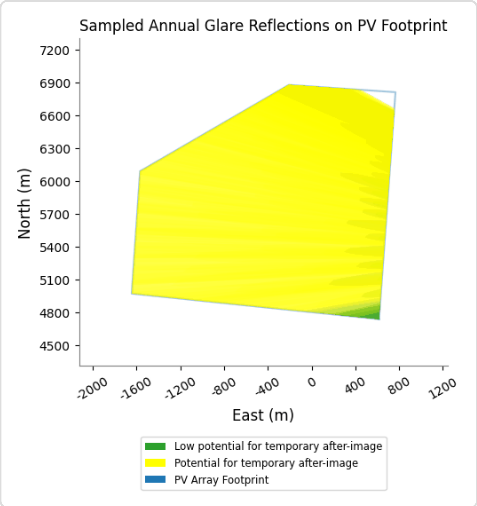
Receptor type: Observation Point

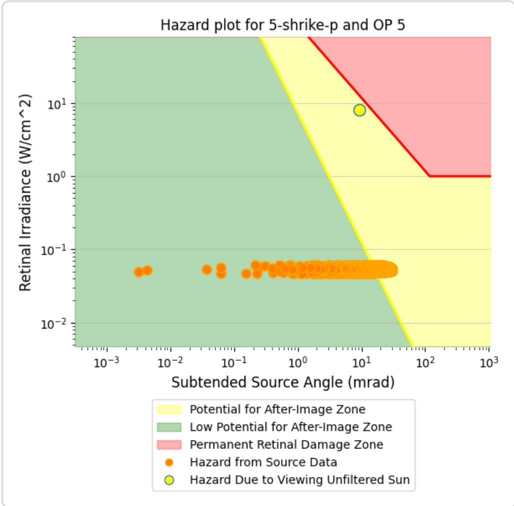
3,400 minutes of yellow glare

781 minutes of green glare







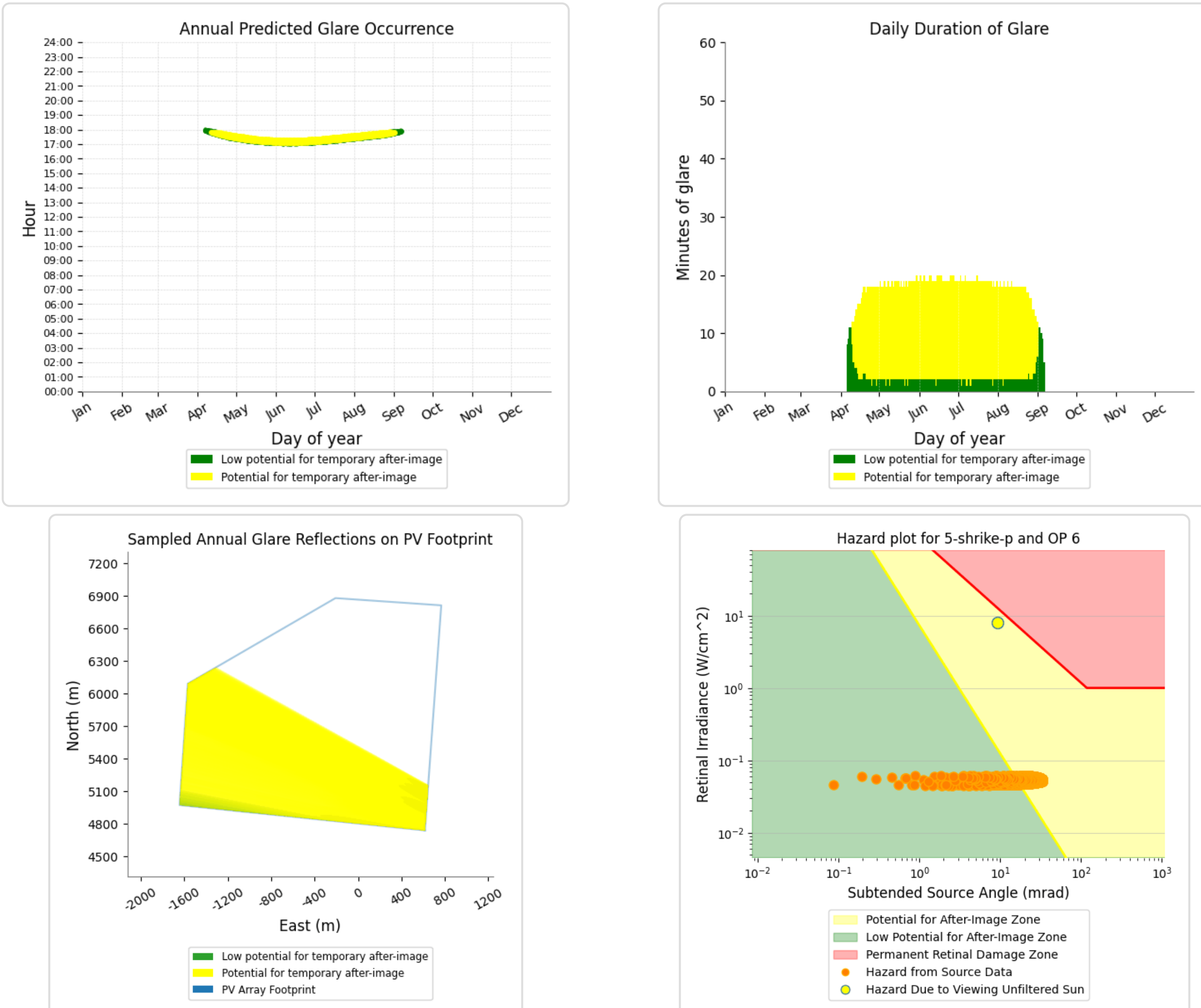


5 - Shrike PV and OP 6

Receptor type: Observation Point

2,341 minutes of yellow glare

389 minutes of green glare

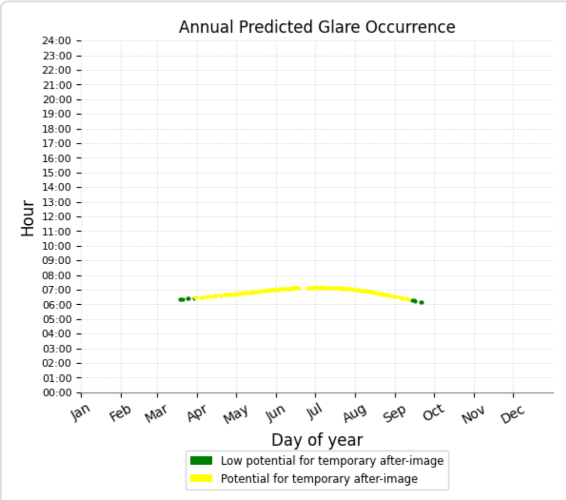


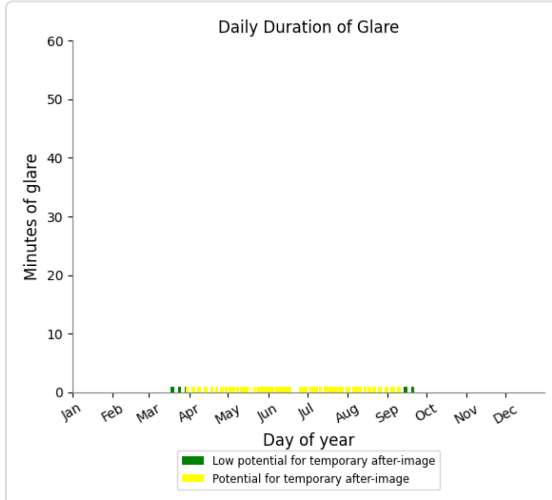
5 - Shrike PV and OP 11

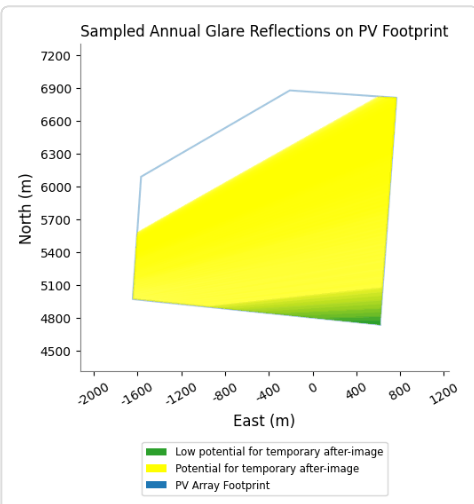
Receptor type: Observation Point

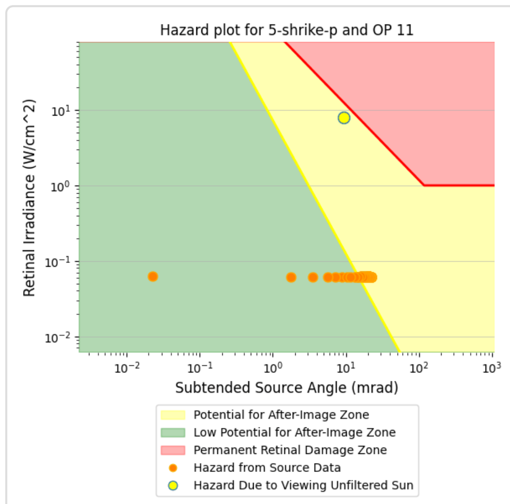
125 minutes of yellow glare

11 minutes of green glare







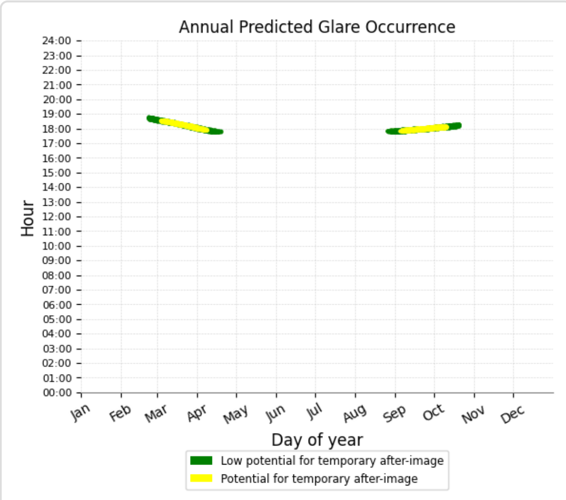


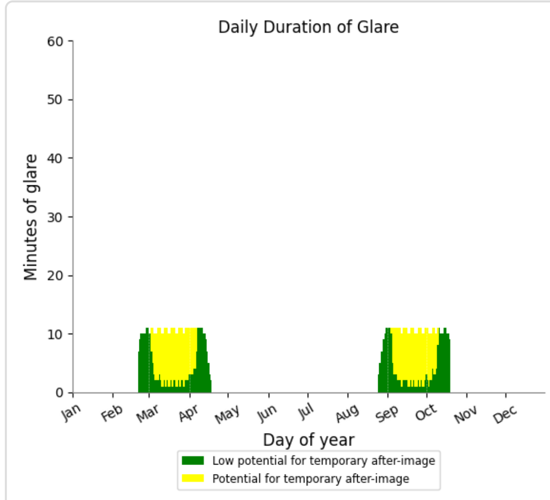
5 - Shrike PV and OP 12

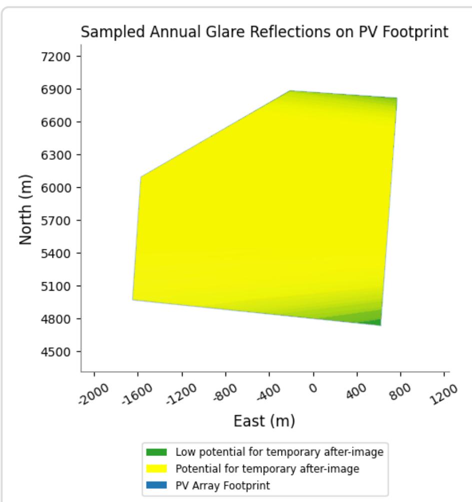
Receptor type: Observation Point

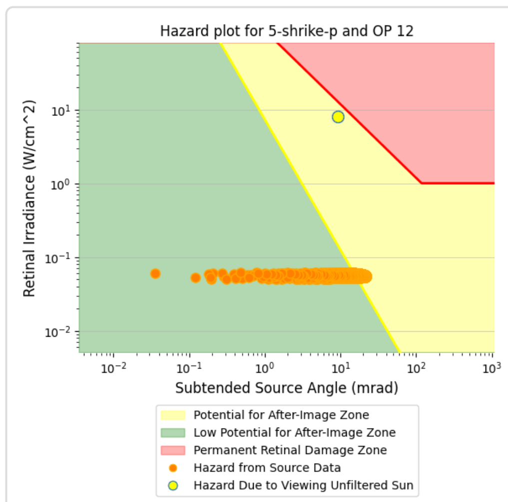
605 minutes of yellow glare

540 minutes of green glare







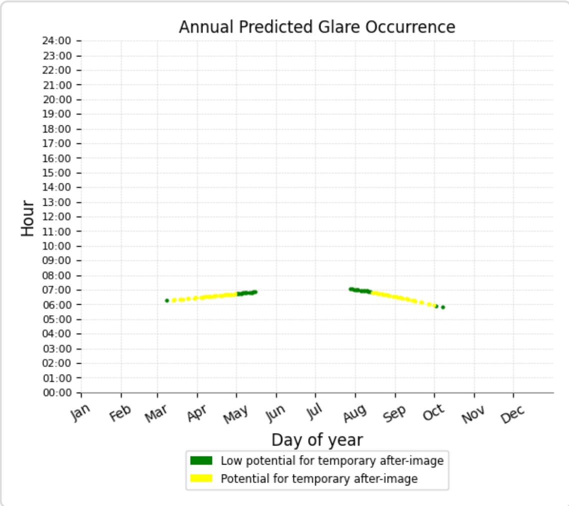


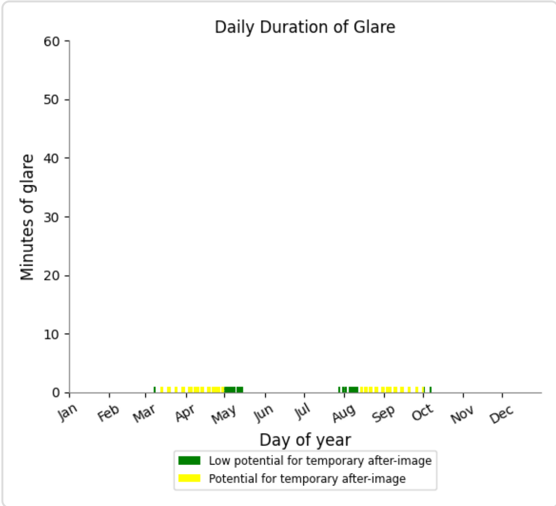
5 - Shrike PV and OP 13

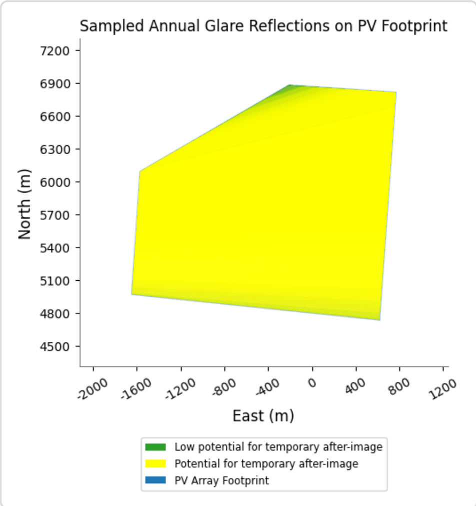
Receptor type: Observation Point

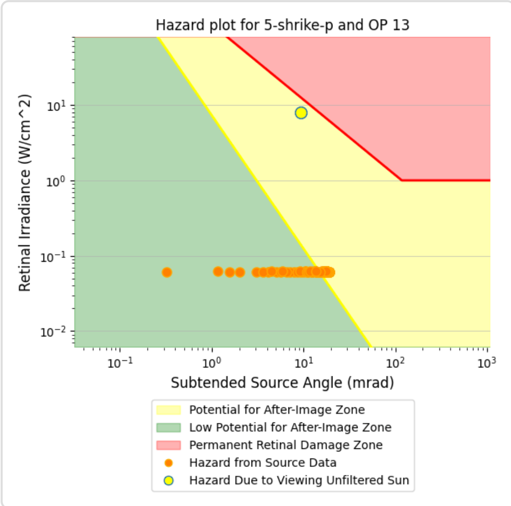
61 minutes of yellow glare

31 minutes of green glare







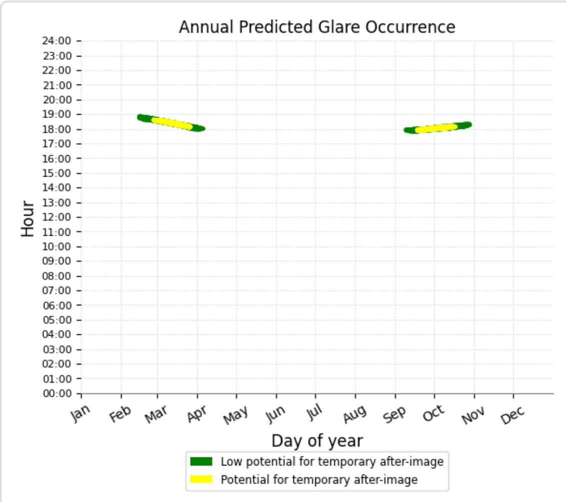


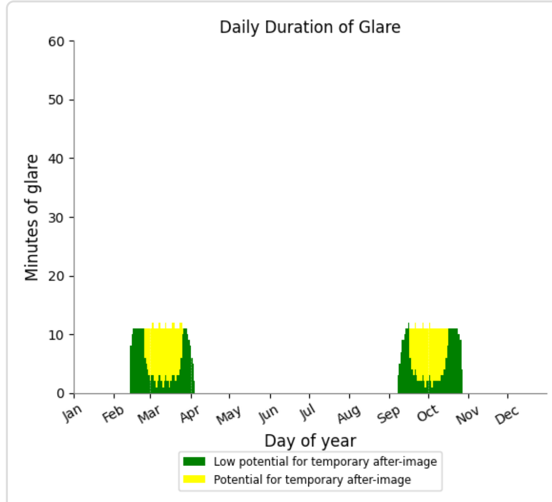
5 - Shrike PV and OP 22

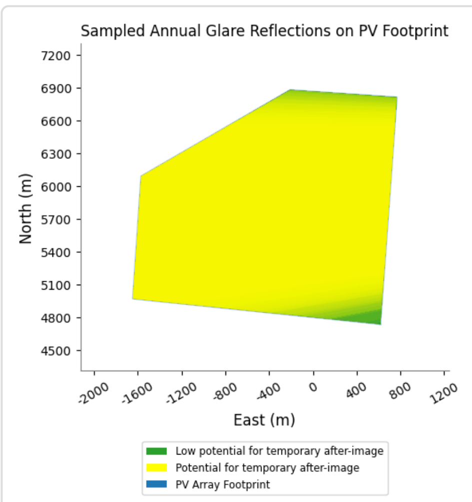
Receptor type: Observation Point

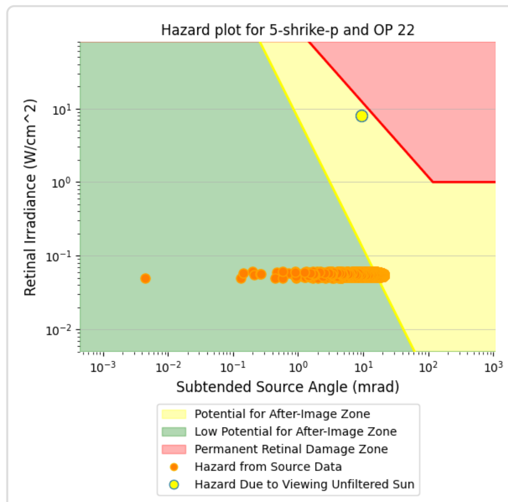
493 minutes of yellow glare

554 minutes of green glare







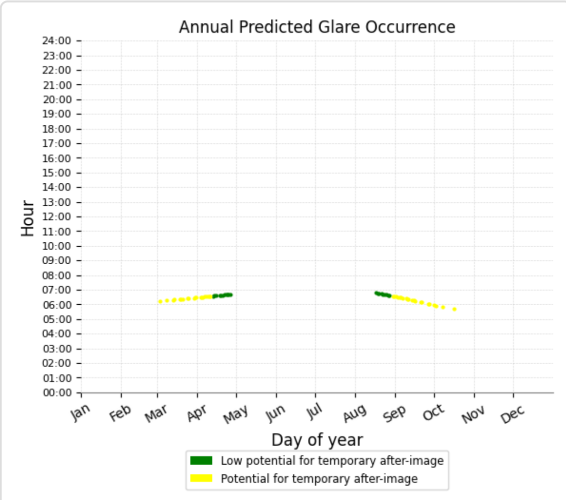


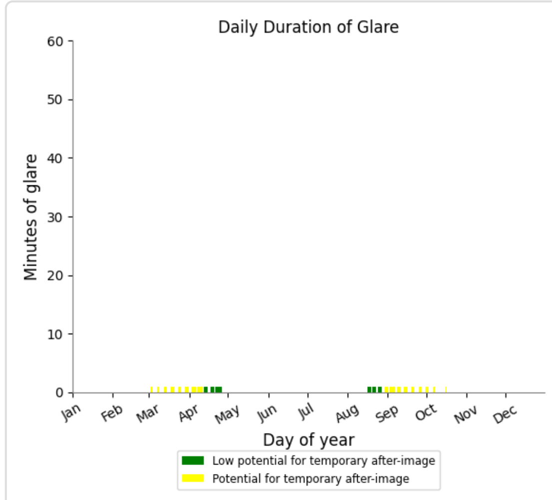
5 - Shrike PV and OP 25

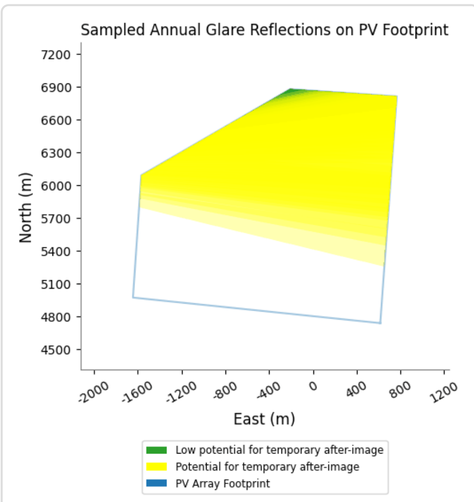
Receptor type: Observation Point

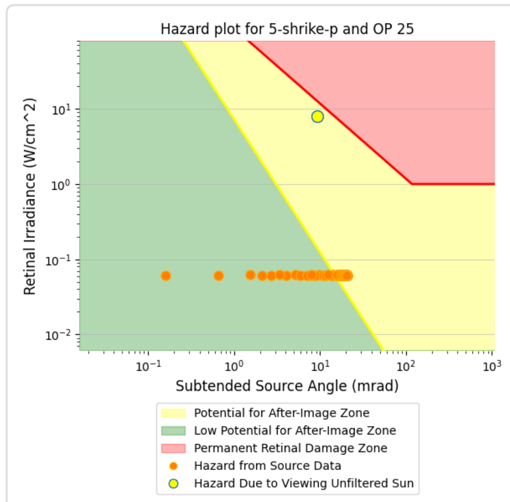
41 minutes of yellow glare

20 minutes of green glare







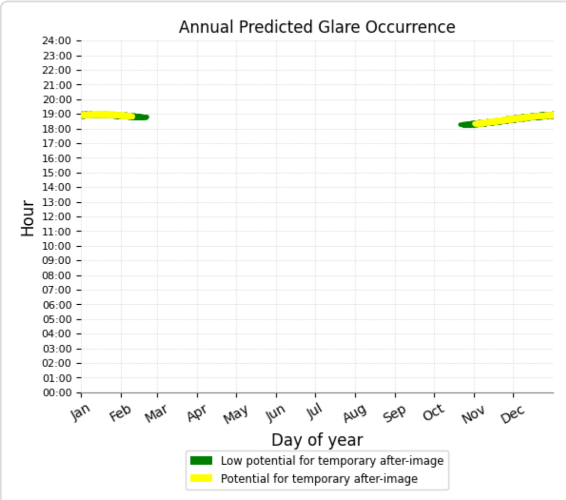


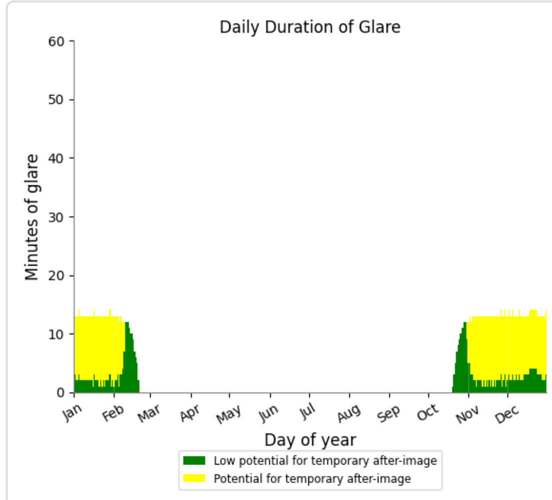
5 - Shrike PV and OP 26

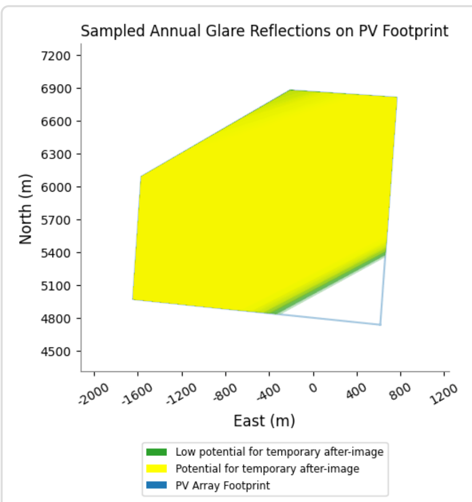
Receptor type: Observation Point

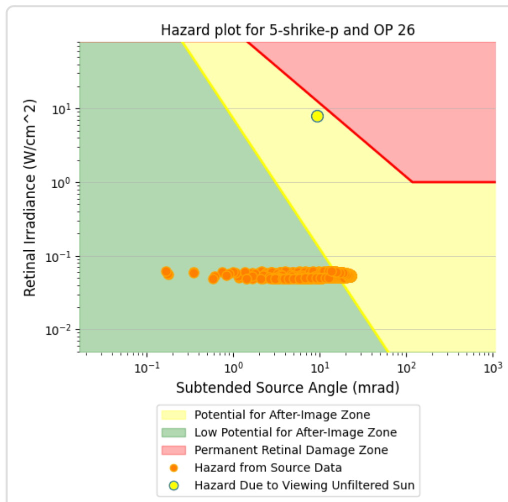
1,090 minutes of yellow glare

430 minutes of green glare







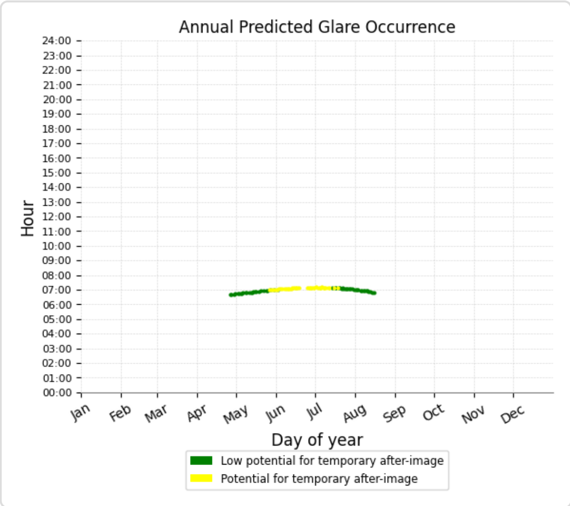


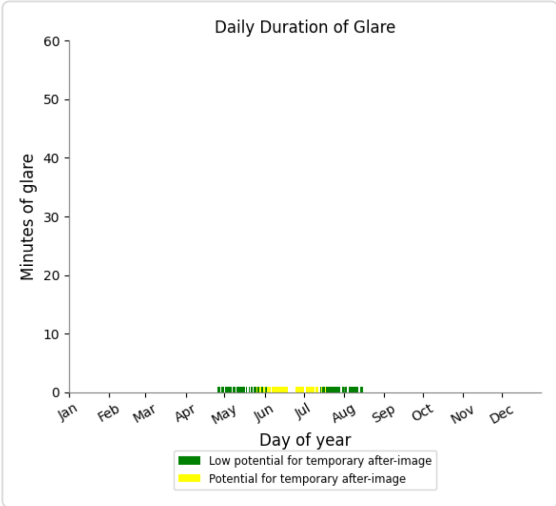
5 - Shrike PV and OP 28

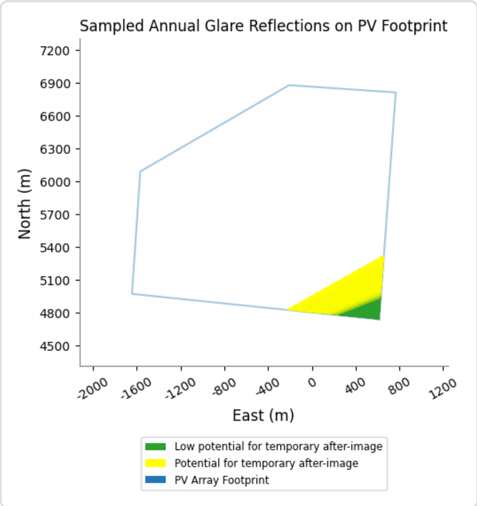
Receptor type: Observation Point

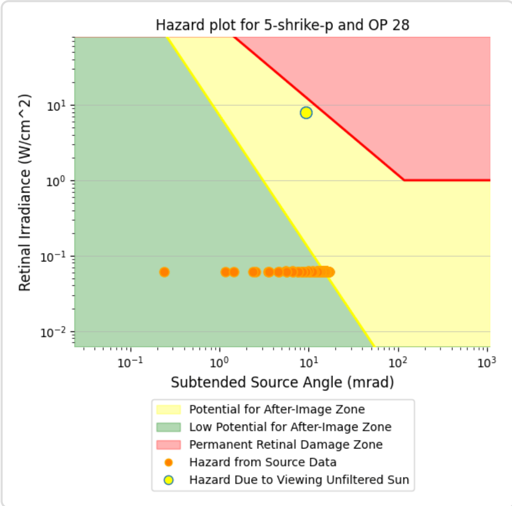
38 minutes of yellow glare

53 minutes of green glare







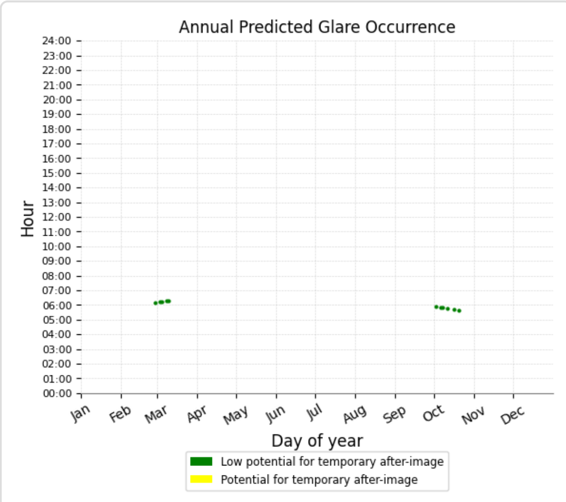


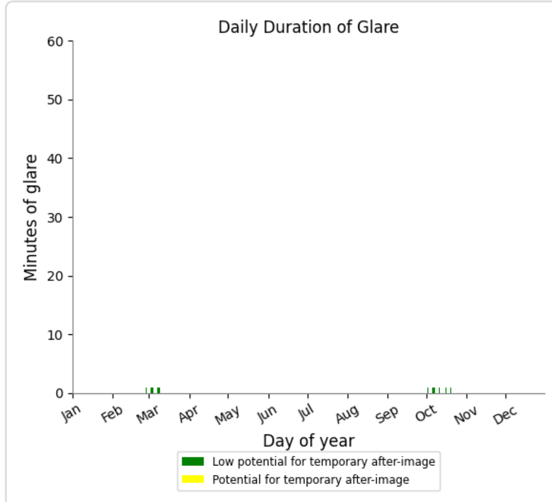
5 - Shrike PV and OP 14

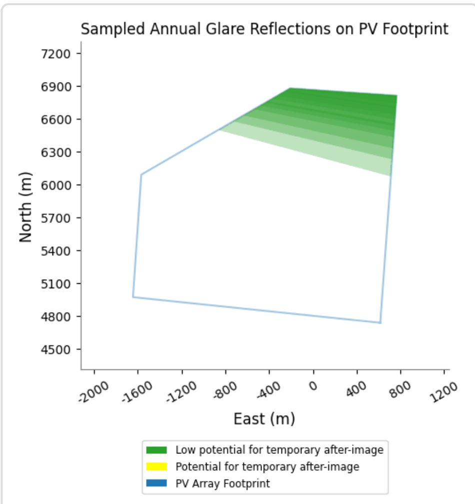
Receptor type: Observation Point

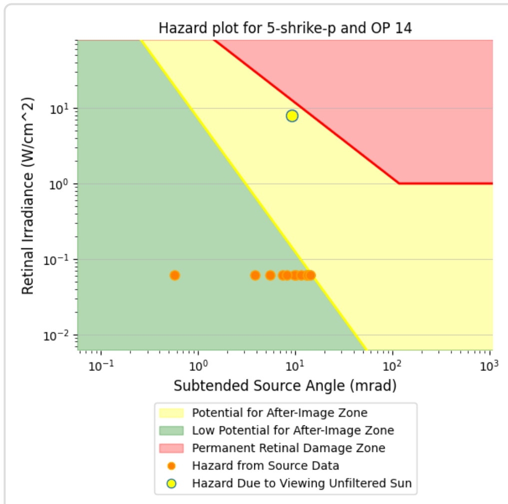
0 minutes of yellow glare

11 minutes of green glare







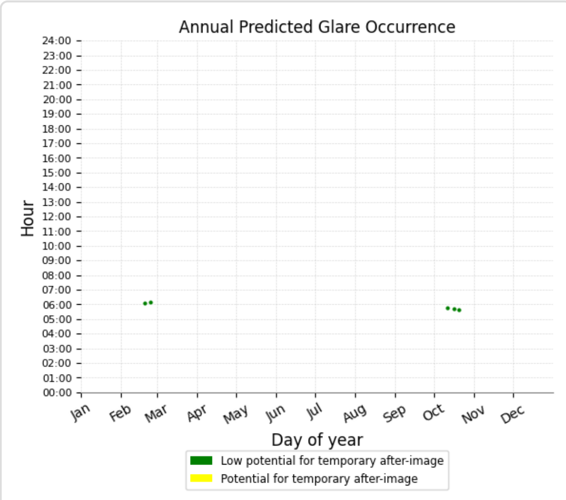


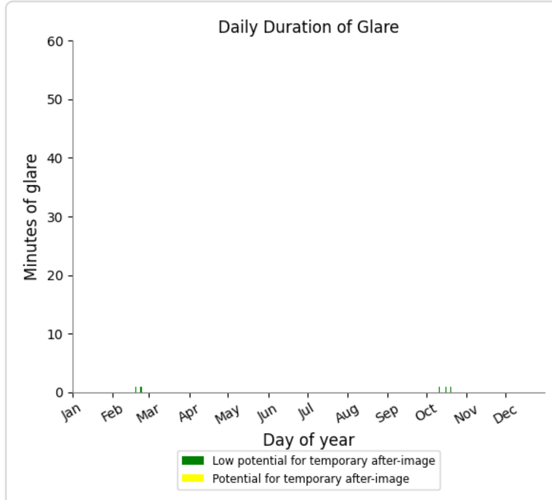
5 - Shrike PV and OP 15

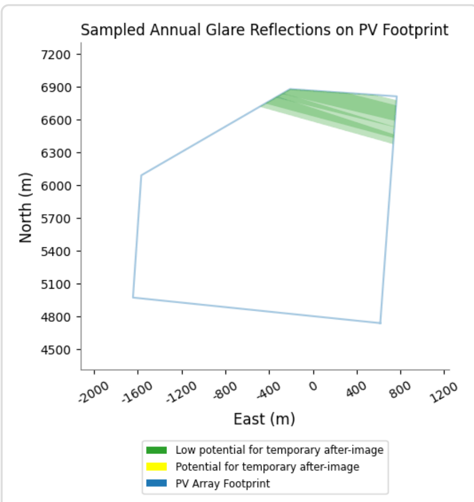
Receptor type: Observation Point

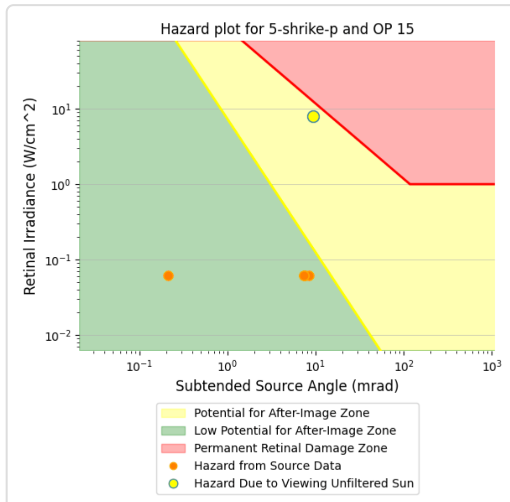
0 minutes of yellow glare

5 minutes of green glare



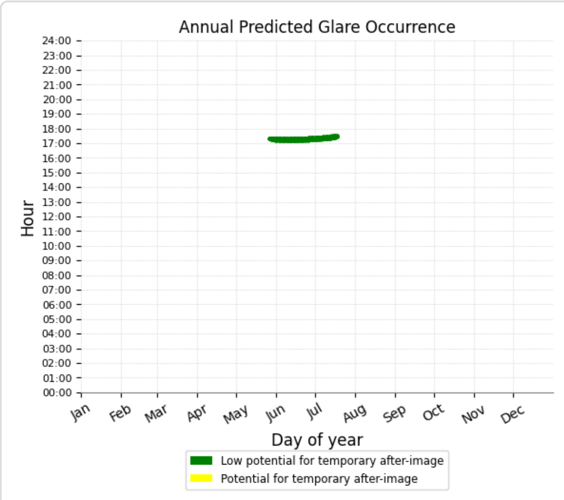


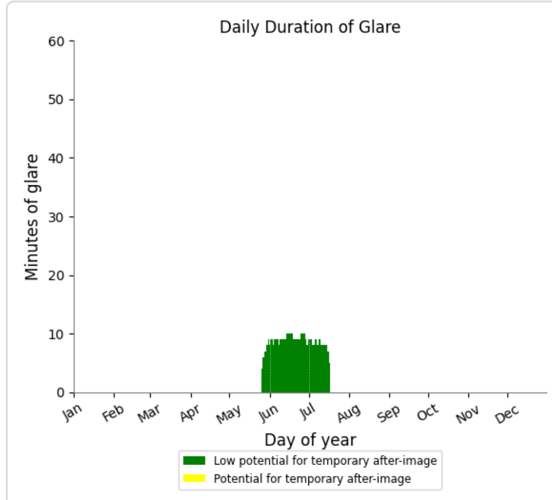


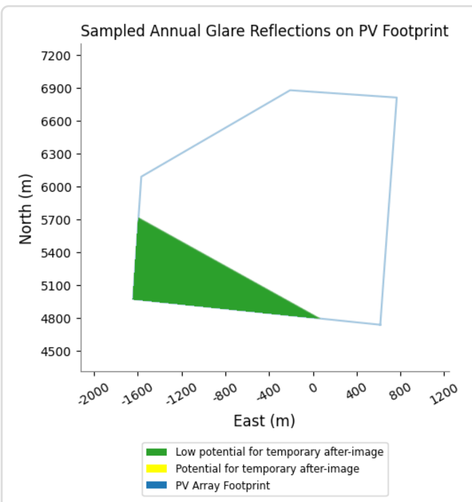


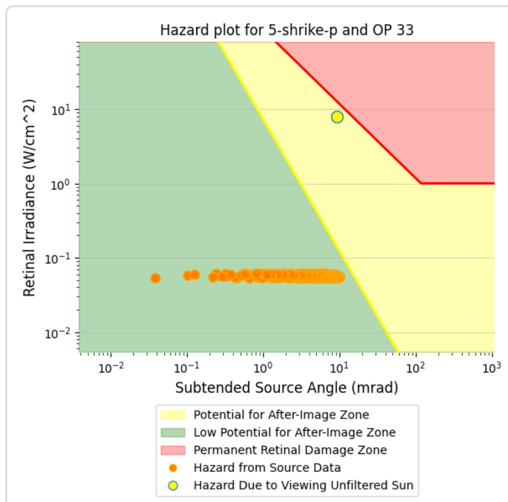
5 - Shrike PV and OP 33

Receptor type: Observation Point
0 minutes of yellow glare
455 minutes of green glare









5 - Shrike PV and OP 7

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 8

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 9

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 10

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 16

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 17

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 18

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 19

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 20

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 21

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 23

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 24

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 27

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 29

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 30

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 31

Receptor type: Observation Point
No glare found

5 - Shrike PV and OP 32

Receptor type: Observation Point
No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

Appendix F Shrike PV Facility Baseline and Impact Assessment

1 Shrike PV Visual Context (Affected Environment)

The Shrike PV Facility is located in northwestern corner of the project site and occupies an area of 405 ha across Rietfontein RE/388 and 36/388.

This appendix addresses the potential visual impact anticipated of the Shrike PV array, on-site substation (IPP-Portion), 11 – 33 kV underground / overhead powerlines, BESS and associated infrastructure.

2 Analysis of the Magnitude of Visual Impact for Shrike PV

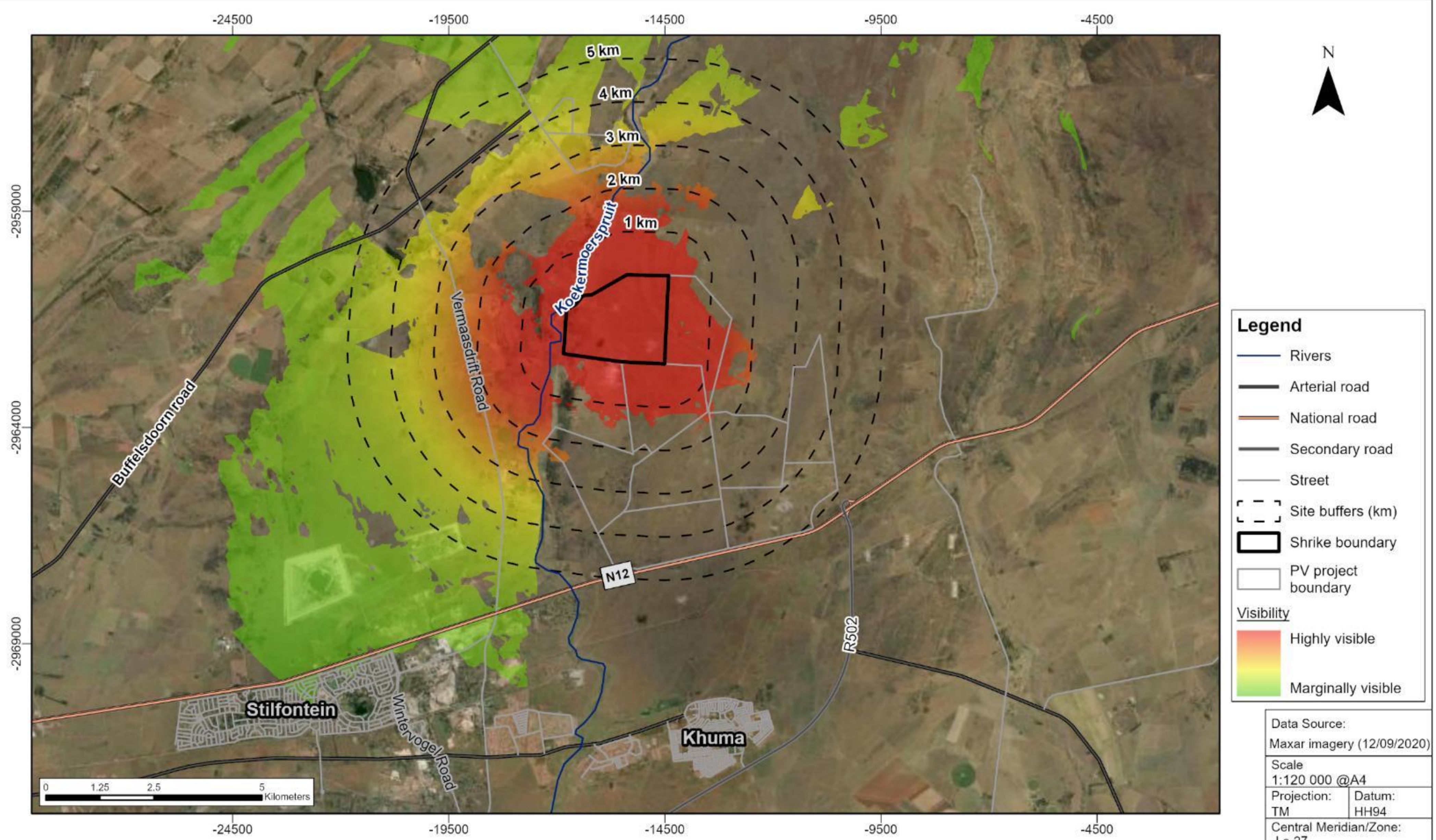
Numerous factors were considered in the main VIA to determine the magnitude or intensity of the overall visual impact of the Cluster. However, this section evaluates the magnitude or intensity of the visual impact of the Shrike PV Facility, on-site substation (IPP-Portion), 11 – 33 kV underground / overhead powerlines, BESS and associated infrastructure.

2.1 Visual Exposure

The viewshed modelled for the Shrike PV Facility (Figure 2-1) identifies the areas from which the Shrike PV Facility *could* be visible, it is a function of topography and the dimensions of the project *only*, but not the location of the visual receptors. The viewshed analysis assumes maximum visibility of the PV Facility, or part thereof, in an environment stripped bare of vegetation and structures. The viewshed indicates the visibility of the project accounting for reducing visibility as distance from the project increases.

The Shrike PV Facility will be visible in the following areas:

- Farmsteads to the north, west and south-west of Shrike PV Facility will have a view of the Facility in the background;
- Patrons at the Khora Lion Park and Louico Camp will a view of the Shrike PV Facility in the background; and
- Motorists on the northern portion of Vermaasdrift Road may view the Shrike PV Facility in the background.



srk consulting

STILFONTEIN PV CLUSTER VIA
SHRIKE VIEWSHED

Data Source: Maxar imagery (12/09/2020)	
Scale 1:120 000 @A4	
Projection: TM	Datum: HH94
Central Meridian/Zone: Lo 27	
Date: 22/03/2022	Compiled by: BRCH
Project No. 581877	Fig No.

Revision: A Date: 19 01 2023

Path: \\CTN-SVR0.ctn.za.srk.ad\vol1\Root\Proj\New Proj\581877_Stilfontein PV BA\8GIS\GISPROJ\PRO\581877_Stilfontein_VIA\APR\581877_STILFONTEIN_VIA.aprx\581877_STILFONTEIN_SOLAR_ShrikeView_A4L_20220323

2.2 Visual Absorption Capacity

The VAC of the project area is as described in Section 5.2 of the VIA.

2.3 Sensitivity of Visual Receptors

The sensitivity of the potential viewers is as described in Section 5.3 of the VIA.

2.4 Visibility and Viewing Distance

While the visibility and viewing distances of the project in general is considered to be moderate in Section 5.4 of the VIA, the location of Shrike PV Facility, on-site substation (IPP-Portion), 11 – 33 kV underground / overhead powerlines, BESS and associated infrastructure and surrounding topography and location of receptors are such that the Facility is expected to have a low visibility, and is likely to be screened by existing vegetation surrounding the Facility site to the west and north.

The receptors are located at a distance and their view of the Facility will be in the background.

2.5 Integrity with the Existing Landscape / Townscape

The integrity with the existing landscape / townscape detailed in section 5.5 of the VIA is applicable to the Shrike PV Facility, on-site substation (IPP-Portion), 11 – 33 kV underground / overhead powerlines, BESS and associated infrastructure.

As such, the Shrike PV Facility are deemed to have ***low*** integrity with the surrounding landscape, whereas the associated infrastructure is considered to have ***moderate*** integrity with the surrounding landscape.

2.6 Glare Analysis

Based on the input parameters (Table 5-7) the glare analysis demonstrated that glare from Shrike PV Facility, will be experienced by visual receptors (residents and motorists). However, none of the Observation Points (OPs) will experience > 60 minutes per day for three months or more.

Notable findings from the modeling of the glare are summarised below:

- OP 2 will experience < 15 minutes of glare per day between 17h00 and 18h30 between April and mid-June and July and mid-September;
- OP 3 will experience <15 minutes of glare per day between 17h00 and 18h30 between mid-March and mid- May and mid-July and September;
- OP 4 will experience < 15 minutes of glare per day between 17h00 and 18h30 between April and August;
- OP 5 will experience < 20 minutes of glare per day between 17h00 and 19h00 between February and October;
- OP 6 will experience < 20 minutes of glare per day between 17h00 and 18h00 between April and September;
- OP 12 will experience < 15 minutes of glare per day between 17h30 and 19h00 between February and April and September and October;
- OP 22 will experience < 15 minutes of glare per day between 18h00 and 19h00 between February and mid-April and September and October;
- OP 26 will experience < 15 minutes of glare per day between 18h00 and 19h00 between October and February;
- Motorists on the N12 will experience glare between 17h00 and 19h00 between March and early October. Motorists will be exposed to glare

emanating from the Shrike PV Facility while travelling along ~6.5 km section of the N12 to the west of Shrike PV Facility. The duration of exposure depends on the speed of travel: at 90 km/h a period of ~ 5 minutes; and

- Motorists on the Unnamed Road East will experience glare between 17h00 and 19h00 between March and early October. Motorists will be exposed to glare emanating from the Shrike PV Facility while travelling along ~ 1 km section of the road. The duration of exposure depends on the speed of travel: at 80 km/h a period of ~ 40 seconds.

3 Impact Assessment and Mitigation Measures

3.1 Construction Phase

3.1.1 Altered Sense of Place and Visual Intrusion caused by Construction Activities

Visual impacts will be generated by construction activities such as stripping of vegetation, bulk earthworks (which can generate dust) and from construction infrastructure, plant, and materials on site (e.g. site camp, cranes, and stockpiles). Dust generated during construction will be visually unappealing and may detract from the visual quality (sense of place) of the area. These impacts are typically limited to the immediate area surrounding the construction site, during the construction period.

The Shrike PV Facility is partially visible to motorists on Vermaasdrift Road, Louico Camp, Khora Lion Park, and residents of farmsteads to the north, all over ~3 km away from the Facility. Due to the distance from the receptors, the visual impacts of construction activities are not expected to be significant.

The impact is assessed to be of ***very low*** significance with and without the implementation of mitigation (**Error! Reference source not found.**).

Table 3-1: Altered sense of place and visual intrusion caused by Strike PV construction activities

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Short-term	Very Low	Definite	**VERY LOW**	-ve	High
	1	2	1	4				
Mitigation Measures: ▪ Limit vegetation clearance and the footprint of construction to what is absolutely essential. ▪ Consolidate the footprint of the construction camp to a functional minimum. ▪ Avoid excavation, handling and transport of materials which may generate dust under very windy conditions. ▪ Keep stockpiled aggregates and sand covered to minimise dust generation. ▪ Implement dust suppression on access roads during dry conditions. ▪ Keep construction site tidy.								
With mitigation	Local	Medium	Short-term	Very Low	Probable	**VERY LOW**	-ve	High
	1	2	1	4				

3.2 Operational Phase

3.2.1 Altered Sense of Place and Visual Intrusion caused by the Shrike PV Array

The Shrike PV array will occupy over 405 ha. The development of this Facility will introduce infrastructure that may be perceived as conflicting with the current natural landscapes of grassland and treescapes. While there is evidence of anthropogenic influence within the surrounding area, it is largely confined to an area southeast of the Facility. This individual PV array will be of a different size, scale, texture and layout to that which already exists within the landscape, and as such is anticipated to negatively impact the sense of place of the region.

Although largely screened by vegetation, the PV array will be partially visible in the background to residents of farmsteads to the north of the Facility and patrons of the Khora Lion Park and Louico Camp ~ 3 km to the west of the site. Where visible, the PV array will present as a visual intrusion to visual receptors.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***medium*** (Table 3-2).

Table 3-2: Altered sense of place and visual intrusion caused by the Shrike PV array

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	High	Long-term	High	Definite	**HIGH**	-ve	High
	1	3	3	7				
Mitigation Measures: ▪ Plant tall vegetation (that will reach ~5 m in height) along the northern and western boundary of the site upon completion of construction, to screen the site but not cast shadow across the PV array. ▪ Fence the perimeter of the site with a green or black fencing.								
With mitigation	Local	High	Long-term	High	Possible	**MEDIUM**	-ve	High
	1	3	3	7				

3.2.2 Altered Sense of Place and Visual Intrusion caused by the 11-33 kV Powerlines and Pylons

Two existing 400 kV Hermes/Pluto powerlines traverse the site and have marginally inured receptors to powerlines within the landscape. Nevertheless, it is expected that the development of the 11-33 kV powerline (where overhead powerlines may be required) will detract from the scenic value of the project site and surrounding areas, albeit to a limited degree.

Due to the central location of the powerline, visually unobtrusive design of pylons, and the limited receptors within close proximity, it is anticipated that the visual intrusion caused by the powerline is not significant.

The impact is assessed to be of ***low*** significance with and without the implementation of mitigation (Table 3-3).

Table 3-3: Altered sense of place and visual intrusion caused by the 11-33 kV powerlines and pylons

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Definite	**LOW**	-ve	High
	1	1	3	5				
Mitigation Measures: ▪ Do not install or affix lights on pylons.								
With mitigation	Local	Low	Long-term	Low	Probable	**LOW**	-ve	High
	1	1	3	5				

3.2.3 Altered Sense of Place caused by the Shrike BESS and On-site Substation (IPP-Portion)

The Shrike BESS and on-site substation (IPP-Portion) will be of a different form to the few farmsteads dotted across the project site. The ~10 ha BESS can be stacked to a maximum height of ~ 15 m. There are few structures within the landscape that have prominent vertical profiles, as such, the BESS may alter the scenic value of the landscape.

The on-site substation (IPP-Portion) will have a footprint of 2 ha[11], however the vertical dimensions are unknown at this stage. Two locations alternatives are proposed for this on-site substation, however these do not differ significantly.

The height of the BESS and the footprints of the BESS and on-site substation will diminish the scenic value of the project site, albeit to a lesser degree than the PV arrays.

The proposed location for the on-site substation is toward the northwestern corner of the Cluster, set back ~ 4 km from roads, highways and surrounding receptors. The BESS may be located anywhere within the surrounding receptors. The proposed BESS and the on-site substation are expected to be visually intrusive. Due to the distance from receptors, and thus reduced visibility of the BESS and on-site substation the visual impact is mitigated to a degree.

The impact is assessed to be of ***medium*** significance with and without the implementation of mitigation (Table 3-4) for both on-site substation alternatives.

[11] The on-site substation comprising of the IPP-Portion and the Eskom-Portion will occupy ~ 4 ha in total; with the IPP- and Eskom-Portions each occupying ~2 ha.

Table 3-4: Altered sense of place caused by the Shrike BESS and on-site substation (IPP-Portion)

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Long-term	Medium	Definite	**MEDIUM**	-ve	High
	1	2	3	6				
Mitigation Measures: ■ Consolidate the BESS and on-site substation footprint, as far as practically possible. ■ Ensure that the on-site substation roof and BESS container colour blends into the landscape. ■ Limit the stacking of containers to a height of 10 m.								
With mitigation	Local	Medium	Long-term	Medium	Probable	**MEDIUM**	-ve	High
	1	2	3	6				

3.2.4 Visual Discomfort and Impaired Visibility Resulting from Glint and Glare

Due to the proximity of the PV Facility to residential areas and roads, the potential glare impact was modelled.

The glare analysis indicated that glare (and potentially glint) will be experienced at numerous OPs and on two roads. The OPs expected to experience glare from the Shrike PV Facility are located to the east and west of the PV Facility, however these OPs are anticipated to experience <20 minutes of glare per day. Less than 20 minutes of glare per day experienced by residential receptors is not considered significant (Section 5.6.1 of the VIA). Motorists on the N12 and Unnamed Road East will experience glare in the evening.

These durations of glint experienced by sensitive receptors (motorists) are considered of a level that may cause visual discomfort or impaired visibility to motorists travelling along the N12 which experiences high volumes of traffic. The glare experienced by stationary receptors (OPs) is not considered to be a level that will cause visual discomfort or impair visibility but may be experienced as a nuisance by the receptors if not mitigated.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***low*** (Table 3-5).

Table 3-5: Visual discomfort and impaired visibility resulting from glint and glare

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	High	Long-term	High	Definite	**HIGH**	-ve	Medium
	1	3	3	7				
Mitigation Measures: ■ Plant tall vegetation (that will reach ~5 m in height) along the northern and western boundary of the site upon completion of construction, to screen the site but not cast shadow across the PV array. ■ Fence the perimeter of the site with a green or black fencing.								
With mitigation	Local	Low	Long-term	Low	Probable	**LOW**	-ve	Medium
	1	1	3	5				

3.2.5 Altered Visual Quality caused by Light Pollution at Night

It is anticipated that lighting will be installed along the perimeter of the PV Facility and / or around the BESS's and on-site substation (IPP-Portion) to improve safety and security.

The installation of lighting on the site perimeter and / or around the BESS and on-site substation (IPP-Portion) is anticipated to generate nightglow that currently does not emanate from the natural, undeveloped site. As such, the introduction of lighting on the site alters the sense of place and visual quality to surrounding receptors. Nightglow may become more intense to the farmstead receptors currently located some distance from the nightglow emanating from the towns of Stilfontein, Khuma and Klerksdorp.

Lighting is not easily screened by vegetation or topography, and the proposed lighting for the PV Facility is anticipated to contribute to nightglow in surrounding residential areas, and significantly alter the visual quality of the surrounding area.

The impact is assessed to be of ***medium*** significance with and without the implementation of mitigation (Table 3-6).

Table 3-6: Altered visual quality caused by light pollution at night

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Long-term	Medium	Definite	**MEDIUM**	-ve	High
	1	2	3	6				
Mitigation Measures: ■ Reduce the height of lighting masts to a workable minimum. ■ Direct lighting inwards and downwards to limit light pollution.								
With mitigation	Local	Medium	Long-term	Medium	Probable	**MEDIUM**	-ve	High
	1	2	3	6				

3.3 The No-Go Alternative

The No Go alternative entails no change to the status quo, in other words, no PV Facility.

Should the application for the Shrike PV Facility and associated infrastructure be refused, the visual impacts (i.e. sense of place will not be altered, no visual intrusion, glint or glare or light pollution) will not be realised. However, this would also mean that no renewable energy will be generated by this project.

4 Shrike PV Findings and Recommendations

The construction phase visual impacts are assessed to be *very low* with the implementation of mitigation, and considered to be of an acceptable level. During the operational phase visual impacts such as altered sense of place and visual intrusion, and glare experienced by the surrounding receptors have been assessed to be higher (*high, medium or low)* and with mitigation are reduced to *medium, low* or *very low* significance.

Based on the assessment and the assumption that the mitigation measures will be implemented, and noting the location of the PV Facility in a designated REDZ, the specialist is of the opinion that the visual impacts of the project are acceptable and, from a visual perspective, there is no reason not to authorise the project.