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Waterval Solar Park:

Visual Impact Assessment for the Proposed Construction of Facilities for a Renewable Energy Plant consisting of 200 Ha of Photovoltaic Panels as well as a Manufacturing Plant for Solar Panels.

DEA #: 14/12/16/3/3/2/825

TFS Solar (Pty) Ltd

5 February 2016

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List of Abbreviations

CSP	Concentrating Solar Power
DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GDARD	Gauteng Department of Agriculture and Rural Development
GIS	Geographical Information System
Ha	Hectares
HTF	Heat Transfer Fluid
I&APs	Interested and Affected Parties
NEMA	National Environmental Management Act
PV	Photovoltaic
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment

1. Introduction

Eon Consulting has been appointed TFS Solar (Pty) Ltd to conduct a Visual Impact Assessment (VIA) for the proposed construction of facilities for a renewable energy plant consisting of 200Ha of photovoltaic panels as well as manufacturing plant for solar panels. This VIA forms part of an Environmental Impact Assessment (EIA) study that is currently in the process under the reference number: 14/12/16/3/3/2/825, with the Department of Environmental Affairs (DEA). The EIA project is currently in its scoping phase. This report will describe issues relating to possible visual impact on a scoping level.

The proposed activity will consist of 3 aspects, namely:

- Glass manufacturing
- Silicon manufacturing
- Photovoltaic installation to generate electricity

The aluminium frames and silver grid which form part of the PV cells are pre-manufactured on another site.

The complex will include an office building and ablution facilities for workers.

2. Baseline Study

2.1. Proposed Locality

The proposed development site is located on Farm Waterval 150-IR, Portion 6 near Meyerton, situated within the Midvaal Local Municipality in the Sedibeng District, south of the Gauteng Province. The area of development falls within an industrial complex, and is currently characterised as vacant/derelict land previously used for agricultural purposes.

- Northern: Industrial area (Heineken-Sedibeng Brewery, Everite Building).
- Centre: Informal Settlement (Peace Farm)
- Eastern: R59, M61 vacant/derelict land, Transnet Railway. Further east the Suikerbosrand Provincial Nature Reserve.

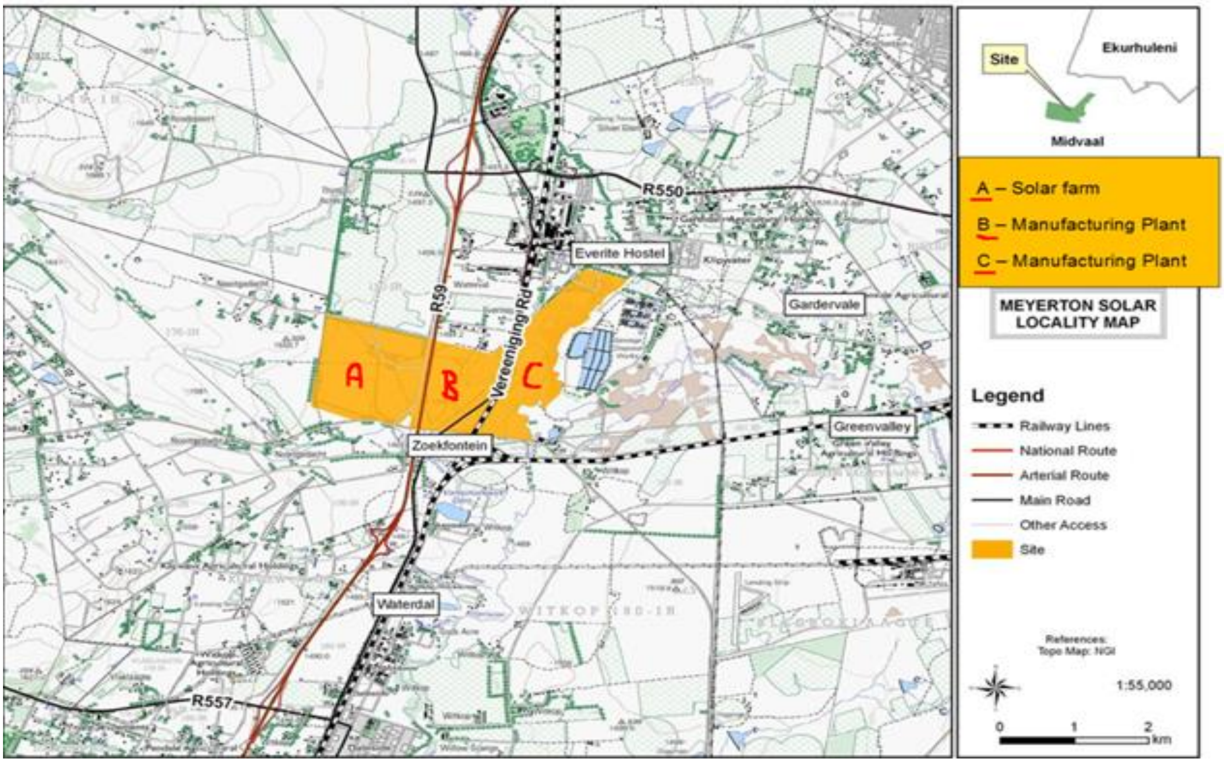


Figure 1: Locality Map

The map below indicates the extent of the areas referred to above. The cross on the map indicates the maturation ponds of the waste water treatment works of the Midvaal Municipality.

- The site does not fall within a conservancy.
- The site does not fall within a protected area.
- The Klip River and associated flood plains form the eastern boundary of the site
- No natural ridges occur on the site.

Figure 2: Surrounding Areas

3. Nature of the proposed development

The project entails the following production units:

- The construction of a production plant for the manufacturing of solar panels through the use of a Fluidized Bed Reactor (FBR) to manufacture poly-silicon through the application of hydrochloric acid to silica. The plant will produce 6 000 tons of solar-grade poly-silicon per annum.
- The construction of a solar energy plant for the generation of 100MW of electric power
- The construction of a float glass manufacturing plant (65 000 tons per annum)
- Production units referred to above (a-c) will be constructed on Portion 6 of the Farm Waterval 150-IR, Meyerton, Gauteng. The total size of the farm is 438Ha. The buildings, in which the manufacturing units will be housed, will consist of 40 Ha and the solar energy plant will consist of 200 Ha of land.

4. Scope of works/Assessment Methodology

The aim of this Visual Impact Assessment is to detail the spatial context/sphere of influence of the proposed development in terms of its visibility to its receiving environment. The spatial context of the assessment is to determine a visible analysis and proximity of receptors to the proposed solar plant. This is based on the following:

- A site visit conducted on 1st of February 2016 to:-
  - EAP to familiarise with the site and its surroundings:
    - Identification of the scenic resources and visually sensitive environments;
    - The potential visual impact of the facility on the visual character of the landscape and sense of place of the region;
    - The potential visual impact of ancillary infrastructure (i.e. the substation, power line, internal access roads) on observers in close proximity to the proposed facility;
    - The visibility of the facility to, and visual impact on the industrial area and informal settlement in close proximity to the proposed facility as well as within the region;
    - Determine and assess the issues that may affect Interested and Affected Parties (IAPs); and
    - Identify possible visual receptors.
- Mapping
    - Topography;
    - Land Use/Land cover;
    - Vegetation
    - Visibility.

5. Assumptions and Limitations

It should be noted that the ‘experiencing’ of visual impacts is subjective and largely based on the perception of the viewer or receptor. The presence of a receptor in an area potentially affected by the proposed housing development does not thus necessarily mean that a visual impact would be experienced.

6. Project Technical Description

The footprint of the proposed plants is approximately 2000ha and the components include and will consist of 3 aspects, namely:

- Glass manufacturing
- Silicon manufacturing
- Photovoltaic installation to generate electricity

The aluminium frames and silver grid which form part of the PV cells are pre-manufactured on another site.

6.1. Concentrating Solar Power and Photovoltaic Technologies to Generate Electricity

6.1.1. Concentrating Solar Power

Concentrating Solar Power (CSP) technologies collect energy carried by sunrays; these in turn allow heat transfer fluid (HTF) to imbibe the collected energy and thereby converting the thermal energy into further useful forms such as electricity.

Presently, there are four principal Concentrating Solar Power (CSP) technologies which can be categorised by two concentrating methods according to the receiver types. In Figure 3, these technologies utilize sun rays which are reflected to a line receiver as in parabolic trough technology or to a point as in power tower. In Figure 4, these technologies also utilise sun rays but are line focus systems, similar to the parabolic trough, which solar radiation is concentrated on an elevated inverted (downward facing) liner receivers using arrays of flat or slightly curved mirrors/reflectors. Water flowing through the absorbers/receivers is heated and converted into steam. This steam is in turn used to generate electricity by means of a steam turbine and electric generator. The former is the preferred alternative.

6.1.2. Photovoltaic Technology

In photovoltaic technology the power conversion source is via photovoltaic modules that convert light directly to electricity. This differs from the other large-scale solar generation technology, concentrated solar power, which uses heat to drive a variety of conventional generator systems. Solar panels produce direct current (DC) electricity, so solar parks need conversion equipment to convert this to alternating current (AC), which is the form transmitted by the electricity grid. This conversion is done by inverters. To maximise their efficiency, solar power plants also incorporate maximum power point trackers, either within the inverters or as separate units. These devices keep each solar array string close to its peak power point. There are two primary alternatives for configuring this conversion equipment; centralised and string inverters, although in some cases individual, or micro-inverters are used. Single inverters allow optimizing the output of each panel, and multiple inverters increase the reliability by limiting the loss of output when an inverter fails.

(Find figure for this)

Technologies	Advantages	Disadvantages
CSP - Parabolic Trough Technology 	• Is the most proven CSP technology; • Over 30+ years of operating experience; • Energy storage is feasible and can be added. Therefore, the system could provide energy under cloudy conditions or at night; and • The cost, performance and risk of parabolic trough technology are well established with existing parabolic trough plants around the world.	• Relatively low thermal efficiency; • Requires significant site grading with gradient <3%.
CSP - Central Receiver Technology 	• When using tower technology, energy storage could be added. Therefore, the system could provide energy, even in cloudy conditions or at night; • Requires minimum site grading (can tolerate gradients >5%); • Energy storage is feasible and can be added; and • The advantage of this design above the parabolic trough design is the higher temperature (up to 550°C compared to 400°C). Thermal energy at higher temperatures can be converted to electricity more efficiently and can be more cheaply stored for later use.	• Central receiver technology needs to proceed from conceptual to demonstration to commercial development. Currently less experience with commercial deployment than trough technology; • Central receiver design is a challenge – specifically in seismic zones.

Figure 3: Examples of Technology Alternatives (a)

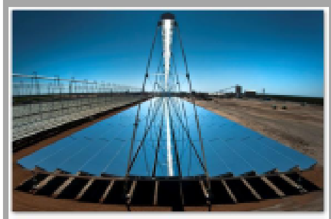
Technologies	Advantages	Disadvantages
CSP – Linear Fresnel Technology 	• Commercially proven technology albeit on a relatively small scale. Modular design allows for an easy scale-up of the plant capacity; • Storage can be added. Therefore, the system could provide energy under cloudy conditions or at night; and • Linear Fresnel technology has a relatively low footprint and therefore limits environmental disturbance.	• Low thermal efficiency and relatively small install base. The technology has not benefitted from the same technology advancement as the other concentrated solar thermal technologies.
Photovoltaic Technology 	• PV panels provide clean – green energy. During electricity generation with PV panels there is no harmful greenhouse gas emissions thus solar PV is environmentally friendly; • PV cells have a very long lifespan that needs minimum upkeep; • PV is currently the lowest price solar technology due to the lower costs of PV panels; • Minimal operations and maintenance support staff required; • Require a minimal amount of water; and • Solar energy is a locally available renewable resource. It does not need to be imported from other regions of the country or across the world. This reduces environmental impacts associated with transportation and also reduces our dependence on imported oil. And, unlike fuels that are mined and harvested, when we use solar energy to produce electricity we do not deplete or alter the resource.	• Some toxic chemicals, like cadmium and arsenic, are used in the PV production process. These environmental impacts are minor and can be easily controlled through recycling and proper disposal; • Solar energy is somewhat more expensive to produce than conventional sources of energy due in part to the cost of manufacturing PV devices and in part to the conversion efficiencies of the equipment. As the conversion efficiencies continue to increase and the manufacturing costs continue to come down, PV will become increasingly cost competitive with conventional fuels; • Energy storage options (batteries) are expensive; • Significant power output fluctuations due to no inertia in the system; • PV efficiency is significantly affected at high ambient temperatures; and • Solar power is a variable energy source, with energy production dependent on the sun. Solar facilities may produce no power at all some of the time, which could lead to an energy shortage if too much of a region's power comes from solar power.

Figure 4: Examples of Technology Alternatives (b)

6.1.3. Site Alternatives

A site alternative has not been considered by the applicant as the area under investigation is uniform with the same characteristics in terms of plants, animals and other resources. The preferred site has been acquired by various preceding negotiations and agreements with the respective land owners. A site alternative will therefore not be assessed. In terms of the site selection process, the requirements for a CSP project are firstly access to the Eskom grid at a point where there is capacity to tie-in the plant and the availability of water. Then the requirements are a flat site of low agricultural or land value and no environmental issues. The proposed site meets these criteria.

6.1.4. Access Roads

Temporary routes will be determined and utilised during construction. Permanent road access will be designed and once the proposed development layout has been finalised.

7. A Description of the receiving environment

(Excerpt from the Final Scoping Report for Section 7)

7.1. Geographical

The spatial structure of the Midvaal municipal area is predominantly rural with extensive farming constituting approximately 50% of the total area of jurisdiction. Several natural features, which present significant tourism opportunities, occur in the area, of which the Suikerbosrand Nature Reserve, the Klip River and the Vaal River are the most prominent. The Suikerbosrand Nature Reserve is a formal nature reserve protected by law.

The region also falls within the Grassland Biome, which includes approximately one-third of the mammal species of South Africa. The Klip River is an important habitat for birds and small animals.

The map below provides an overview of the immediate location of the proposed project. As can be seen, the different land-uses in the area are mainly associated with industrial use, road and railway networks as well as residential areas. Informal houses occur on the site.

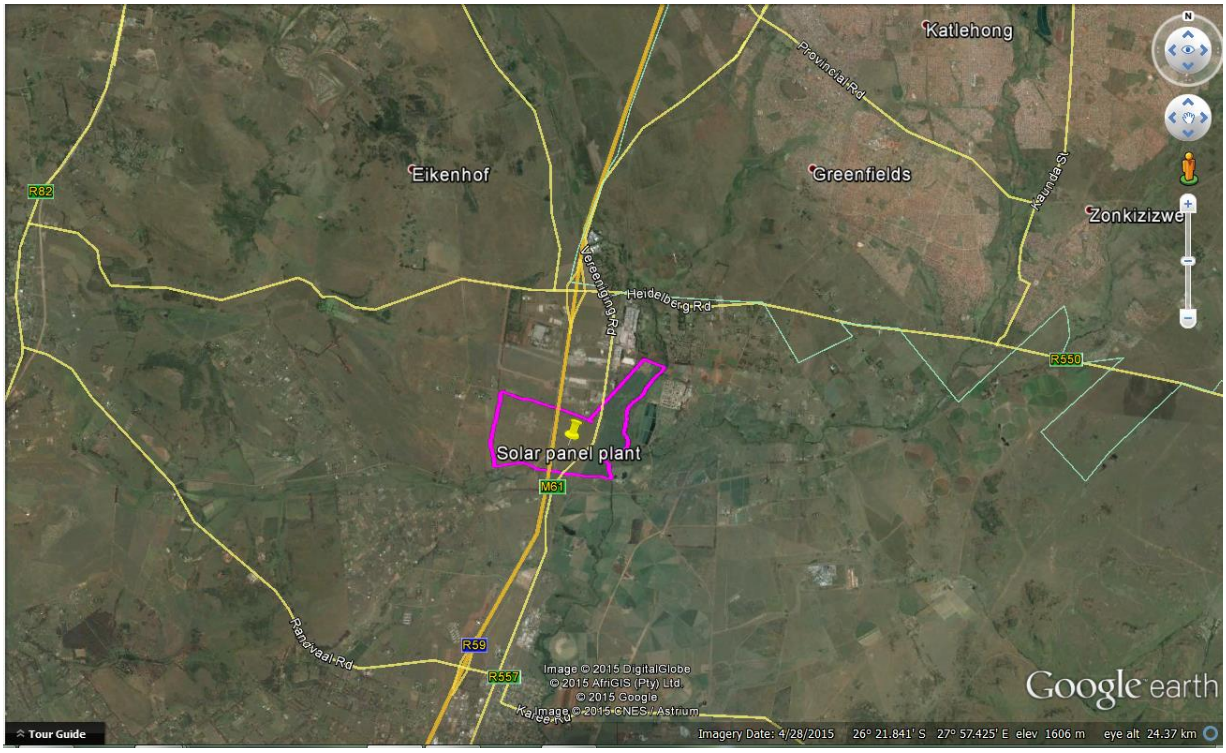


Figure 5 - The location of the proposed activity

The land cover map below (obtained from BGIS, SANBI, 2015) indicates the land uses associated with the whole of the farm Waterval (of which the relevant portion has been indicated by the red polygon. The land classes associated with the project area is "cultivation, urban built–up and waterbodies".

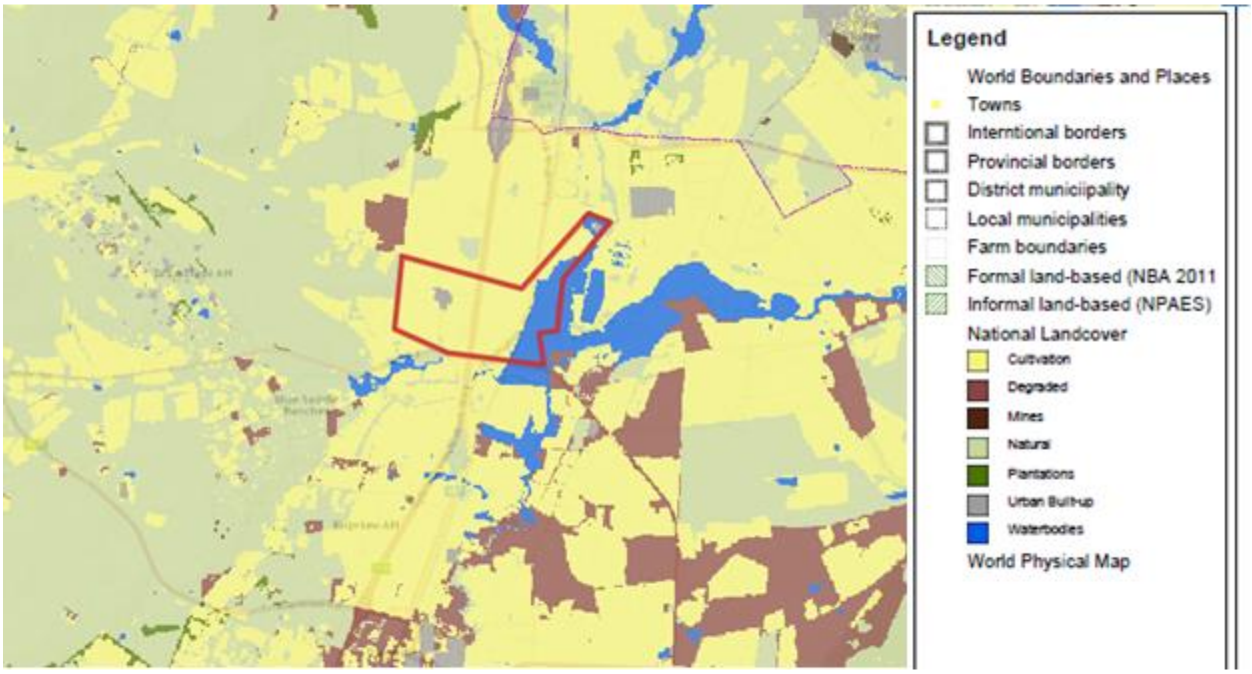


Figure 6 - Land cover classes associated with the region (Data from SANBI; 2012)

7.2. Physical

Relief on the site varies around 1500 mamsl. The site is fairly flat with the highest point towards the western side of the site.

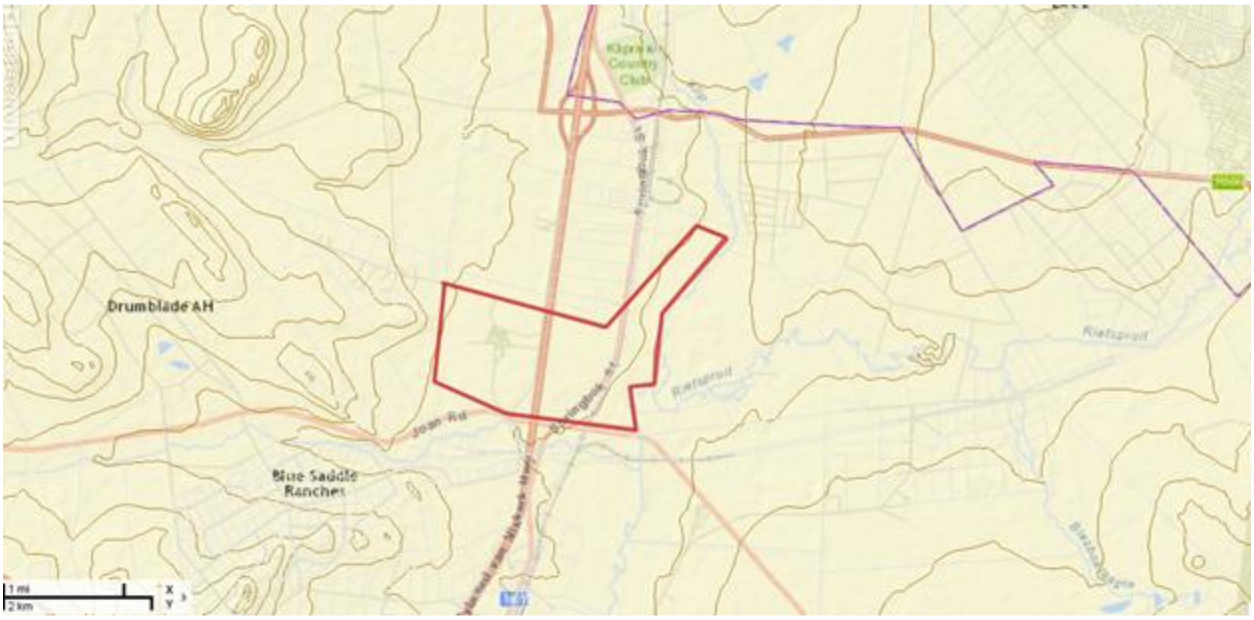


Figure 7 - 20 meter contours associated with the project site, indicating the relative flatness of the site (SANBI, 2015)

7.2.1. Climate

The site falls within the summer rainfall area of South Africa. Daily summer temperatures range between 14°C and 25°C. Winter temperatures range between 1°C and 20°C. Spring temperatures range between 5°C and 22°C, while autumn temperatures range between 6°C and 22°C.

8. Visual Absorption Capacity (VAC)

Visual Absorption Capacity (VAC) refers to the potential of an area to engross the proposed activities, as to minimise visual impact on its surroundings. This is determined by a number of factors:

- Topography and vegetation:

Figure 8: Eucalyptus trees boarding the property on the north of the property

These trees provide a natural screening and increase the VAC of the landscape.

- The level of urbanisation

Figure 9: Industrial area to the North-East of the property.

Industrial areas enable the landscape to absorb the visual impact of the proposed development.

- Scale and density of surrounding developments

Although the proposed development area is vacant land the construction of the factory towards the east of the site will further provide VAC for the development. The R59 Corridor is ear marked for further development in the near future according to the Midvaal Local Municipality: Eastern Region Spatial Development Framework, January 2011.

- Residential communities which may reduce the visibility of the site to people residing towards the back of the residential area;

Figure 10: View from the West of the site from Plot 28 Nooitgedact

People living behind this property will not be visually impacted. The informal settlement which proves to be an eyesore for the surrounding residential community will be relocated. This will be form part of the EIA process.

9. Visual exposure

This is determined by the zone of visual influence or “viewshed”. This refers to the areas from which the proposed development will be visible. The viewshed does not take into consideration man-made obstacles and vegetation. The area that was determined to have high exposure is the R59 and adjacent neighbours.

Figure 11: View of the R59 from the proposed development site (East).

The proposed development will be designed is to have a 6m high wall.

This will serve in two folds:

Security for the solar panels; and

Minimise glare onto the R59 for vehicles passing in the project boarder, which may cause distraction to road users.

Furthermore, the colour of the wall should not have a high contract to its surrounding area as not to affect the idea of "sense of place" or Genus Loci, the general identity of the area.

10. Mitigation Measure and Conclusion

Mitigation measures should be considered for the proposed development. These measures should be appropriate and visually acceptable through all phases on development. These should also form part of the Environmental Management Programme (EMPr) and adhered to, should the project be approved.

10.1. Construction phase

- Temporary ablution facilities for personnel on site;
- Implementation of traffic control measures;
- Location of lay-down areas and demarcated;
- Dust control: access roads to be kept clean and measure to be taken to minimise dust from construction traffic on gravel roads;
- Surface material should be scraped off, conserved and used for rehabilitation. The remainder could be used for site development, and any surplus disposed of in a manner that appears natural;
- Site offices and structures should be limited to single storey and they should be sited carefully to reduce visual intrusion;
- Colours should reflect hues of the surrounding vegetation and/or the ground.
- Roofs should be grey and non-reflective. Door and window frame colour should reference either the roof or wall colours;
- Litter is to be regarded as a serious offence and no contaminants are to be allowed to enter the environment by any means;

- Road construction and management must take run-off into consideration in order to prevent soil erosion;
- The topsoil of naturally occurring substrate should be separated and then spread over finished levels;
- The developer will be required to ensure that the footprint areas of all impact sites utilised in construction are rehabilitated in that phase, and not during operation, and restored as near as possible to previous natural vegetation;
- The fencing should be grey in colour and located as close as possible around the PV site. If possible, natural waterways and drainage lines indicated as sensitive should not be fenced in; and
- To limit the potential of sunlight reflecting off the panels creating glint and glare impacts, it is recommended that the Fixed Tilt structure option is utilised. With the tilt access aligned north-south, the panels will always be facing towards the sun which reduces the potential for impacts of reflection and glint.

10.2. Operational phase

- Sunlight reflection, lights at night and movement of maintenance vehicles. The visual impact of lighting will be significant because it can give a project a far greater zone of visual influence at night than the structures have during the day;
- All lighting is to be kept to a minimum, within the requirements of safety and efficiency;
- Where such lighting is deemed necessary, low-level lighting, which is shielded to reduce light spillage and pollution, should be used;
- No naked light sources are to be directly visible from a distance. Only reflected light should be visible from outside the site;
- Any necessary aircraft warning lights are to be installed as per the relevant authority requirements;
- External lighting must use down-lighters shielded in such a way as to minimise light spillage and pollution beyond the extent of the area that needs to be lit;
- Security and perimeter lighting must also be shielded so that no light falls outside the area needing to be lit. Unnecessarily tall light poles are to be avoided; and
- External signage should be kept to a minimum and where possible attached to existing buildings to avoid free-standing signs in the landscape;
- With regards to lighting, the following should be considered:
  - Lighting on the fence line and security lighting should be faced inwards, except for nocturnal safety lighting; and
  - Lighting internally, wherever possible, should be low foot-level lighting, fitted with low intensity bulbs should be used.
- These lighting recommendations should be considered only if they do not pose a threat to site safety.

The receiving environment of the project has a great capacity to absorb the proposed development. This is due to the fact that the area is surrounding by industrial area. The potential impacts of glare and glint on the road users of the R59 if adequately investigated and mitigated will not be an area of concern. Due to the small number of receptors, the visual recommendation is that project could proceed. The preferred CSP technology alternative with tilt panel structures will generate less potential for glint and glare.

The need for the undertaking of further more detailed visual studies will be determined based on the technologies in the EIAR phase of the project.

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