Department of Planning and Environment

NSW GOVERNMENT

Technical Supplement - Landscape and Visual Impact Assessment

Large-Scale Solar Energy Guideline

August 2022

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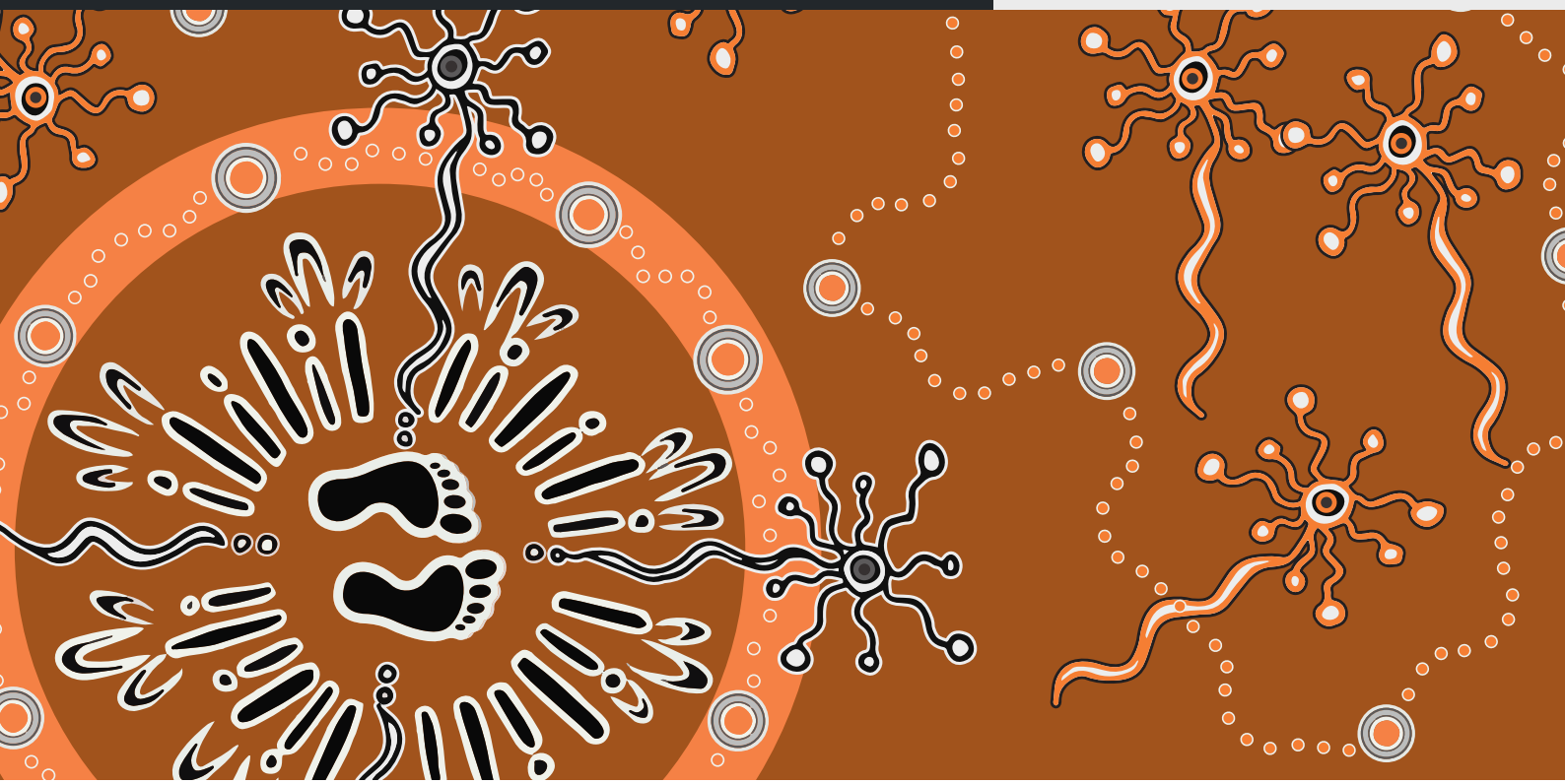

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Glossary of terms

Applicant	The applicant of an SSD project seeking consent for a development application or modification application.
Landscape	A holistic area comprised of its various parts including landform, vegetation, buildings, villages, towns, cities and infrastructure.
Large-scale solar energy development	Works, infrastructure and buildings for the purpose of generating electricity using ground-mounted photovoltaic panels that are state significant development (SSD).
Sensitivity	The capacity of a landscape or viewpoint to absorb the impacts from a proposed land use change and/or built form.
View	The sight of a landscape or scene.
Viewpoint	A location within the public or private domain with a potential view of a large-scale solar energy project.
Visual impact	The impact on views from private and public places. It is determined by considering the visual magnitude and sensitivity.
Magnitude	The apparent size of a solar energy project in the landscape or when viewed from a given viewpoint.

Image credits

Page 7	Wellington North Solar Farm	lightsourcebp.com/au/projects
Page 11	Goonumbla Solar Farm	goonumblasolarfarm.com
Page 24	Broken Hill Solar Farm	agl.com.au/about-agl/how-we-source-energy/broken-hill-solar-plant
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1 Introduction

1. Introduction

This technical supplement provides additional guidance for applicants, consent authorities and the community using the Large-Scale Solar Energy Guideline to understand the process and requirements for assessing visual and landscape character impacts of large-scale solar energy development in NSW.

1.1 Purpose

This technical supplement provides a detailed description of the landscape character and visual impact assessment process.

It ensures that all applications for large-scale solar energy developments are accompanied by an assessment that is proportionate to the scale and impacts of the development, is easy to understand and considers community views and values of the surrounding landscape.

The technical supplement identifies information that must be provided in a landscape character and visual impact assessment and includes assessment tools and requirements that must be used to produce consistent and comparable results.

This technical supplement also aims to:

- facilitate good site selection, layout and design of solar energy projects early in the planning process
- guide the relevant identification, mitigation and management of significant impacts on the surrounding landscape and viewpoints from the private and public domain
- strengthen the landscape and visual impact assessment process to ensure consistent decision making and to reduce delays in the assessment process
- encourage the appropriate development of the large-scale solar industry in NSW.

1.2 General requirements

The applicant must prepare a detailed landscape and visual impact assessment as part of an environmental impact statement (EIS).

The assessment must include a full description of the proposed solar energy project design and use maps to show the location of the project in relation to viewpoints and surrounding landscapes identified for analysis.

It must include details of:

- the type, height and scale of PV arrays, including tracking type (fixed, single-axis or multi-axis tracking)
- roads / access tracks
- ancillary structures including batteries, fencing, inverters, substations and electricity distribution lines.

Tools and reference information that will aid the assessment process include:

- the most recent and highest resolution satellite imagery, aerial photography and available orthophotos at a scale of 1:25,000 (where used the applicant should provide the date the imagery was captured)
- topographic mapping, zoning and other land use information available on the NSW Planning Portal or SEED

- Google Earth™ or a similar mapping service and the most recent vegetation mapping, particularly vegetation information that gives an idea of the structure and height of vegetative cover.

The applicant must engage with the community, including the indigenous community, as early as possible and throughout the preparation of the assessment in order to verify the outcomes and to consult on any measures proposed to mitigate impacts.

Importantly, the assessment process should be undertaken alongside the design and siting of a solar energy project so that the design can be effectively informed by the community's input.

The assessment must be informed by field visits to establish and ground truth important inputs into the assessment process including the scenic quality and sensitivity of the area.

Professional assessment skills

Professional assessment skills are critical to an effective landscape character and visual impact assessment. The applicant is expected to engage relevant professionals (for example, landscape architects, architects, environmental planners, geographers, or other visual assessment specialists) with demonstrated experience and capabilities. Experts should follow the guidance in this document to perform an effective and consistent assessment for large-scale solar energy development.

1.3 Approach to assessment

The technical supplement differentiates between:

- landscape character impact assessment (the assessment of impact on an area's cumulative built, natural and cultural character or sense of place), and
- visual impact (the assessment of impact on views).

The two assessments should be clear and discrete as it is likely the design responses and mitigation measures to address landscape character impact will be different to those for visual impact.

Landscape character assessment

This is the process for determining the overall impact of a project on an area's character and sense of place including what people think and feel about it and how society values it.

Visual impact assessment

This is the process for determining the day-to-day visual effects of a project on people's views (what people see at a place, when they are there) from the private and public domain.

In both cases, the likely impacts of a large-scale solar energy development can only be determined by understanding the sensitivity of an area or view to change and the magnitude of a proposed development in that area or view.

Sensitivity

Sensitivity refers to how sensitive the landscape or view is to the proposed change. For example, a pristine natural environment is likely to be more sensitive to change than an industrial area. A view from a residence is also likely to be more sensitive to change than from a local road where views are more intermittent and less frequent.

Magnitude

Magnitude refers to the physical scale of the solar energy development and is influenced by a range of factors including:

- the apparent size of a solar energy development decreases significantly as the distance from the viewer increases
- the apparent size of a solar energy development increases as the relative height between the viewer and solar array increases
- the apparent size of a solar energy development increases with the physical scale and dimensions of a solar energy development, although this is less discernible as distance from the viewer increases.

For example, a distant solar energy development would have a lesser magnitude than one nearer to residents. The magnitude is also likely to be higher from areas overlooking a solar array as more of the project would be visible than if the viewer were at a similar elevation.

2

Landscape character assessment

2. Landscape character assessment

The EIS must include an assessment of how the project will affect the elements that make up the landscape, the aesthetic and perceptual aspects of the landscape and its distinctive character. Landscape character assessment can help the community, applicants and consent authorities understand the sensitivities of a landscape and to determine the overall impact of a project on an area's character and sense of place.

This process is distinctly different from visual impact assessment which is solely focused on individual views. Consequently, landscape character assessment can help to understand the cumulative effect of a project on a much broader area.

The key tasks to be undertaken in assessing landscape character impacts are described below.

The level of assessment should be appropriate for the context in which the development is proposed and should be proportionate to the likely impacts of the development. The applicant is encouraged to consult with the department in scoping its project to determine the level of detail that may be required in the landscape character assessment.

The study area for the landscaper character assessment should generally be approximately 5km from the proposed development. However, the character of landscapes can vary significantly and justification may be provided for analysing a smaller area.

2.1 Baseline analysis

Applicants must undertake a baseline study to establish the existing landscape character of the area and its sensitivity. This should be based on desktop analysis and field visits and should provide a descriptive and illustrative analysis of the qualities of the place, what makes it valued and any challenges that could arise in relation to the proposed development.

It is important that applicants engage with the community (including the indigenous community), local council and potentially affected landowners as early as possible to identify and establish the importance of particular landscape values and characteristics. Gauging these values can provide a firm basis for siting and designing a solar energy project that seeks to avoid or minimise impacts.

In undertaking consultation, applicants must adopt the approaches and objectives outlined in the NSW Government's Undertaking Engagement Guidelines for State Significant Projects.

The baseline analysis should identify and describe:

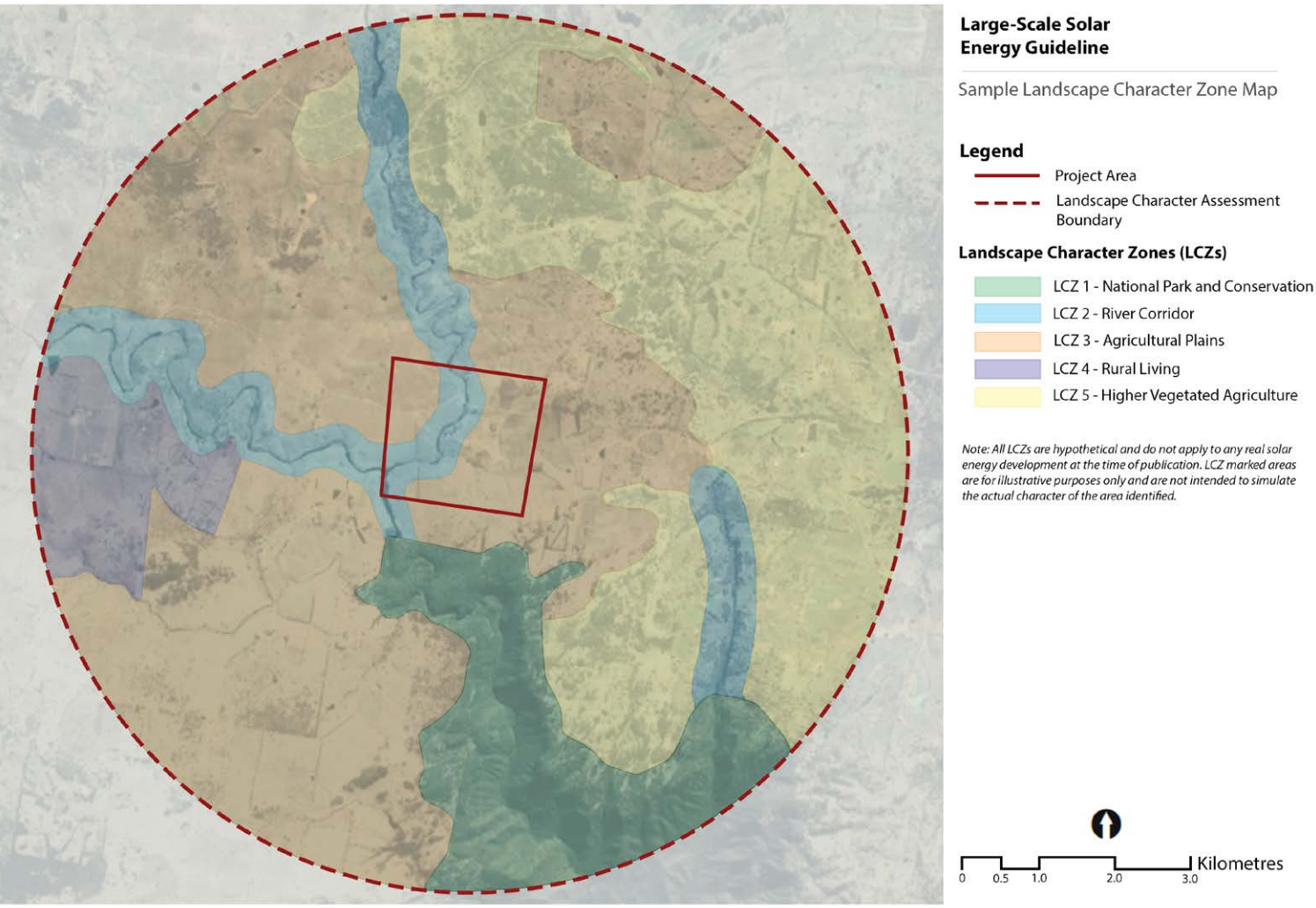
- the elements that make up the landscape in the study area, including:
  - physical influences (such as geology, soils, landform, natural drainage and water bodies)
  - ecological characteristics and land cover of an area (such as whether it is forested, wetland, scrub, grass etc.) and the quality and type of vegetation cover
  - the influence of human activity, including land use and management and the character of any settlements and buildings
  - key landscape features or attributes of the landscape associated with high visual interest or quality that stand out visually in the landscape, including natural features (such as a distinctive mountain peak or hilltop), cultural or agricultural features

- the aesthetic and perceptual aspects of the landscape, particularly emphasising those that are key characteristics contributing to the distinctive character of the landscape (such as its scale, complexity, openness, tranquillity or wildness)
- aspects of the landscape that have important aboriginal cultural heritage value (with the exception of artefacts and intangible values that would be assessed in detail as part of an Aboriginal Cultural Heritage Assessment), including why they are valuable to the community
- the overall character of the landscape in the study area, including any distinctive landscape character types or areas that can be identified (see further guidance below)
- the condition of the landscape, including the condition of elements or features such as buildings or vegetation
- the planning designations of an area relating to landscape character, including sensitive land use designations, zonings and heritage listings
- the location of any existing operational or approved large-scale energy developments within a regional and local context, including projects which may have the potential to create direct or indirect cumulative impacts with the project.

Applicants should use a combination of descriptive text and photographs to provide a visual profile of the region, including what types of landscape features are typical, less common, rare or unusual and outstanding.

The baseline analysis should also be used to inform the categorisation of scenic quality when determining the visual impact on viewpoints (see **Section 5**).

Figure 1: Landscape character zones



2.2 Identify landscape character zones

If the landscape includes distinct areas that have different qualities, the study area should be broken down into different character zones (see **Figure 1**).

Landscape character zones should divide the landscape based on common distinguishing visual characteristics including landforms and major land cover patterns. These patterns are formed by combinations of vegetation, water bodies, landforms and land use, from which the key landscape features can also be identified.

Dividing the landscape into zones will make the assessment of likely impacts (as described further below) simpler, easier to understand and more accurate.

Sources to use in identifying and establishing the type of regional landscape character zones include:

- Learmonth, Nancy and Andrew (1971) Regional Landscapes of Australia: Form, Function and Change, Angus and Roberson Publishers, Sydney
- Mitchell, Peter (2022) Descriptions for NSW (Mitchell) Landscapes Version 2, NSW National Parks and Wildlife Service
- Tudor, C. (2019) An approach to landscape sensitivity assessment – to inform spatial planning and land management. Natural England: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/817928/landscape-sensitivity-assessment-2019.pdf
- Australia's bioregional framework as delineated via the Interim Biogeographic Regionalisation for Australia (IBRA): https://www.environment.gov.au/land/nrs/science/ibra/australias-bioregions-maps
- eSPADE Spatial Viewer for soil landscape mapping, NSW Environment, Energy and Science: https://www.environment.nsw.gov.au/eSpade2WebApp

2.3 Assess the landscape character impact

Applicants should determine the impact of the proposal on each landscape character zone by evaluating the sensitivity of the landscape and the magnitude of the project's effects in that area.

The sensitivity and magnitude should be assigned a rating (low, moderate or high) that can be used to determine the overall landscape character impact on any given zone. Rationale for the ratings must be provided as part of the assessment.

Applicants should consider the following matters when analysing and rating the magnitude of a project:

- size and scale including:
  - the extent of existing landscape elements that may be lost and the contribution of that element to the character of the landscape
  - the extent to which the project becomes a minor or major element in the landscape and its dominance in the visual catchment
  - the extent to which the project changes the key characteristics of the landscape, which are critical to its distinctive character
- geographical area – the area of the landscape over which the effects will be experienced, having regard to the nature and scale of the project's effects. This could vary from the immediate setting of the site to larger scales where the project may influence several landscape characters zones
- duration and reversibility of the effects on the landscape.

The sensitivity of the landscape character type should be rated based on the inherent capability of the area to absorb changes from the project.

Where impacts are expected to be high, the assessment should propose measures to avoid or mitigate these impacts including re-siting and re-sizing elements of the project. Any significant residual impacts on the landscape remaining after mitigation should then be summarised as the final step in the process.

An example landscape character assessment is provided in **Appendix A – Example Landscape Character Assessment.**

3

Visual Impact Assessment

3. Visual impact assessment

The EIS must include a visual impact assessment that considers the likely impacts of the development on viewpoints within the private and public domain. The process can be broken into two key stages – a preliminary assessment and a detailed assessment which are explained in detail throughout this section.

3.1 Preliminary assessment

The preliminary assessment stage is used to identify viewpoints that will require a detailed assessment in stage 2. Applicants should select sites, designs and layouts that are informed by preliminary tools and consultation to avoid and mitigate significant visual impacts.

A preliminary visual assessment must be included in an applicant's scoping report as part of their request for the Secretary's environmental assessment requirements (SEARs). If the proposed development is not designated development, then a scoping report is not required (see **Section 2.3.1** of the Large-scale Solar Energy Guideline). In these cases, the preliminary assessment does not need to be provided in an application for SEARs.

In all cases, the preliminary visual assessment should be presented in the EIS.

3.1.1 Preliminary Assessment Tools

The preliminary assessment tools (**Figure 2** and **Table 2**) must be used to identify viewpoints that require detailed assessment in the EIS.

The tools should also be used to identify where consultation with potentially affected landowners and the local community should be focused.

The tools are designed to eliminate the need to assess viewpoints that are likely to experience very low impacts. This is based on the vertical and horizontal field of view that a development is likely to occupy when viewed from each viewpoint and is influenced by distance, height elevation changes, and width of a project. Further information about vertical and horizontal field of view, including a method for roughly measuring the field of view an object occupies, is provided in **Section 3**.

To use the preliminary assessment tools:

- identify all viewpoints from public roads and rail lines within 2.5 km of the proposed development
- identify other public and private viewpoints within 4 km of the proposed development
- calculate the distance of each of these viewpoints from the nearest point of the proposed development
- determine the 'relative height difference' between the proposed development and each viewpoint (see **Figure 3**)

- plot each viewpoint on the Preliminary Assessment Tool – Vertical Field of View (**Figure 2**) to determine the indicative vertical field of view (as either 1, 2, 3 or 4+ degrees)
- measure the worst-case horizontal field of view of the project from each viewpoint (not considering topography or vegetation)
- compare the vertical and horizontal fields of view using the matrix in **Table 1** to determine whether detailed visual assessment of each viewpoint is required.

The calculations can be based on either the project area, or the development footprint depending on the level of information available at the time. A more refined approach that uses the development footprint, may result in less viewpoints requiring assessment.

The parameters used to determine whether an assessment is required should be included in the scoping report (if required) and the EIS. All viewpoints should be labelled for identification purposes and remain consistent through the assessment process.

The Preliminary Assessment Tools focus on viewpoints with views to the solar array. Additional viewpoints should be considered if ancillary infrastructure, such as substations, have the potential to cause impacts beyond the distances prescribed in the tool.

Figure 2: Preliminary Assessment Tool – vertical field of view

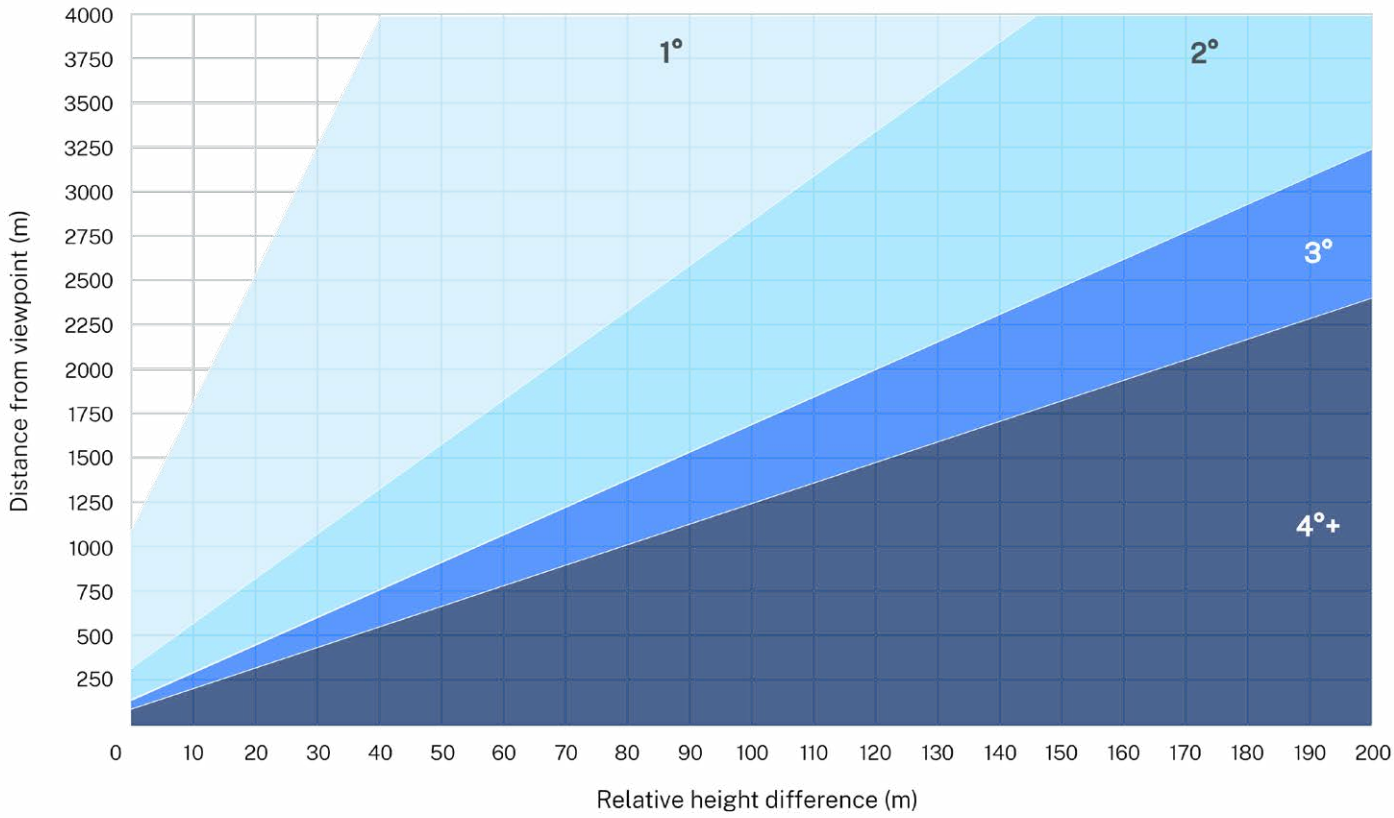
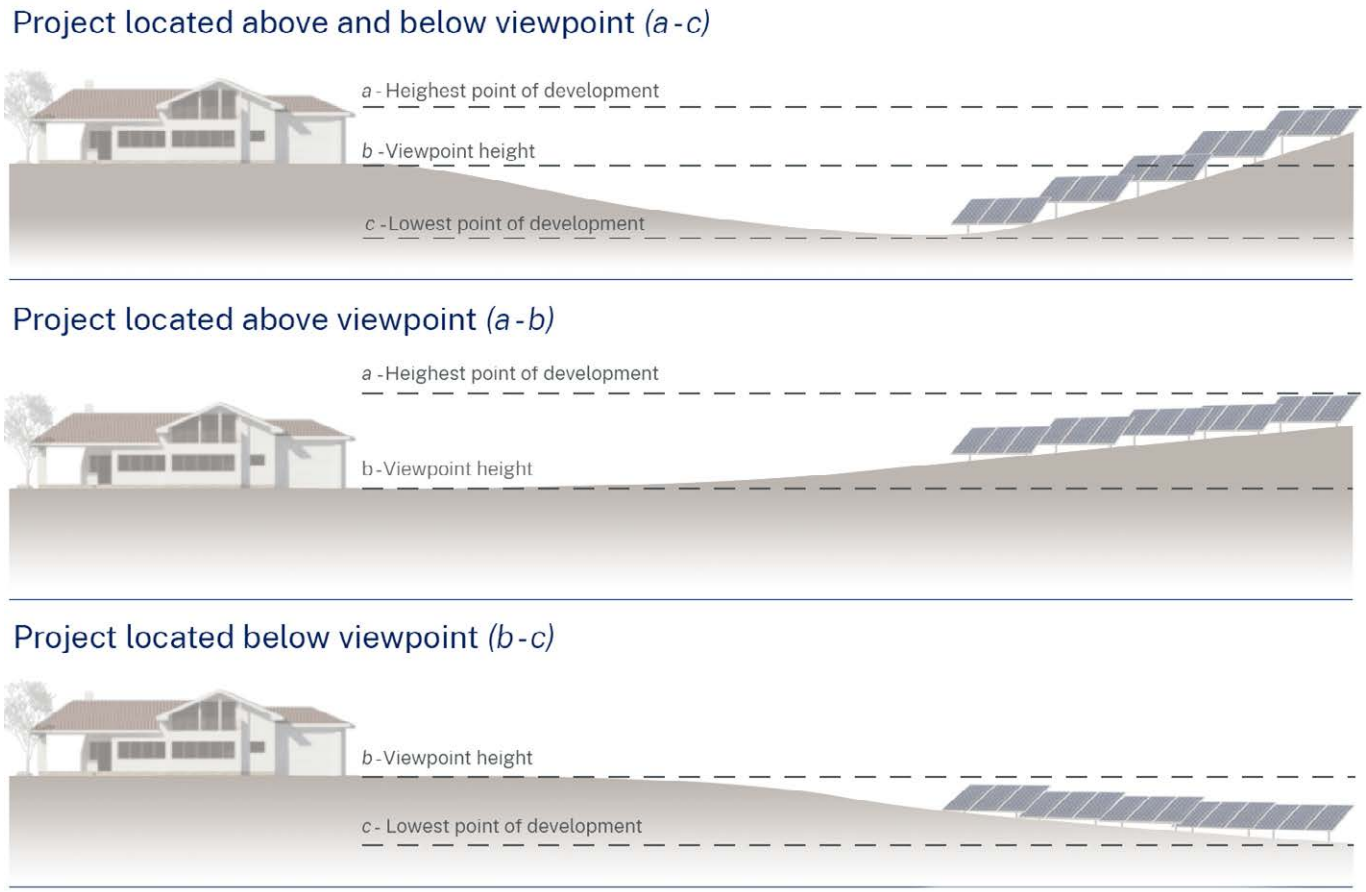


Figure 3: Calculating relative height difference



3.1.2 Viewshed mapping

A viewshed map identifies all areas from which a project may be viewed. Viewshed mapping can be achieved by using geographic information systems (GIS) that account for topography and line of sight between viewpoints and the project.

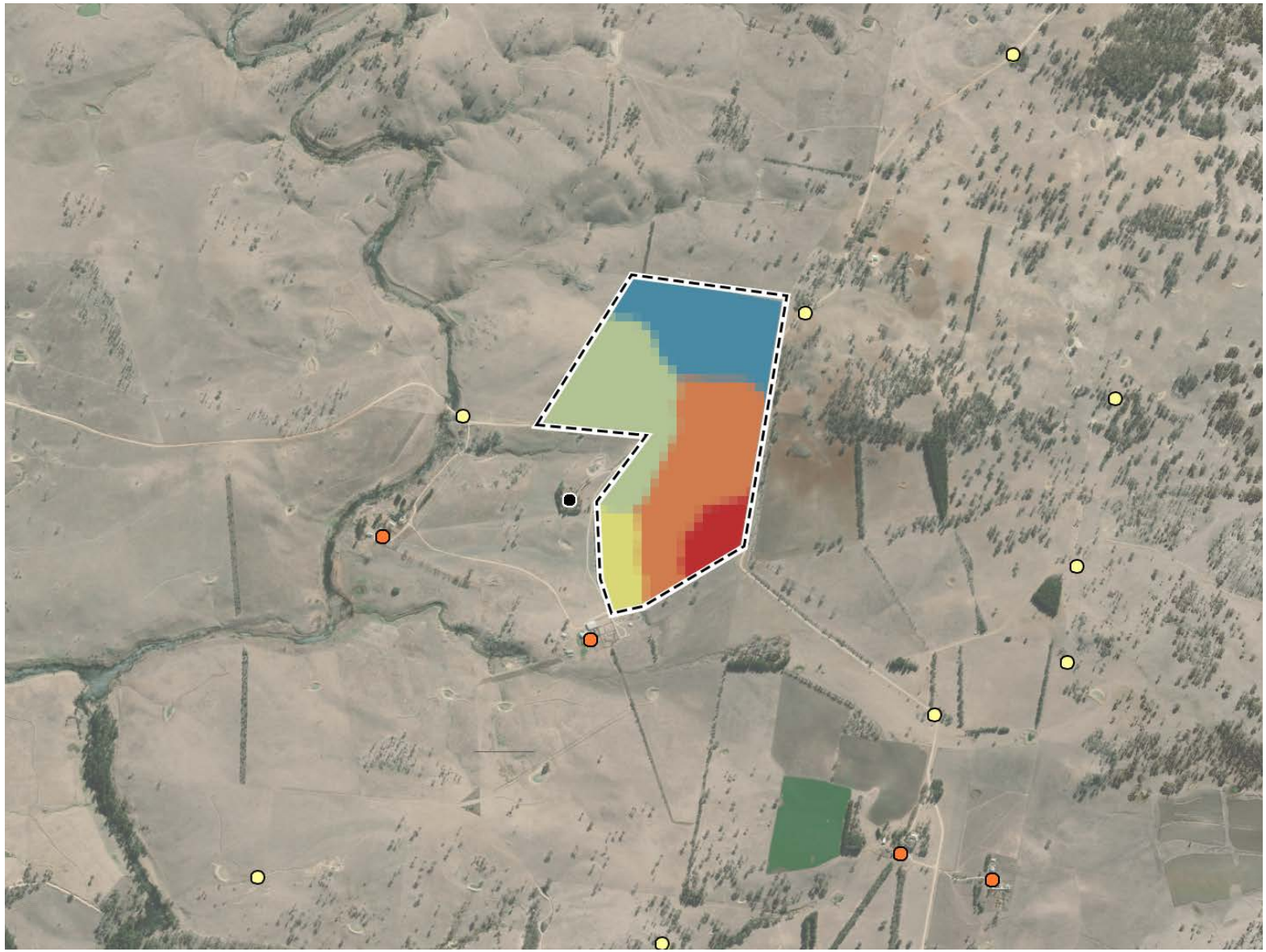
The applicant can use viewshed mapping to further eliminate the need to assess viewpoints that fall below the lines in the Preliminary Assessment Tool if the analysis shows there is intervening terrain that would block line of sight to a particular viewpoint. This step is optional but is recommended as it can reduce assessment requirements in cases where topography will play a significant role in limiting the view of a project. Where a viewshed analysis is used, this should be informed only by terrain and not by other intervening factors including built structures and vegetation screening.

The applicant should also consider undertaking a reverse viewshed analysis (see **Figure 4**). This can be a useful tool to refine project design process to reduce any significant impacts. It can also be used to communicate the visibility of certain parts of the project and aid consultation with the community. This analysis should be used to highlight parts of the project that can be seen from the greatest number of viewpoints.

Table 1. Preliminary visual assessment tool – assessment requirements

Horizontal field of view of project	1° vertical field of view	2° vertical field of view	3° vertical field of view	4°+ vertical field of view
1-10°	No assessment required	No assessment required	No assessment required	No assessment required
11-20°	No assessment required	No assessment required	No assessment required	Assessment required
21-30°	No assessment required	No assessment required	Assessment required for all viewpoints except road/rail	Assessment required
31-40°	No assessment required	Assessment required for all viewpoints except road/rail	Assessment required for all viewpoints except road/rail	Assessment required
41-50°	No assessment required	Assessment required for all viewpoints except road/rail	Assessment required	Assessment required
51-60°	No assessment required	Assessment required for all viewpoints except road/rail	Assessment required	Assessment required
61-70°	No assessment required	Assessment required	Assessment required	Assessment required
71-130°	Assessment required for all viewpoints except road/rail	Assessment required	Assessment required	Assessment required
130°+	Assessment required	Assessment required	Assessment required	Assessment required

Figure 4: Reverse viewshed analysis

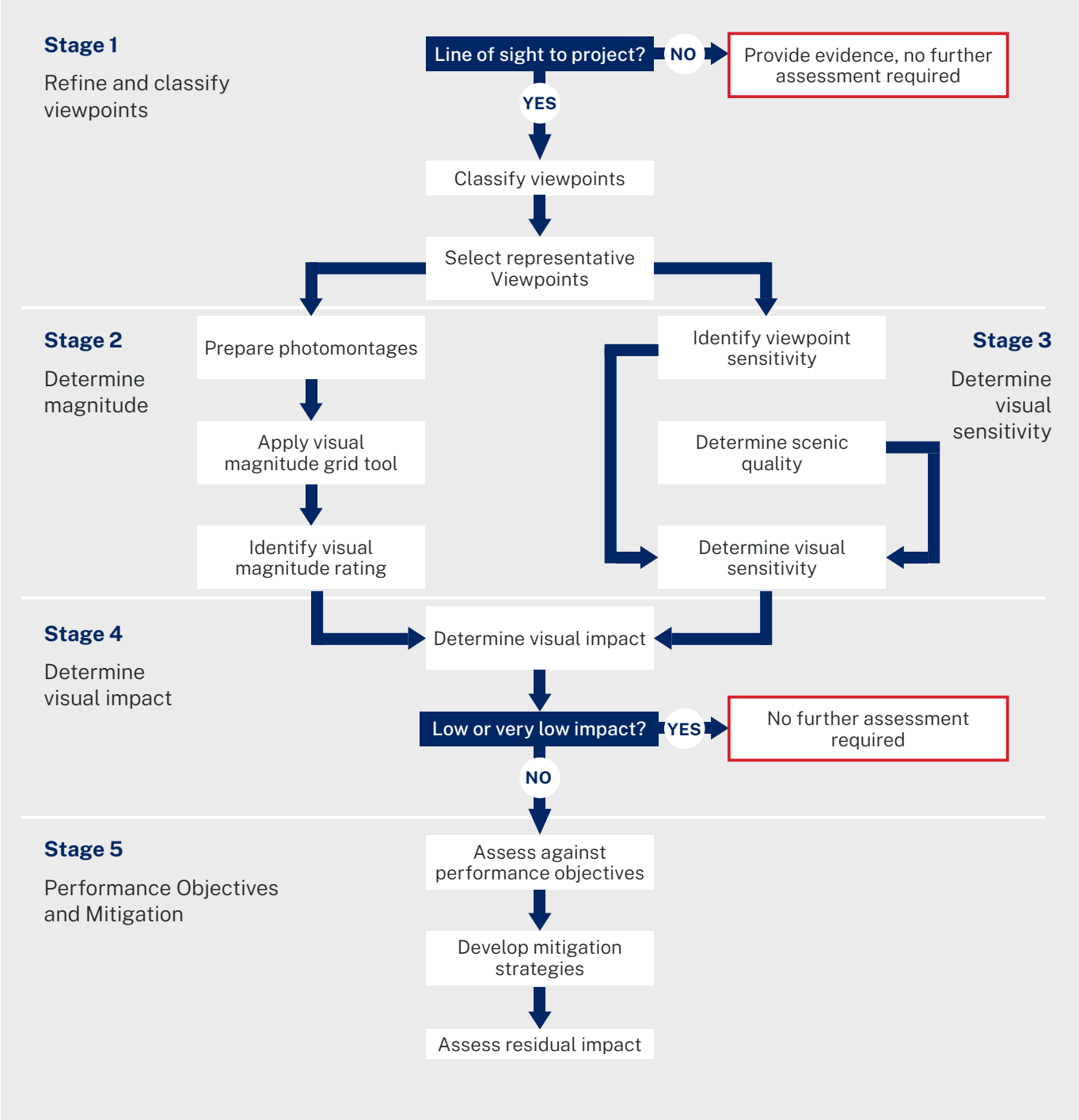


3.2 Detailed viewpoint assessment

The detailed assessment stage is used to undertake a comprehensive assessment of the visual impacts on viewpoints identified in the preliminary assessment, including any strategies to mitigate these impacts.

The detailed assessment must be prepared in accordance with the process outlined in **Figure 5** described below.

Figure 5: Detailed visual impact assessment process



Stage 1 – Refine and classify viewpoints

All viewpoints identified in the preliminary assessment need to be assessed in the EIS.

However, a detailed assessment does not need to be completed where existing features completely obstruct the view of the project. In such a case, the applicant must provide evidence that intervening topography, screening or existing structures would eliminate any impact from the project and so the viewpoint does not require detailed assessment. Evidence based on topography (such as a viewshed mapping) or photography must be presented in the EIS.

Representative viewpoints

While it is preferred that each viewpoint be assessed individually, representative viewpoints may be selected and assessed in lieu of dwellings when viewpoints are clustered close together in:

- rural residential areas
- rural villages
- urban residential and commercial areas.

When utilising representative viewpoints, the applicant must:

- clearly identify the number and location of dwellings that are the subject of the selected representative viewpoint
- carefully assess the topography and vegetation of the selected viewpoint area identify the most sensitive viewpoint with the highest visibility of a proposed project (i.e. worst case) location in the selected area as the representative viewpoint.

Representative viewpoints should only be used for dwelling viewpoints and should not be used for public domain viewpoints unless there are many viewpoints along a public road that could be represented by a single viewpoint.

Classifying residential viewpoints

For residential viewpoints, the assessment must focus only on views from the dwelling and not from the property boundary or other parts of the property. The assessment should focus on the potential worst-case views that have the greatest potential to impact on the residential amenity of the dwelling. Residential amenity encompasses the overall quality, experience and nature of views and outlook available to occupants of a residence and its immediate surrounds including pool areas and gardens.

The view/s from a rural dwelling should be categorised according to their importance. Primary views are considered more important than secondary views (see **Table 2** for guidance and the Land and Environment Court planning principle related to views[1]). The applicant must identify how each of the residential viewpoints has been classified in the EIS.

Table 2: Primary and secondary viewpoints from rural dwellings

Primary viewpoint	Secondary viewpoint
Principal/frequented living spaces (e.g. living rooms, kitchens, dining areas)	Less frequented living and service areas (e.g. bedrooms, laundries, bathrooms, garages, studies)
Front and rear views from a dwelling, particularly from any porch, balcony, veranda, deck or patio	Side views from a dwelling

[1] Tenacity Consulting v Warringah Council [2004] NSWLEC140 at 25-29

Stage 2 – Visual magnitude

The visual magnitude of a project is its apparent size determined by the volume of the horizontal and vertical fields of view occupied. Understanding the visual magnitude is a key step in determining the overall visual impact on viewpoints.

The typical design and layout of a large-scale solar energy development is relatively standard. Assumptions have been made and incorporated into the following methodology to improve the efficiency and consistency of determining the visual magnitude of these projects. For example, almost all large-scale solar energy developments are comprised of similar infrastructure that is low lying and exhibits common characteristics including colour, texture and contrast with the rural landscapes in which they are located.

To determine the visual magnitude for each viewpoint:

1. capture a panoramic photograph that comprises 180 degrees of horizontal field of view
2. produce a photomontage by overlaying a 3D model of the proposed development on the panoramic photo
3. overlay the Visual Magnitude Grid Tool on the photomontage
4. identify and count the number of grid cells that the project would occupy
5. determine the magnitude rating based on the number of cells and the thresholds in **Table 4**.

The process is summarised in **Figure 6** and described in detail below. An example of how this information should be presented in the EIS is provided in **Appendix B** – Presenting the visual impact assessment.

Step 1 - Baseline panoramic photograph

Panoramic photographs must be constructed by merging a series of photographs together to form a single image with a horizontal field of view of 180°. To ensure consistency and accuracy, these montages must be prepared in accordance with the requirements in **Table 3**.

If the applicant is unable to take a photograph from a viewpoint and cannot choose an appropriate representative viewpoint, it may capture other photography to show the characteristics of the view and landscape. However, the applicant should make all reasonable efforts to take representative panoramic photos to ensure the assessment is as accurate as possible.

Table 3: Panoramic photography requirements

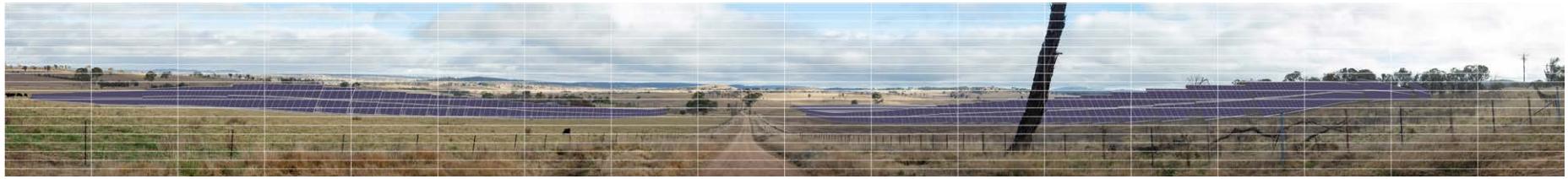
Parameter	Requirement
Camera	• Full frame camera • 50mm focal length of lens • Camera positioned 1.5m above the ground • Use of tripod (with levelling tools) and panoramic head • Photographs taken in portrait orientation
Composition	• Horizon positioned at the midpoint of the photographs • Multiple photographs taken every 15 degrees or at such frequency to provide adequate overlap (approximately 30%) between images
Location and conditions	• Where possible, photographs should be taken with no or minimal cloud cover and when the sun is positioned high in the sky (generally between the hours of 9 am and 3 pm)
Merging photographs	• Photographs merged to achieve a panoramic photograph with 180° horizontal field of view • Merged panoramic photographs avoid distortion or warping of the individual images

Figure 6: Steps to determine visual magnitude

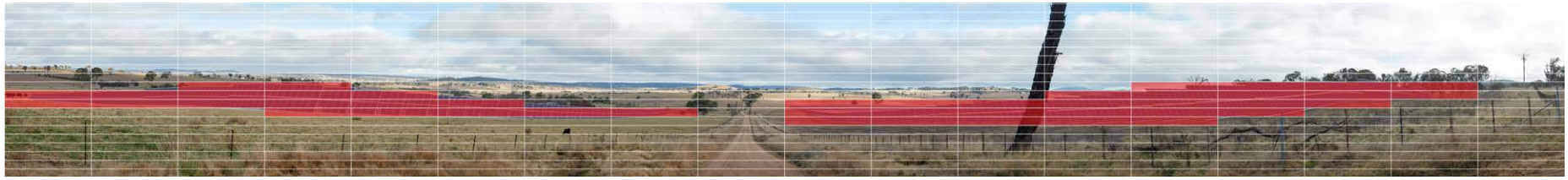
Capture baseline panoramic photograph

Produce photomontage

Overlay visual magnitude grid tool



Identify occupied cells



Determine magnitude rating

Magnitude Rating	Very Low	Low	Moderate	High	Very High
No. Cells	1-6	7-12	13-21	22-30	31+

Step 2 - Panoramic photomontages

The panoramic photomontage is a composite image generated by overlaying the baseline panoramic photograph with a computer-generated model of the proposed solar energy development.

When produced consistently, panoramic photomontages provide a highly effective means of assisting stakeholders and consent authorities in appreciating the scale and scope of a proposed large-scale solar energy development's visual presence in context with the landform, land uses and existing vegetation.

The model of the solar energy development can be either a basic wireframe, indicating the worst-case scale of a project, or a more detailed render and it must:

- account for the solar arrays at their highest point (worst-case scenario) and any other significant infrastructure
- be generated using a bare earth digital terrain model
- be captured from the same location as the baseline panoramic photograph
- align with the perspective of the base line panoramas.

If the applicant is unable to take a representative panoramic photograph, then it may complete this step by producing an image of the model (see **Figure 7**) that represents the worst-case visibility of the project.

If a basic wireframe is used, this must be replaced by a detailed render if the impact rating is later determined to be moderate or high.

Panoramic photomontages must be supplied at the highest resolution possible within the EIS and be readily available to the consent authority as separate files on request.

While photomontages are highly effective visual communication tools, when compressed on a smaller page, they can underrepresent the view. For this reason, the assessment of each viewpoint must also include a full-size 50 mm image of the area of the photomontage with the highest magnitude (see below) that more appropriately represents the view of the development from the human eye (see **Appendix B**).

Step 3 - Visual Magnitude Grid Tool

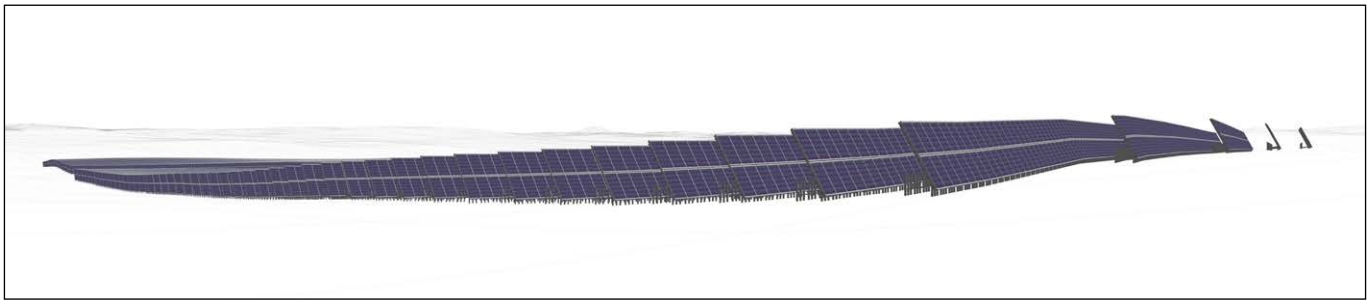
A Visual Magnitude Grid Tool has been developed to account for the form and scale of large-scale solar energy projects.

This tool is a transparent grid that, when overlayed with an accurate photomontage, can ensure a consistent method for understanding the visual magnitude of a project when viewed from an individual viewpoint. The tool splits the photomontage into individual cells each comprising a 1° vertical and 10° horizontal field of view.

The grid is designed in this manner to weight vertical changes in magnitude more than horizontal changes. This reflects best practice understanding and assessment of visual impacts, including the concept that vertical changes to the field of view are perceived to be much greater or more impactful than horizontal changes.

For example, a 10 m high development that is 100 m wide is likely to have less impact on a viewpoint than if it were 10 m wide and 100 m high. This is particularly the case in low-lying regional and pastoral areas where landscapes do not commonly contain natural and built features that occupy large portions of the vertical field of view.

Figure 7: Render without a baseline panoramic photo



The applicant must overlay the grid on all panoramic photomontages. When overlaying the grid, it should be scaled (so the aspect ratio remains unchanged) to ensure that the width matches the photomontage. The grid is available in various file formats on the Department's website.

Once scaled appropriately, the visual magnitude tool grid should be moved incrementally to accurately cover the number of cells that would be occupied by the project and to reduce partly occupied cells.

Step 4 - Identifying occupied cells

Once the grid has been applied to a panoramic photomontage, the applicant must identify the number of cells that are occupied by the built form of the project.

A cell is unoccupied if elements of the project, including solar panels, battery energy systems, or other associated infrastructure do not occupy more than approximately 25% of a cell.

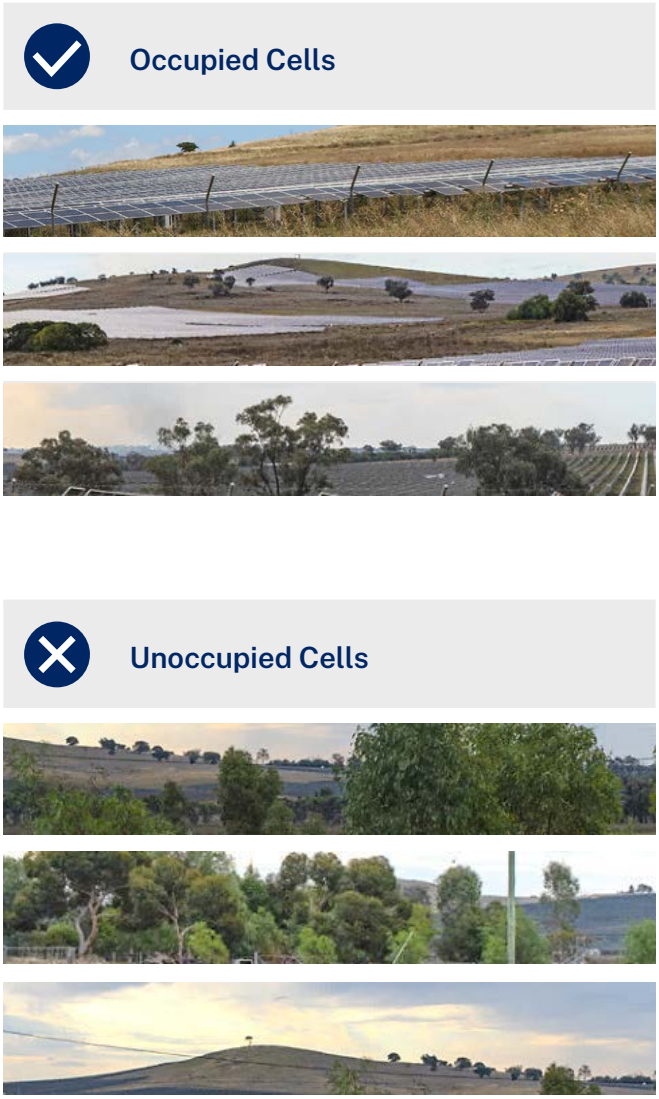
A cell is also considered unoccupied if:

- existing vegetation would substantially screen elements of the project such that any residual view would be less than 25% in any given cell or very intermittent
- any existing screening would effectively mitigate the view of the project such that moving the viewpoint a few metres in any direction would not significantly change the amount of screening provided
- the vegetation is not temporary, seasonal or identified as a common weed.

Cells that are occupied by the project should be clearly highlighted as shown in **Figure 6**.

Examples of occupied and unoccupied cells are provided in **Figure 8**.

Figure 8: Visual reference for identifying occupied cells



Step 5 - Visual magnitude rating

Once occupied cells have been identified, the total number of cells can be counted and then compared to the visual magnitude thresholds in **Table 4** to determine the visual magnitude rating.

The visual magnitude is classified into one of 5 ratings (very high, high, moderate, low and very low) and provides an indication of the apparent size of the solar array from each viewpoint.

Importantly, the visual magnitude rating does not indicate the visual impact from the development. This can only be determined in conjunction with information about the sensitivity of each viewpoint and the scenic quality of the area being viewed as set out below.

Examples of each magnitude rating are provided in **Appendix C**.

Table 4: Visual magnitude thresholds

Number of occupied cells	Visual magnitude rating
1 – 6	Very low
7 – 12	Low
13 – 21	Moderate
22 – 30	High
31 +	Very high

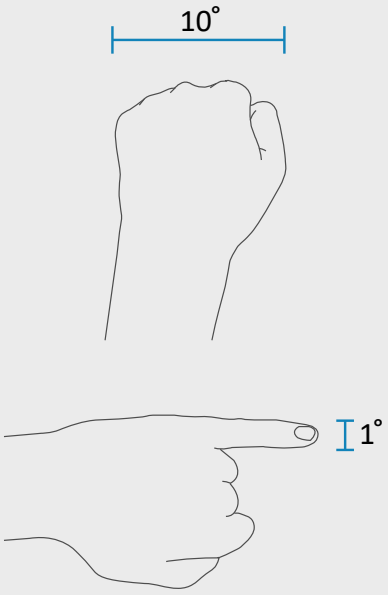
Figure 9: Rule of thumb examples for measuring magnitude

Rule of thumb for measuring magnitude

It is possible to roughly measure the field of view that objects occupy in landscapes and our day-to-day lives using nothing more than your hand and fingers. This can provide a practical approach for visualising how the magnitude ratings would appear, and how they might compare to other features in the landscape.

To measure a part of your field of view, first hold your hand at arm's length and close one eye.

Make a fist with the back of your hand facing upwards. The width of your fist is approximately 10 degrees, or one cell wide. Hold your little finger in a horizontal position. The height of your little finger is approximately 1 degree, or the equivalent of one cell high. See **Figure 9** as an example.



Stage 3 – Visual sensitivity

Visual sensitivity refers to the quality of the existing view and how sensitive the view is to the proposed change. In some cases, visual sensitivity is also related to the direction of the view and where it can be viewed from (such as a resident's living room).

The visual sensitivity is determined by identifying the sensitivity of each viewpoint and categorising the scenic quality of the area in view.

Step 1 - Viewpoint sensitivity

Viewpoint sensitivity relates to the relative importance of viewpoints and the value that the community or visitors may place on landscapes viewed from public use areas, public travel ways and private viewpoints such as dwellings.

The applicant must classify the sensitivity of each viewpoint into one of 4 sensitivity ratings (very low, low, moderate, high) considering the examples in **Table 5**, the baseline landscape study, and consultation with the community and individual landholders.

While **Table 5** is a good guide, it is not determinative, and the other inputs must be considered in arriving at the final rating.

Step 2 - Scenic quality

Scenic quality refers to the relative scenic, cultural or aesthetic value of the landscape within the viewshed based on the presence or absence of key landscape features known to be associated with community perceptions of low, moderate, or high scenic quality. It is typically a complex process undertaken by experts in visual impact assessment and must take community values into consideration.

The baseline analysis and landscape character assessment should be used to inform the classification of scenic quality values; including aerial photos, topographic maps and any relevant information from field visits.

The suggested scenic quality classification criteria in **Table 6** can be used as a guide, however, the EIS should consider whether a combination of landscape features influences the overall scenic quality of the setting as well as any community values.

In other words, the presence of just one, or even two high quality features (such as a visually prominent stream) may not be sufficient justification for the landscape to be considered of high quality. On the other hand, the presence of one highly valued feature (such as a world heritage area) may be significant in and of itself irrespective of other features.

Table 7 provides a visual reference to assist applicants, the community and consent authorities in understanding how scenic quality values may present across the different categories.

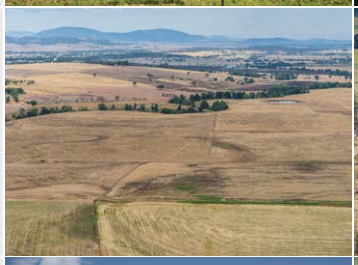
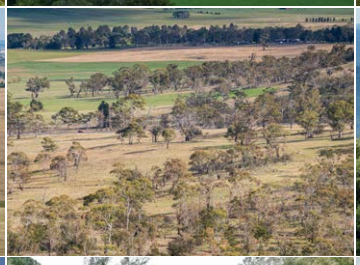
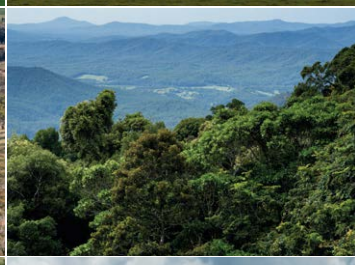
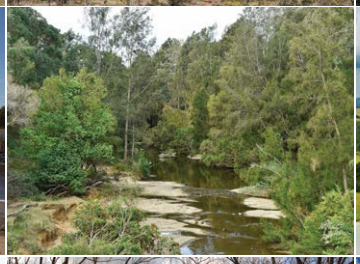
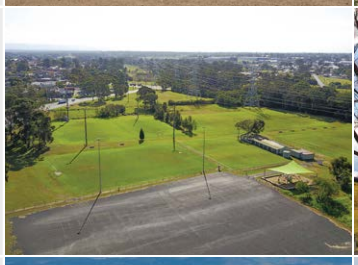
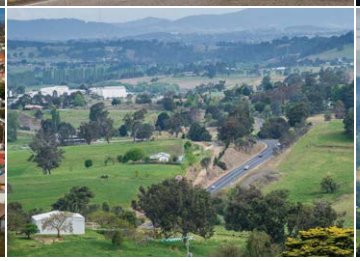
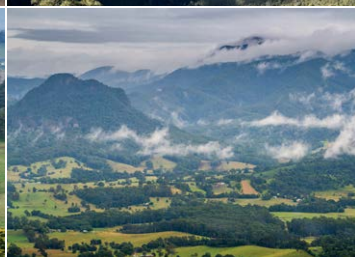
Table 5: Viewpoint sensitivity levels and examples

Viewpoint type	Very low viewpoint sensitivity	Low viewpoint sensitivity	Moderate viewpoint sensitivity	High viewpoint sensitivity
Residential	No place of residence present	Secondary view from dwellings in rural areas (zoned RU1, RU2, RU3, RU4 and RU6), large lot residential areas (zoned R5) and in environmental or conservation areas (zoned C2, C3 and C4)	Primary view from dwellings in rural areas (zoned RU1, RU2, RU3, RU4 and RU6), large lot residential areas (zoned R5) and in environmental or conservation areas (zoned C2, C3 and C4)	Dwellings in residential areas and rural villages (land zoned R1, R2, R3, R4 and RU5) Historic rural homesteads/ residences on the national, state or local heritage list
Transport / infrastructure	Local sealed and unsealed roads Passenger rail lines with daily daylight services State highways, freeways and classified main roads Walking tracks and navigable waterways	Tourist roads and scenic drives Walking tracks and navigable waterways	N/A	N/A
Social / cultural	Private recreation areas and sporting fields (defined as land zoned RE2)	Cemeteries, memorial parks	Tourist and visitor accommodation and places of worship (such as bed and breakfasts, motels, hotels) Tourist uses in tourist areas (zoned SP3) Publicly accessible green and open spaces including picnic areas, parks, public recreation areas Town centres and central business districts	N/A

Table 6: Frame of reference for scenic quality values

Viewpoint type	Low scenic quality	Moderate scenic quality	High scenic quality
Landform	Large expanses of flat or gently undulating terrain. Indistinct, dissected or unbroken landforms that provide little illusion of spatial definition or landmarks with which to orient	Steep, hilly and undulating ranges that are not visually dominant Broad shallow valleys Moderately deep gorges or moderately steep valley walls Minor rock outcrops	Isolated peaks, steep rocky ridges, cones or escarpments with distinctive form and/or colour contrast that become focal points Large areas of distinctive rock outcrops or boulders Well defined, steep sided valley gorges
Vegetation	Extensively cleared and cropped areas with very limited variation in colour and texture Pastoral areas, human created paddocks, pastures or grasslands and associated buildings typical of grazing lands	Predominantly open forest or woodland combined with some natural openings in patterns that offer some visual relief Vegetative stands that exhibit a range of size, form, colour, texture and spacing including human influenced vegetation such as vineyards, and orchards	Strongly defined patterns with combinations of native forest, naturally appearing openings, streamside vegetation and/or scattered exotics Distinctive stands of vegetation that may create unusual forms, colours or textures in comparison to surrounding vegetation
Waterbodies	Absence of natural waterbody Farm dams, irrigation canals or stormwater infrastructure	Intermittent streams, lakes, rivers, swamps and reservoirs	Visually prominent lakes, reservoirs, rivers, streams, wetlands and swamps Presence of harbour, inlet, bay or open ocean
Social / cultural	Places of worship, cemeteries/memorial parks, private open spaces	Local heritage sites Distinguishable entry ways to a regional city identified in the Transport and Infrastructure SEPP	Culturally important sites, world heritage areas, national parks/reserves, Commonwealth and state heritage sites
Human presence	Dominating presence of infrastructure, human settlements, highly modified landscapes and higher density populations such as regional cities, industrial areas, agricultural transport or electricity infrastructure	Dispersed yet evident presence of human settlement such as villages, small towns, isolated pockets of production and industry, lower scale and trafficked transport infrastructure	Natural/undisturbed landscape Minimal evidence of human presence and production

Table 7: Visual reference for scenic quality values

Viewpoint type	Low scenic quality	Moderate scenic quality	High scenic quality
Landform			
Vegetation			
Waterbodies			
Social / Cultural			
Human Presence			

Step 3 - Visual sensitivity

Once the viewpoint sensitivity and scenic quality are determined, these can be combined using the visual sensitivity matrix in **Table 8** to determine the overall visual sensitivity of each assessable viewpoint.

Table 8: Visual sensitivity matrix

	High scenic quality	Moderate scenic quality	Low scenic quality
High viewpoint sensitivity	High	High	Moderate
Moderate viewpoint sensitivity	High	Moderate	Moderate
Low viewpoint sensitivity	Moderate	Low	Low
Very low viewpoint sensitivity	Low	Very low	Very low

Stage 4 – Visual impact

The overall visual impact rating of each viewpoint must be determined for each assessable viewpoint by combining the visual magnitude and visual sensitivity using the matrix in **Table 9**.

Examples of different visual impacts are provided in **Appendix D**.

Table 9: Visual impact matrix

	High visual sensitivity	Moderate visual sensitivity	Low visual sensitivity	Very low visual sensitivity
Very high magnitude	High	High	Moderate	Moderate
High magnitude	High	Moderate	Moderate	Low
Moderate magnitude	Moderate	Moderate	Low	Low
Low magnitude	Moderate	Low	Low	Very low
Very low magnitude	Low	Low	Very low	Very low

Stage 5 – Performance objectives and mitigation

Performance Objectives

Applicants must address the relevant performance objective for each assessable viewpoint and the level of impact identified (see **Table 10**).

Avoidance and mitigation

Several different avoidance and mitigation options may be considered as potential methods of minimising visual impacts.

Re-siting or removing infrastructure

Project infrastructure such as PV arrays and substations could be re-sited to locations where they will have less visual impact. Removal of panels should also be considered if there are limited options available to re-site parts of the array. This should be the first measure applicants should consider and may also be considered by the consent authority during the assessment of the project.

Re-sizing

PV arrays and other associated solar energy development infrastructure (roads, buildings, electricity transmission) can be resized to reduce visual magnitude and to reduce impacts from sensitive viewpoints.

Table 10: Visual performance objective

	High visual impact	This level of impact should be avoided unless the applicant can justify that: • all reasonable efforts have been made to avoid the impact and alternative project designs are not feasible or would be unlikely to materially reduce the impact • all reasonable mitigation options have been considered • the proposed mitigation measures would effectively mitigate the impact and would not result in a significant obstruction of views • the project site is strategically important because of its location • the project is in the public interest.
	Moderate visual impact	Visual impact mitigation is required in consultation with the affected landowner and should be proportionate to the scale of impact. There is no expectation this mitigation should eliminate the view of the development entirely but must reduce the impact to an acceptable level. Appropriate mitigation options include vegetation screening or project landscaping to reduce impacts. If the available mitigation options would not be effective in reducing impacts or are unsuitable due to the nature of the impact (e.g. screening would result in the obstruction of views), then project redesign and/or impact agreements should be considered.
	Low and very low visual impact	No mitigation is required.

Vegetation screening and landscaping plans

Vegetation screening, or the planting of trees and shrubs, to visually screen solar energy projects or other potential visual impacts (such as glint and glare) from view may be a useful mitigation option for selected viewpoints. On-site screening, such as perimeter planting, should be considered in the first instance. If this is unlikely to be effective, screening can be considered at affected viewpoints.

However, there are several limitations to the use of vegetation screening that must be considered.

Vegetation screening can obstruct views of the landscape resulting in further impacts to particular views. This can cause conflicts between the community, individual residents and the applicant of the proposed solar energy project.

Further, vegetation screening can take many years to establish and during drought or other unfavourable conditions may not achieve optimal growth or have the desired screening effect.

Given these considerations, vegetation screening should not result in significant impacts on the amenity of private viewpoints (such as the obstruction of scenic views) and should be designed in consultation with the affected landowner.

Applicants should select appropriate plant species that are suited to the environmental conditions (for example, drought-tolerant native species if relevant) and if possible, of suitable maturity to provide maximum screening effectiveness in the shortest possible time. A mix of vegetation of various heights should be employed to ensure the most effective screening coverage.

Vegetation should be planted as soon as possible to reduce the time that impacts would be unmitigated. The consent authority may impose conditions to require any landscape treatments to meet certain performance objectives to ensure they are timely and effective.

If screening is proposed, a photomontage must be prepared to visualise the effectiveness of the vegetation (see **Figure 10**). This should accompany the photomontages prepared in Step 2 and be presented with and without an overlay of the Visual Magnitude Grid Tool.

Where screening is proposed, the EIS must also include a draft landscaping plan to provide details about the proposed landscape treatments. This plan must:

- be prepared by a suitably qualified landscape expert

Figure 10: Photomontage with mitigation

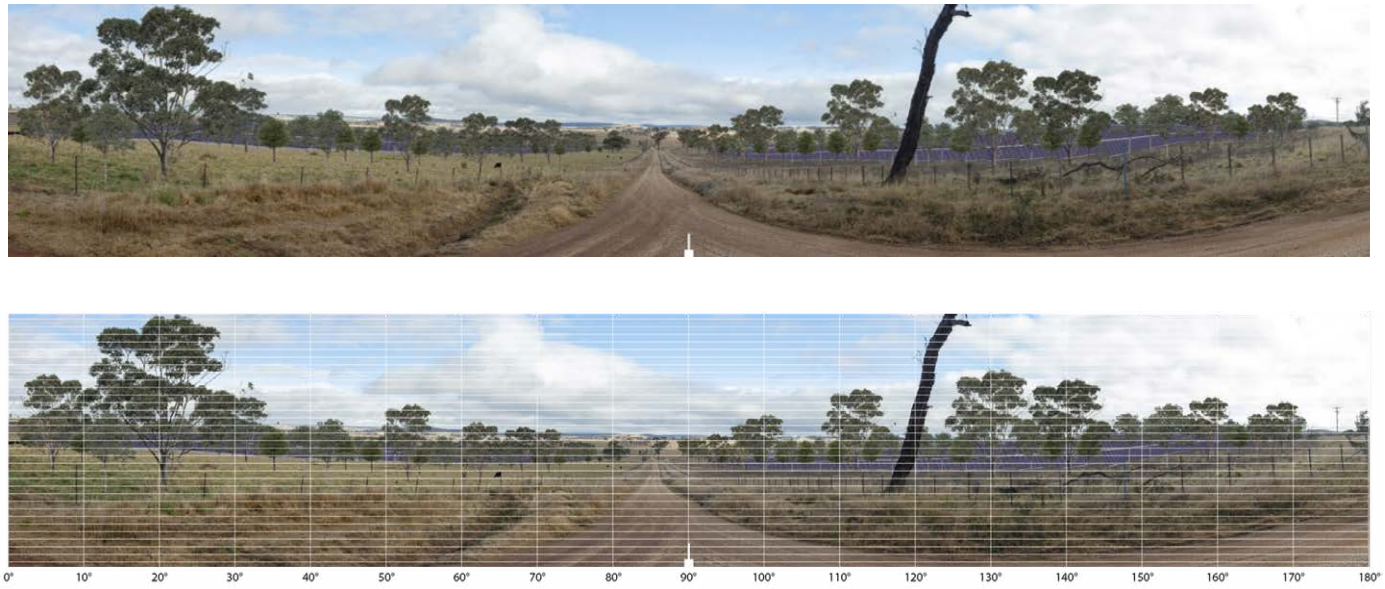
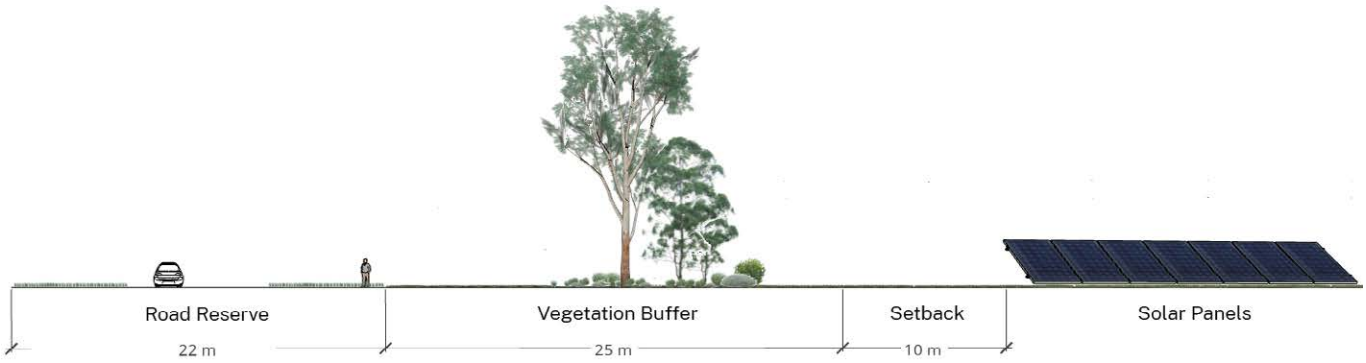


Figure 11: Section illustration for landscaping plans



- be developed in consultation with the community, including affected landowners, and include evidence of how any feedback has been addressed
- include a map of the project site that identifies important features including roads (including access roads), infrastructure (PV arrays, substations, inverters, transmission lines, building areas, site fencing), site boundaries, landscape features (rivers, dams), existing vegetation and tree cover and adjacent receivers
- include details of the proposed landscaping including an indicative planting schedule which specifies the type, species and location of any trees, shrubs and/or grasses and groundcovers to be used, the mature height of the species (in metres) and the mature spread of the species (in metres)
- include indicative timeframes for the establishment of vegetation, including an estimate for when the desired level of mitigation would be achieved
- include evidence that any landscaping would be consistent with the general native vegetation profile of the local area and can be supported by local landform, geology and soil type
- verify that the proposed planting can achieve the mitigation outcomes within a reasonable timeframe.

Applicants should also consider including sectional illustrations (see **Figure 11**) in the draft landscaping plan that show the indicative growth of proposed vegetation in comparison to the height of roads, site infrastructure and residential properties.

At-receiver mitigation

As an alternative to other mitigation options, the applicant may consider the use of at-source treatments at an affected viewpoints in consultation with the landowner. These options could include other structural or built features (for example a shed) that could be constructed to screen views. Any agreed mitigation must be subject to an impact agreement.

Impact agreements

Applicants may consider impact agreements with specific landowners as a form of mitigation when all other options have been exhausted. Further information about these agreements is provided in **Appendix B** of the *Large-Scale Solar Energy Guideline*.

Residual impact assessment

The applicant should assess the visual impact that would remain after the adoption of mitigation measures. This is to determine whether the overall visual magnitude rating of the project would decrease.

Appendix A

Example landscape character assessment

Landscape character zone	Sensitivity	Magnitude	Landscape character impact
LCZ 1 Agricultural plains	**Low** • The landscape has been highly modified from its natural state. • Human modifications are clearly evident through widespread clearance of native vegetation and the presence of roadways, dwellings, ancillary agricultural buildings and domestic scale electricity infrastructure. As such, it is considered to have some capacity to absorb the type of change envisaged by the solar energy development. • No specific planning controls attribute special value to this landscape. • The landscape elements that contribute to its quality will remain unchanged. • The solar energy development would not disrupt any key landscape features.	**Moderate** • Views of the project are likely to be limited to close range where screening vegetation is absent. • The project would occupy a relatively small portion of this LCZ. • The project infrastructure will have an evident change in landscape characteristics in close range. However, the extent of this change is considered minor in relation to the extent of this LCZ. • Supporting project infrastructure is of a scale and form that is commensurate with the existing built form typology of the rural landscape and could be adequately absorbed by the landscape.	**Low-Moderate**
LCZ 2 Floodplain	**Low** • The floodplain within the study area has a higher concentration of vegetation associated with the floodplain and associated waterways. • No specific planning controls attribute special value to this landscape.	**Low** • When viewed from afar, the project is not expected to compete visually with the landform and associated vegetation. • When viewed from within the LCZ, views toward the project are expected to occupy a small proportion of the horizontal and vertical fields of view, often only through the gaps of existing vegetation, minimising their ability to indirectly impact upon the character of this LCT.	**Low**

Appendix

B

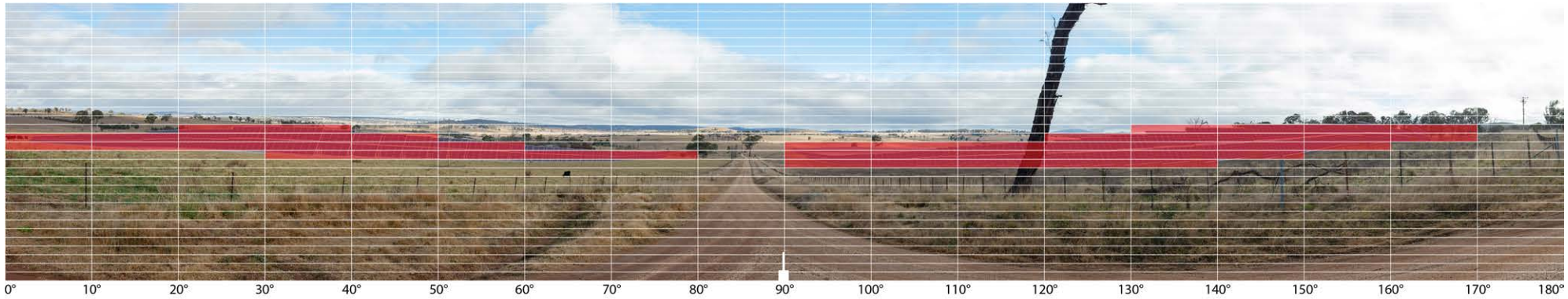
Presenting the visual impact assessment

The visual impact assessment should be presented in accordance with the requirements outlined below and depicted in the following examples.

Assessment component	Requirements
Viewpoint information and imagery	• reference to the viewpoint name/number • baseline panoramic image (using requirements in **Table 2**) • delineation of the horizontal field of view under imagery • viewpoint location • GPS coordinates • distance to the development • direction of view towards the project
Sensitivity analysis	• identification of viewpoint type (e.g. residential, transport/infrastructure, recreational/social/cultural) • identification of viewpoint sensitivity (see **Table 4**) • identification of scenic quality (see frame of reference in **Table 5** and **Table 6**) • overall visual sensitivity (using **Table 7**) • relevant commentary on how the scenic quality has been derived
Magnitude analysis	• panoramic photomontage with render/wireframe and magnitude grid tool overlaid • clear identification of cells that would be occupied by the project (see **Figure 6** and **Figure 8**) • identification of the total number of cells that would be occupied by the project • identification of the magnitude rating (using **Table 3**)
Visual impact rating	• identification of the visual impact rating (using **Table 8**) • excerpt(s) of the photomontage displayed separately and at size representative of the actual view – should show areas with the greatest impact
Performance objectives, mitigation and residual impact	• commentary on the visual impact including relevant performance objectives (see **Table 10**) and any proposed mitigation measures • detailed justification for high visual impacts that cannot be avoided • panoramic photomontage with inclusion of proposed mitigation with and without the magnitude grid tool (see **Figure 10**) • age/timing for the development of vegetation used in montages

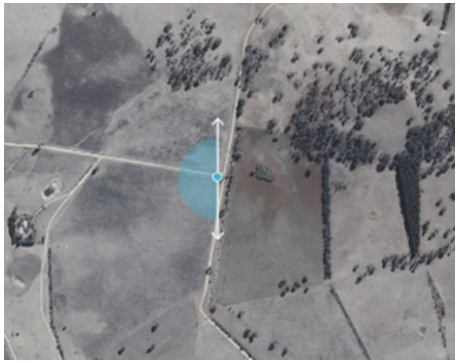
VIEWPOINT 3 | Gara Road, Metz

Sensitivity and Magnitude



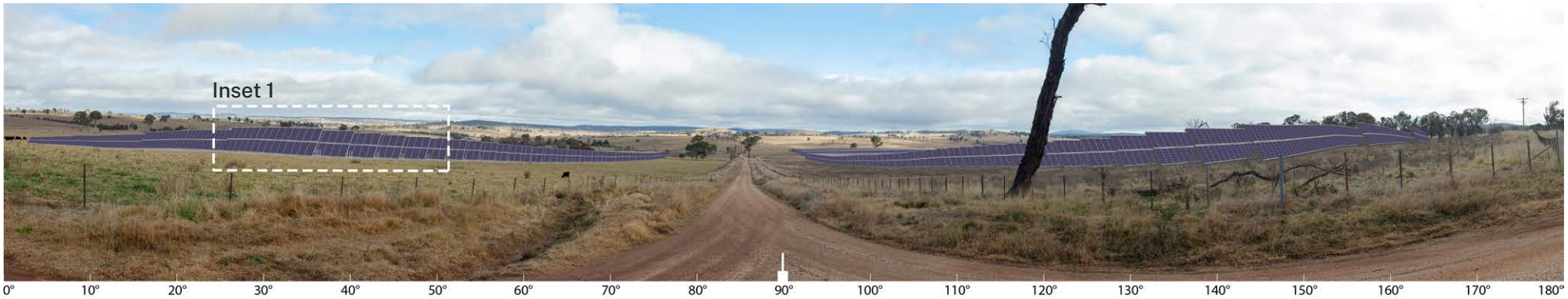
Visual Sensitivity Discussion

Coordinates	Distance to Development	Viewpoint Type	Viewpoint Sensitivity	Scenic Quality	Overall Sensitivity	Occupied Cells	Magnitude Rating
30°34'45.99"S 151°49'14.66"E	450 metres	Transport/ Infrastructure	Very Low	Low	Very Low	46	Very High



VIEWPOINT 3 | Gara Road, Metz

Visual Impact Rating: Moderate

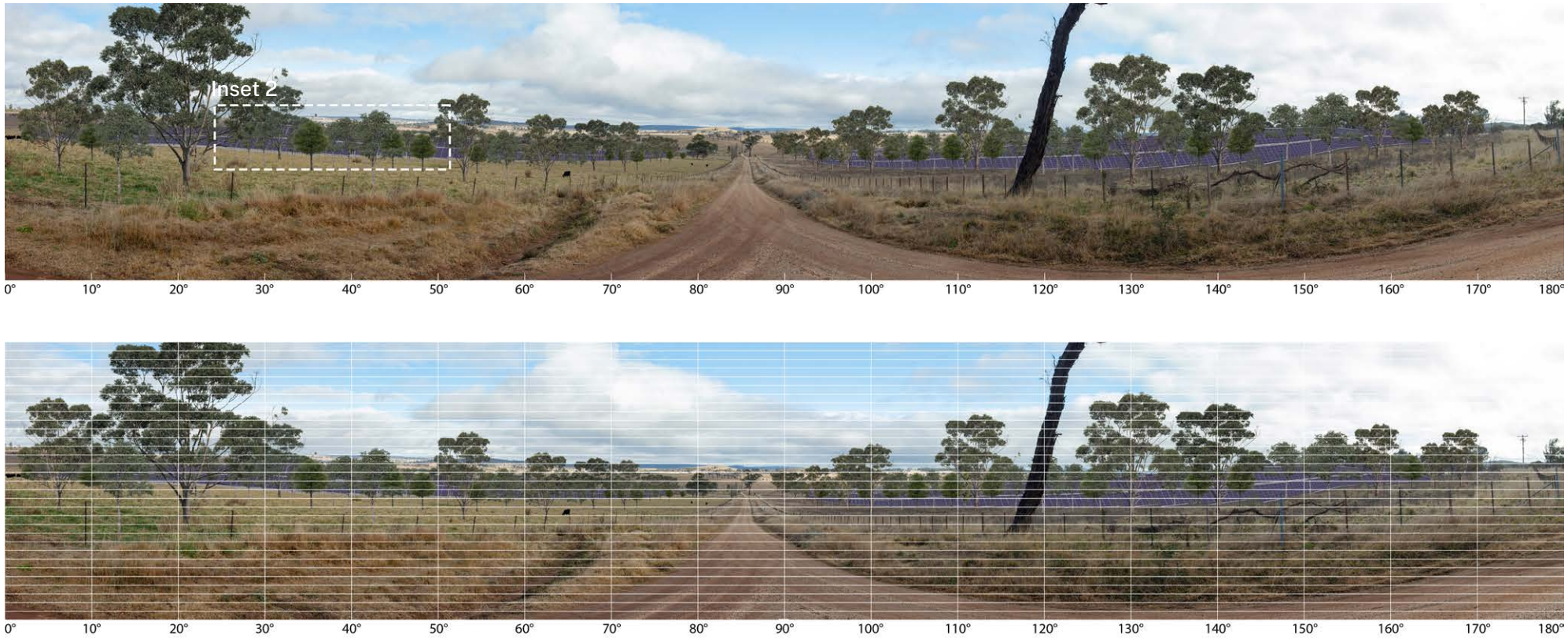


Note: The inset image(s) provide an accurate representation of the view when the document is viewed at 100% zoom and at arms length from the screen

VIEWPOINT 3 | Gara Road, Metz

Mitigation

Vegetation Screening at 5 years



Mitigation and Residual Impact Discussion

VIEWPOINT 3 | Gara Road, Metz

Mitigation

Vegetation Screening at 5 years

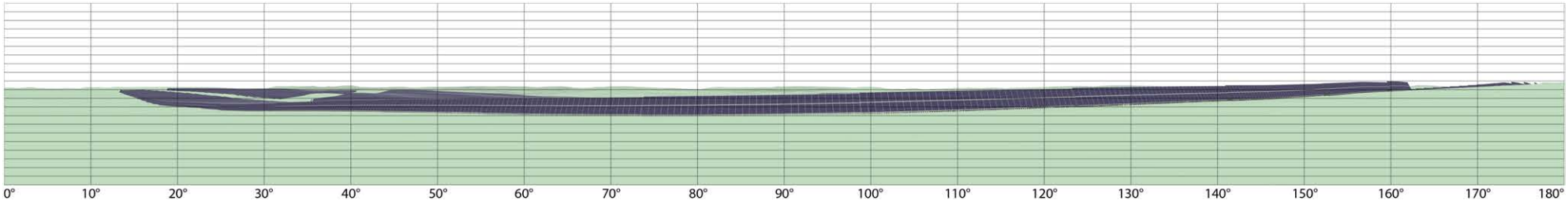
Note: The inset image provides an accurate representation of the view when the document is viewed at 100% zoom and at arms length from the screen

Appendix C

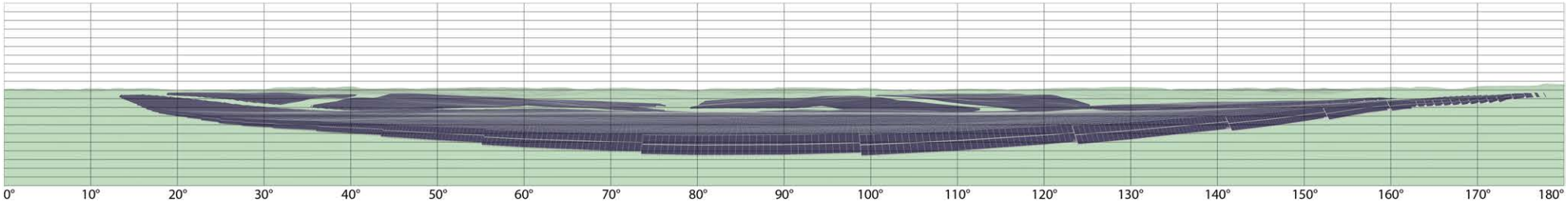
Visual magnitude examples

The following examples depict the magnitude of a solar energy development approximately 2km wide and 2km deep. These are highly conservative examples that do not consider intervening vegetation or other mitigating factors.

100 m from development

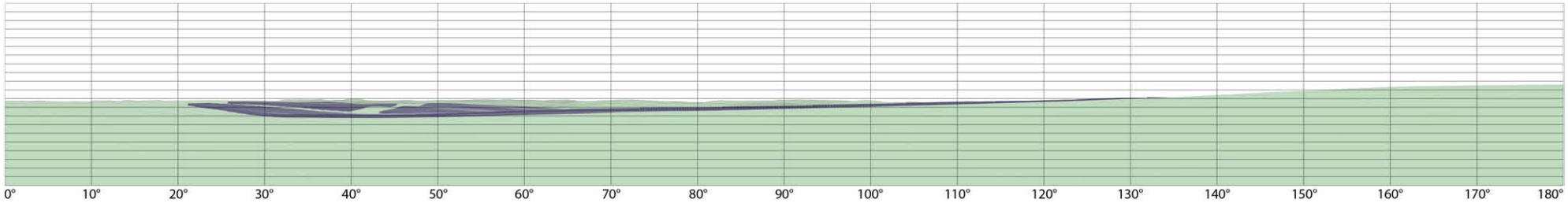


1.5 m height (very high magnitude)

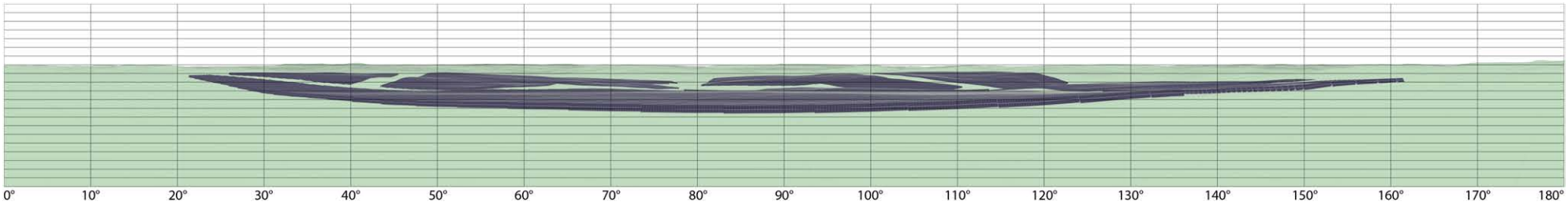


10 m height (very high magnitude)

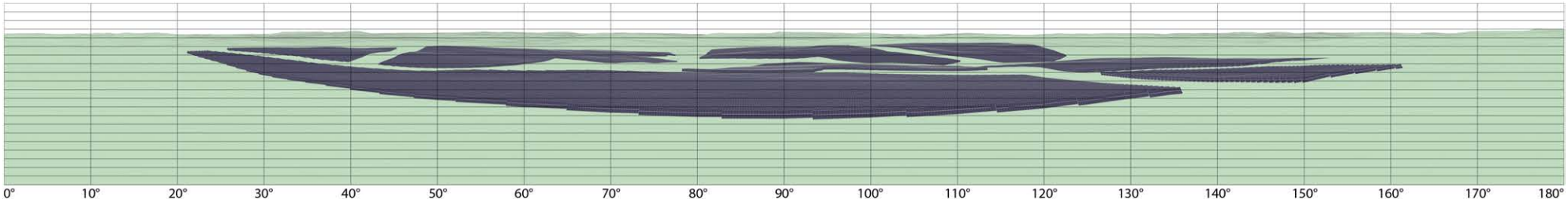
250 m from development



1.5 m height (moderate magnitude)

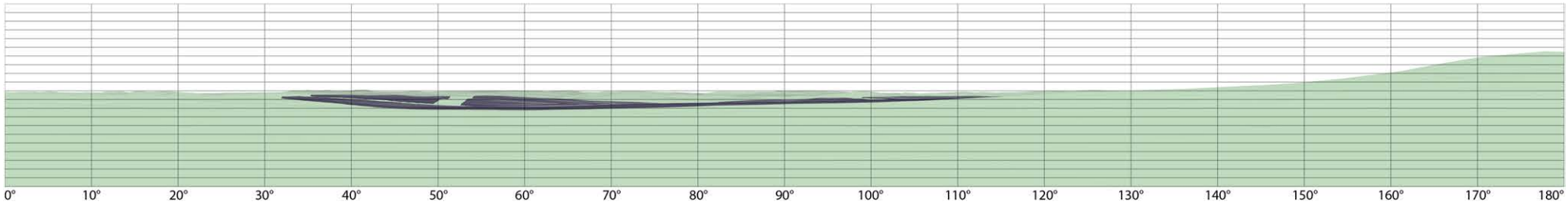


20 m height (very high magnitude)

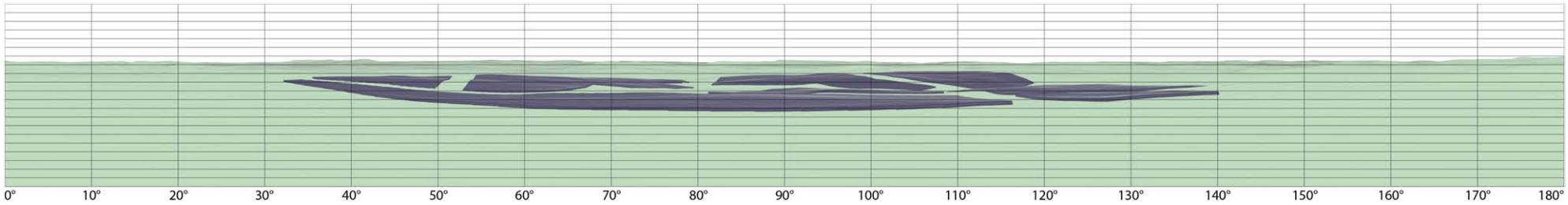


40 m height (very high magnitude)

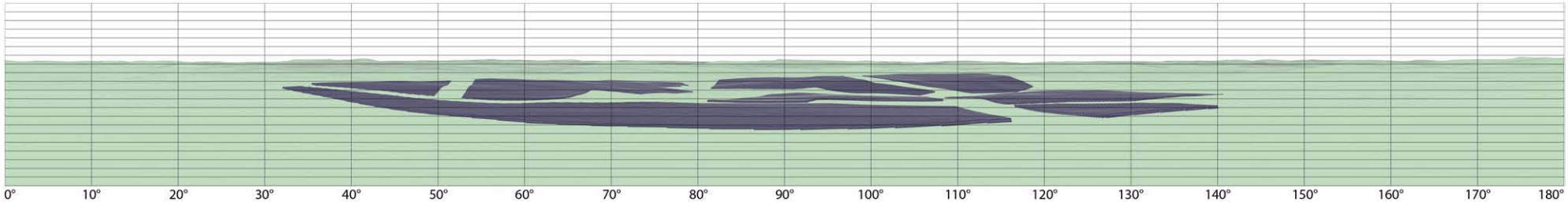
500 m from development



1.5 m height (low magnitude)

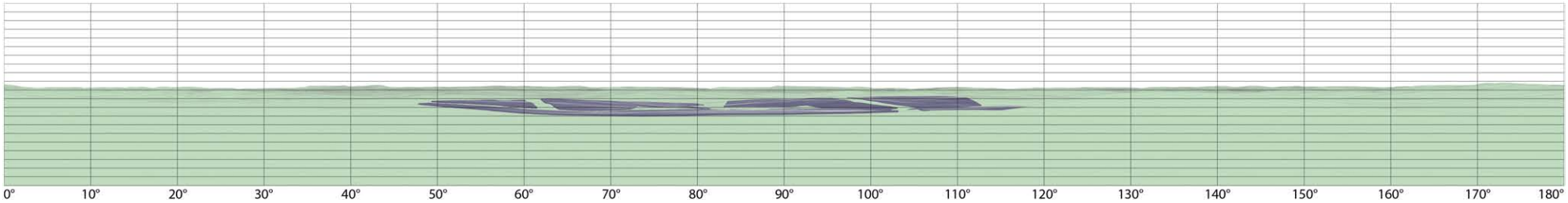


40 m height (very high magnitude)

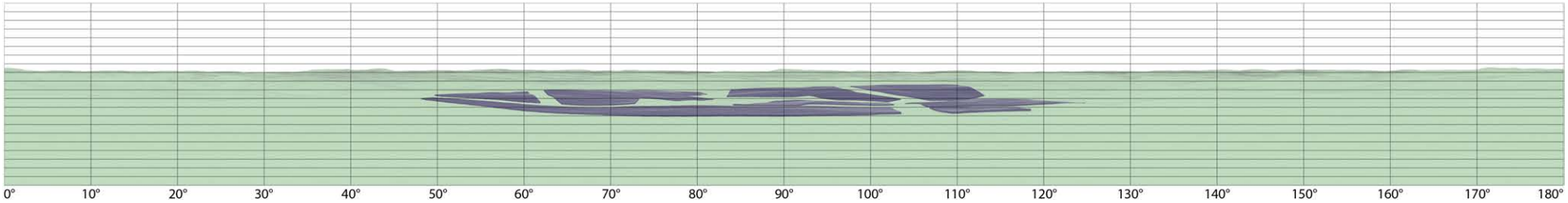


60 m height (very high magnitude)

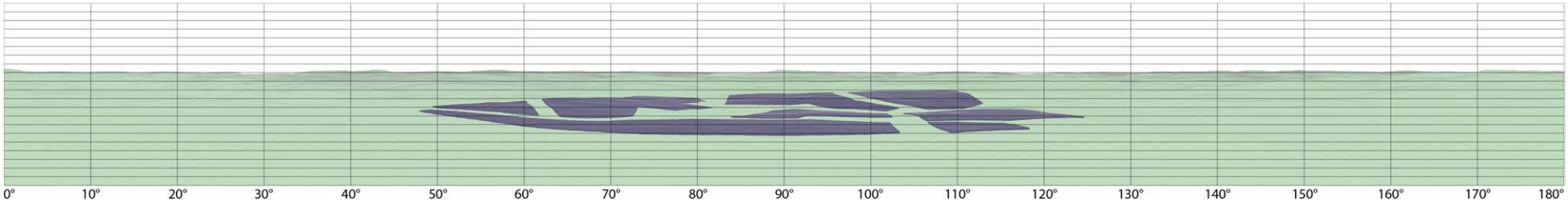
1,000 m from development



40 m height (moderate magnitude)

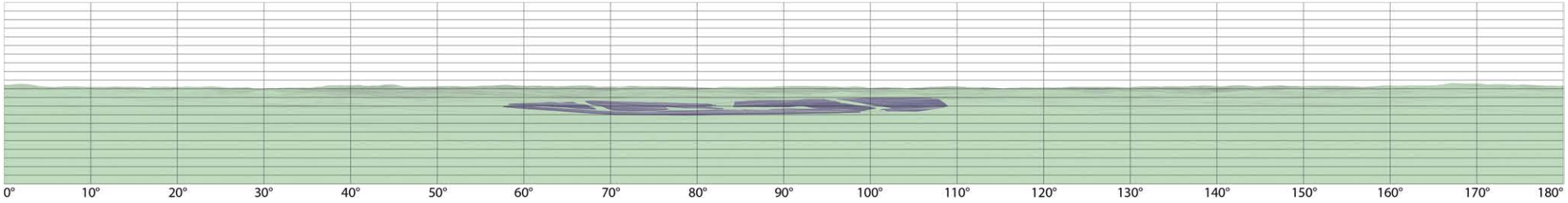


80 m height (high magnitude)

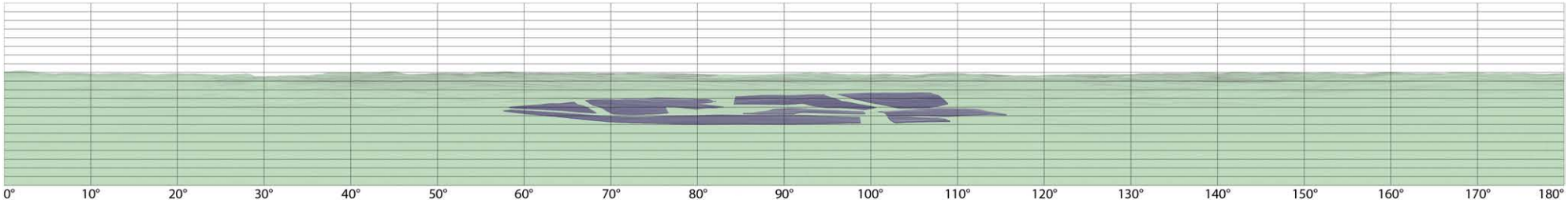


120 m height (high magnitude)

1,500 m from development

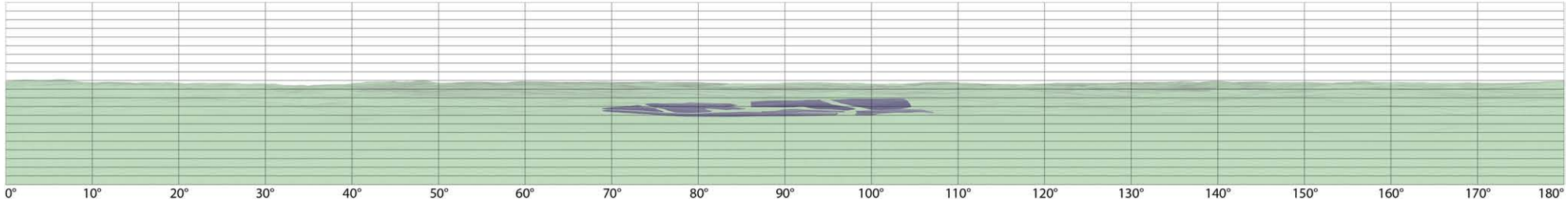


80 m height (low magnitude)



160 m height (moderate magnitude)

2,500 m from development



200 m height (low magnitude)

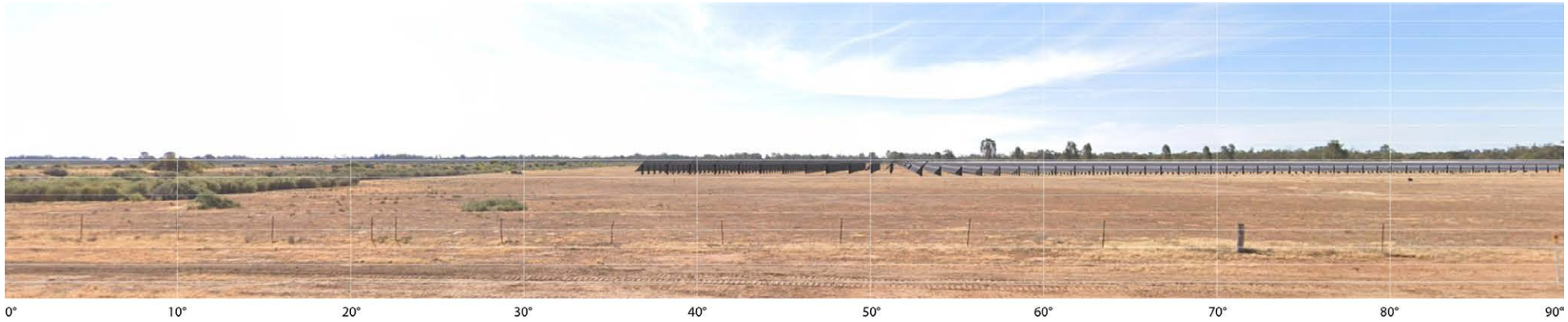
Appendix

D

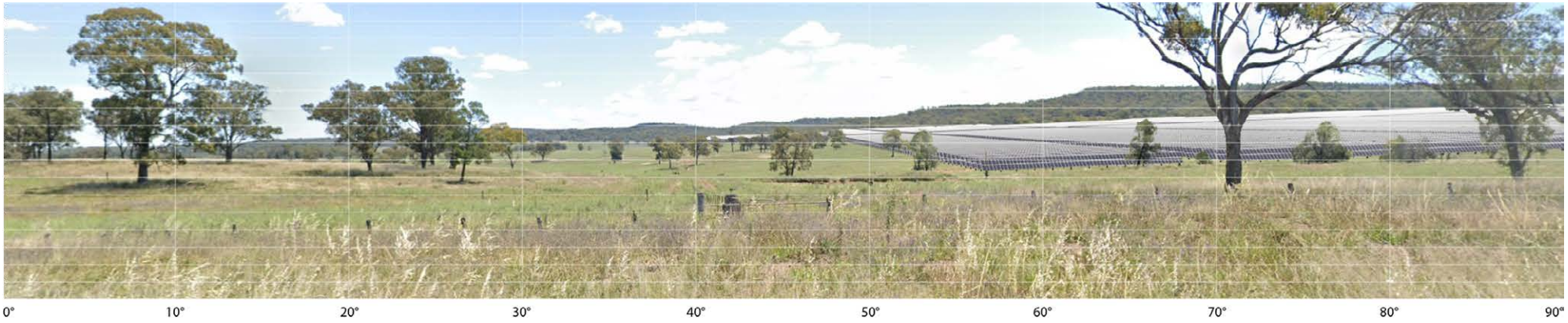
Visual impact examples

Residential viewpoints

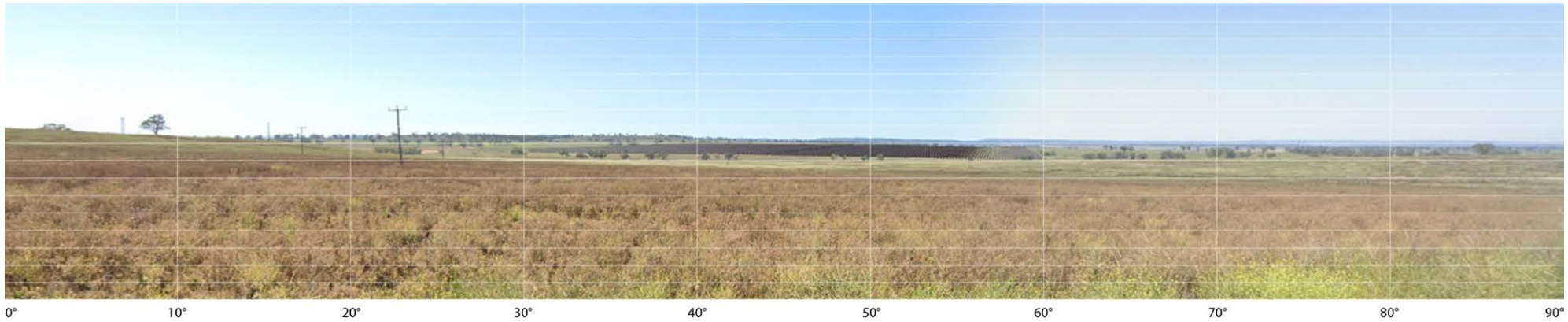
Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
250 metres	Rural dwelling secondary view	Low	Low	Low	10	Low	Low



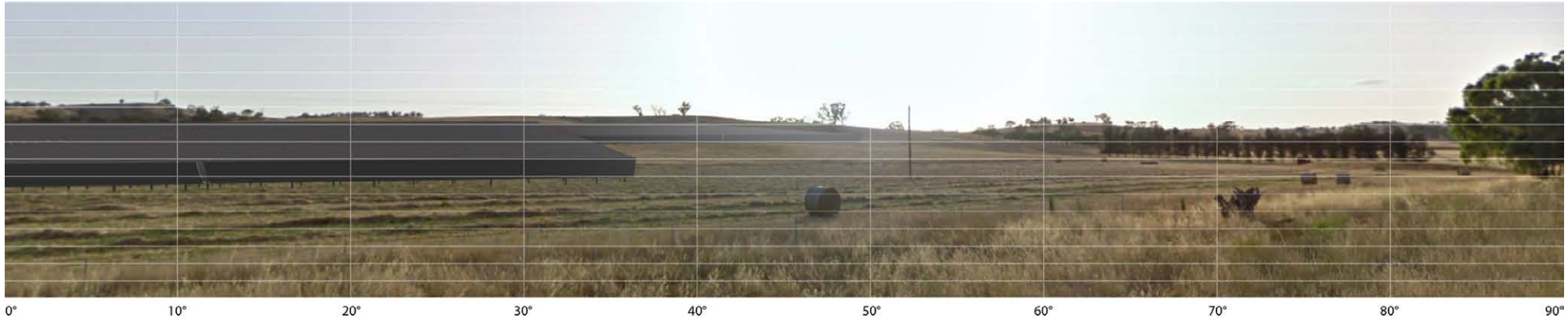
Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
250 metres	Rural dwelling secondary view	Low	Moderate	Low	14	Moderate	Low



Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
1400 metres	Rural dwelling primary view	Moderate	Low	Moderate	3	Very low	Low



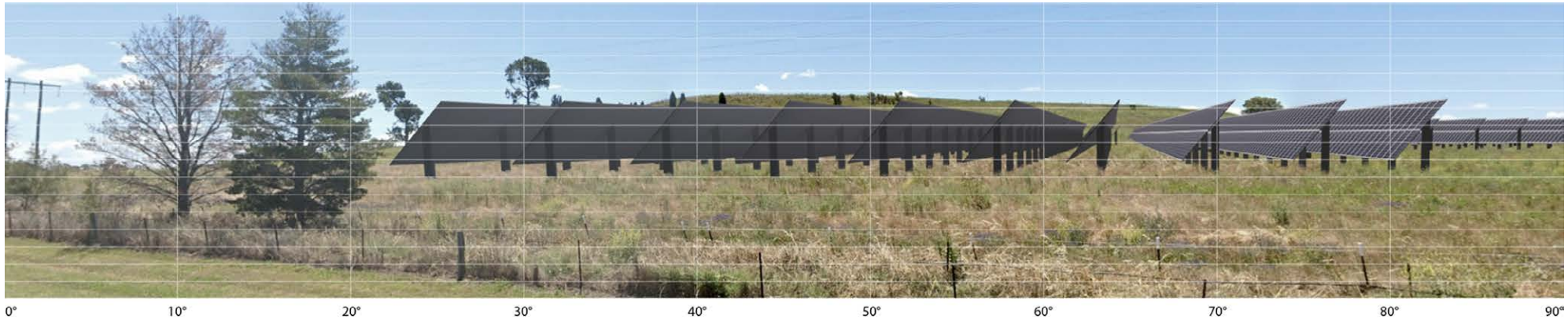
Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
125 metres	Rural dwelling primary view	Moderate	Low	Moderate	18	Moderate	Moderate



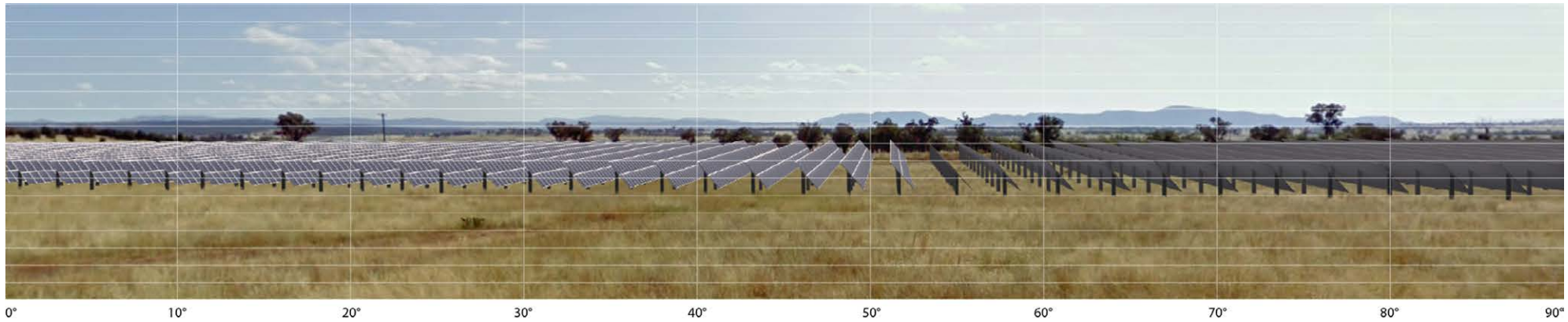
Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
250 metres	Rural village	High	Moderate	High	18	Moderate	Moderate

Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
60 metres	Rural dwelling primary view	Moderate	Moderate	High	33	Very high	High

Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
40 metres	Historic homestead	High	Low	Moderate	34	Very high	High

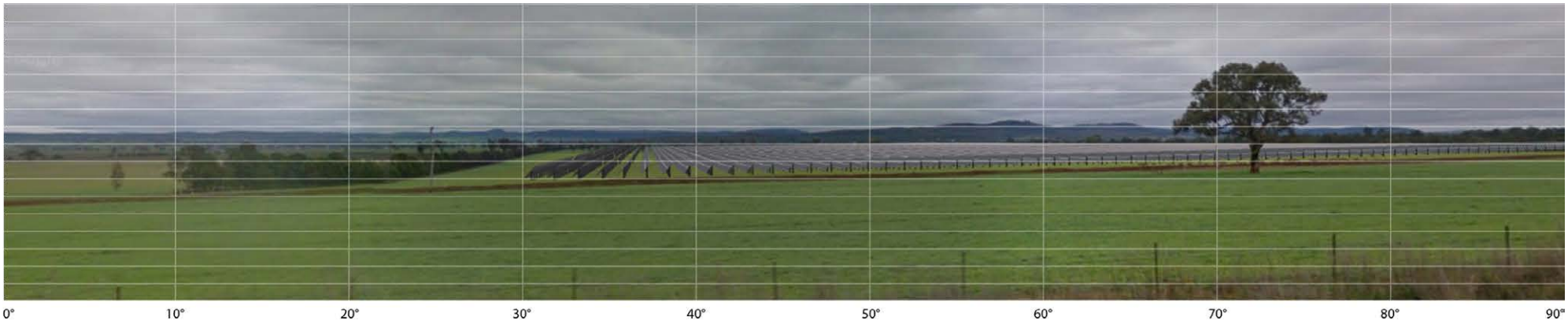


Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
55 metres	Rural village	High	Moderate	High	27	High	High

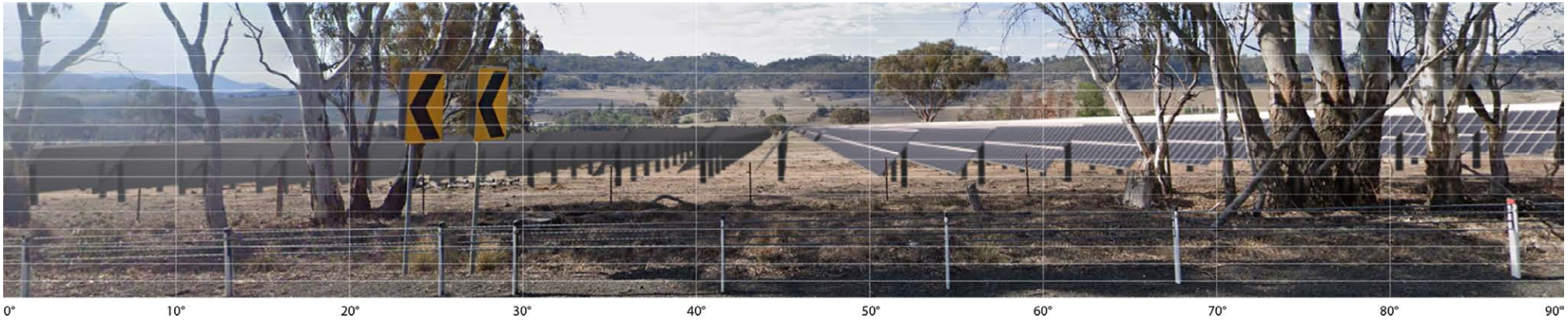


Transport / Infrastructure viewpoints

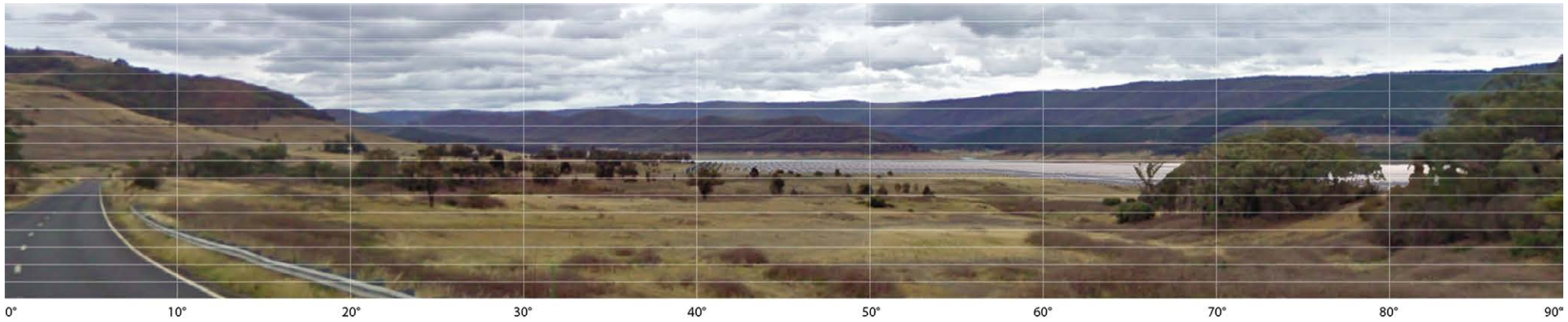
Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
135 metres	Local road	Very low	Moderate	Very Low	11	Low	Very low



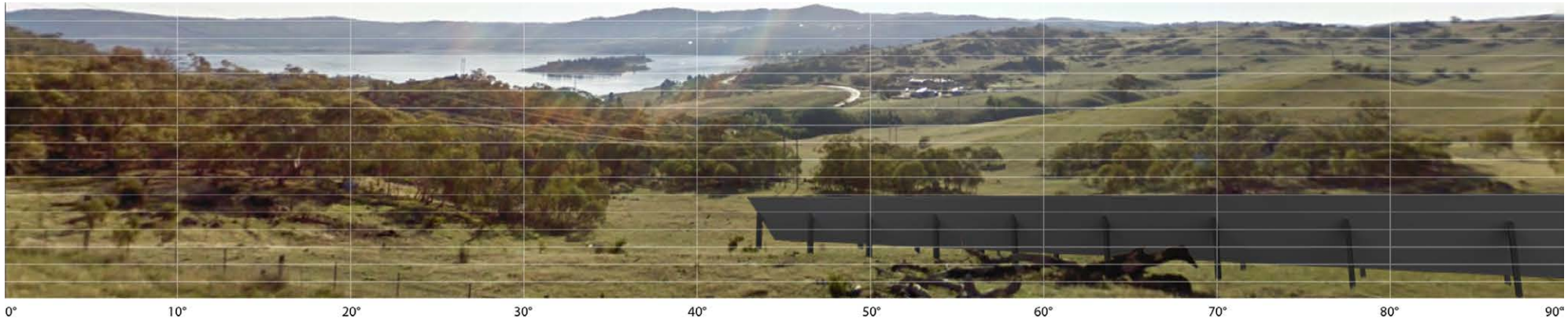
Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
50 metres	Local road	Very low	Moderate	Very Low	26	High	Low



Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
270 metres	Scenic drive	Low	High	Moderate	9	Low	Low



Distance to development	Viewpoint type	Viewpoint sensitivity	Scenic quality	Overall sensitivity	Occupied cells	Magnitude rating	Impact rating
35 metres	Scenic drive	Low	High	Moderate	24	High	Moderate



Department of Planning and Environment

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