Visual Impact Assessment
Addendum B
FINAL

Proposed ACWA Power SolarReserve
Redstone Solar Thermal Energy Plant
Photovoltaic Power Plant

Graham A Young (PrLArch)

Newtown Landscape Architects

PROPOSED REDSTONE CSP

PHOTOVOLTAIC POWER PLANT

ADDENDUM B *FINAL*

Submitted to:

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NLA Project No:	____/V18NC
Report No:	*01_FINAL*
Date Issued:	26 April 2018
Prepared By:	Graham A Young (PrLArch)
Reference:	Redstone CSP Solar Reserve: ADDENDUM B _ PV Project

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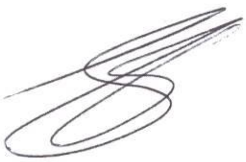
Experience in Years:	34 years
Experience	Graham is a landscape architect with thirty years' experience. He has worked in Southern Africa and Canada and has valuable expertise in the practice of landscape architecture, urban design and environmental planning. He is also a senior lecturer, teaching urban design and landscape architecture at post and under graduate levels at the University of Pretoria. He specializes in Visual Impact Assessments and has won an Institute of Landscape Architects Merit Award for his VIA work.

DECLARATION OF INDEPENDANCE

I, Graham Young, declare that –

- I am contracted as the Visual Impact Assessment Specialist for Proposed Redstone PV Project n the Northern Cape Province, Republic of South Africa;
- 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 over 30 years' expertise in conducting specialist reports relevant to this application;
- 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.



Graham A. Young PrLArch FILASA

26 April 2018

1.0 INTRODUCTION and BACKGROUND

Newtown Landscape Architects (NLA) produced a Visual Impact Assessment (NLA 2011) report for the Humansrus Concentrated Solar Power (CSP) plant project, located in the Northern Cape Province and east of the mining town Postmasburg. Subsequently, the project was renamed the ACWA Power SolarReserve Redstone Solar Thermal Power Plant (the Redstone CSP Project).

In 2014 NLA created a computer model of the Redstone CSP Project that illustrated its design, with the central receiving tower at 200m. During the design process the engineers indicated that the central receiving tower height may have to increase by 50m to 250m to improve the efficiency of the solar field as the higher the tower the lesser blocking and shadowing occurs. This change in technology necessitated that the Redstone CSP Project undergo a Part 2 Amendment in terms of the 2014 EIA Regulations, which required an impact assessment process, which included an amendment to NLA's original 2011 report. In this amendment (NLA 2015), the power block footprint remained within the power block approved area and the heliostats will remained at a height of between 12m and 15m. Subsequently, approval was given for the Redstone CSP Project with the proposed new tower height. The Redstone CSP Project layout and tower design at 250m are indicated in the aerial photographs in Figures 1, 2 and 3.

Currently, the ACWA Power SolarReserve Redstone Solar Thermal Power Plant RF (Pty) Ltd (the "Applicant") is investigating the addition of a Photovoltaic (PV) Power Plant to the Redstone CSP Project in order to provide the Redstone CSP Project its required auxiliary power supply. As the EIA for the Redstone CSP Project, was undertaken in 2011, the Department of Environmental Affairs (DEA) has requested that the specialists update their findings in order to adequately assess the proposed new PV Power Project. The Visual Impact Assessment, is one of the specialist reports that requires an amendment. This report is therefore Addendum B to the original Visual Impact Assessment (VIA) (NLA 2011) report.

1.1 The proposed PV project

The Project Site is located within the governing boundaries of the Tsantsabane Local Municipality and the ZF Mgcawu District Municipality. The PV Power Project is designed to allow the Redstone CSP Project to generate renewable green energy for self-consumption in order to operate and run the Redstone CSP Projects' auxiliary load requirements. The Redstone CSP Project was authorised under the National Environmental Management Act 107 of 1998 (NEMA) by the Department of Environmental Affairs (DEA) Ref. No. 12/12/20/2316 (AM7).

The Applicant proposes the development, construction and operation of a Photovoltaic (PV) Power Project with the generation capacity of up to 20 MW, with up to 30MW hours storage, for the auxiliary load requirements, on the Remaining Extent of the Farm 469, Hay District, on a development footprint of less than 20 hectares. The planned PV Power Project will be located approximately 30 km east of the town Postmasburg in the Northern Cape Province, adjacent to the Redstone CSP Project. Two development alternatives are being considered.

Option A: The positioning of the PV Power Project on the western boundary of the Project Site, adjacent to the Redstone CSP Project, for ease of access to the power block/substation. Refer to Figure 01 below. This is the preferred option and will be assessed in this report.

Option B: The positioning of the PV Power Project within the heliostat field of the Redstone CSP Project, for ease of access to the power block/substation.

1.2 Limitations

The following assumptions / limitations have been made in the study:

- The site was not visited again in 2018 by the specialist;
- Current information about the site and surrounding areas is gleaned from the latest Google Earth aerial photography and the findings in the original NLA report (2011) and subsequent Addendum (2015);

2.0 PROJECT DESCRIPTION

The PV Power Project entails the development, construction and operation of a PV Power Project (fixed or tracking) with a generation capacity of up to 20MW (the "**PV Power Project**")on the Remaining Extent of the Farm No. 469, Hay District, Northern Cape Province (the "**Project Site**"). The Project Site is ~35.3 ha in size, however the PV Power Project will only occupy less than 20 ha of the Project Site. The PV Power Project will be connected to the Redstone Noko Substation and/or Redstone CSP Project power block via underground or surface cabling – via Cabling Route 1) the external Redstone CSP Project ring-road route or Cabling Route 2.) straight through the heliostat field via the internal roads.

2.1 PV Panel Field

A PV system consists of PV panels that encase the solar cells. Solar cells are solid-state semiconductor devices that convert light into direct-current electricity. A top protective and anti-reflective layer of glass is applied to the surface of the PV panels, to protect the sensitive PV layers below and to prevent photons from reflecting off of the panel resulting in lost energy. The panels will be mounted on metal frames with a height of approximately 3-5 m above the ground, supported by rammed, concrete or screw pile foundations, and they will face north in order to capture the optimum amount of sunlight. The PV Power Project will either be a fixed PV plant where the solar panels are stationary; or a tracking PV plant where the solar panels rotate to track the sun's movement (the exact type of PV plant system will be determined following on-site solar resource modelling and detailed engineering design).

PV panels are typically up to 6 m^2 in size and will be situated in long rows called arrays, usually made up of approximately 100 m sections extending across the proposed site. The length of the rows and the optimal design and layout will be determined during the Final Engineering Design stages. The general arrangement of the panel arrays may be based on [1 - 5 MW] power blocks or more depending on the final engineering design. A panel surface area of less than 20 hectares is required for the project to generate the required auxiliary load of up to 20MW.

Refer to Figures 2 and 3 which illustrate existing PV installations (Lesedi and Jasper) and which are indicative of the proposed PV Power Project.

2.2 Substations

The project design will include an 11kV step-up substation that will allow the PV Power Project to be connected into the on-site Noko substation/power block connection point.

2.3 Network Integration and Switching Yard

The output generated by the PV Power plant will be fed from the PV step up substation via 11kV underground/surface cabling AC-network to the power to the site substation/power block from where it will be absorbed and utilised by the Redstone Solar Thermal Power Plant CSP Facility. Two routing options have been selected for the integration of the power generated by the PV Power Plant:

Cabling Route 1:	Power to be evacuated via 11kV underground cables/surface cabling within the reserve of the Redstone CSP Project ring-road, to the Noko-Olien Substation and the Power Block.
Cabling Route 2:	Power to be evacuated via 11kV underground cables/overhead power lines within the reserve of the Redstone CSP Project power block access roads, to the Noko-Olien Substation and the Power Block.

2.4 Project Phases

2.4.1 Construction Activities and Facilities

The construction phase will involve the construction and assembly of the PV panels, electrical systems, buildings, and other infrastructure required for the operation of the plant. In this regard, the activities and/or facilities relevant to the construction phase are listed below,:

- **Site establishment and the construction of access roads and services**
- **Site clearing and earthworks**
- Bulk material laydown and consumable stores – shared service CSP
- Refueling and maintenance – shared service CSP
- Power supply and use – shared service CSP
- Water supply and use – shared service CSP
- Construction camp – shared service CSP
- Staff facilities – shared service CSP
- Management and administration – shared service CSP
- Waste management – shared service CSP

The construction period for the PV Power Plant will take approximately 2 – 6 months.

2.4.2 Operation and Maintenance Activities and Facilities

The operational phase will involve the generation of power using the PV technology and electrical systems as described as well as the day-to-day management and maintenance of associated support services and infrastructure. In this regard, the activities and/or facilities relevant to the operational phase are listed below –

- Access and security services – shared service CSP
- **Generation of electricity using PV technology**
- **Operational power supply and use**
- Water supply, storage and use – shared service CSP
- Procurement, storage and use of consumables – shared service CSP
- Maintenance and repair to operational equipment – shared service CSP
- Waste management – shared service CSP
- Storm-water management infrastructure – shared service CSP
- Management and administration facilities – shared service CSP
- Fire protection for plant services and infrastructure – shared service CSP

The operational period for the PV Power Project which is linked with that of the Redstone CSP Project Power Purchase Agreement (PPA) of 25 years.

2.4.3 Decommissioning Activities and Facilities

Depending on refitting and maintenance of the plant as well as national energy market conditions, the PV Power Project could continue to operate – however long it is required to. However, should plant operations be ceased for whatever reason, decommissioning and closure of the PV Project will be undertaken in accordance with the applicable EIA regulations. It is suggested that a detailed plan for the decommissioning and closure of the plant will be drawn up before operations are ceased and submitted to the relevant competent authority for authorisation and ultimate implementation.

Similar to construction, the removal of the infrastructure associated with the project may involve the preparation of the area, given the amount of machinery and workers that will remain and work on the decommissioning. The following decommissioning activities are relevant:

- Operational access roads are expected to be in good condition and be appropriate for the transit of decommissioning equipment (heavy cranes, special trucks, etc.).
- A small temporary decommissioning camp may be established with associated staff facilities.
- Laydown areas may be prepared as required. In this regard vegetation may require stripping and topsoil may be stockpiled for use in rehabilitation.
- All waste materials and chemicals will be removed for reuse in other facilities or proper management through authorised waste management service providers.
- The elimination of all lubricants and chemical products stored in the plant will be carried out. These products may be sold or turned over to an authorised waste management service provider, as they are not the plant’s main components.

- Re-usable elements will be components that can be used again, i.e. are not waste. It is advantageous to find a use for these so-called sub-products, due to the reduced costs involved with the consequent economic and environmental benefits. The possible sub-products from the PV plant may be multiple in terms of type, quantity and volume. Thus, certain substances are not considered "usable", such as electrical system oils, other lubricants, etc. Other materials from the plant may be reusable in other such facilities, depending on their condition.
- The PV panels, including the mounting structures, positioners, etc. will be dismantled and either sold (if still usable) or disposed of at appropriate facilities.
- Storage tanks, pipes and pumps may be managed by recycling or reusing.
- Electrical components will be removed and may be sold as second-hand equipment (if usable) or for their copper content.
- Steel structures will be dismantled and may be sold as second-hand equipment (if usable) or for their scrap value.
- Concrete structures and buildings (including foundations) will be demolished and the rubble will be disposed of at appropriate facilities, unless otherwise agreed for an alternative use in line with the decommissioning and closure plan.

3.0 SCOPE OF WORK

NLA have been appointed to carry out Addendum B to the original VIA specialist report (NLA 2011). The following updates needs to provided:

- Project description – Option A the preferred option
- Impact table
- Direct, indirect and cumulative impacts associated with the PV Project inclusion.
- Mitigation measures
- Impact statement regarding PV impact on receiving environment (acceptable or not).

4.0 CUMMULATIVE IMPACT PV PROJECT

The original VIA report (NLA 2011) investigated the larger Project Site and proposed activities and concluded that the Redstone CSP Project would have a moderate negative effect on the visual and aesthetic environment. It identified and rated the impact and made recommendations regarding management measures. The original findings stated:

> *Visual resource impacts would result from the construction, operation, and maintenance of the proposed Redstone CSP Project. Specifically, impacts would result from project components being seen from potentially sensitive viewpoints and from effects to the scenic values of the landscape. The visual impacts that could result from the project would most likely be direct, moderately adverse and long-term.*
>
> *The study area has aesthetic value, albeit compromised to some degree through current man made mining and agricultural activities. Is has also been established that whilst the landscape's scenic value is rated moderate, it is not unique within the sub-region, nor would it evoke a strong sense of place amongst locals or people visiting the study area. The region is a known mining area and no tourism activities are known within the study area. However, the visual impacts that would result from the construction and operation of the proposed Redstone CSP Project will have an adverse effect on the character of the landscape and on the visual environment of people living in, working and visiting the area. However, to date visual issues have not been raised as a concern by the community. Visual impacts would result from the construction and operation of the proposed Redstone CSP Project. The significance of visual impact is moderate for people living in and visiting the area during both of these phases but would perhaps be more severe during the construction phase due to all the activities and the generation of potential dust in a very dry environment. This would be especially so during the period when major earthworks are being carried out.*
>
> *Mitigation measures, in the form of a visual buffer along the northern boundary of the site, are feasible and can reduce the impact of the Redstone CSP Project on foreground views from the R385. Good housekeeping and the introduction of a visitor's center could negate any potentially negative reactions to the visual aspects of the project and even turn the project into a tourist attraction for the region.*

The VIA Addendum A report (NLA 2015) found that:

> *The proposed height change, from 200 m to 250 m, of the central receiving tower will increase the visibility of the tower slightly. It will remain visible for less than half the zone of potential influence as was the case in the original 200 m design. Also, the greatest increase in visibility and exposure occurs in what would be background to distant views i.e. views greater than 12 km from the Project Site.*

> *Very few sensitive viewer locations are being affected. The most affected area occurs along the R385 east of the site but from this distance (over 15km), the tower, even at 250m height, would barely be visible. The visual exposure of the higher tower would affect foreground and middle ground views but this would not result in a substantive change to the receptor i.e. the visual impact (rated as moderate negative in the original VIA report) will not increase.*
>
> *Mitigation measures, as proposed in the original VIA, remain valid and will successfully buffer most of the project's components from foreground and middle ground views.*

These findings remain valid for the Redstone CSP project. The impact of the proposed PV Power Project are recorded in the tables below. The proposed PV Power Project will have a minor cumulative effect[1] on the visual and aesthetic environment. Sensitive views along the R385 and the local road to the west of the PV Power Project will be the most affected. However, as illustrated in Figures 2a and 3a and the simulations in Figures 5 – 7, the impacts will remain within the viewing envelope that already includes existing PV sites (introduced subsequent to the original 2011 study but which were in place when the 2015 study was undertaken) and will include the proposed Redstone CSP Project. A comparative analysis of current aerial photographs (Google Earth) with the original situation indicates that surrounding land-uses and visual sensitivities related to viewer location remain essentially the same.

It is clear in the aerial views of the proposed PV Power Project (Figures 2 and 3) that the small scale of its installation relative to the Redstone CSP Project, would be absorbed into existing views of the PV installations (Lesedi and Jasper PV Power Projects, currently operational on the Project Site) as well as future views of the Redstone CSP Project. This effect is illustrated in the simulations in Figures 5, 6 and 7, of panoramic views to the project site from the R385. Therefore, the visibility of the PV Power Project, from sensitive viewing sites, would be much the same as the visibility of the original Redstone CSP Project i.e. visibility would not increase due to the installation of the PV Power Project due to the dominant nature of the Redstone CSP Project.

Using visual intrusion criteria (refer to Appendix B) the cumulative impact of the PV Power Project is rated *low* because the PV Power Project:

- Has a minimal additional effect on the visual quality of the landscape;
- Contrast minimally with the patterns or elements that define the structure of the landscape;
- Is mostly compatible with land use, settlement or enclosure patterns (existing and future);

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[1] Cumulative effect is the summation of effects that result from changes caused by the development in conjunction with the other past, present or reasonably foreseeable actions.

- Is 'absorbed' into the existing and future planned elements in the landscape.

The severity or magnitude of impact of the PV Power Project will also be *low* when considered against operational PV developments and the Redstone CSP Project because the project will cause a minor loss of or alteration to key characteristics of the baseline i.e. the pre-development landscape or view and/or the introduction of the PV Power Project elements are not uncharacteristic when set within the attributes of the receiving landscape, which includes existing operational PV installations and the (approved) Redstone CSP Project. The cumulative significance (see criteria listed in Appendix B) of visual impact for the various phases of the project are summarized in the following three tables.

Table 1: *Significance* of Visual Impact – PV Power Plant Project Option A

Phase: Construction					
Aspect:	**Type: Visual**				
Activity:	Construction activities are visible				
Impact:	**Physical Presence of PV Project and impact of sensitive views:** The proposed VP Project is located in a landscape of moderate value partially tolerant of change; The construction activities are visible from less than half the zone of potential influence; Views from the R385, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues had not been raised as a concern by these communities. **Cumulative Impacts:** Construction activities will cause a minor change in landscape characteristics over localized area resulting in minor changes in key views in the short term and have a cumulative negative effect on the visual quality of the area				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	2	4	3	**21**
Post-Mitigation	1	2	4	2	**14**
Mitigation Measures:	See Section 5.0 below				

Table 2: *Significance* of Visual Impact – PV Power Plant Project Option A

Phase: Operation					
Aspect:	**Type: Visual**				
Activity:	Operational activities are visible				
Impact:	**Physical Presence of PV Project and impact of sensitive views:** The operation activities are visible from less than half the zone of potential influence; Views from the R385, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some project activities will be visible from these areas although visual issues have not been raised as a concern by these communities; Operation activities will cause a minor change in landscape characteristics over localized area resulting in minor changes in key views in the long term and have a high negative effect on the visual quality of the area. **Cumulative Impacts:** Operational activities will cause a minor change in landscape characteristics over a localized area resulting in minor changes in key views in the short term and have a cumulative negative effect on the visual quality of the area				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	4	2	4	3	**30**
Post-Mitigation	4	2	4	2	**20**
Mitigation Measures:	See Section 5.0 below				

Table 3: *Significance* of Visual Impact – PV Power Plant Project Option A

Phase: Decommissioning and Rehabilitation					
Aspect:	**Type: Visual**				
Activity:	Construction activities are visible				
Impact:	**Physical Presence of PV Project and impact of sensitive views:** The proposed VP Project is located in a landscape of moderate value partially tolerant of change; The decommissioning activities are visible from less than half the zone of potential influence; Views from the R385, nearby farmsteads, the Groenwater community and dirt road west of the site are the most sensitive. Some decommissioning activities will be visible from these areas although visual issues had not been raised as a concern by these communities. **Cumulative Impacts:** Decommissioning activities will cause a minor change in landscape characteristics over localized area resulting in minor changes in key views in the short term and have a cumulative positive effect on the visual quality of the area once / if all structures etc. have been removed and rehabilitation of the site is successful and managed in the long term.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	2	4	3	**21**
Post-Mitigation	1	2	2	1	**5**
Mitigation Measures:	See Section 5.0 below				

5.0 MANAGEMENT MEASURES

Mitigation measures are feasible and can reduce the impact of the PV Power Project on sensitive views from the R385 and the local road west of the project site.

considering mitigating measures there are three rules that must be taken into account:

- The measures should be feasible (economically);
- Effective (how long will it take to implement and what provision is made for management/maintenance);
- And acceptable (within the framework of the existing landscape and land use policies for the area);

To address these, the following principles have been established:

- Mitigation measures should be designed to suite the existing landscape character and needs of the locality. They should respect and build upon landscape distinctiveness.
- It should be recognized that many mitigation measures, especially the establishment of planted screens and rehabilitation, are not immediately effective.

Mitigation measures should be feasible and effective in reducing the visual impact on views from some surrounding landowners and roads. It is proposed that the following general actions be implemented for the PV Power Project:

Site Development

- The minimum amount of existing vegetation and topsoil should be removed. Ensure, wherever possible, all existing vegetation is retained and incorporated into the site rehabilitation.
- Good 'housekeeping' (keeping the site tidy and neat) is essential throughout all phases of the project.

Earthworks

- Dust suppression techniques should be in place at all times especially during the construction phase.
- Only the footprint and a small 'construction buffer zone' around the proposed activities should be exposed. In all other areas, the existing vegetation should be retained and access prohibited during the construction phase.

Access Roads

During construction and operational phases, access roads will require an effective dust suppression management programme, such as regular wetting and / or the use of non-polluting chemical stabilisation that will retain moisture in the road surface.

Lighting

Light pollution should be seriously and carefully considered and kept to a minimum wherever possible as light, at night, travels great distances. Security and flood lighting should only be used where absolutely necessary and carefully directed i.e. away from nearby sensitive receptors, residences and communities. Wherever possible, lights should be directed downwards so as to avoid illuminating the sky.

The negative impact of night lighting, glare and spotlight effects, can be mitigated using the following methods:

- Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the Project Site.
- Avoid high pole top security lighting along the periphery of the site, where possible, unless a security risk is posed and consider the use of lights that are activated on movement at illegal entry to the Project Site.

6.0 CONCLUSION

It is concluded that the PV Power Project will have a minor cumulative impact on the visual and aesthetic environment and that the specialist assessments conducted for the original application (NLA 2011) and subsequent Addendum (NLA 2015) are still valid. Mitigation measures are feasible and if implemented effectively and managed can reduce the impact of the PV Power Project.

It is the opinion of the author that all aspects of the PV Power Project, from a potential visual impact perspective, should be approved provided that the mitigation/management measures are effectively implemented, managed and monitored in the long term.

*** NLA ***

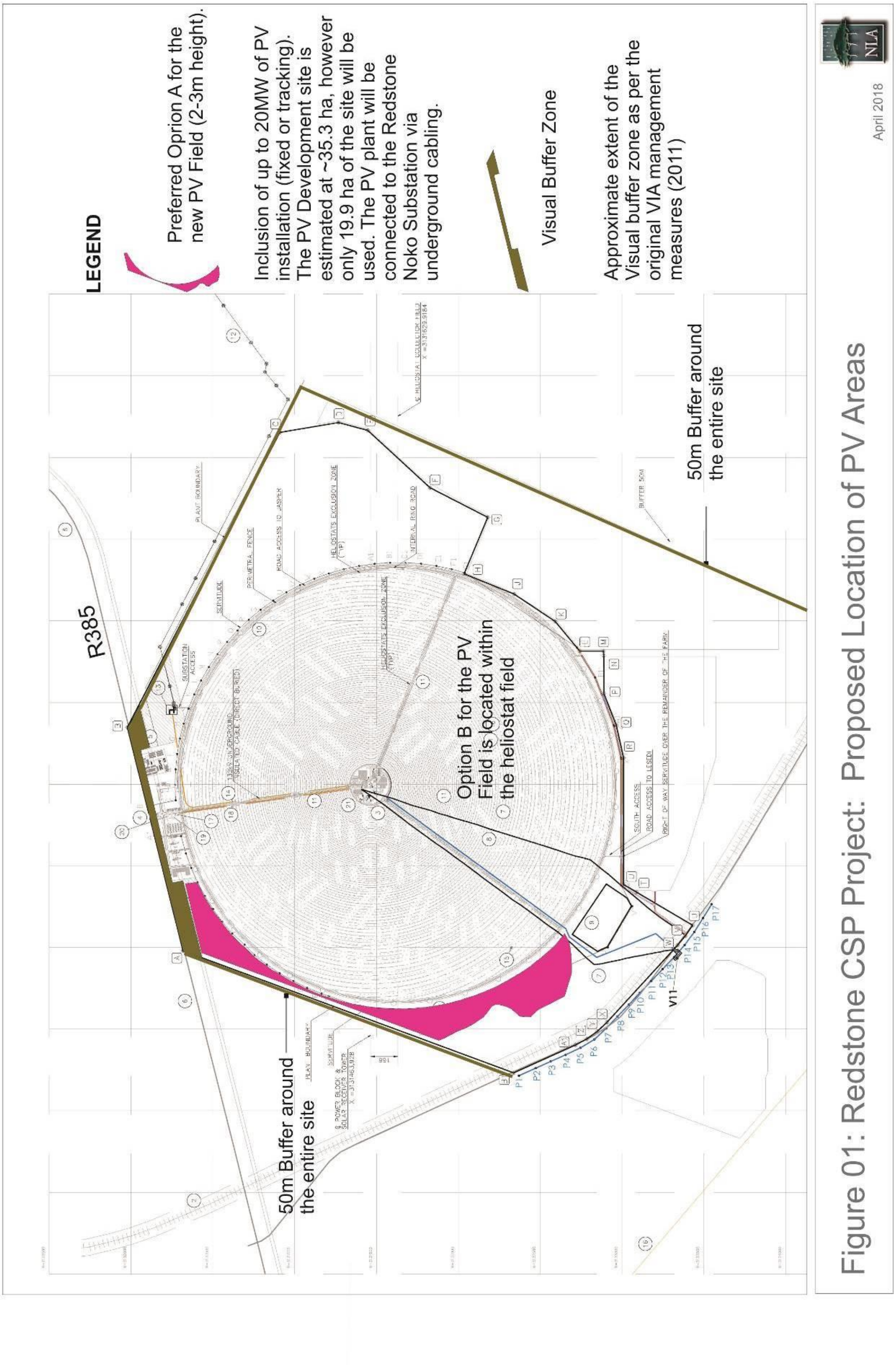

Figure 01: Redstone CSP Project: Proposed Location of PV Areas

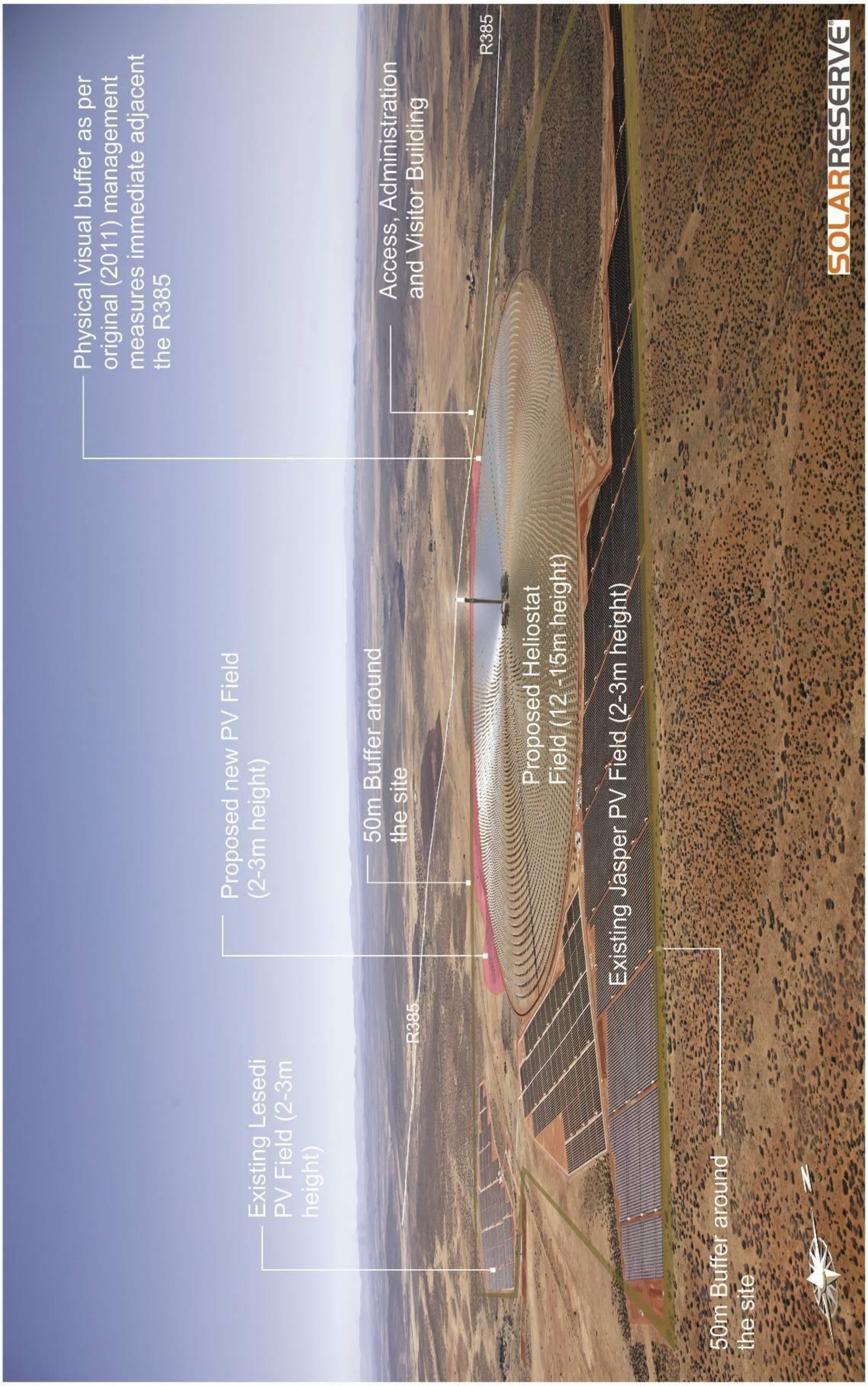

Figure 02: Redstone CSP Project: Additional PV Areas_Aerial 01

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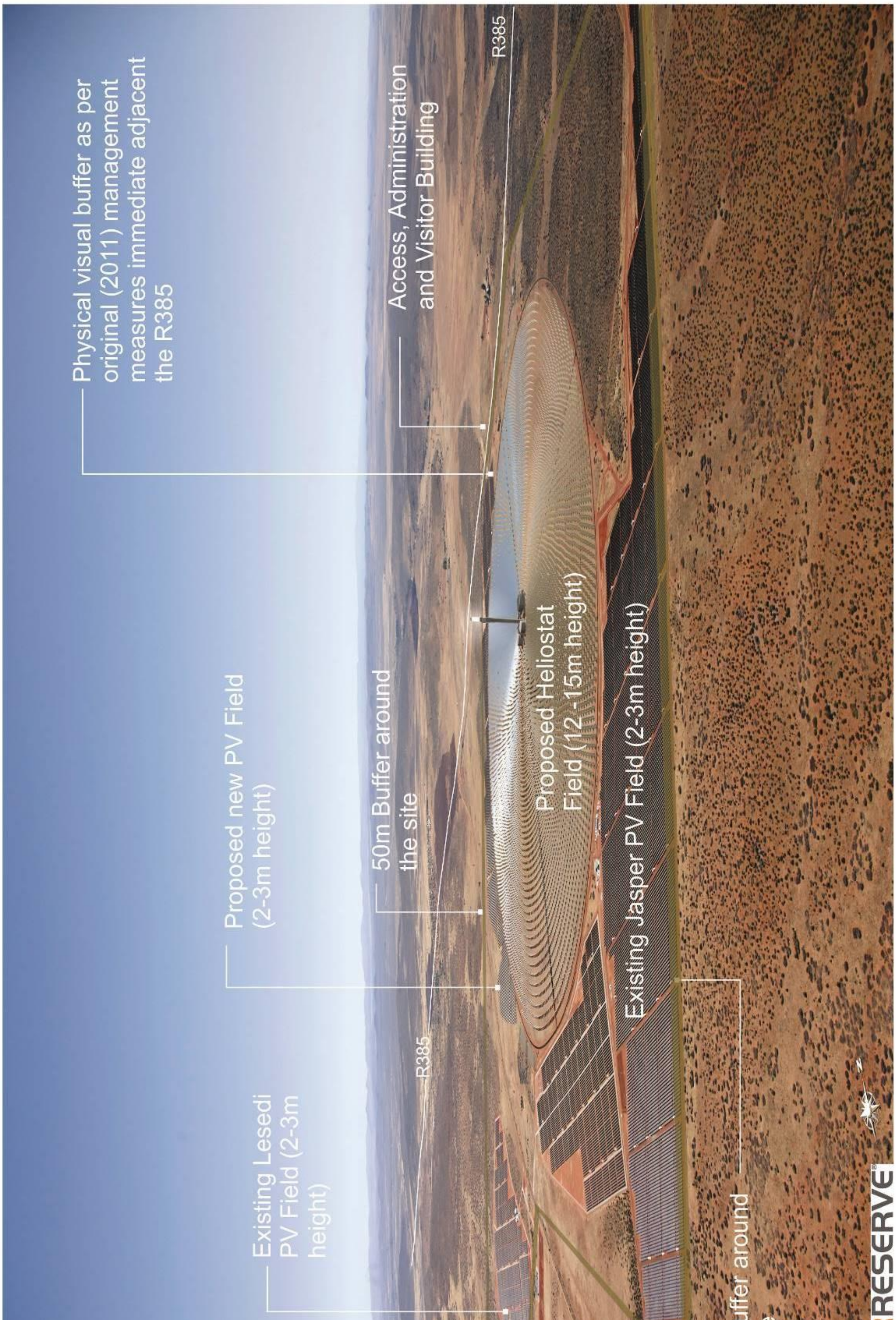

Figure 02a: Redstone CSP Project: Additional PV Areas_Aerial 01_Simulation

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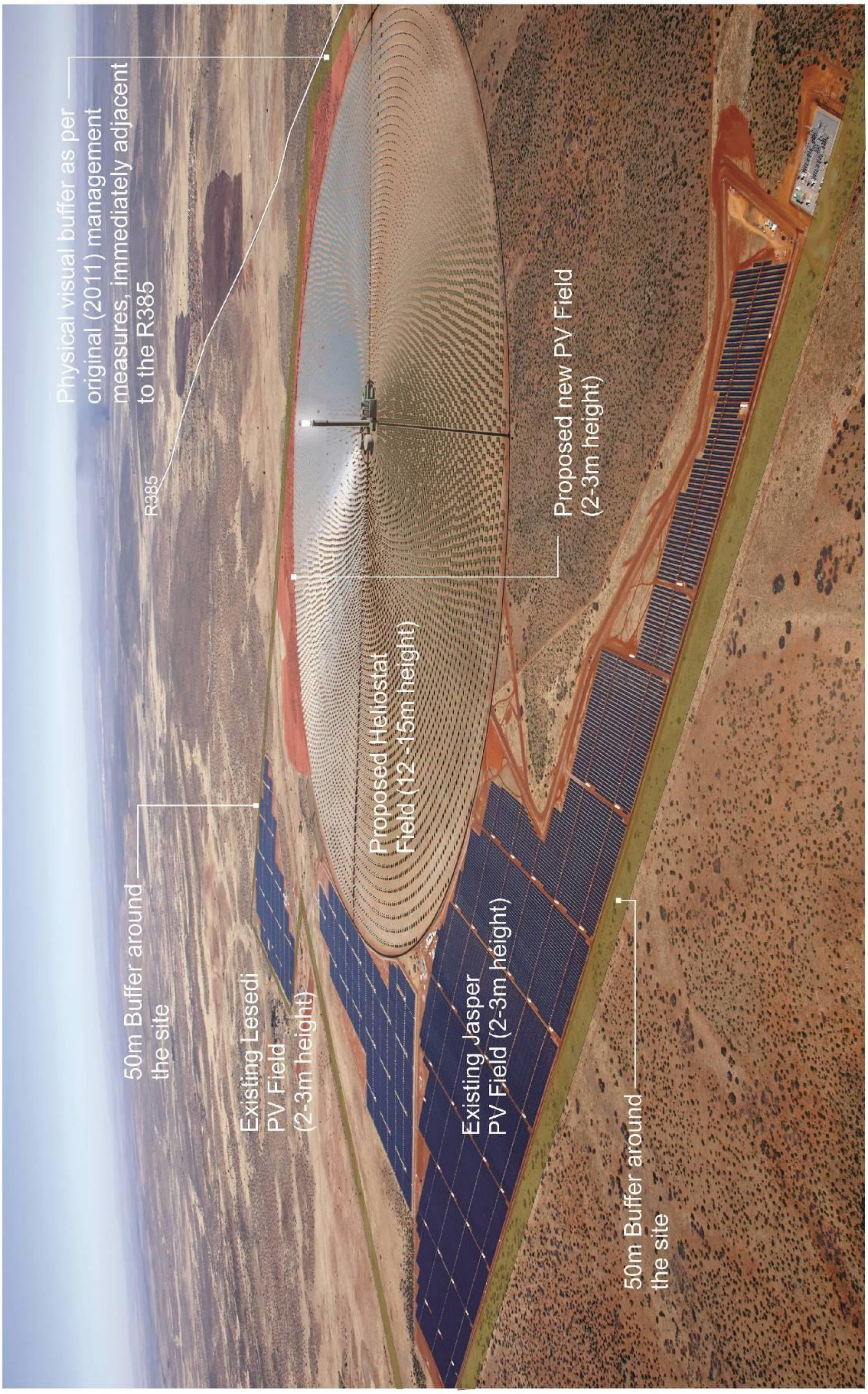

Figure 03: Redstone CSP Project: Additional PV Areas

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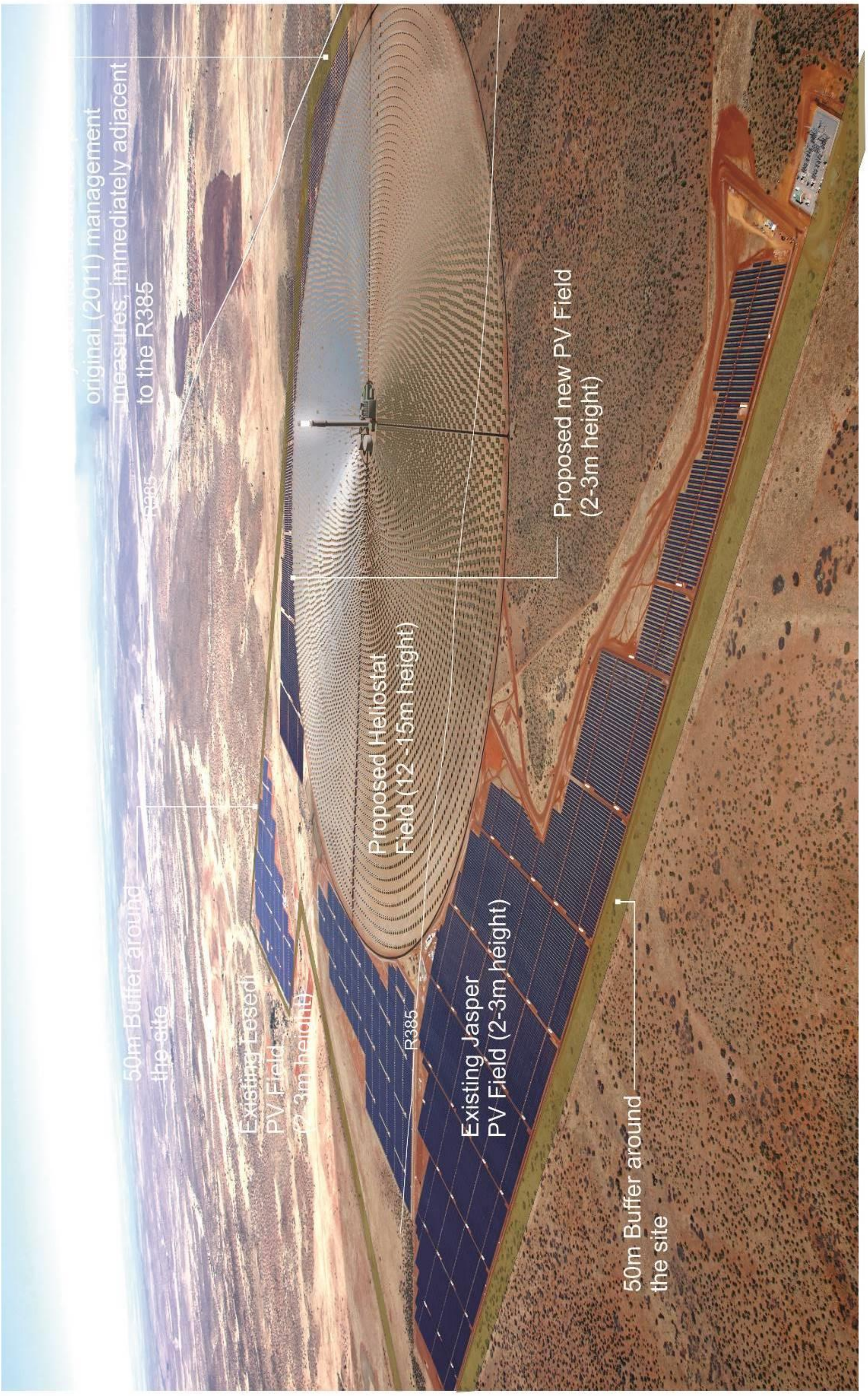

Figure 03a: Redstone CSP Project: Additional PV Areas-Simulation

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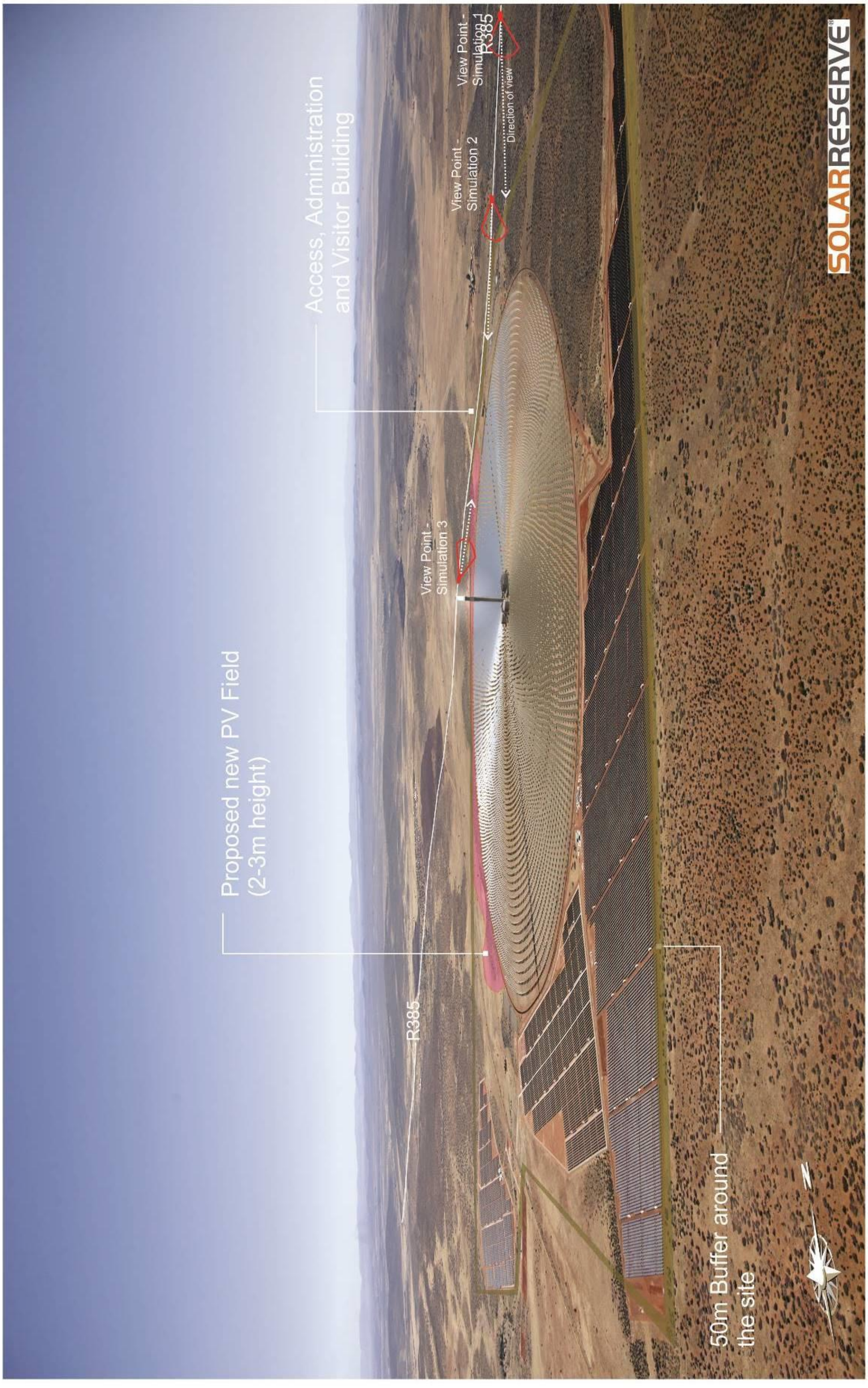

Figure 04: Redstone CSP Project: Ground View Sites - Simulations

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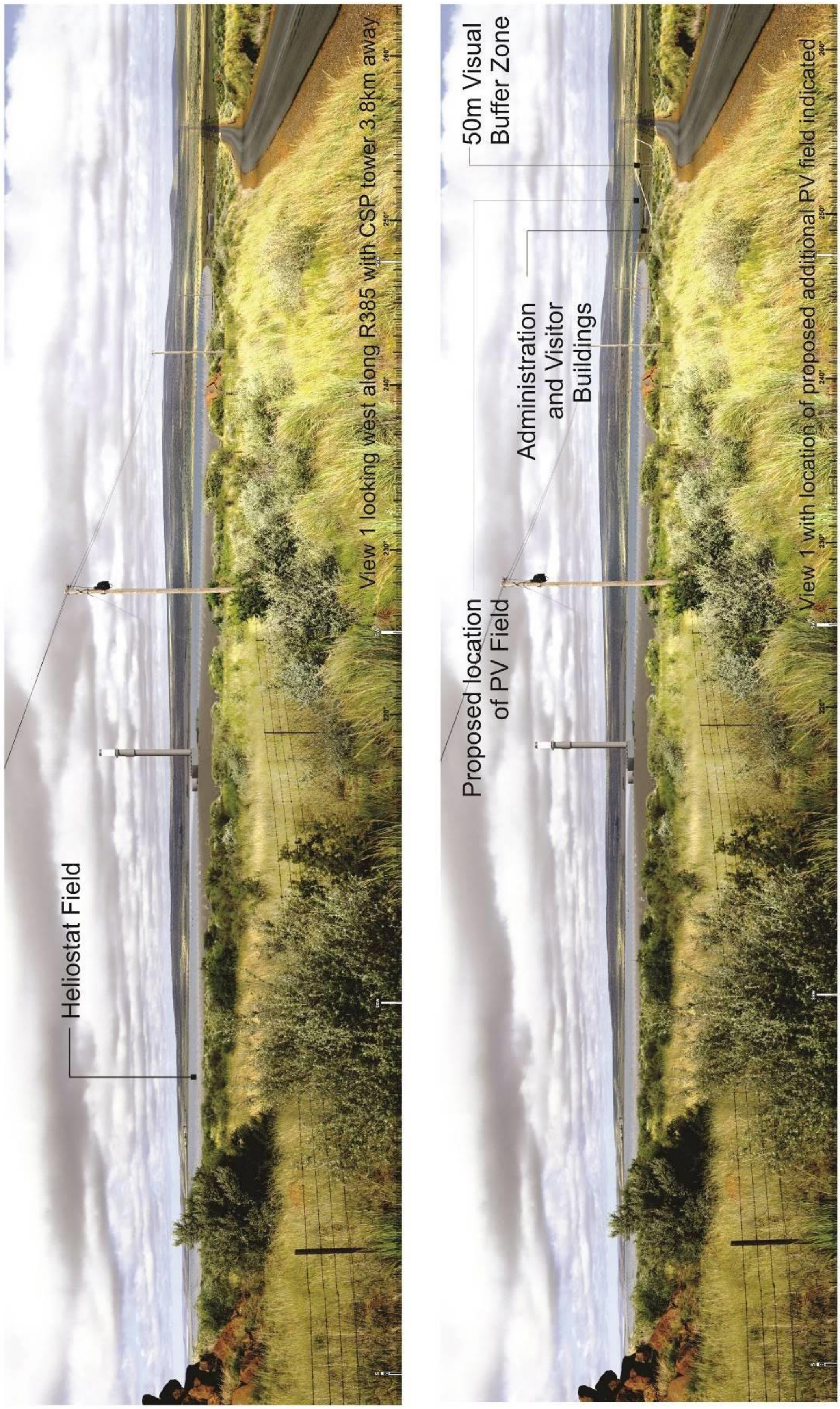

Figure 05_: Redstone CSP Project_ Simulation View 1

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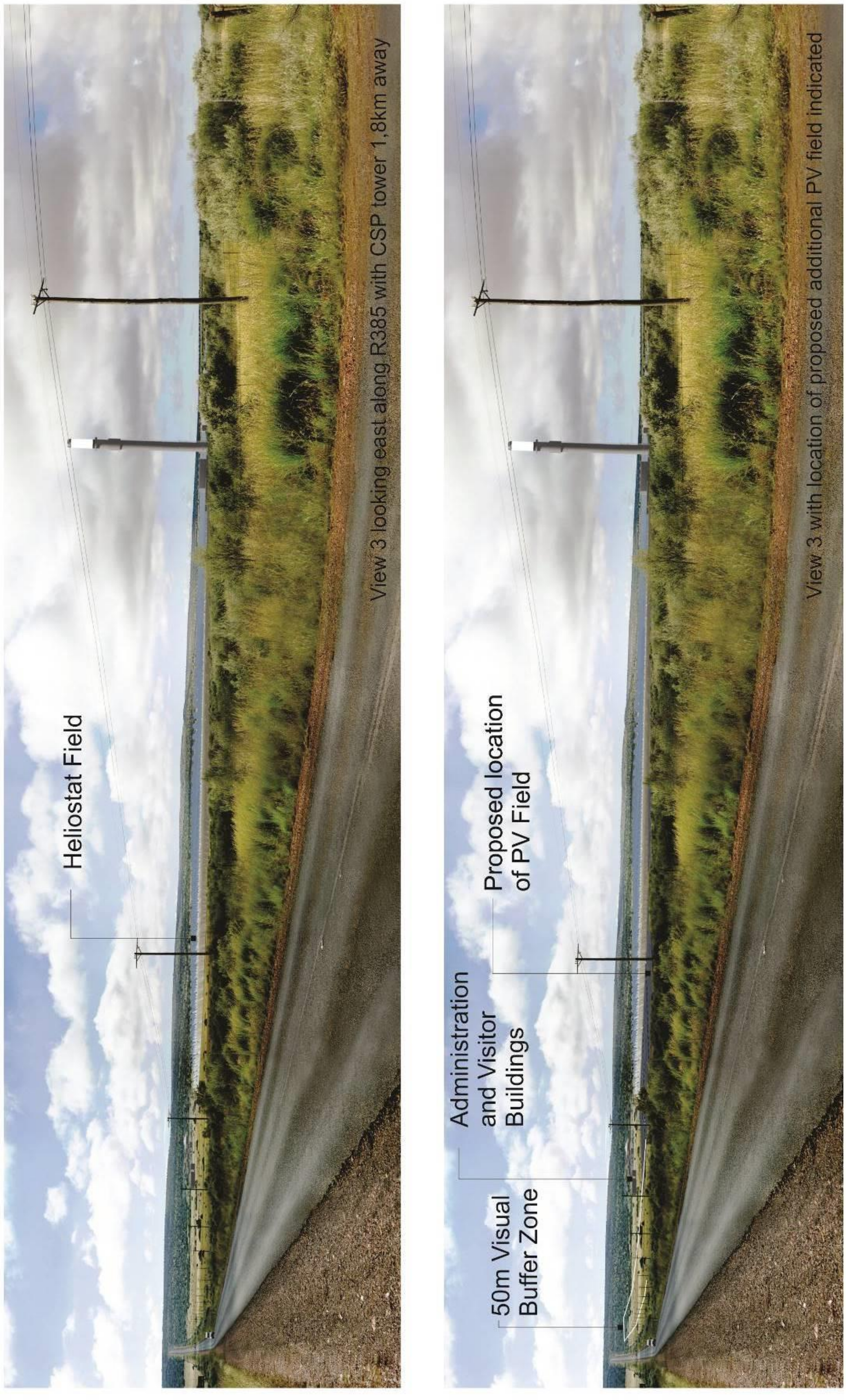

Figure 07: Redstone CSP Project_ Simulation View 3

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APPENDIX A: CURRICULUM VITAE GRAHAM A YOUNG

Graham is a registered landscape architect with interest and experience in landscape architecture, urban design and environmental planning. He holds a degree in landscape architecture from the University of Toronto and has practiced in Canada and Africa, where he has spent most of his working life. He has served as President of the Institute of Landscape Architects of South Africa (ILASA) and as Vice President of the Board of Control for Landscape Architects.

During his 30 years plus career he has received numerous ILASA and other industry awards. He has published widely on landscape architectural issues and has had projects published both locally and internationally in, scientific and design journals and books. He was a being a founding member of Newtown Landscape Architects and is also a senior lecturer, teaching landscape architecture and urban design at post and under graduate levels, at the University of Pretoria. He has been a visiting studio critic at the University of Witwatersrand and University of Cape Town and in 2011 was invited to the University of Rhode Island, USA as their Distinguished International Scholar for that year. Recently, Graham resigned from NLA and now practices as a Sole Proprietor.

A niche specialty of his is Visual Impact Assessment for which he was cited with an ILASA Merit Award in 1999. He has completed over 250 specialist reports for projects in South Africa, Canada and other African countries. He was on the panel that developed the *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes* (2005) and produced a research document for Eskom, *The Visual Impacts of Power Lines* (2009). In 2011, he produced '*Guidelines for involving visual and aesthetic specialists'* for the Aapravasi Ghat Trust Fund Technical Committee (they manage a World Heritage Site) along with the *Visual Impact Assessment Training Module Guideline Document.*

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APPENDIX B: METHOD FOR DETERMINING THE INTENSITY OF LANDSCAPE AND VISUAL IMPACT

A visual impact study analysis addresses the importance of the inherent aesthetics of the landscape, the public value of viewing the natural landscape, and the contrast or change in the landscape from the project.

For some topics, such as water or air quality, it is possible to use measurable, technical international or national guidelines or legislative standards, against which potential effects can be assessed. The assessment of likely effects on a landscape resource and on visual amenity is more complex, since it is determined through a combination of quantitative and qualitative evaluations. (The Landscape Institute with the Institute of Environmental Management and Assessment (2002).

Landscape impact assessment includes a combination of objective and subjective judgements, and it is therefore important that a structured and consistent approach is used. It is necessary to differentiate between judgements that involve a degree of subjective opinion (as in the assessment of landscape value) from those that are normally more objective and quantifiable (as in the determination of magnitude of change). Judgement should always be based on training and experience and be supported by clear evidence and reasoned argument. Accordingly, suitably qualified and experienced landscape professionals carry out landscape and visual impact assessments (The Landscape Institute with the Institute of Environmental Management and Assessment (2002),

Landscape and visual assessments are separate, although linked, procedures. The landscape baseline, its analysis and the assessment of landscape effects all contribute to the baseline for visual assessment studies. The assessment of the potential effect on the landscape is carried our as an effect on an environmental resource, i.e. the landscape. Visual effects are assessed as one of the interrelated effects on population.

Landscape Impact
Landscape impacts derive from changes in the physical landscape, which may give rise to changes in its character and from effects to the scenic values of the landscape. This may in turn affect the perceived value ascribed to the landscape. The description and analysis of effects on a landscape resource relies on the adoption of certain basic principles about the positive (or beneficial) and negative (or adverse) effects of change in the landscape. Due to the inherently dynamic nature of the landscape, change arising from a development may not necessarily be significant (Institute of Environmental Assessment & The Landscape Institute (2002)).

Visual Impact
Visual impacts relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity. Visual impact is therefore measured as the change to the existing visual environment (caused by the physical presence of a new development) and the extent to which that change compromises (negative impact) or enhances (positive impact) or maintains the visual quality of the area.

To assess the magnitude of visual impact four main factors are considered.

Visual Intrusion:

- The nature of intrusion or contrast (physical characteristics) of a project component on the visual quality of the surrounding environment and its compatibility/discord with the landscape and surrounding land use.

Visibility:

- The area / points from which project components will be visible.

Visual exposure:

- Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion.

Sensitivity:

- Sensitivity of visual receptors to the proposed development

Visual Intrusion / contrast

Visual intrusion deals with the notion of contextualism i.e. how well does a project component fit into the ecological and cultural aesthetic of the landscape as a whole? Or conversely what is its contrast with the receiving environment. Combining landform / vegetation contrast with structure contrast derives overall visual intrusion/contrast levels of high, moderate, and low.

Landform / vegetation contrast is the change in vegetation cover and patterns that would result from construction activities. Landform contrast is the change in landforms, exposure of soils, potential for erosion scars, slumping, and other physical disturbances that would be noticed as uncharacteristic in the natural landscape. Structure contrast examines the compatibility of the proposed development with other structures in the landscape and the existing natural landscape. Structure contrast is typically strongest where there are no other structures (e.g., buildings, existing utilities) in the landscape setting.

Photographic panoramas from key viewpoints before and after development are presented to illustrate the nature and change (contrast) to the landscape created by the proposed development. A computer simulation technique is employed to superimpose a graphic of the development onto the panorama. The extent to which the component fits or contrasts with the landscape setting can then be assessed using the following criteria.

- Does the physical development concept have a negative, positive or neutral effect on the quality of the landscape?
- Does the development enhance or contrast with the patterns or elements that define the structure of the landscape?
- Does the design of the project enhance and promote cultural continuity or does it disrupt it?

The consequence of the intrusion/contrast can then be measured in terms of the sensitivity of the affected landscape and visual resource given the criteria listed below. For instance, within an industrial area, a new sewage treatment works may have an insignificant landscape and visual impact; whereas in a *valued* landscape it might be considered to be an intrusive element. (Institute of Environmental Assessment & The landscape Institute (1996)).

Visual Intrusion

High	**Moderate**	**Low**	**Positive**
If the project: - Has a substantial negative effect on the visual quality of the landscape; - Contrasts dramatically with the patterns or elements that define the structure of the landscape; - Contrasts dramatically with land use, settlement or enclosure patterns; - Is unable to be 'absorbed' into the landscape. *Result* Notable change in landscape characteristics over an extensive area and/or intensive change over a localized area resulting in major changes in key views.	If the project: - Has a moderate negative effect on the visual quality of the landscape; - Contrasts moderately with the patterns or elements that define the structure of the landscape; - Is partially compatible with land use, settlement or enclosure patterns. - Is partially 'absorbed' into the landscape. *Result* Moderate change in landscape characteristics over localized area resulting in a moderate change to key views.	If the project: - Has a minimal effect on the visual quality of the landscape; - Contrasts minimally with the patterns or elements that define the structure of the landscape; - Is mostly compatible with land use, settlement or enclosure patterns. - Is 'absorbed' into the landscape. *Result* Imperceptible change resulting in a minor change to key views.	If the project: - Has a beneficial effect on the visual quality of the landscape; - Enhances the patterns or elements that define the structure of the landscape; - Is compatible with land use, settlement or enclosure patterns. *Result* Positive change in key views.

Visual intrusion also diminishes with scenes of higher complexity, as distance increases, the object becomes less of a focal point (more visual distraction), and the observer's attention is diverted by the complexity of the scene (Hull and Bishop (1988)).

Visibility

A viewshed analysis was carried out to define areas, which contain all possible observation sites from which the development would be visible. The basic assumption for preparing a viewshed analysis is that the observer eye height is 1.8m above ground level. Topographic data was captured for the site and its environs at 10 m contour intervals to create the Digital Terrain Model (DTM). The DTM includes features such as vegetation, rivers, roads and nearby urban areas. These features were 'draped' over the topographic data to complete the model used to generate the viewshed analysis. It should be noted that viewshed analyses are not absolute indicators of the level of significance (magnitude) of the impact in the view, but merely a statement of the fact of potential visibility. The visibility of a development and its contribution to visual impact is predicted using the criteria listed below:

Visibility

High	**Moderate**	**Low**
Visual Receptors	*Visual Receptors*	*Visual Receptors*
If the development is visible from over half the zone of potential influence, and / or views are mostly unobstructed and / or the majority of viewers are affected.	If the development is visible from less than half the zone of potential influence, and / or views are partially obstructed and or many viewers are affected	If the development is visible from less than a quarter of the zone of potential influence, and / or views are mostly obstructed and / or few viewers are affected.

Visual Exposure

Visual exposure relates directly to the distance of the view. It is a criterion used to account for the limiting effect of increased distance on visual impact. The impact of an object in the foreground (0 – 800m) is greater than the impact of that same object in the middle ground (800m – 5.0 km) which, in turn is greater than the impact of the object in the background (greater than 5.0 km) of a particular scene.

Distance from a viewer to a viewed object or area of the landscape influences how visual changes are perceived in the landscape. Generally, changes in form, line, colour, and texture in the landscape become less perceptible with increasing distance.

Areas seen from 0 to 800m are considered foreground; foliage and fine textural details of vegetation are normally perceptible within this zone.

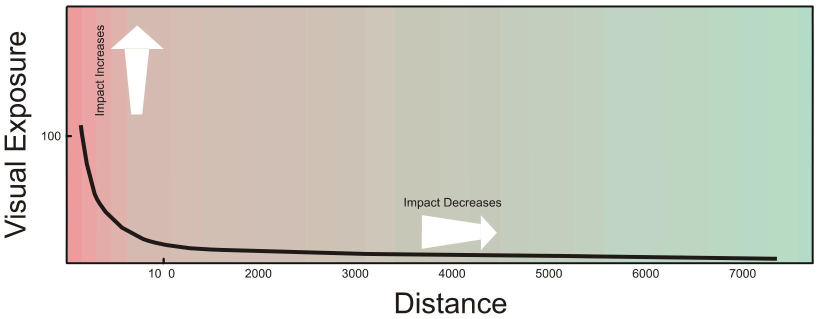
Areas seen from 800m to 5.0km are considered middle ground; vegetation appears as outlines or patterns. Depending on topography and vegetation, middle ground is sometimes considered to be up to 8.0km.

Areas seen from 5.0km to 8.0km and sometimes up to 16km and beyond are considered background. Landforms become the most dominant element at these distances.

Seldom seen areas are those portions of the landscape that, due to topographic relief or vegetation, are screened from the viewpoint or are beyond 16km from the viewpoint. Landforms become the most dominant element at these distances.

The impact of an object diminishes at an exponential rate as the distance between the observer and the object increases. Thus, the visual impact at 1000 m would be 25% of the impact as viewed from 500 m. At 2000 m it would be 10% of the impact at 500 m. The inverse relationship of distance and visual impact is well recognised in visual analysis literature (e.g.: Hull and Bishop (1988)) and is used as an important criteria for the study. This principle is illustrated in the Figure below.

Effect of Distance on Visual Exposure



Sensitivity of Visual Receptors

When visual intrusion, visibility and visual exposure are incorporated, and qualified by sensitivity criteria (visual receptors) the magnitude of the impact of the development can be determined.

The sensitivity of visual receptors and views will be depended on:

- The location and context of the viewpoint;
- The expectations and occupation or activity of the receptor;
- The importance of the view (which may be determined with respect to its popularity or numbers of people affected, its appearance in guidebooks, on tourist maps, and in the facilities provided for its enjoyment and references to it in literature or art).

The most sensitive receptors may include:

- Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape;
- Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;
- Occupiers of residential properties with views affected by the development.
- These would all be high

Other receptors include:

- People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value);
- People travelling through or past the affected landscape in cars, on trains or other transport routes;
- People at their place of work.

The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

In this process more weight is usually given to changes in the view or visual amenity which are greater in scale, and visible over a wide area. In assessing the effect on views, consideration should be given to the effectiveness of mitigation measures, particularly where planting is proposed for screening purposes (Institute of Environmental Assessment & The Landscape Institute (1996).

Sensitivity of Visual Receptors

High	Moderate	Low
Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape;	People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value);	The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view (i.e. office and industrial areas).
Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;	People travelling through or past the affected landscape in cars, on trains or other transport routes;	Roads going through urban and industrial areas
Occupiers of residential properties with views affected by the development.		

Magnitude (Intensity) of the Visual Impact
Potential visual impacts are determined by analysing how the physical change in the landscape, resulting from the introduction of a project, are viewed and perceived from sensitive viewpoints. Impacts to views are the highest when viewers are identified as being sensitive to change in the landscape, and their views are focused on and dominated by the change. Visual impacts occur when changes in the landscape are noticeable to viewers looking at the landscape from their homes or from parks, and conservation areas, highways and travel routes, and important cultural features and historic sites, especially in foreground views.

The magnitude of impact is assessed through a synthesis of visual intrusion, visibility, visual exposure and viewer sensitivity criteria. Once the magnitude of impact has been established this value is further qualified with spatial, duration and probability criteria to determine the *significance* of the visual impact.

For instance, the fact that visual intrusion and exposure diminishes significantly with distance does not necessarily imply that the relatively small impact that exists at greater distances is unimportant. The level of impact that people consider acceptable may be dependent upon the purpose they have in viewing the landscape. A particular development may be unacceptable to a hiker seeking a natural experience, or a household whose view is impaired, but may be barely noticed by a golfer concentrating on his game or a commuter trying to get to work on time (Ittleson *et al.,* 1974).

In synthesising these criteria, a numerical or weighting system is avoided. Attempting to attach a precise numerical value to qualitative resources is rarely successful, and should not be used as a substitute for reasoned professional judgement. (Institute of Environmental Assessment and the Landscape Institute (1996)).

Magnitude (Intensity) of Visual Impact

High	**Moderate**	**Low**	**Negligible**
Total loss of or major alteration to key elements/features/characteristics of the baseline. I.e. Pre-development landscape or view and/or introduction of elements considered to	Partial loss of or alteration to key elements/features/characteristics of the baseline. I.e. Pre-development landscape or view and/or introduction of	Minor loss of or alteration to key elements/features/characteristics of the baseline. I.e. Pre-development landscape or view an/or introduction of elements that may not	Very minor loss or alteration to key elements/features/characteristics of the baseline. I.e. Pre-development landscape or view and/or introduction of elements that are not

be totally uncharacteristic when set within the attributes of the receiving landscape. High scenic quality impacts would result.	elements that may be prominent but may not necessarily be considered to be substantially uncharacteristic when set within the attributes of the receiving landscape. Moderate scenic quality impacts would result	be uncharacteristic when set within the attributes of the receiving landscape. Low scenic quality impacts would result.	uncharacteristic with the surrounding landscape – approximating the 'no change' situation. Negligible scenic quality impacts would result.

Cumulative effects

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect the way in which the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise a range of benefits, they may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the intervisibility (visibility) of a range of developments and /or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effect on visual receptors within their combined visual envelopes. Intervisibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions. (Institute of Environmental Assessment and The landscape Institute (1996)).

APPENDIX C: DETERMINING THE SIGNIFICANCE OF IMPACT

The significance (quantification) of potential environmental impacts identified have been determined using a ranking scale, based on the following (terminology has been taken from the Guideline Documentation on EIA Regulations, of the Department of Environmental Affairs and Tourism, April 1998):

Occurrence

- Probability of occurrence (how likely is it that the impact may occur?)
- Duration of occurrence (how long may it last?)

Severity

- Magnitude (severity) of impact (will the impact be of high, moderate or low severity?)
- Scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?)

Each of these factors has been assessed for each potential impact using the ranking scales represented

Table 1: Ranking scale of the four factors considered to determine significance rating

Probability	Duration
1 - very improbable (probably will not happen 2 - improbable (some possibility, but low likelihood) 3 - probable (distinct possibility) 4 - highly probable (most likely) 5 - definite (impact will occur regardless of any prevention measures)	1 - of a very short duration (0–1 years) 2 - of a short duration (2-5 years) 3 - medium-term (5–15 years) 4 - long term (> 15 years) 5 - permanent
Extent	**Magnitude**
1 - limited to the site 2 - limited to the local area 3 - limited to the region 4 - will be national 5 - will be international	0 - small and will have no effect on the environment 2 - minor and will not result in an impact on processes 4 - low and will cause a slight impact on processes 6 - moderate and will result in processes continuing but in a modified way 8 - high (processes are altered to the extent that they temporarily cease) 10 - very high and results in complete destruction of patterns and permanent cessation of processes

The environmental significance of each potential impact is assessed using the following formula:

Significance Points (SP) = (Magnitude + Duration + Extent) x Probability

The maximum value is 100 Significance Points (SP). Potential environmental impacts were rated as high, moderate or low significance on the following basis:

- < 30 significance points = **LOW** environmental significance.
- 31- 60 significance points = **MODERATE** environmental significance
- 60 significance points = **HIGH** environmental significance

This section in the final impacts table then summarises the potential impacts associated to the three different phases of the proposed development activities. The potential impacts and risks are explored by investigating each aspect (i.e. air quality, Wetland and Ecological, heritage and social) associated to the proposed activities.

- For the purpose of this section, the mitigation measures recommended will only be summarise to demonstrate the approach taken to manage each risk. A detailed mitigation plan will form part of the final BAr and EMPr.

Table 2: Explanation of colour indicator

Colour	Significance Points	Explanation
	≤ 30	**LOW** environmental significance
	31 - 60	**MODERATE** environmental significance
	> 60	**HIGH** environmental significance