12. VISUAL IMPACT ASSESSMENT

The visual impact assessment was undertaken and compiled by Lourens du Plessis from MetroGIS (Pty) Ltd in his capacity as a visual assessment and Geographic Information Systems specialist.

12.1. Introduction

The placement, construction and operation of the Concentrating Solar Power (CSP) plant in the Upington area is a first for South Africa and one of few similar projects worldwide. Careful consideration and research identified this region as an ideal location for this project. This ambitious project, if/when it is constructed, is set to be the largest of its kind in the world.

It is with this in mind, and the fact that it will be located in a primarily natural area, that the visual impact assessment was undertaken. This report sets out to identify, quantify and make recommendations related to the potential visual impacts associated with the CSP plant and its associated infrastructure. It is hoped that this will assist the project team, authorities and interested and affected parties in making informed decisions regarding the visual aspects of this project.

12.2. Scope of Work

The visual impact assessment entails the assessment of the potential visual impacts related to the construction, operation and decommissioning of the Concentrating Solar Power (CSP) plant proposed for the Northern Cape.

The study area for the undertaking of spatial analyses and the assessment of the visual impacts includes a minimum radius of 16 km from the proposed site. This report will attempt to identify areas of potential visual impact within this study area and quantify the impact in terms of nature, extent, duration, intensity, probability, significance and the potential for mitigation.

Specific issues identified in the Visual Assessment section of the Environmental Scoping Report (ESS) will be addressed in this report. These issues include:

- The visibility of the CSP plant to, and visual impact on, major tourist routes in the area (i.e. the N10/N14 roads to Augrabies Falls National Park, Kgalagadi Transfrontier Park and Namibia).

- The visibility of the CSP plant to, and visual impact on, not only major built up centres or populated places but also individual/isolated landowners (specific complaints).
- The potential visual exposure of the facility to protected areas in the immediate vicinity (i.e. the Spitskop Nature Reserve and the Augrabies Falls National Park).
- The potential visual impact of the exposure of the CSP plant to water related recreational activities and tourism potential of the Orange River.
- The potential visual impact of the construction of ancillary infrastructure (i.e. the construction of a transmission line, pipeline and pump station).
- The potential visual impact of operational and security lighting of the facility at night.
- The potential to mitigate visual impacts.

12.3. Methodology for the Assessment of the Visual Impact

12.3.1. General

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from the 20 m interval contours, supplied by the Surveyor General.

Site visits were undertaken to source information regarding land use, vegetation cover, topography and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

The results of the spatial analysis and other relevant orientation data are displayed on a number of supplementary maps, which will be referred to in the text.

12.3.2. Potential Visual Exposure

The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed CSP plant and associated infrastructure weren't visible, no impact would occur.

Viewshed analyses of the proposed CSP plant and the related infrastructure (mainly the heliostats), based on a 20 m interval digital terrain model of the study area, indicate the potential visibility.

Map 5 (included in Appendix G) indicates the potential visual exposure of the CSP plant based on the dimensions of the facility's structures. The dimensions of the facility, which will potentially be the largest in the world, are considerable. The central receiver will consist of a 190 m high concrete structure with the central receiver (20m high and 15 m in diameter) perched on top of the concrete structure. The central receiver will appear white hot during daytime operations but the brightness is comparable to only a 400 W light bulb when viewed from a distance of 1 km. 6000 heliostats (12 m x 12 m each) will surround the central receiver over an approximate surface area of 4 km^2 (2 km diameter). Ancillary infrastructure in the immediate proximity of the central receiver will include two salt tanks (12 m high and 30 m diameter) and an auxiliary house.

Figure 12.1: *Solar Tres* - CSP plant in Spain. (Photo: Solar PACES Website).

The above photograph shows the *Solar Tres* CSP plant in Spain. This facility is similar to the CSP plant planned for the Northern Cape, but is considerably smaller. The central receiver structure (lattice) is less than 100 m tall and there are just under 2500 heliostats covering an area of approximately 29 ha. The proposed Northern Cape CSP plant will virtually be double the size of the Solar Tres plant in terms of dimensions. *Also see Map 7* (included in Appendix G) *for a perspective view of the facility.*

The joint exposure of the central receiver and the heliostats are indicated on Map 5 (included in Appendix G). The orange shading indicates areas from which the central receiver and the heliostats would potentially be visible and the light brown shading indicates areas where only the central receiver would be visible. It becomes clear from this viewshed analysis that the facility (especially the central receiver) would be

exposed to a large geographical area within this region due to the relatively flat topography.

The CSP plant will be exposed to populated areas south and west of Upington, whilst only the central receiver will be exposed to the smaller settlements along the Orange River (if exposed at all). The facility will further be visible from the major roads in the area and from the Spitskop Nature Reserve north-west of Upington.

12.3.3 Visual Distance / Observer Proximity to the facility

The principle of reduced impact over distance is applied in order to determine the core area of visual influence for this type of structure. It is envisaged that the nature of the structure and the relatively natural state of the environment would create a significant contrast that would make the facility visible and recognisable from a great distance. This would be especially true where the observer has an elevated vantage point.

The proximity radii for the CSP plant are indicated on Map 4 in order to indicate the scale and viewing distance of the facility and to determine the prominence of the structure in relation to its environment.

The proximity radii (shown on Map 4 - included in Appendix G) chosen for the CSP plant are:

- 0 - 4 km. Short distance view where the CSP plant would dominate the frame of vision and constitute a very high visual prominence.

- 4 - 8 km. Medium distance view where the CSP plant would be easily and comfortably visible and constitute a high visual prominence.

- 8 - 16 km. Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a high to medium visual prominence.

- Greater than 16 km. Long distance view of the facility where the CSP plant would still be visible though not as easily recognisable. This zone constitutes a medium visual prominence for the facility.

The visual distance theory and the observer's proximity to the facility are closely related, and especially relevant, when considered from areas with a high viewer incidence and a predominantly negative visual perception of the proposed facility.

12.3.4. Viewer Incidence/Viewer Perception

The number of observers and their perception of a structure determine the concept of visual impact. If there are no observers or if the visual perception of the structure is favourable to all the observers, there would be no visual impact.

It is necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed CSP plant and it's related infrastructure. It would be impossible not to generalise the viewer incidence and sensitivity to some degree, as there are many variables when trying to determine the perception of the observer; regularity of sighting, cultural background, state of mind, purpose of sighting, etc. which would create a myriad of options.

For the purpose of this study five areas were classified as having differing observer incidences and/or perceptions. These are indicated on Map 3 (included in Appendix G).

The **first zone** of high viewer incidence and potential negative perception are the built-up (residential) areas within the study area. These include Upington, Louisvale Road, Orangevallei, Ses Brugge, Louisvale, Klippunt and Kanoneiland. Observers residing in these areas are accustomed to the wide natural expanses and vistas afforded by this relatively unspoilt region. Developments, especially industrial style structures, visible from these areas may constitute a negative visual impact. *It must be noted that no complaints, as far as the author is aware, were received from individual landowners in the study area regarding the construction and operation of the CSP plant.*

The **second zone** with medium observer incidence and potentially negative viewer perception encompasses the cultivated areas adjacent to the Orange River. This zone consists mainly of vineyards and activities related to the cultivation of grapes. It is perceived that it would have fewer observers but could still evoke potentially negative perceptions of the facility.

Areas that are greatly devoid of random observers make up the **third zone** with low observer incidence and/or a predominantly neutral perception of the facility. This area includes large tracts of sparsely populated land (thicket, bushland, shrubland and grassland) and built-up areas around Upington that already has industrial structures and activities. It also includes commercial and retail land uses that generally support activities and observers that would not be sensitive (or even

notice) the construction of the CSP plant due to the nature of the activities already present.

A **fourth zone** that could have a potential negative experience of the CSP plant and could constitute an area of potential conflicting land uses, are protected areas (Spitskop Nature Reserve), water courses (Orange River) and wetlands. The sensitive nature of these areas and the activities (nature oriented tourism) could conflict with the industrial style development in question.

The **fifth and final zone** comprises corridors along the main roads in the area. These corridors have a higher frequency of observers. Observers could potentially have either negative or positive perceptions of the CSP plant depending on their travel purpose. This is especially true for the National and Main roads in the study area, as these roads function as tourist routes to and from the Kgalagadi Trans-frontier National Park, the Augrabies Falls National Park and Namibia. The Secondary roads (mainly dirt roads) have a lower frequency of potential observers, but still act as transportation veins that would increase the frequency of potential sightings of the facility.

12.3.5. Visual Absorption Capacity of the natural vegetation

The digital terrain model utilised in the calculation of the visual exposure of the facility does not incorporate the potential visual absorption capacity (VAC) of the natural vegetation of the region. It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, supplemented with field observations.

The vegetation units (see Map 3 - included in Appendix G) present in the study area surrounding the CSP plant are on average only 2 m high. This, coupled with the sparse distribution of the plant species and the dimensions of the facility, contributes to a low to negligible VAC for virtually the entire study area.

12.3.6. Visual Impact Index

The results of the above analyses were merged in order to determine where the areas of likely visual impact would occur. These areas were further analysed in terms of the previously mentioned issues (related to the visual impact) and in order to judge the severity of each impact.

12.4. Regional Overview

12.4.1. Description of the affected environment

Please refer to Maps 1,2 and 3 for the Locality, Topography and Land Use/Cover maps (included in Appendix G).

The proposed location for the CSP plant is situated approximately 20 km by road east of Upington on the farm Olyvenhouts Drift. Access to the farm is afforded by means of an 8 km stretch of secondary (dirt) road that joins the N14 national road near the small town of Oranjevallei. Other small towns and settlements along the Orange River include Ses Brugge, Louisvale, Klippunt and Kanoneiland.

The N14, N10, R360 and R359 are the primary roads in the region and are the main link between Gauteng and Namibia, the Augrabies Falls National Park and the Kgalagadi Trans-frontier National Park.

The topography of the region is relatively homogenous and is described predominantly as lowlands with hills, dune hills and irregular or slightly irregular plains. Relatively prominent hills occur towards the south-west of the study area.

The terrain surrounding the farm is predominantly flat with an even south-eastern slope towards the Orange River valley that forms a distinct hydrological feature in the region. It has to a large degree dictated the settlement patterns in this arid region by providing a source of perennial water for the cultivation of grapes. This and the associated production of wine is the primary agricultural activity of this district and also its international claim to fame. Cattle and game farming practises also occur at a less intensive degree. Other land-use activities include conservation and nature oriented tourism in the form of the Spitskop Nature Reserve north-west of Upington (along the R360) and the Augrabies Falls National Park (approximately 120 km west of Upington).

The majority of the study area is ill populated (less than 10 people per km^2) and consists of a landscape of wide-open expanses and vast desolation. The scarcity of water and other natural resources has dictated the settlement patterns of this region. The population distribution is primarily concentrated in and around the small towns along the Orange River.

Vegetation cover in this semi-desert region is restricted to thicket, bushland, shrubland and grassland. Planted vegetation in the form of vineyards, for the cultivation of grapes, is found along the Orange River floodplain.

Source: Department of Environmental Affairs and Tourism (2001), CSIR/ARC NLC (2000) and site observations.

12.4.2. Site description

The proposed footprint for the CSP plant is located roughly in the centre of the farm Olyvenhouts Drift at about 850 m above mean sea level. The site is flat with hardly any existing structures or man-made features. The existing structure are restricted to a windmill and cattle farming infrastructure. The vegetation cover is low thicket and bushland and no major hydrological features are present.

The photograph below of the area identified for the CSP plant footprint gives a good indication of the wide-open expanse and unrestricted vistas afforded by the terrain.

Figure 12.2: Photograph of the proposed site taken from the access road (looking north).

12.5. Site Specific Results

12.5.1. Visual impact index

Please refer to Map 6 (included in Appendix G) *for the visual impact index of the proposed CSP plant.*

The visual impact index is a combined weighted index of the visual exposure (both the central receiver and the heliostats), the observer proximity, the viewer incidence/perception and the visual absorption capacity (presence/absence of vegetation cover) of the proposed CSP plant. The result of the combination of the above criteria gives an indication of the likely area of visual impact. This helps in

focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

The index immediately gives a strong indication that observers in close proximity to the facility (within 4 km) would have the highest visual experience of the facility and would receive the highest visual impact. This is especially true for observers travelling along the access road. This area is however not of the greatest concern as it is generally deserted (devoid of random observers) and that the road, albeit a public road, does not carry a large number of motorists. It is envisaged that people travelling along this road would more than likely be, either visiting the facility, or farmers or local workers travelling to town. It is unlikely that tourists would accidentally travel along this road.

Other areas highlighted by the visual impact index are the built-up (residential) areas south and south-west of Upington. These areas would be impacted on at distances of between 8 and 16 km. It is interesting to note that the other smaller towns and settlements along the Orange River would either not be able to see the CSP plant or would at best catch glimpses of the top of the central receiver. This is due to these settlements's location on the south-eastern facing slope (away from the CSP plant) of the sunken river valley.

The CSP plant (both the central receiver and the heliostats) would be visible from the major roads in the study area at varying intervals and distances (8 km at the closest). These impacted roads are the primary tourist routes in a region where Upington functions as the gateway and activity hub to a host of world-class eco-tourism destinations.

Another area that would be exposed to the CSP plant's infrastructure is the Spitskop Nature Reserve. Both the central receiver and the heliostats would be visible and would constitute a visual impact due to the conflicting land uses. The CSP plant will not be visible from the Augrabies Falls National Park (75 km line of sight west of the plant) as show below. Even without surface curvature and light refraction correction the exposure to the national park proved to be highly unlikely and at this distance, negligible.

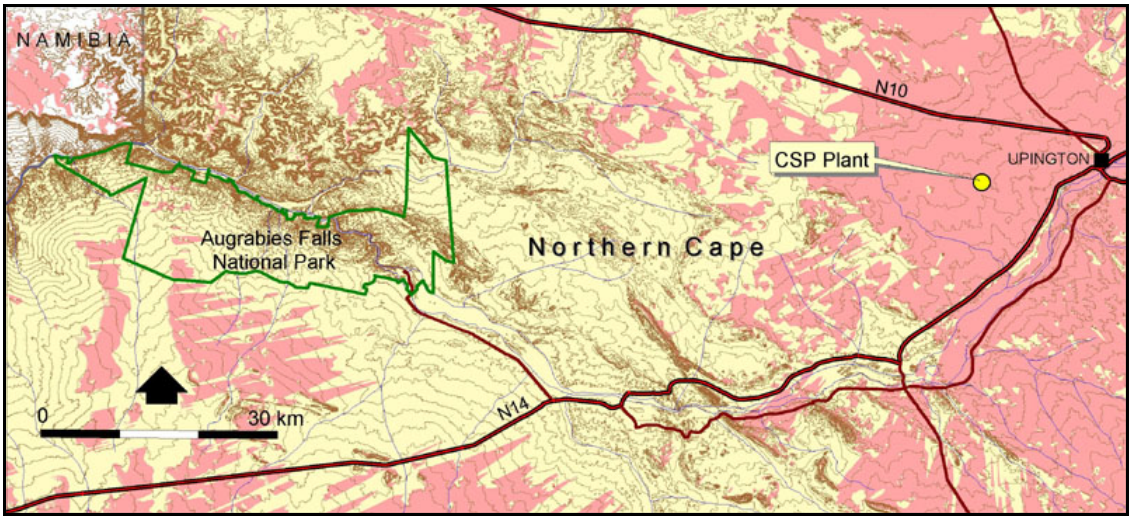

Figure 12.3: Viewshed analysis indicating lack of exposure (red areas) to the Augrabies Falls National Park.

12.5.2. Issues related to the visual impact of the CSP plant

The previous section of the report identified specific areas where likely visual impacts would occur. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the issues identified in the ESS. These issues were mentioned under the heading "Scope of work" earlier in this report.

Visibility to and visual impact on major tourist routes.

It has been established that the CSP plant would be visible from the major tourist routes within the region. The facility will be highly noticeable and will form a stark contrast with the natural surrounds. In the event that the observers' purpose for visiting the region is “nature oriented” the industrial nature of the facility's structure, will be in conflict with the immediate surroundings. This applies to the N10 and N14 that will have a shorter distance visibility and the R360 and R359 that will have a slightly longer distance view of the facility.

Table 12.1: Visual impact on major tourism routes.

Area of Visual Impact	Nature	Extent	Duration	Intensity	Probability	Significance	Mitigation potential
N10/N14/ R360/R359	Negative	Regional	Long term	High	Highly Probable	High	Low

Visibility to and visual impact on built-up (residential) areas.

The CSP plant (both central receiver and heliostats) will be visible from residential areas south and south-west of Upington and will impact negatively on observers that are used to seeing only natural wide open spaces. It must however be borne in mind that built-up areas have their own visual clutter and structures that already obstruct long distance views. The general assumption is that the CSP plant would, where it is visible within these areas, constitute a visual impact.

Other lesser-affected built-up areas include Louisvale, Louisvale Road and Kanon Eiland. These towns are further removed from the CSP plant and would potentially only have long distance views of the central receiver.

Towns or settlements that are not envisaged to be affected by the operation of the CSP plant are Oranje Vallei, Ses Brugge, and Klippunt. These towns are situated on the south and south-easterly facing slope of the Orange River floodplain and are effectively shielded by the topography. Potential glimpses of the central receiver could however occur from some areas in these towns.

Table 12.2: Visual impact on built-up (residential) areas.

Area of Visual Impact	Nature	Extent	Duration	Intensity	Probability	Significance	Mitigation potential
Upington	Negative	Regional	Long term	Medium - High	Probable	High	Low
Louisvale, Louisvale Road, Kanon Eiland	Negative	Regional	Long term	Medium	Probable	Medium - high	Low
Oranje Vallei, Ses Brugge, Klippunt	Negative	Regional	Long term	Low	Probable	Medium	Low

Visual exposure to protected areas/nature reserves.

The CSP plant will be visible and impact on the Spitskop Nature Reserve north-west of Upington. The conflicting nature of activities, i.e. nature tourism and wildlife experience and the industrial structures associated with the CSP plant, create a contrast and is generally visually incompatible. The Spitskop Nature reserve is also impacted by the industrial area of upington as well as the airport which lie to the south east.

The CSP plant will have no visual impact on the Augrabies Falls National Park.

Table 12.3: Visual impact on protected areas.

Area of Visual Impact	Nature	Extent	Duration	Intensity	Probability	Significance	Mitigation potential
Spitkop NR	Negative	Regional	Long term	High	Highly Probable	High	Low
Augrabies Falls NP	Neutral	Regional	Long term	Low	Improbable	Low	N.A.

Visual impact on water-based recreational activities and tourism potential of the Orange River.

The construction and operation of the CSP plant is not envisaged to have a major negative visual impact on the existing water-based activities and future tourism potential of the Orange River. The central receiver may be visible from certain stretches along the river but the nature of recreational activities (angling, canoeing, etc.) is not likely to be significantly influenced.

Table 12.4: Visual impact on Orange River recreational activities and future tourism potential.

Area of Visual Impact	Nature	Extent	Duration	Intensity	Probability	Significance	Mitigation potential
Orange River	Neutral/ Negative	Regional	Long term	Low - medium	Probable	Low - medium	Low

Potential visual impact of ancillary infrastructure.

The ancillary infrastructure associated with the CSP plant consist mainly of the construction of salt tanks, an auxiliary house, a transmission line and a pipeline. The former two are placed adjacent to the central receiver in the centre of the 6000 heliostats and are generally overshadowed by the much taller central receiver and the myriad of heliostats. These structures will not significantly add to the visual impact of the central receiver and the heliostats. The salt tanks may even be placed underground in order to mitigate potential visual impacts.

The transmission line (not sure of type, height, kV, etc.) is planned along the access road and will join with an existing transmission line approximately 2 km north-west of the N14 national road near Oranjevallei. The transmission line is generally far removed from observers and will not constitute a significant visual impact.

The pipeline, will be placed underground, and will therefore not have a significant visual impact. It is recommended that the necessary rehabilitation (proper re-instatement and re-vegetation) of the pipeline servitude be undertaken to negate potential visual impacts associated with vegetation clearing and potential unsightly erosion scarring.

Table 12.5: Visual impact of ancillary infrastructure.

Area of Visual Impact	Nature	Extent	Duration	Intensity	Probability	Significance	Mitigation potential
Salt tanks	Negative	Local	Long term	Medium	Probable	Low	High
Auxiliary house	Negative	Local	Long term	Low	Improbable	Low	Low
Trans-mission line	Negative	Local	Long term	Medium	Probable	Low	Low
Pipe line	Negative/ Neutral	Local	Long term	Low	Probable	Low	High

Lighting impacts.

The area earmarked for the placement of the CSP plant and the surrounding areas (for a radius of approximately 8 km is) is not populated. The effects of security and after-hours operational lighting (flood lights), in terms of light trespass and glare,

are therefore not significant due to the absence of sensitive visual receptors. This should however not distract from the careful planning and sensitive placement of light fixtures for the facility, designed to contain rather than spread the light. It is still necessary to be pro-active in the mitigation of potential lighting impacts on future developments in the region.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the 210 m high central receiver and tower. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance (i.e. possibly from the Spitskop Nature Reserve). As the Civil Aviation Authority requires these lights the mitigation potential is low.

Another potential lighting impact is the phenomenon known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow. The CSP plant may contribute to the effect of sky glow in an otherwise dark environment.

Table 12.6: Lighting impacts.

Visual Impact	Nature	Extent	Duration	Intensity	Probability	Significance	Mitigation potential
Glare: Floodlights	Negative	Local	Long term	Medium	Probable	Medium	High
Glare: Aircraft warning lights	Negative	Local	Long term	Medium	Probable	Medium	Low
Spill light	Negative	Local	Long term	Low	Improbable	Low	High
Sky glow	Negative	Local-regional	Long term	Low-medium	Probable	Low	Low

Potential to mitigate visual impact.

The potential to mitigate the visual impacts associated with the CSP plant has been stated in the above tables dealing with the issues related to the potential visual impact. In summary it can be said that some of the secondary visual impacts, such as the lighting, pipeline, salt tanks, etc. can be successfully mitigated or even negated. The primary visual impact, namely the appearance and dimensions of the

CSP plant (central receiver and heliostats), is however not possible to mitigate. The functional design of the structures and the dimensions of the facility cannot be changed in order to reduce visual impacts. The potential for mitigation is thus low or non-existent (i.e. no amount of light blue powdered paint is going to hide the structures).

12.6. Conclusions and Recommendations

The placement of the CSP plant and its associated structures will have a visual impact on the natural scenic resources of this region. The natural and relatively unspoiled wide-open views surrounding the CSP plant will be transformed for the entire operational lifespan (approximately 30 years) of the plant. The author is however of the opinion that the CSP plant has an advantage over other more conventional power generating plants (e.g. coal-fired power stations). The facility utilises a renewable source of energy to generate power and is therefore generally perceived in a more favourable light. It does not omit any harmful byproducts or pollutants and is therefore not negatively associated with possible health risks to observers.

The CSP plant further has a novel and futuristic design that invokes a curiosity factor not present with other conventional power generating plants. The advantage being that the CSP plant can become an attraction or a landmark within the region that people would actually want to come and see. As it is virtually impossible to hide the facility, the only option would be to promote it.

This opinion should however not distract from the fact that the CSP plant would be visible for a large area that incorporates various sensitive visual receptors that should ideally not be exposed to industrial style structures.

There are not many recommendations as to the mitigation of the visual impact of the core facility (central receiver and heliostats) as no amount of vegetation screening or landscaping would be able to hide a structure of these dimensions. The facility and its surrounds should generally be maintained in a neat and appealing way. This applies to the associated infrastructure (transmission line, auxiliary house, access road, etc.) of the CSP plant as well.

The construction phase of the facility should be sensitive to potential observers in the vicinity of construction camps. The placement of these camps should be carefully considered in order to not negatively influence the future perception of the CSP plant. Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to

reduce visual impacts. The watering of the access road, or ideally the tarring of the road, timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

A lighting engineer should be consulted to assist in the planning and placement of light fixtures in order to reduce visual impacts associated with glare and light trespass.

Ancillary structures (the salt tanks and pipeline) should, if possible, be placed underground to avoid additional visual clutter. Proper re-instatement and re-vegetation is recommended for the pipeline.

The facility should be dismantled upon decommissioning and the site and surrounding area should be rehabilitated to its original (current) visual status.