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Barnawartha Solar Farm and Energy Storage

Landscape and Visual Impact Assessment

Barnawartha Solar Pty Ltd

Reference: 520618

2022-07-07 Revision: 4

ARP Australian Solar Pty. ltd

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Abbreviations

Term	Definition
BESS	Battery Energy Storage System
CHMP	Cultural Heritage Management Plan
DELWP	Department of Environment, Land, Water and Planning
ESO	Environmental Significance Overlay
Foreground	The area that immediately surrounds the project up to a distance of 0.5 kilometres.
HO	Heritage Overlay
Km	kilometre
LVIA	Landscape and visual impact assessment: The assessment of the impacts of the proposal on landscape and visual values.
Landscape	Its constituent elements, its character and the way this varies spatially, its geographic extent, its condition, the way the landscape is experienced, and the value attached to it.
LCT	Landscape Character Types
LPPF	Local planning policy framework: Local planning policies are tools used to implement the objectives and strategies of the Municipal Strategic Statement.
m	metre
Study Area	The area designated relevant for assessment of the project, determined by viewshed analysis
the Project	ARP Barnawartha North Solar Farm
The Site	Proposed location for the Project
Viewpoint (VP)	Moderate or high sensitivity location from which views to the construction process or components of the project may be possible.
Viewshed	The area visible from a particular viewing location.
Visual amenity	The qualities of a landscape setting that are appreciated and valued by a viewer.
Visual catchment	The area over which an object can be seen within the landscape based on the line of sight.
Visual impact	The result of assessing the sensitivity level of a viewer and the modification level of a development.
Visual sensitivity	The degree to which various user groups would respond to change based on their expectation of a particular experience in a given setting for example the expectation of a high level of visual amenity in a national park.

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Executive summary

Project overview

The purpose of the Landscape and Visual Impact Assessment (LVIA) is to support an application for a Planning Permit to the Department of Environment, Land, Water and Planning (DELWP) for developing the Barnawartha Solar Farm and Energy Storage (the Project). The Site is located within the Farming Zone (FZ) and the Project comprises a ~64 Megawatts (MW) solar energy farm, with ~64MW battery storage, substation and power cable connection to the existing Barnawartha Substation to the east.

The landscape and visual baseline

This assessment examines the existing landscape and visual conditions of the LVIA Study Area (both physical and statutory) to establish a baseline against which potential impacts of the Project can be assessed.

The LVIA Study Area has been defined within a radius of two kilometres from the location of the Site. This area captures where the Barnawartha Solar Farm will be observable, based upon the height of Project elements, topographical characteristics and intervening elements in the surrounding area.

Relevant planning policies and legislation have been reviewed to understand any specific landscape or visual designations relating to the Study Area, as well as a desktop study to understand the various physical elements that combine to create landscape and visual character.

The Project is located in an area subject to the planning scheme of Indigo Shire Council and is approximately 1.7 kilometres south of the New South Wales border. There are no specific planning designations attributing any specific landscape or visual value within the Study Area. The Project is in close proximity to areas under City of Wodonga, in which there are significant landscape overlays of the hill range including Mount Lady Franklin, which contributes to the landscape character of the area.

The baseline assessment identified a total of two distinct Landscape Character Types (LCTs) within the Study Area, including:

- LCT 1: Rural landscape; and
- LCT 2: Industrial area.

These LCTs have been determined to have a moderate and high ability to absorb the change as proposed by the Project.

There are seven representative public viewpoints identified within the Study Area that were assessed. Table 1.1 summarises the visual impacts from these representative viewpoints.

Table 1.1 Summary of visual impacts

Viewpoint no.	Description	Construction impacts	Operational impacts	Residual impacts
Viewpoint 01 (VP1)	Murray Valley Highway/Barnawartha Road, 400m northwest of the Project Site. Viewpoint is representative of that experienced by rural residential properties.	Low	Low	Low
Viewpoint 02 (VP2)	Murray Valley Highway/Coyles Road, approximately 100m north of the project site. Viewpoint is representative of that experienced by arterial road users.	Low	Low	Low
Viewpoint 03 (VP3)	Bay Road, approximately 850m west of the Project Site. Viewpoint is representative of that experienced by a rural residential property.	Negligible	Negligible	Negligible
Viewpoint 04 (VP4)	Baxter-Whelans Road, 550m east of the Project Site entrance. Viewpoint is representative of that experienced by a rural residential property.	Moderate	Moderate	Low
Viewpoint 05 (VP5)	330 Baxter-Whelans Road, 50m south of the Project Site. Viewpoint is representative of that experienced by a rural residential dwelling.	Moderate	Moderate	Low

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Viewpoint no.	Description	Construction impacts	Operational impacts	Residual impacts
Viewpoint 06 (VP6)	Corner of Barnawartha-Howlong Road and Baxter-Whelans Road, 50m southwest of the Project Site. Viewpoint is representative of that experienced by local road users.	Low	Low	Low
Viewpoint 07 (VP7)	Hermitage Road Project associated landowner. This Viewpoint is representative of the residence associated with the Project.	High	High	High

Landscape and visual assessment findings

For the assessment of landscape and visual impacts, the 'Indicative overall site layout – Planning submission' for Barnawartha Solar Farm (BARNSF-GN-LAY-0226-V, 30 March 2022, produced by Wirsol Energy for Australian Solar Ltd (ARP), has been used.

The level of visual modification due to the Project is a combination of the degree of change and the ability of the landscape setting to absorb the change. The prominence and level of intrusion of the development within a landscape setting is a key determinant of the level of visual modification.

The landscape characters identified within the Study Area have been assessed to have the ability to absorb change, as proposed by the Project, with rural landscapes considered to have a moderate absorptive capability.

This report has assessed that a moderate adverse visual impact would be experienced during both construction and Year 1 of operation from nearby residential dwellings to the south on Baxter-Whelans Road (VP4 and VP5), due to the proximity and open views experienced from these users of the construction and operational activities. A high adverse visual impact is experienced by the landowner from the residential property on Hermitage Road (VP7), during both construction and Year 1 of operation. This is due to both the proximity of the Project and being surrounding from north, east, south and southwest. This landowner is associated with the Project and has agreed to the proposed development. They would not normally be considered as part of this assessment, however, has been included at DELWP's request (pre application meeting).

The visual impact experienced during both construction and Year 1 of operation from nearby residential dwellings to the north along Murray Valley Highway/Barnawartha Road (VP1) and west along Bay Road (VP3) would experience a low adverse and negligible rating respectively. The dwellings have existing intervening vegetation and have farm sheds near to the dwellings, with which proposed building infrastructure is commensurate. The expanse of the solar panels, although noticeable, are a height at up to 4.7 meters, with views toward them interrupted by retained vegetation.

Although the Project would be visible by motorists travelling along Murray Valley Highway (VP2) and Barnawartha-Howlong Road (VP6), these are arterial roads with travelling speeds up to 100Km/hr and as such the road users experience is a short duration that is transient with glimpses between existing intervening vegetation. Consequently, a low adverse visual impact would be experienced during both construction and Year 1 of operation for these arterial road users.

The Site layout has been modified during the assessment phase, responding to sensitive residential receptors to the south of the Site along Baxter-Whelans Road. The location of PV panels has been offset from the southern property boundary to allow screen planting to reduce visibility of the Project. Consequently, the residual visual impact rating is reduced to low adverse at year 10 when vegetation screening is established, for these receptors as assessed in VP4 and VP5.

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Mitigation

To assist the next design process, recommendations have been provided for mitigation and management measures to reduce potential visual impacts as a result of the Project during construction and operation. These are intended to provide guidance.

Mitigation measures are based on minimising the level of intrusion that the Project has on its existing landscape setting and is subject to further detailed design, operational and safety requirements. The

mitigation measures for the Project include minimising disturbance to existing vegetation in and around the Site, planting mid-level vegetation where possible to soften views, and using materials and colours of structures to blend into the existing environment where possible.

In accordance with CFA guidance, any vegetation planting would need to be suitably designed to reduce bushfire hazards including a fire buffer zone.

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1 Introduction

1.1 Project Background

The project entity is known as Barnawartha Solar Pty Ltd. Wirsol Energy are co-developing the Barnawartha Solar Farm and Energy Storage (the Project) with ARP Australia Solar (ARP).

A planning permit is being sought for a proposed solar energy farm, battery storage and associated connection to the Barnawartha Substation, in Barnawartha, Victoria. The proposal includes:

- Installation of a ~64 MW (AC) solar energy farm;
- Construction of ~64 MW battery storage;
- Underground power cables internally to connect the sites to the substation; and
- The construction of 2.9 km of overhead lines (OHL) between the proposed facility and the existing Barnawartha Substation to the east.

The proposed solar energy farm site is currently a grazing area of approximately 130 ha at 49 Hermitage Road, Barnawartha.

1.2 Purpose of this report

Aurecon Australasia Pty Ltd (Aurecon) has been engaged by ARP to prepare a Landscape and Visual Impact Assessment (LVIA). The purpose of the LVIA is to support an application for a Planning Permit to the Indigo Shire Council, for the proposed Project at Barnawartha North, Victoria.

The report will assist in identifying any impacts to the existing landscape character and visual amenity as a result of the Project and whether further approvals or assessments are required. This assessment provides identification of any key risk areas of the Project and provides recommendations for mitigating adverse impacts of project infrastructure.

1.3 Location

The Subject Site (the Site) is located at 49 Hermitage Road, approximately 4km north-east of the Barnawartha township and 18km west of Wodonga (see Figure 1.1). It is bordered by the Murray Valley Highway to the north, Coyles Road to the east and parallel to Barnawartha-Howlong Road. The Site access is located on Hermitage Road, which is accessed from Baxter-Whelans Road. The Site comprises total area of 120.7 hectares.

The Site is currently used as grazing land and is located within a FZ and is bordered on the northern side by a Road Zone Category 1 (RDZ1) (Murray Valley Highway) under the Indigo Planning Scheme. Other farming uses surround the Site.

The location of the Site and proposed cable route alignment to the existing substation are shown in Figure 1.2, and the Land Zoning is shown in Figure 1.3.

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Figure 1.1 Site context (red outline the Site)

Figure 1.2 Barnawartha Solar Farm and Energy Storage Site (red outline the Site; blue line the proposed cable route alignment to the existing substation)

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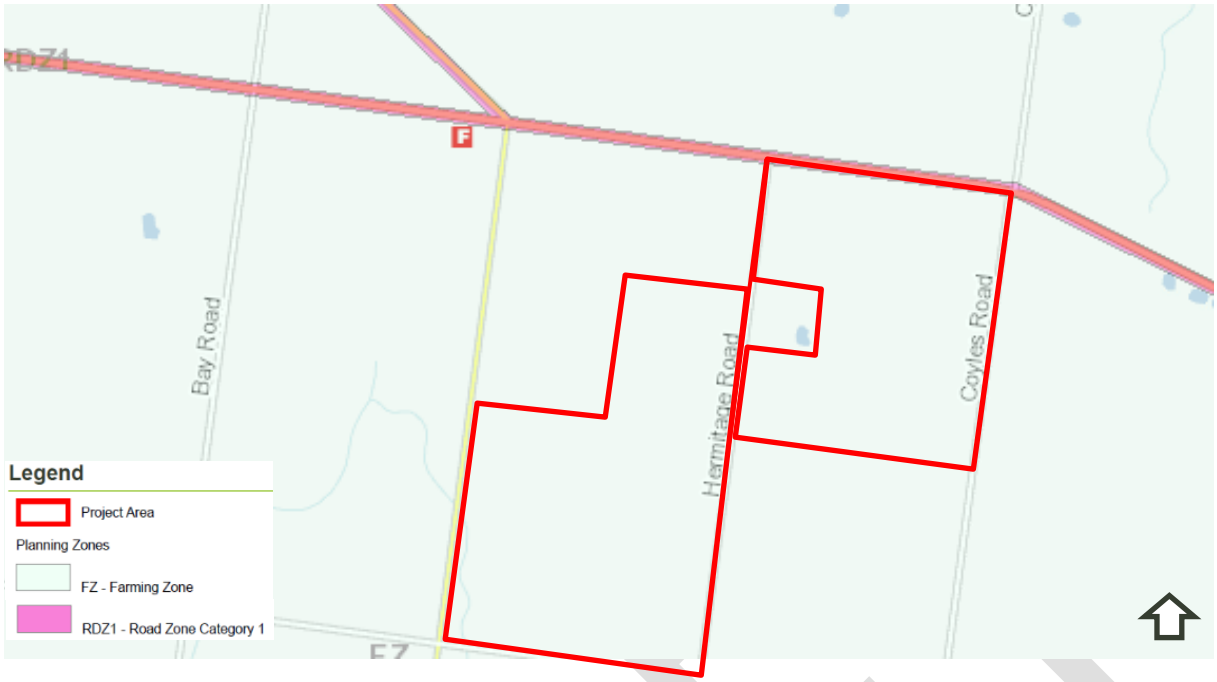

Figure 1.3 Land Zoning Map

1.4 Study Objectives

The objectives of the Landscape and Visual Impact Assessment were to:

- Understand the natural and built landscape and visual attributes and characteristics in the vicinity of the Project, including their relationship to use patterns and history;
- Identify areas of sensitivity to landscape and visual change associated with the Project;
- Identify opportunities to improve and enhance the visual environment from a precinct perspective and for the Project's components;
- Assess the landscape and visual impacts associated with the Project; and
- Satisfy regulatory requirements under the Planning and Environment Act 1987.

1.5 Structure of the report

The structure of the report is outlined below.

- Section 1 – introduces the report;
- Section 2 – describes the methodology for the assessment;
- Section 3 – identifies relevant landscape and visual policy and legislation pertinent to the proposal;
- Section 4 – describes the existing site conditions and landscape setting;
- Section 5 - describes the proposal's features and operation relevant to the LVIA;
- Section 6 – identifies the landscape character types within the Study Area;
- Section 7 – assesses the potential visual impacts of the proposal;
- Section 8 – provides guidelines for mitigating potential impacts; and
- Section 9 – summarises the assessment findings.

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2 Methodology

2.1 Approach to the assessment

The Project is located in land zoned FZ and is not seeking a planning scheme amendment to change land use. A determination of the prominence of the proposed development within a landscape setting is treated as being of a lower relevance to assess the visual impact than the sensitivity or perception of a viewer.

The report's key focus therefore is on the visual sensitivity being the tolerance of the viewer and the landscape setting to change as a result of the proposed development. The visual impact of the Proposal is determined by evaluating the degree of its visual fit in the context of the visual sensitivity of the surrounding land uses (based on the land use zones of the applicable planning scheme).

2.2 Study area

A viewshed is defined as the surface area visible from a given viewing location. As the distance increases from any proposed development, the field of view decreases causing the visibility of components to diminish. Appendix A defines this diminishing visual prominence rationale.

The extent of the Site's potentially visible surface area from a given viewing location was identified during a desktop study using topographical data. The Study Area for the purposes of this assessment includes the Proposal extents (the Site) and a conservative viewshed analysis of a two kilometre radius from the Site boundary.

The potential viewpoints were then validated from imagery taking during a field visit to account for potential screening and filtering effect on views from topography, existing vegetation and built form.

2.3 The study method

Figure 2.1 illustrates the key steps for the methodology of the assessment.

The level of visual impact resulting from the proposed development has been assessed against the following components:

Visual sensitivity made up of the following:

- Visual sensitivity made up of the following:
  - Viewer sensitivity: the sensitivity of the viewer to the development/change and distance from the viewpoint; and
  - Landscape sensitivity: the ability of the landscape setting to absorb the development/change.
- Scale of modification: how well the development/change contrasts or blends with the surrounding land use based on varying levels of visual prominence.

Establishing the level of visual impact involves assigning levels of visual sensitivity and modification such as high, medium low or very low. A determination matrix is then used to assign an overall level of visual impact.

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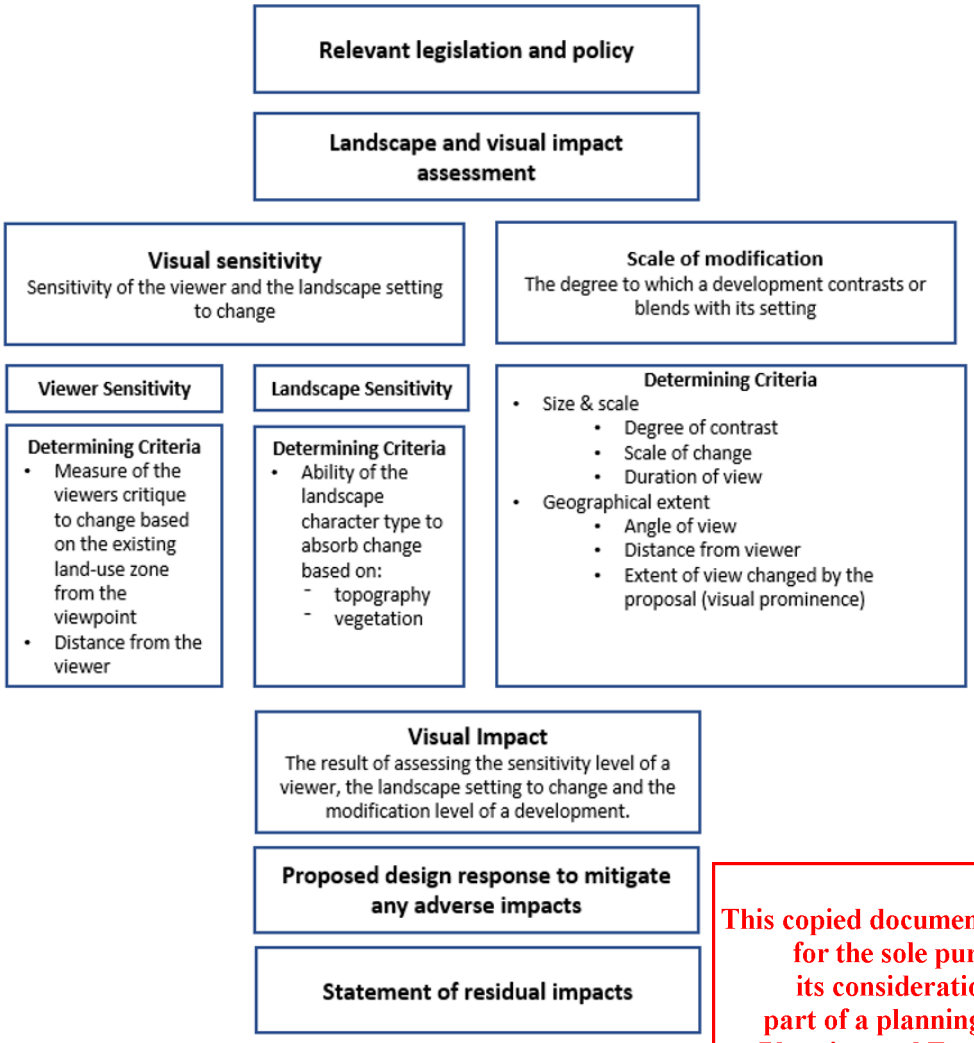

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Figure 2.1 LVIA study method

2.4 Visual sensitivity

Visual sensitivity is composed of two parts: viewer sensitivity and landscape sensitivity.

2.4.1 Viewer sensitivity

Viewer sensitivity is a measure of how critically a change to the existing landscape setting would be regarded based on the land use of the area and the distance from where it is viewed.

Various landscape settings have differing indexes to the relative importance the viewer places on them. For example, individuals would view changes to the visual setting of their residence more critically than changes to the visual setting in which they travel or work.

As such, levels of viewer sensitivity are based on land use because this largely defines a viewer's expectation of what they would typically expect within a particular setting. This approach is consistent with the visual management system (*Landscape Aesthetics – A Handbook for Scenery Management*, United States Department of Agriculture& Forest Service, 1995).

The viewer sensitivity levels relating to existing land use zones within the Study Area are outlined in Table 2.1.

The next critical component to rating the viewer sensitivity is the distance of the proposal from the identified land use area. As illustrated in Table 2.1, there are three viewing distances to consider:

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- Foreground (0 – 500 metres);
- Middle ground (501 – 2000 metres); and
- Background (> 2000 metres).

As outlined in Appendix A, as the distance increases from the land use area the field of view decreases causing the visibility of the proposal components to diminish or be absorbed in the landscape setting. Consequently, as distance from the viewer to the proposal increases, the level of viewer sensitivity reduces.

Table 2.1 Viewer sensitivity determination matrix

LAND USE (Sensitivity of the viewing location)	DISTANCE FROM THE PROPOSAL				
	FOREGROUND		MIDDLEGROUND		BACKGROUND
	0 – 200 m	201 – 500 m	501 – 1000 m	1001 – 2000 m	> 2000 m
Residential / Accommodation	H	H	H	M	L
Parks and reserves	H	H	H	M	L
Townships and settlements	H	H	M	M	L
Arterial road	M	M	M	L	L
Rural roads (sealed)	M	M	L	L	VL
Local tracks (unsealed)	L	L	L	VL	VL
Agricultural areas	L	L	VL	VL	VL
Industrial areas	VL	VL	VL	VL	VL
Legend - H = High, M = Medium, L = Low, VL – Very Low					

Landscape Sensitivity

To understand the sensitivity of a landscape and its ability to absorb change, landscape character types (LCTs) need to be identified and defined. Identifying the LCTs of an area provides the basis for understanding the features that are important, and how different types of development would sit within a particular landscape

LCTs are defined based on physical characteristics such as:

- topography;
- vegetation;
- drainage patterns;
- geology; and
- land use patterns.

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Once the LCTs are defined, an assessment of how well the landscape units are able to accommodate or absorb change such as a development is undertaken.

The key factors considered in determining a LCTs absorptive capability are:

- topographic variation;
- presence of and patterning of vegetation and density; and
- human modification such as presence of built from and/or extensive clearly resulting in a highly altered landscape.

In areas of elevated topography with no or lowland vegetation, open, unobstructed views towards a proposed development is highly likely. The ability for the setting to absorb the development and/or screen

views using vegetation for example would be hard to achieve. Consequently, the ability to absorb the development in this scenario would be very low.

In areas where there are bands of dense vegetation in the surrounding landscape or the presence of built form that inhibit views towards the proposed development, the setting would have a greater capacity to absorb change compared to a cleared, expansive landscape or no structures.

Areas that contain signs of human modification such as farming land and industrial areas are typically not considered as high-quality landscape settings compared to natural landscapes such as mountain ranges. As such, the higher level of human modification the greater capacity the landscape has to absorbing change.

The absorptive capability levels relating to landscape sensitivity are outlined in Table 2.2.

Table 2.2 Landscape absorptive capability level

Landscape absorptive capability level	Description
Very Low	The extent of alteration would result in the landscape losing significant natural landscape features, its character and/or sense of place. Open, expansive and bare landscapes. Elevated, bare and/or groundcover vegetation. The viewer is highly sensitive to changes in their immediate surroundings such as residents or 'natural' areas such as National Parks.
Low	The extent of alteration would result in the landscape partially losing some natural or designed landscape features, its character and/or sense of place. Open, expansive and moderately vegetated landscapes including canopy trees. Elevated and vegetation landscape including canopy trees. The viewer is moderately sensitive to changes in their immediate surroundings such as users of regional and local reserves.
Moderate	Modified landscapes with an abundance of built form and limited natural characteristics. Built-up landscapes typically interspersed with canopy trees. The viewer is aware of the change but not overly sensitive to changes in their immediate surroundings such as users of commercial areas and farming land.
High	Highly modified and/or degraded landscapes with limited to no natural characteristics. Undulating or elevated topography with dense tree cover. The viewer is not critical/sensitive to changes in their immediate surroundings such as roads and industrial areas.

2.5 Assigning a level of visual sensitivity

The visual sensitivity is a result of combining the viewer sensitivity level with the landscape absorptive capability level using the visual sensitivity determination matrix illustrated in Table 2.3.

Table 2.3 Visual sensitivity determination matrix

Viewer sensitivity level

Landscape absorptive capability level	**H**	**M**	**L**	**VL**
VL	H	H	M	L
L	H	M	L	VL
M	M	L	L	VL
H	L	VL	VL	VL

VL = Very low
L = Low
M = Moderate
H = High

Level of visual sensitivity

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2.5.1 Visual modification

Visual modification is not easily predicted objectively, and interpretation and professional judgment is applied. A clear picture of the modification is determined from a combination of the degree of change to the view due to the project including the extent of the area over which changes would be visible, the period of exposure to the view and reversibility.

The assessment of visual modification is based on the Proposal design outlined in Section 5.

The assessment of visual modification does not include an evaluation of the merit of the urban design. It is recognised that that assessment of urban design outcomes is highly subjective, therefore an assumption has been made that the changes are adverse. Table 2.4 outlines the four categories of modification used for determining the degree of visual modification potentially resulting from the project.

The key considerations in determining the level of visual modification as outlined in Table 2.4 include:

- Size and scale;
  - The scale of the change in the view with respect to the loss or addition of features in the view, and changes to the composition including the proportion of the view occupied by the project components;
  - The degree of contrast or integration of the project components in the landscape setting with the existing or remaining elements including form, mass, line, height, colour, texture and materiality;
  - The nature of the view towards the project components in terms of duration of the view;
- Geographical extent;
  - The angle of the view in relation to sensitive land use;
  - The distance of the viewpoint from the project component(s); and
  - The extent of the area over which the changes would be visible.

Table 2.4 Criteria for determining the visual modification level

MODIFICATION LEVEL	DESCRIPTION
High	The proposal is highly visible and intrusive in regard to the size, scale and geographical extent, and would disrupt views currently experienced from sensitive land use areas and/or strongly contrasts with the existing landscape setting which has limited capacity for change and/or the extent of area over which the changes would be visible from sensitive land use areas is significant.
Moderate	The proposal partially intrudes in regard to the size, scale and geographical extent or somewhat obstructs current views from sensitive land use areas and/or a noticeable compositional change to the existing landscape setting in which there is moderate capacity for change and/or the extent of area over which the changes would be visible from sensitive land use areas is moderate.
Low	The proposal is barely perceptible resulting in minor deterioration to the view currently experienced from sensitive land use areas; and/or results in a small change to the existing landscape setting in which change is possible without harm and/or the extent of area over which the changes would be visible from sensitive land use areas is limited.
Very low	There is minimal compositional contrast and a high level of integration of form, line, shape, pattern, colour or texture values between the proposal and the environment in which it sits. In this situation, the proposal may be noticeable, but does not markedly contrast with the existing landscape setting and/or the extent of area over which the changes would be visible from sensitive land use areas is negligeable.
Not apparent	There are no views of the proposal components and as such, there is no impact.

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2.5.2 Assigning a level of impact

The visual impact therefore is a result of combining the visual sensitivity level with the degree of visual modification using the visual impact determination matrix illustrated in Table 2.5.

The consequence of the application of the matrix is that (except where the project cannot be seen) the project would have some adverse impact, whether low, moderate or high, depending on the level of visual modification and viewer sensitivity from the location at which the project can be viewed.

Table 2.5 Impact determination matrix

Visual Sensitivity

Degree of modification

	H	M	L	VL
H	H	H	M	L
M	H	M	L	VL
L	M	L	L	VL
VL	L	VL	VL	VL

VL – Very low
L = Low
M = Moderate
H = High
Level of Visual impact*

***Adverse, Neutral or Beneficial**

2.5.3 Consideration of night lighting impacts

There is little guidance locally on the assessment of night time visual impact. Therefore, the methodology applied to this report is drawn from the United Kingdom. The Institute of Lighting Professionals (ILP) Guidance Notes for the Reduction of Obtrusive Light (2020) includes four categories or zones with which to describe the lit situation of the landscape. These environmental zones are supported by design guidance for the reduction of light pollution which can then inform proposed mitigation techniques (refer to Appendix B).

A full night time visual assessment has not been undertaken, however this report has included a broad assessment of likely impacts. This assessment includes identification of existing lighting levels within the study area (referencing the ILE environmental zones), identification of the likely sources of lighting associated with the project and consideration of likely lighting impacts.

2.5.4 Mitigation measures

Once the landscape and visual impacts have been determined, mitigation actions are recommended for viewpoints and locations of highest visual sensitivity.

Generally residual impacts would be reduced by at least one level where landscape measures have been proposed and matured due to filtering or inhibiting views to the proposal.

2.5.5 Residual impacts

A residual impact occurs when the mitigation measures have a limited effect on reducing or avoiding landscape or visual impacts. Impacts which are assessed as being moderate to high are those which should be given greatest consideration in decision making, relative to other levels of landscape and visual impacts. Minor to moderate levels of impact are of progressively reducing importance, but nonetheless requiring consideration especially near to sensitive receptors.

The residual impact assessment level has considered the existing view in comparison to the view ten years after project opening. Maturation of the landscape plantings that have been included in the design would filter or inhibit views at some locations, potentially reducing the visual impact of the project over time. These are discussed in the viewpoint assessments in Section 0.

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2.6 Links to other Technical Reports

Some of the technical requirements include other aspects and impacts that are not directly related to this report and are covered in the following specialist disciplines:

- Desktop Ecological Risks Assessment - Revision 0, Aurecon; and
- Heritage Due Diligence Assessment - Revision 0, 2021-12-01, Aurecon.

2.7 Limitation and assumptions

2.7.1 Limitations

There are the following limitations associated with this assessment:

- There are limited specifications for the assessment of landscape and visual impacts specific to Australia. Therefore, the below guidelines have been used as a basis for the methodology for this assessment.
  - The Guidance for Landscape and Visual Impact Assessment (GLVIA), Third Edition (2013), prepared by Landscape Institute and Institute of Environmental Management & Assessment (IEMA, UK);
  - Guideline for Landscape Character and Visual Impact Assessment (August 2020), Transport for New South Wales; and
  - Guidance Note for Landscape and Visual Assessment (June 2018), Australian Institute of Landscape Architects (Queensland chapter).
- The LVIA process aims to be objective and, as such, seeks to describe any changes factually. Potential changes resulting from the Proposal have been defined. However, the significance of these changes requires qualitative (subjective) judgements to be made. Therefore, the conclusions to this assessment combine both objective measurement and subjective professional interpretation. This assessment has attempted to be objective, however it is recognised that visual assessment can be highly subjective, and individuals are likely to associate different visual experiences to the Study Area;
- This LVIA is based on:
  - ARP Indicative overall site layout – Planning submission (Drawing number: BARNSF-GN-LAY--0226-V2, 24 June 2022)
- The report has excluded assessment of the power connection into the Electricity Grid Substation to the east.
- The impact assessment is focused on the current land uses and zoning.
- A night time visual assessment has not been undertaken.
- Access to sensitive viewpoints on private land, such as residences or accommodation, were not undertaken for this LVIA. However, where there are expected impacts from private properties, representative viewpoints are assessed adjacent the property boundaries looking towards the proposal to capture the typical existing visual conditions. It is noted that the accuracy of these viewpoint assessments for private land are limited to what is visible in the viewpoint.
- Methodology, program and timing of the construction works are currently indicative and dependent upon planning approvals. Consequently, construction impacts have not been assessed in this report. However, it would be acceptable to predict that there would be impacts during construction and would be similar degree of visual impact to the operational phase assessment findings.

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2.7.2 Assumptions

This report has been developed based on the following assumptions:

- Desktop investigations were undertaken to inform the findings of this report.
- No stakeholder consultation or engagement on environmental matters has occurred.
- Further investigation is required to confirm the findings of this report and any other approvals.
- The preliminary environmental assessments were undertaken based on the Project investigation area mapped in each specialist assessment. Any additional Project area has not been considered by these reports and therefore has not been considered to date.
- The environmental assessments are based on the Project Description as outlined in Section 5. As the design of the Project is not yet finalised, our advice provides a point in time reference that is subject to change.
- The methodology adopted for this landscape and visual impact assessment assumes that if the works would not be seen, there is no impact.
- For the purpose of the assessment, an unobstructed viewpoint from a publicly accessible location has been used as a worst-case scenario of potential visual impacts.
- It is assumed that the OHL connection from the Project substation will utilise existing OHL poles to the south of Baxter-Whelans Road, with new OHL poles east of Lady Franklin Road within an existing City of Wodonga easement.

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3 Legislation and Policy

Legislation, policies and guidelines that have been reviewed and that are applicable to this impact assessment are outlined below.

3.1 Commonwealth legislation

Commonwealth legislation applicable to the Project includes:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Native Title Act 1993*

3.2 State legislation

Victorian legislation contains several Acts that are relevant to the Project, including:

- *Planning and Environment Act 1987*
- *Environment Effects Act 1978* and the *Environment Protection Act 1970*
- *Flora and Fauna Guarantee Act 1988 Flora* and *Fauna Guarantee Amendment Bill 2019*
- *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulation 2018*
- *Heritage Act 2017*

3.3 Municipal planning schemes

The *Planning and Environment Act 1987* (PE Act) provides the framework for land-use and development in Victoria. Planning schemes prepared under the provisions of the Act apply to each municipal area in Victoria.

The project is located in an area subject to the planning scheme of Indigo Shire Council and is approximately 1.7 kilometres south of the New South Wales border. It is in close proximity to industrial uses to the east within Wodonga City Council area.

The relevant planning schemes control the use and development of land and are structured to include:

- Planning Policy Framework;
- Local Planning Policy Framework;
- Municipal Strategic Statement;
- Local Planning Policy;
- Zones and overlays;
- Particular and general provisions; and
- Definitions and incorporated documents.

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3.3.1 Planning Policy Framework

The Planning Policy Framework (PPF) provides a context for spatial planning and decision making in Victoria. The following is a summary of the key documents assessed:

Table 3.1 Planning Policy Framework documents

Legislation/Policy reference	Brief description legislation, salient parts and intent	How legislation/policy is relevant to the study
Indigo Shire PS Ordinance, Wodonga Planning Scheme	**15.01-6S Design for rural areas** • Ensure that the siting, scale and appearance of development protects and enhances rural character. • Protect the visual amenity of valued rural landscapes and character areas along township approaches and sensitive tourist routes by ensuring new development is sympathetically located. • Site and design development to minimise visual impacts on surrounding natural scenery and landscape features including ridgelines, hill tops, waterways, lakes and wetlands.	Proposed site is within existing farming zone. Proposed use is compatible to the PPF.

3.3.2 Local Planning Policy Framework (LPPF)

Table 3.2 Relevant local planning policies

Legislation/Policy reference	Brief description legislation, salient parts and intent	How legislation/policy is relevant to the study
Municipal Strategic Statement and Local Planning Policy	The Indigo MSS includes policy direction that reflects the diverse land uses and development intensity in the municipality. **Clause 21.05-6 Barnawartha** • Provide an appropriate area of industrial land to cater for existing and future demand. **Clause 21.05-9 Rural Areas** • Protection and conservation of biodiversity, including native vegetation retention and provision of habitats for native plants and animals and control of pest plants and animals • Protection of landscapes and significant open spaces that contribute to character, identity and sustainable environments. • Management of land use change and development in rural areas to promote agriculture and rural production.	Proposed land use is compatible to the LPPF
Wodonga Planning Scheme	**Clause 21.04-2 Significant landscape – Hillsides** • To safeguard the visual and natural values of hillside landscapes.	Site is not within area of SLO and proposed land use does not affect hillside landscape

3.3.3 Zones and overlays

Zones

The Site and surrounding land are located within a Farming Zone (FZ). Land uses including IN1Z, IN2Z and PPRZ are zones within the City of Wodonga, as shown in Table 3.3 and mapped in Figure 3.1 Land use zones.

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Table 3.3 Land uses

PLANNING ZONES	Land Use Features
FZ: Farming	Project site and surrounds
IN1Z: Industrial 1	Logic Centre and Wodonga TAFE Logic campus (IN1Z)
IN2Z: Industrial 2	Includes un-developed land within the Logic Centre precinct
PPRZ: Public Park and Recreation	Land zoned (currently undeveloped) for recreation between TAFE and Logic centre
RDZ1: Road	Murray Valley Highway and Hume Freeway
PUZ4: Public Use - Transport	Railway corridor
LDRZ: Low Density Residential	Barnawartha (Indigo Drive)
GRZ1: General Residential	Barnawartha

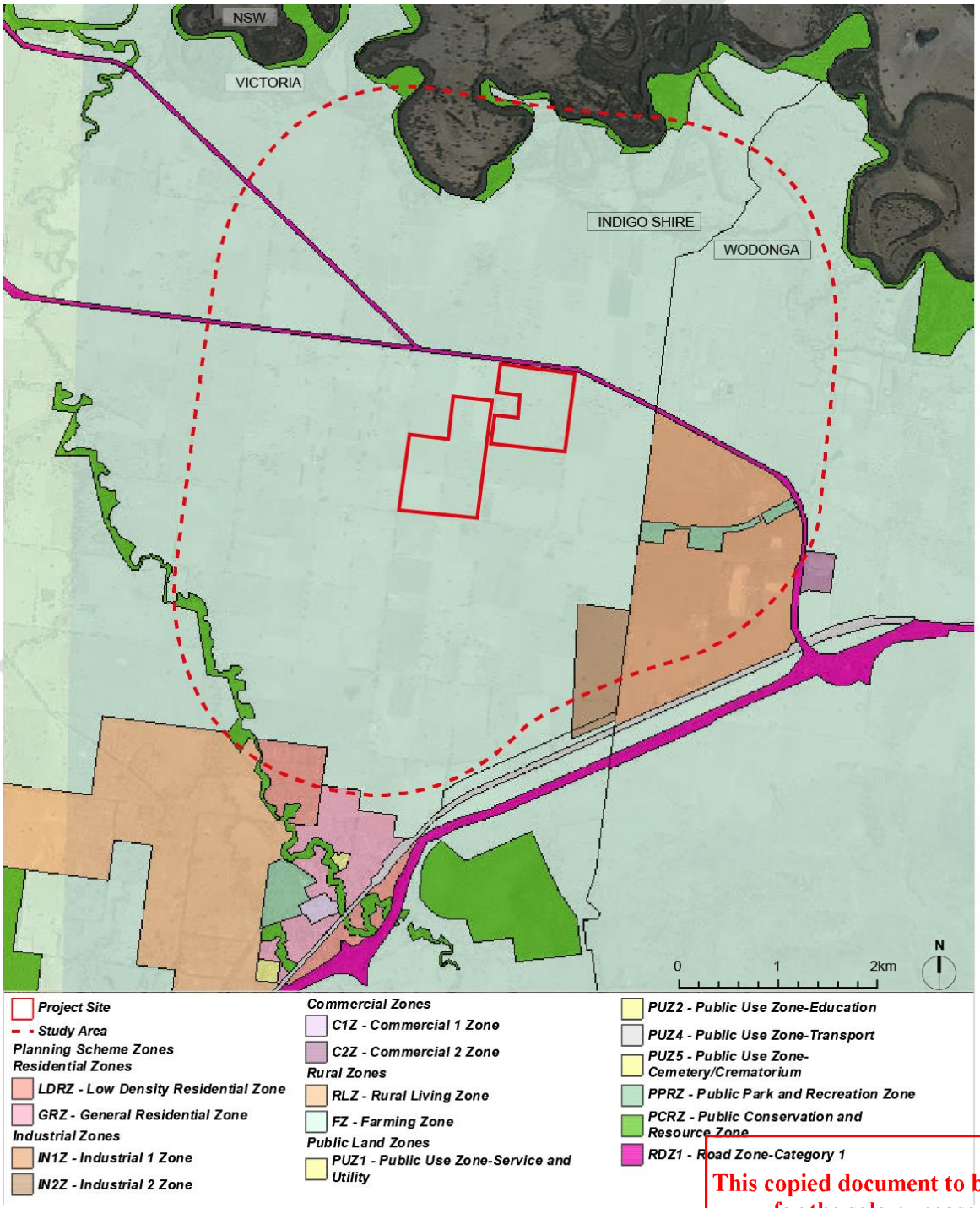

Figure 3.1Land use zones (image: DELWP VicMap)

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Overlays

The Site and surrounding land are in an area with an Environmental Significant Overlay (ESO – schedule 3). The purpose of the Environmental Significance Overlay is to identify areas where the development of land may be affected by environmental constraints and to ensure that development is compatible with identified environmental values.

The statement of environmental significance specified at schedule 3 within the Indigo Planning Scheme states the north eastern section of the Ovens River Basin includes a number of smaller water courses which drain directly to the Murray River upstream of Lake Mulwala including the Black Dog Creek, located to the south and southeast of the Site. The Black Dog Creek Waterway Management District displays a number of significant drainage problems and the environmental objective is to maintain the quality and flow of water within the catchment.

The Study Area comprises two Heritage Overlays to the north of the Site including Barnawartha House, Gehrig's Winery (HO4) and The Hermitage (HO5). Refer to the Heritage Due Diligence Assessment - Revision 3, March 2022, Aurecon for further details.

Numerous waterways traverse the surrounding landscape including the Murray River to the north and Indigo Creek to the west, which comprise sites of Aboriginal cultural heritage sensitivity. Refer to the Heritage Due Diligence Assessment - Revision 0, 2021-12-01, Aurecon for further details.

The Significant Landscape Overlay (SLO) applies to the south, outside of the Study Area within the hill range including Mount Lady Franklin. Views of this range from the surrounding areas, contribute to the landscape character of the Site.

Other nearby Planning overlay are shown in Table 3.4 and mapped in Figure 3.2.

Table 3.4 Planning overlays

PLANNING CODE	Components
ESO3: Environmental significant overlay	Black Dog Creek Catchment
HO: Heritage Overlay	Barnawartha House and The Hermitage (HO4 & HO5 respectively– refer)
DDO: Design Development Overlay	Logic Centre
Aboriginal Cultural Heritage Sensitivity	Murray River, Indigo Creek and tributary near to Wodonga TAFE

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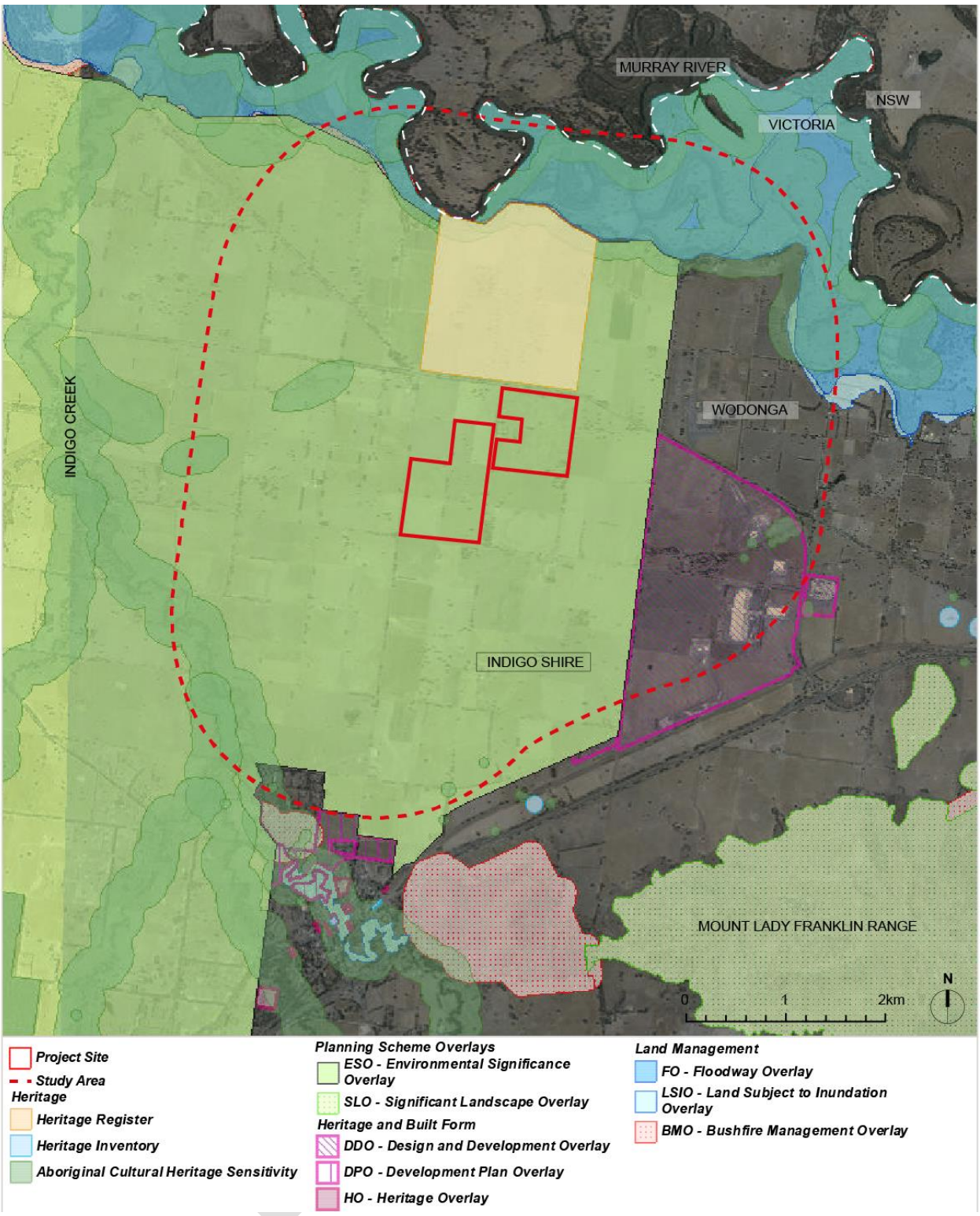

Figure 3.2Planning overlays (image: DELWP VicMap)

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4 Site context and appraisal

4.1 Site context

The Site is located approximately 4 km north of Barnawartha, within the Indigo Shire Council catchment, in the upper Murray Valley.

4.1.1 Overview

The following section provides a brief description of the existing conditions, associated land uses and key landscape features surrounding the Site.

Land Use

Land use in the surrounding area predominantly consists of agricultural land, with the Site currently used for small scale grazing (Figure 4.1 -  **Figure 4.2**).

The Northern Victoria Livestock Exchange (NVLX) is located to the northeast of the Site, on Murray Valley Highway and is the largest cattle selling center in Victoria[1] (Figure 4.3). The region is known for cattle breeding and grazing.

The nearby Logic Centre (a national freight distribution hub) is located a short distance to the east of the Project (Figure 4.5). This comprises large warehouses which are used as a logistic hub for large supply stores, strategically located off the Hume Freeway with access to Sydney, Canberra and Melbourne; and the Sydney-Melbourne rail line. This industrial estate is frequented by B-double trucks. The Wodonga TAFE's Logic Campus provides short courses for local employment including agriculture and horticulture, traffic control, transport licensing, warehousing and logistics, safety, first aid and hospitality[2].

The centre is expected to be a catalyst for the revitalisation of the township by providing a major regional employment node. Commercial development is commensurate with the relatively small township size and role Barnawartha plays as a commuter settlement to Albury-Wodonga.

The Shire's rural areas are a valued natural and community resource. They underpin the Shire's economy through a mix of agricultural production, various densities of rural residential activity and tourism and they contain abundant and significant environmental and landscape value.

The Murray Valley Highway is an east-west arterial road, in close alignment to the Murray River and connects Rutherglen (west) to Wodonga (east), joining to the Hume Freeway.

[1] https://rlx.com.au/sites/nvlx-northern-victoria-livestock-exchange/

[2] https://www.wodongaTAFE.edu.au/Portals/0/_MKT_NOV%20DEC%20SC%20BM%20ad%20T44_191021.pdf

The closest residential land uses are located 4 km to the south in the Barnawartha township (Figure 4.4).

A gas scraper station (gas pipeline surface facility[3]) is located on Barnawartha-Howlong Road, approximately 2km south of the Site (Figure 4.6).

Figure 4.1 Farming infrastructure

Figure 4.2 Rural pasture

Figure 4.3 Northern Victoria Livestock Exchange on Murray Valley Highway

Figure 4.4 Residential housing to the north of Barnawartha

Figure 4.5 Logic industrial estate

Figure 4.6 APA scraping station on Barnawartha-Howlong Road

Topography, landform and waterways

The Study Area is on a flat plain at approximately 160m Australian Heigh Datum (AHD). The land falls slightly to the north where the Murray River curves around a wide river plain. The Indigo Creek flows north to the west of the site. There are no tributaries with the Site, only a small farm dam.

[3] https://www.apa.com.au/about-apa/our-projects/western-slopes-pipeline/project-overview/

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The Hermitage (see Cultural Heritage) is located on a small hill to the north of the Study Area.

A steep range is located approximately 3.5km to the southeast, up to 480 AHD at Mount Lady Franklin and 360 m AHD at Barnawartha Scenic Reserve. This range joins with Hunchback Hill to the south of Wodonga. It provides a significant landscape feature in the setting, noticeable from far away. Conversely the hills offer vantage points with far views to the surrounding area, although there are no current designated viewing areas. Public access to the Barnawartha Scenic Reserve is via gated tracks, suitable for walking, mountain biking or four-wheel drive. (see Figure 4.7 - Figure 4.8).

Figure 4.7 View south towards Mount Lady Franklin and Barnawartha Scenic Reserve from Baxter-Whelans Road

Figure 4.8 View from Barnawartha Scenic Reserve looking northwest towards Site

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Figure 4.9 Topography and hydrology plan – Project site in red outline (image: mapshare.vic.gov.au)

Vegetation

The Site is within the Victorian Riverina Bioregion. Ecological Vegetation Class (EVC) indigenous to this bioregion is Plains Grassy Woodland (EVC 55_61), which is an open, eucalypt woodland on well-drained, flat or gently undulating plains.

The Study Area has been subject to a high level of past disturbance due to practice of cropping and grazing by stock, with only small patches and scattered trees within the Site which are located mostly to the perimeter of paddocks (see Figure 4.10 Figure 4.13).

Tree plantings identified in the *Flora and Fauna Assessment and Net Loss Reporting - Barnawartha North Solar Farm* include non-indigenous native trees such as River Red Gum (*Eucalyptus camaldulensis*) and Red Ironbark (*Eucalyptus sideroxylon*), and the indigenous species Red Box (*Eucalyptus polyanthemos*) and Yellow Box (*Eucalyptus melliodora*).

The agricultural paddocks contain a variety of exotic grasses including barley and rye.

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Figure 4.10 Row trees to edge of roads (within south Site) and grass crops within paddock

Figure 4.11 Scattered native trees within northeast Site

Figure 4.12 Row trees to edge of Hermitage Road and grass crops within paddock

Figure 4.13 Scattered native trees within Site

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Cultural Heritage

The Site does not intersect with an area of Aboriginal Cultural Heritage Sensitivity. As indicated in Figure 3.2 Planning overlays (image: DELWP VicMap) areas of Aboriginal cultural sensitivity are located to the west along Indigo Creek and to the north along the Murray River. Scarred trees are the second most frequent Aboriginal place type in the area, and there is potential for unrecorded scarred trees to be present within the Site.

A summary of findings from the Victorian Heritage Register (VHR), includes the following.

- There is one VHR listed heritage place, The Hermitage (HO5 Indigo Planning Scheme / H279 Victorian Heritage Register), situated approximately 1km north of the Site (2132 Murray Valley Highway, Barnawartha - see Figure 4.14 -Figure 4.15). It comprises a farmhouse constructed 1856 by one of the first settlers in the Ovens district. It is of architectural, historical and scientific (horticultural) significance to the State of Victoria. This is enhanced by its rough form, the use of local granite, and its sympathy with the natural environment[4].
- Barnawartha House, Gehrig's Winery Barnwartha (HO4) is listed under the Indigo Shire Planning Scheme. The vineyard with a stone and brick cottage is located 1.7km northwest of the Site and was established in 1858. Barnawartha House is a substantial red brick house with a three storey brick tower built 1867-1870. To the south of house are remnant early plantings including one remaining Bunya pine near the front gate. The winery is still owned by Gehrig family members[5].

Figure 4.14 The Hermitage (HO5) (image: Heritage Council Victoria 2008)

Figure 4.15 Small hill location of The Hermitage (HO5)

Figure 4.16 Gehrig's Winery, Barnawartha House HO4
(image: ISC – Heritage Study 2002)

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[4] https://vhd.heritagecouncil.vic.gov.au/places/89#statement-significance

[5] Indigo Shire Council – Heritage Study 2002, Volume 2 (July 2018)

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5 Project Description

5.1 Overview

The Project is located 4 km north of Barnawartha on land currently used for grazing. The proposed site layout plan is shown in Figure 5.6. The Site is comprised of two diagonally adjacent properties totalling 131.75 hectares, located at:

- Site 1 (eastern site): 49 Hermitage Rd, Barnawartha; and
- Site 2 (western site) Hermitage Rd, Barnawartha.

Construction is estimated to extend over a 12-18 month period, with an operation life of approximately 25 years.

5.2 Project components

Table 5.1 outlines the key project components of the Proposal. The key aspects of the Proposal relevant to landscape and visual include:

- A ~64 MW AC Solar Energy and Energy Storage Facility and ancillary uses;
- A Utility Installation (64 MW battery storage, underground cabling, inverters, substations) primarily consisting of;
  - No. 148,000 solar panels of 600W each;
  - Panels will be fitted on a single axis tracker system moving east to west during the day. All mounting will be pile driven and thus reducing the need for concrete; and
  - No. of Inverters confirmed during grid connection process.
- 2.9 km of overhead lines connecting (utilising an existing AusNet easement) to the Substation to the east for connection into the Electricity Grid;
- Associated buildings and works (access tracks, construction compounds, worker office & amenities buildings);

The scope of works requiring approval includes the following project elements:

- Business identification signage;
- Security and safety fencing;
- Site parking, internal access roads and drainage;
- Temporary construction compound and lay down area; and
- Removal of Native (and non-native) vegetation.

Table 5.1 Project components

Component	Description	Indicative scale (w x h x d) m
Solar Panels	Photovoltaic panel mounted on tracking system, facing east/west and located in rows running north-south. Refer Figure 5.1 - Figure 5.2	1.13 x 2.09 m, standing up to maximum 4.7m height
PV Inverters	Contained in housing (description above) – see Figure 5.3	4.32 x 2.25 x 1.02 m
Battery storage	Fluence GridStack or other similar storage (i.e. Tesla, CATL) – Located near to PV panel rows	Up to 2.57 x 2.54 x 2.16m
Substation	Located to the west of Hermitage Road, approximately 100m north of Baxter-Whelan Road – see Figure 5.4, layout and elevation is provided in Appendix C.	Transformers approx. 4m *h*, up to 13m *h*
Ancillary buildings	Ancillary buildings including: Operations and Maintenance (O&M) building, switch room and building/facility. Building	O&M building up to 3.01m *h*

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	colour in environmental green colorbond cladding (see Figure 5.5 and Appendix C.), located adjacent substation.	Switch room up to 4.2m *h* Warehouse building up to 12 x 5.1m x 15m
Storage Containers	Housing for inverters, electrical switch gear & NSP equipment and substation. Building colour in environmental green, located adjacent substation	Up to 12.2 x 2.6 x 2.44 m
Security fence	Wire mesh security fencing to site perimeter	2.4m h
Site signage	Identification sign and water tank directional sign to southern site entrance and northern site entrance	1.5 x 2 m

Figures 5.1 to 5.5 provide indicative illustrations of the Project components.

Figure 5.1 Solar panels (image: nextracker.com)

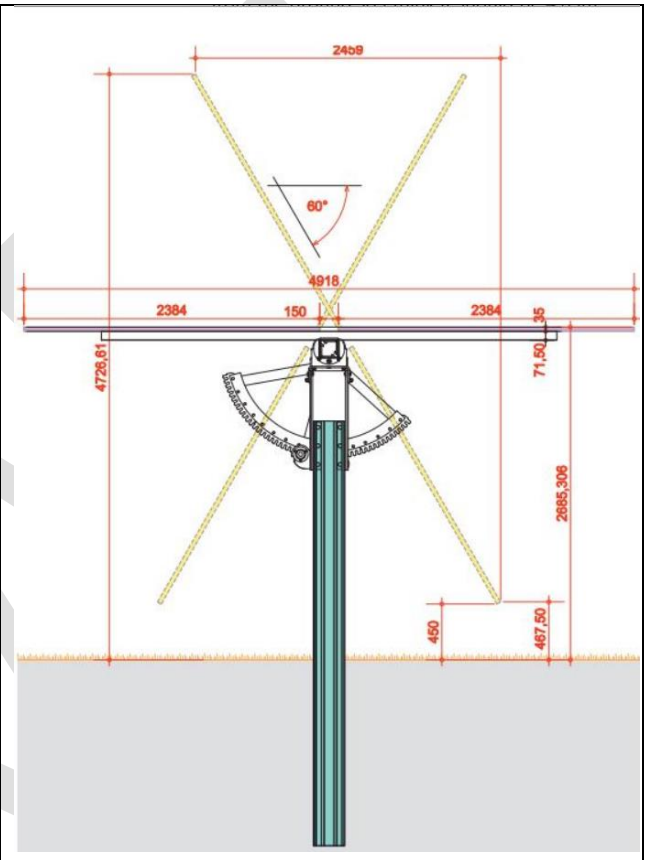

Figure 5.2 Solar panel on tracker indicative dimensions

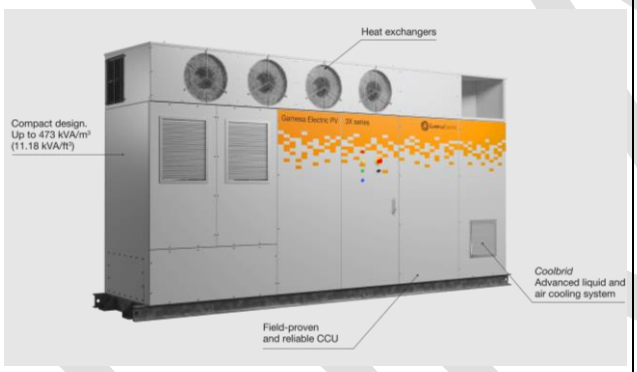

Figure 5.3 PV inverters (image: GamesaElectric.com)

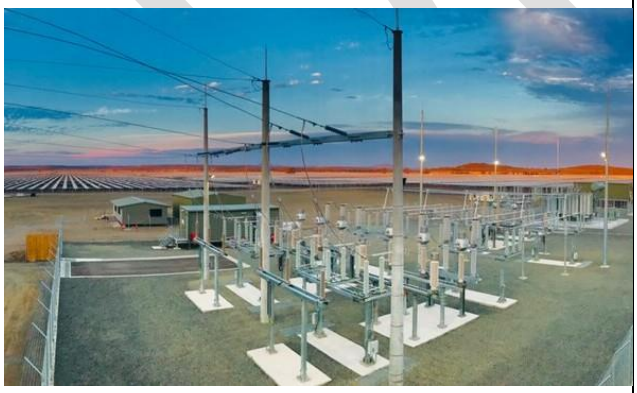

Figure 5.4 Example substation (image: Yarranlea Solar Farm, energymagazine.com.au)

Figure 5.5 Example ancillary warehouse

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5.3 Construction

Methodology, program and timing of the construction works are currently indicative and dependent upon planning approvals. Consequently, construction impacts have not been assessed in this report.

It is anticipated that the construction activities will take place over a 12 – 18 month timeframe and occur over two main phases:

- Site pioneering and civil works:
  - Site clearing, fencing and establishment of laydown area;
  - General earthworks, storage and removal of spoil (including the treatment of contaminated soil, where required); and
  - site benching, access roads and drainage.
- Energy installation and other works:
  - Installation of solar panels, trackers, inverters and associated infrastructure;
  - Construction of transmission connection; and
  - Testing and commissioning.
- Site access for construction and operation is proposed to occur on Hermitage Road via Baxter-Whelans Road, with an alternative access point 30m south of Murray Valley Highway and Coyles Road intersection.

5.4 Landscape screening

As indicated in Appendix D Landscape Mitigation Plan, there is additional landscaping to the southern perimeter of the Site to provide visual screening and replacement of removed trees. The Site Layout was adjusted to allow this screen planting to the southern perimeter of the Site, providing screening between residential receptors on Baxter-Whelans Road and Project elements.

The proposed Landscape Mitigation Plan has been considered in the assessment of residual impacts at 10 year maturity.

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B400
Murray Valley Hwy
Barnawartha-Howlong Rd
Coyles Rd
Baxter Whelans Rd
REFER NOTE 6
ALTERNATE ACCESS POINT NOTE 8
REFER NOTE 4
PRIMARY ACCESS POINT NOTE 11
WATER TANK
CFA WATER DIRECTION SIGN
BUSINESS SIGNS
MV CONNECTING CABLE NOTE 9
REFER NOTE 2
REFER NOTE 5
REFER NOTE 3
ALTERNATE ACCESS POINT
SUBSTATION, SWITCHROOM AND BUILDING FACILITY AREA. REFER NOTE 7.
REFER NOTE 10
N
General Notes
1. BASIC INDICATIVE LAYOUT DESIGN. FOR PLANNING SUBMISSION ONLY. NOT FOR CONSTRUCTION OR CALCULATION PURPOSES, DESIGN IS NOT FINALISED. SOURCE DRAWING IS BARNSF-ON-LAY-0219.
2. GAS PIPELINE AND COMMS EASEMENT (NOT TO SCALE). ENSURE ADEQUATE STANDOFF OF FENCE AND PERIMETER ROAD.
3. 30M OFFSET FROM PROJECT LANDOWNER PROPERTY BDRY TO SOLAR PANELS INC VEGETATION SCREENING.
4. 30M OFFSET FROM SOLAR PANEL TO NEIGHBOURING PROP BDRY.
5. 30M OFFSET FROM SOLAR PANEL TO NEIGHBOURING PROP BDRY INC VEGETATION SCREENING.
6. RETAINED TREES AREA.
7. APPROX 100 X 50M AREA RESERVED FOR SUBSTATION AND BUILDINGS. REFER TO DWG BARNSF-ON-GAD-0209 FOR INDICATIVE LAYOUT WITHIN.
8. ALT ENTRY TO BE > 30M SOUTH OF MURRAY VALLEY HWY COYLES RD INTERSECTION.
9. CONNECTING CABLE TO BE BORED UNDER HERMITAGE RD.
10. EXISTING AUSNET OHL TO AUSNET OHLS OF BAXTER-WHELANS RD. REFER TO SHEET 2
11. 1 X 45,000L WATER TANK TO BE LOCATED CLOSE TO GATE INSIDE EACH SITE PRIMARY ACCESS POINT. EACH PRIMARY ACCESS POINT TO HAVE BUSINESS IDENTIFICATION SIGN AND CFA WATER TANK DIRECTION SIGN ON OR NEAR GATE FACING OUTWARDS (REF BARNSES-ON-GAD-0228).
12. INTERNAL ROADS 4M. PERIMETER FIRE BREAK 10M INC ROAD.
13. INDICATIVE DESIGN SPECS:
13.1. LOCATION: BARNAWARTHA, VICTORIA, AUSTRALIA
13.2. UTM CONVERGENCE: 0.1821°
13.3. ALTITUDE: 162.11 M
13.4. USABLE AREA: 128.93 HA
13.5. PERIMETER FENCE: 7.37 KM
13.6. RATED POWER @ POC: 64MW
13.7. BATTERY CAPACITY: TBC. INDICATIVE 64-192MWH. LOCATION: DISPERSED, NEXT TO PCU.
LEGEND:
Project area
1 Original
2 Addressed DELWP RFIs
No. Revision/Issue Date
WIRSOL
Wirsol Energy
201/39 East Esplanade, Manly, NSW, Australia, 2095
ARP Solar
BARNAWARTHA SOLAR FARM
INTERSECTION HERMITAGE RD AND BAXTER-WHELANS RD, BARNAWARTHA, VICTORIA AUSTRALIA 3688
1 of 2

Figure 5.6 Proposed overall site layout (page 1 of 2)

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Figure 5.7 Proposed overall site layout (page 2 of 2)

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6 Landscape Character

6.1 Landscape Character Types

Landscape Character Types (LCT) help to identify unifying aspects of the landscape and distinguish why one landscape is visually distinct from another. The character zones have been determined through a desktop assessment and confirmed through a site visit, determining that the Project is likely to be noticeable only within a two kilometre radius of the Site boundary. Each character type identified is based on the consideration of the following attributes:

- landscape value, i.e. landscape designated for their scenic or landscape importance or valued recreational function;
- landscape elements that contribute to defining character, i.e. residential, commercial and landform;
- landscape character attributes, including scale, grain, perceptual characteristics such as connection to natural landscape, industrial nature of the area;
- observed land uses and current and future land use zones outlined in strategic planning documents and Local Environmental Plans; and
- topography and vegetation.

The LCTs identified within the Study Area are shown in Figure 6.1 and include LCT 1 – Rural landscape and LCT 2 – Industrial, as described in the following sections. Roads are assumed to take on the character of adjacent LCTs. Residential areas to the south of the Site are not expected to be influenced by the Project.

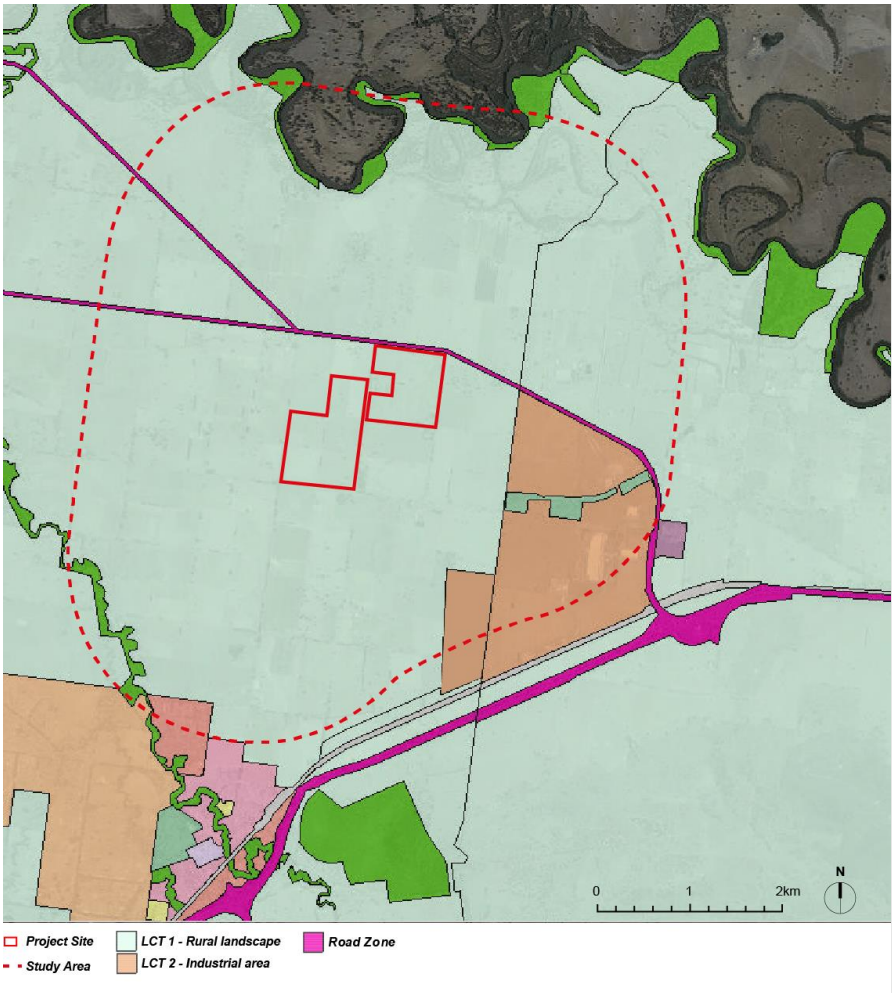

Figure 6.1 Landscape Character Types within Study Area

6.1.1 LCT 1: Rural landscape

It is a rural landscape within and surrounding the Study Area with flat topography. There is a small hill to the north of the Study Area, as well as a range of steep hills including Mound Lady Franklin, to the south east, which form a backdrop to the landscape. There is a small ephemeral waterway to the southeast of the Study Area and Indigo Creek to the southwest. Other water bodies include man-made farm dams and reservoirs in the surrounding landscape.

There are large paddocks used for cattle or sheep grazing and crops. Supporting farm infrastructure includes fencing, sheds, grain silos and machinery. There are rural residential dwellings spotted around the area.

There are scattered native trees and exotic hedgerows. Trees are typically located to the perimeter of paddocks and within road reserves.

Murray Valley Highway is a two laned road, traverses through the Study Area which comprises of both LCT 1 and LCT 2.

Key characteristics:

- Large paddocks with grass or crops;
- Includes scattered residential dwellings and ancillary farm buildings at low densities;
- Views towards the hill range including Mount Lady Franklin and Hunchback Hill;
- Predominately native trees scattered throughout the area, mostly located to the edges of paddocks and parallel to roads. Some exotic tree species used for windows; and
- The landscape often appears as a patchwork of different colours and textures, dependent upon the nature of the farming occurring within any given area and the time of year.

Figure 6.2 LCZ 2: Rural landscape including crops and grassed paddocks, and scattered trees

6.1.2 LCT 2: Industrial

Land zoned industrial is located to the east of the Study Area. This is within the Logic Centre, a transport logistics hub and TAFE, with large warehouses. There are attractive vegetation-lined wide roads with a boulevard to the main entry road. Wide roads cater for the large B-double trucks accessing the warehouses. There are large paved car and truck parking areas surround the buildings. The Site has some influence by industrial uses to the east given its close proximity.

A TAFE campus is also located within this area (see Land Use). The industrial estate is a new with many lots undeveloped.

Key characteristics:

- Large compounds including numerous large sheds for logistics and processing; and
- Wide formal roads.

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Figure 6.3 LCZ 2: Logic centre industrial estate, Logic Boulevard

6.2 Absorptive capability of the Landscape Character Type

The ability of the landscape types to absorb changes has been assessed and is outlined in Table 6.1.

Table 6.1 LCT absorptive capability

Landscape Type	Ability to absorb change	Comments
LCT 1: Rural landscape	Moderate	The rural landscape is modified, containing and surrounded by bulky elements that lessen the sensitivity and provide capacity to absorb further changes.
LCT 1: Industrial area	High	The scale and type of existing warehousing infrastructure has a large influence and provides capacity to absorb further changes.

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7 Visual Appraisal

7.1 Visibility of the Proposal

The assessment of the visual impact has been based on the sensitivity of the view and the degree of modification or changes to the view as part of the proposal at the operational phase. The following section outlines the impact assessment on the visual components at operation of the Proposal.

7.1.1 Detailed assessment of representative viewpoints

A total of seven representative viewpoints were identified for the Proposal based on receptors with the potential of viewing the Project, the design, viewing distance and aspect. The viewpoints are representative of the worst-case scenario view. The locations of the assessed viewpoints are shown in Figure 7.1.

There were no viewpoints within the Study Area that are designated or significant viewpoints.

The details of viewpoint assessments including photographs of their existing conditions can be found in the following section.

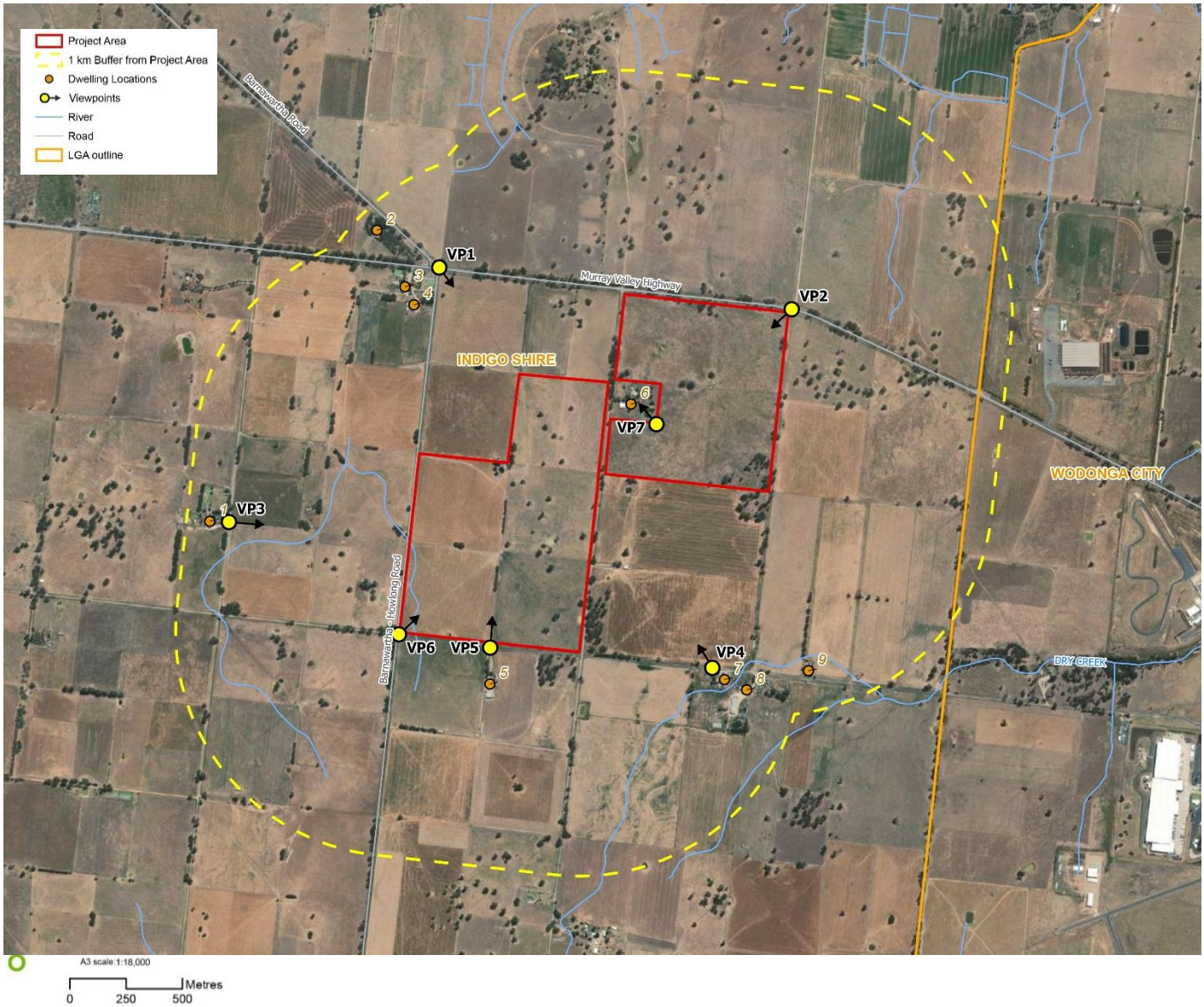

Figure 7.1 Viewpoint assessment locations

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VIEWPOINT 01

Viewing location	The viewpoint is located near to the intersection of Barnawartha Road (C378) and Barnawartha-Howlong Road, with Murray Valley Highway. It is looking southeast towards the Site.		
Existing setting	The viewpoint (refer to Figure 7.2) is representative of residential dwellings (see Figure 7.1 #2,3,4) located to the west of the intersection. These dwellings have trees within the property to the east, screening views in the direction of the Project. The foreground view looks out onto the busy road, with regular truck and car traffic. The middleground view comprises fenced grassed paddocks, with trees to the edge of the roads. Scattered trees are visible in the background with Mount Lady Franklin rising above. The range contains scattered native vegetation and is a steep and dramatic contrast to the foreground plains.		
Viewing context	Duration of view: static	Viewing angle: perpendicular	
Visual Sensitivity Level	**MODERATE**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Residential	Landscape Type	LCT 1 Rural landscape
Viewing distance (m)	Foreground (approx. 400m from closest project component)		
Viewer sensitivity level	**High**	Absorptive ability	**Moderate**
Visual Modification Level	**LOW**		
Viewpoint discussion	From this viewpoint, solar panels and some ancillary infrastructure would be noticeable in the middleground. As the height of these are up to 4.7m, with a grassed surface beneath and in the foreground, the Project would result in a barely perceptible visual change results and a small change to the existing landscape setting, resulting in a minor deterioration to the view for residents and road users.		
Construction Visual Impact	**LOW** Site establishment, installation works and construction traffic during construction would be noticeable to residents. The works are considered commensurate with intensive farm activity such as ploughing or cropping, that would occur a few times a year. The visual impact during construction would result in a low adverse visual impact.		
Operational Visual Impact	**LOW** Consequently, the moderate level of visual sensitivity combined with the low degree of modification, would result in a low adverse visual impact at operation for nearby residents.		
Residual Visual Impact	**LOW** No landscape mitigation is proposed to the northern side of the Site, therefore there is no visible change expected from Year 1.		

Figure 7.2 Viewpoint 1: Existing view from Murray Valley Highway, looking southeast towards the Site (red line indicative of the Project location)

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VIEWPOINT 02

Viewing location	From Murray Valley Road/ Coyles Road, looking southwest towards the Site		
Existing setting	The viewpoint as seen in Figure 7.3, is experienced by motorists travelling along Murray Valley Highway. Rural paddocks are located parallel to the road, with grass/crops enclosed in farm fencing. There are tall native trees to the edge of the road in the foreground and the paddock is framed by trees. The landscape to the southwest is flat so the background views are screened by the trees on the horizon. The beginning of the Mount Lady Franklin (range) is visible in the background to the south (far left of image).		
Viewing context	Duration of view dynamic (moving view)	Viewing angle: parallel	
Visual Sensitivity Level	**LOW**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Arterial Road	Landscape Type	LCT 1 Rural landscape
Viewing distance (m)	Foreground (approx. 100 metres from closest project component)		
Viewer sensitivity level	**Moderate**	Absorptive ability	**Moderate**
Visual Modification Level	**MODERATE**		
Viewpoint discussion	Rows of PV panels will be visible from the Murray Valley Highway, located within the paddock in the foreground. The panels will have grass beneath and the area will remain to be grazed by sheep. The height of the panels, though up to 4.7m are likely to screen trees visible on the horizon line. The introduction of a large number of panels will provide a noticeable compositional change to the existing landscape setting, resulting in a minor deterioration to the view for the road users.		
Construction Visual Impact	**LOW** Site establishment including some tree removals and installation works during construction would be briefly noticeable to motorists. The works would be commensurate with intensive farm activity such as ploughing or cropping, that would occur a few times a year. The level of modification is considered moderate, resulting in a low adverse visual impact.		
Operational Visual Impact	**LOW** The low level of visual sensitivity combined with the moderate degree of modification, would result in a low adverse visual impact at operation for road users along Murray Valley Highway.		
Residual Visual Impact	**LOW** No landscape mitigation is proposed to the northern side of the Site, therefore there is no visible change expected from Year 1.		

Figure 7.3 Existing view from Murray Valley Highway/Cowes Road looking south-west towards the Site (red line indicative of the Project location)

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VIEWPOINT 03

Viewing location	From Bay Road, looking east towards the Site		
Existing setting	The viewpoint is representative of a residential dwelling on Bay Road (refer to Figure 7.4 - #1). The dwelling has trees within the property to the east and a dense hedgerow to the south, screening views in the direction of the Project. The foreground view looks out onto the gravel road, used mostly by local traffic. The middleground view comprises fenced grassed/crop paddocks, with trees on the horizon. Scattered trees are visible in the background with Mount Lady Franklin rising above. The range contains scattered native vegetation and is a steep and dramatic contrast to the foreground plains.		
Viewing context	Duration of view: static	Viewing angle: perpendicular	

Visual Sensitivity Level	**LOW**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Residential	Landscape Type	LCT 1 Rural landscape
Viewing distance (m)	Middleground (approx. 850 metres from closest project component)		
Viewer sensitivity level	**Moderate**	Absorptive ability	**Moderate**

Visual Modification Level	**NEGLIGIBLE**
Viewpoint discussion	Taller Project components including warehouse buildings are considered commensurate in scale and appearance with other farm infrastructure such as sheds. PV panels and ancillary structures are at a distance that would not render them perceptible from this viewpoint.
Construction Visual Impact	**NEGLIGIBLE** Construction activity is not expected to be visible from this distance with intervening vegetation, resulting in a negligible visual impact.
Operational Visual Impact	**NEGLIGIBLE** The very low level of visual sensitivity combined with the negligible degree of modification, would result in a negligible impact at operation for residents from this viewpoint.
Residual Visual Impact	**NEGLIGIBLE** No visible change.

Figure 7.4 Existing view from Bay Road, west of the Site (red line indicative of the Project location)

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VIEWPOINT 04

Viewing location	From Baxter-Whelans Road, looking northwest and north towards the Site		
Existing setting	The viewpoint is representative of three residential dwellings on Baxter-Whelans Road (refer Figure 7.5 #7, 8 and 9). These dwellings have vegetation within the property that partially screens north views, in the direction of the Project. The houses have farm sheds located in close proximity to the dwellings. The foreground view looks out onto the paved road, with a wide grassed/gravel road reserve. There are occasional large native trees to both sides of the road. The road joins Logic Boulevards where road users can access the Logic Centre. The foreground to middleground view comprises fenced grassed/crop paddocks, with trees on the horizon. The landscape is flat with no distinguishable features, except for an open rural landscape and big skies.		
Viewing context	Duration of view: static	Angle of view: perpendicular	
Visual Sensitivity Level	**MODERATE**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Residential	Landscape Type	LCT 1 Rural landscape
Viewing distance (m)	Middleground (approx. 550 m from closest project component)		
Viewer sensitivity level	**High**	Absorptive ability	**Moderate**
Visual Modification Level	**MODERATE**		
Viewpoint discussion	From this viewpoint Site 1 will be visible to the north, to the far side of the paddock, comprising rows of PV panels which will be barely perceptible, with some intervening vegetation retained. Site 2 will be visible in the foreground to the northwest (left), including PV panels up to 4.7m high, the substation, ancillary buildings. The ancillary buildings are considered commensurate in scale and appearance with other farm infrastructure such as sheds in the near vicinity of the viewpoint, with the substation introducing a more industrial appearance. The Project will appear expansive from the angle of this viewpoint and introduce low built components which provide a moderate deterioration to the existing setting.		
Construction Visual Impact	**MODERATE** Site establishment including some tree removals and installation works during construction would be barely noticeable for up to 12-18 months by residents. The works would be commensurate with intensive farm activity such as ploughing or cropping, that would occur a few times a year. The level of modification is considered moderate, resulting in a moderate adverse visual impact.		
Operational Visual Impact	**MODERATE** Consequently, the moderate level of visual sensitivity combined with the moderate degree of modification, would result in a moderate adverse visual impact at operation for nearby residents.		
Residual Visual Impact	**LOW** Landscape screen planting to the Site's southern boundary (see Appendix D), would assist in screening views of PV panels and therefore reduce the level of visual impact.		

Figure 7.5 Baxter-Whelans Road looking north towards the Site (red lines indicative of the Project location)

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VIEWPOINT 05

Viewing location	From the driveway of 375 Baxter-Whelans Road, looking north towards the Site		
Existing setting	The viewpoint is representative of the view from a residential dwelling, which is set approximately 150m south of the road (refer to Figure 7.6, #5). The single-storey dwelling has trees located to the north and within the driveway, partially screening north views, in the direction of the Project. Land and views surrounding the dwelling comprises flat agricultural farming land in the foreground, with low crops. Baxter-Whelans road is a straight paved road used by local traffic and users of the Logic Centre, including heavier trucks. The foreground to middleground view comprises fenced grassed/crop paddocks, with trees on the horizon. The landscape is flat with no distinguishable features, except for an open rural landscape and big skies.		
Viewing context	Duration of view: static	Angle of view: perpendicular	
Visual Sensitivity Level	**MODERATE**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Residential	Landscape Type	LCT 1 Rural landscape
Viewing distance (m)	Foreground (approx. 50m from closest project component)		
Viewer sensitivity level	**High**	Absorptive ability	**Moderate**
Visual Modification Level	**MODERATE**		
Viewpoint discussion	Site 2 will be visible to the north, with proposed rows of PV panels located in the foreground paddock, clearly visible at a height of up to 4.7m. The substation and warehouse buildings will appear over the PV panels in the middleground, with buildings up to 5m and a transformer tower at 13m height. Substation and buildings are not expected to contrast vastly to other farm infrastructure such as sheds, or powerlines that are in near vicinity of the viewpoint, are therefore considered commensurate in scale and appearance. The Project introduces built structures at a height of up to 4.7m, in paddocks containing crops and some scattered trees. This would provide some deterioration to the existing foreground landscape setting for existing residents experiencing the view.		
Construction Visual Impact	**MODERATE** Site establishment including some tree removals and installation works during construction would be noticeable for up to 18 months by residents. The works include PV panel, ancillary structures, perimeter fencing installation and an increase in construction traffic. This is considered commensurate with the scale of intensive farm activity such as ploughing or cropping, that occurs a few times a year. The level of modification is considered moderate, resulting in a moderate adverse visual impact.		
Operational Visual Impact	**MODERATE** The introduction of PV panels in the foreground view would result in moderate degree of modification. Consequently, combined with the moderate level of visual sensitivity, results in a moderate adverse visual impact at operation for nearby residents.		
Residual Visual Impact	**LOW** Landscape screen planting to the Site's southern boundary (see Appendix D), would assist in screening views of PV panels and therefore reduce the level of visual impact.		

Figure 7.6 235 Baxter-Whelan Road looking north towards the Site (red line indicative of the Project location)
image: Google street view

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VIEWPOINT 06

Viewing location	The viewpoint is located near to the intersection of Barnawartha-Howlong Road, with Baxter-Whelans Road. It is looking northwest towards the Site.		
Existing setting	The viewpoint (refer to Figure 7.7) is representative of the view experienced by road users on Barnawartha-Howlong Road. The foreground view looks out onto the arterial road, with a local road to the east. The middleground view comprises fenced grassed paddocks, with trees to the edge of the roads. Scattered trees are visible in the background with very low topographical change.		
Viewing context	Duration of view: dynamic	Viewing angle: perpendicular	
Visual Sensitivity Level	**LOW**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Rural road (sealed)	Landscape Type	LCT 1 Rural landscape
Viewing distance (m)	Foreground (approx. 50 metres from closest project component)		
Viewer sensitivity level	**Moderate**	Absorptive ability	**Moderate**
Visual Modification Level	**MODERATE**		
Viewpoint discussion	From this viewpoint, solar panels would be noticeable in the foreground. As the height of these are up to 4.7m, with a grassed surface beneath and in the foreground, the Project would result in a noticeable visual change to the existing landscape setting, resulting in a moderate deterioration to the view for road users.		
Construction Visual Impact	**LOW** Site establishment, installation works and construction traffic during construction would be noticeable to road users. The works are considered commensurate with intensive farm activity such as ploughing or cropping, that would occur a few times a year. The visual impact during construction would result in a low adverse visual impact.		
Operational Visual Impact	**LOW** Consequently, the low level of visual sensitivity combined with the moderate degree of modification, would result in a low adverse visual impact at operation for road users.		
Residual Visual Impact	**LOW** Landscape screen planting to the Site's southern perimeter (see Appendix D), would be visible however there is no screen planting proposed to the western boundary in the direction where motorists would view the Project, thus no reduction in visual impact is experienced.		

Figure 7.7 Corner of Barnawartha-Howlong Road with Baxter-Whelans Road looking northeast towards the Site (red line indicative of the Project location)

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VIEWPOINT 07

Viewing location	The viewpoint is located near to the residential property at 49 Hermitage Road, understood to be resided in or managed by the landowner of the Site, which surrounds the property. This landowner is associated with the Project and would not normally be considered as part of this assessment, however, has been included in this assessment at DELWP's request (pre application meeting).		
Existing setting	The viewpoint (refer to Figure 7.8, #6) is of the residential property on Hermitage Road. The single-storey house is set amongst mature trees with foreground views of the farm dam, and views of open paddocks with scattered trees. It is located near to an old farm cottage and large shed south of the main residence. The property is the only house on Hermitage Road, a gravel single-laned road with mature native trees. Background views looking southeast, capture Lady Mount Franklin Range.		
Viewing context	Duration of view: static	Viewing angle: perpendicular	
Visual Sensitivity Level	**MODERATE**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Residential	Landscape Type	LCT 1 Rural landscape
Viewing distance (m)	Foreground (48 approx. 100 m from closest project component)		
Viewer sensitivity level	**High**	Absorptive ability	**Moderate**
Visual Modification Level	**HIGH**		
Viewpoint discussion	From this viewpoint, solar panels would be noticeable in the foreground, to all sides of the property. Views of the PV panels are likely through existing tall trees, with the height of these up to 4.7m and grassed surface beneath. Project components to the west including the substation, would be less visible due to further existing intervening vegetation screening and property structures. the Project would result in a noticeable visual change to the existing landscape setting, resulting in a high deterioration to the view for residents.		
Construction Visual Impact	**HIGH** Site establishment, installation works and construction traffic during construction would be noticeable and in close proximity to residents/landowners. The works are considered commensurate with intensive farm activity such as ploughing or cropping, that would occur a few times a year. The visual impact during construction would result in a high adverse visual impact.		
Operational Visual Impact	**HIGH** The moderate level of visual sensitivity combined with the high degree of modification, would result in a high adverse visual impact at operation for road users.		
Residual Visual Impact	**HIGH** There is no proposed landscape screen planting between this residential property and the Project components (see Appendix D), therefore visual impacts are not reduced.		

Figure 7.8 49 Hermitage Road

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7.2 Summary of findings

The following section provides a summary of the landscape and visual impact assessment at operation and the resulting residual impacts.

Table 7.1 Summary of visual impacts

Viewpoint no.	Description	Construction impacts	Operational impacts	Residual impacts
Viewpoint 01 (VP1)	Murray Valley Highway/Barnawartha Road, 400m northwest of the project site. Viewpoint is representative of that experienced by rural residential properties.	Low	Low	Low
Viewpoint 02 (VP2)	Murray Valley Highway/Coyles Road, approximately 100m north of the project site. Viewpoint is representative of that experienced by arterial road users.	Low	Low	Low
Viewpoint 03 (VP3)	Bay Road, approximately 850m west of the project Site. Viewpoint is representative of that experienced by a rural residential property.	Negligible	Negligible	Negligible
Viewpoint 04 (VP4)	Baxter-Whelans Road, 550m east of the project site entrance. Viewpoint is representative of that experienced by a rural residential property.	Moderate	Moderate	Low
Viewpoint 05 (VP5)	330 Baxter-Whelans Road, 50m south of the Project site. Viewpoint is representative of that experienced by a rural residential dwelling.	Moderate	Moderate	Low
Viewpoint 06 (VP6)	Corner of Barnawartha-Howlong Road with Baxter-Whelans Road, approximately 50m from the Project Site. Viewpoint is representative of that experienced by arterial road users.	Low	Low	Low
Viewpoint 07 (VP7)	49 Hermitage Road, approximately 100m from the Project Site. Viewpoint is representative of that experienced by Project-associated residential landowner	High	High	High

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8 Mitigation

The purpose of mitigation is to avoid, reduce or where possible remedy or offset any significant adverse effects on the environment arising from the proposed development. This section provides recommendations for mitigation and management measures to reduce potential landscape and visual impacts as a result of the Proposal during construction and operation. It is intended to provide a broad guideline for the next phase of design.

8.1 Construction phase mitigation

At the time of this report, construction elements have not been designed, therefore the below is a high-level approach to reduce the landscape and visual impacts of the Project on surrounding viewpoints, as well as its landscape setting based on construction access and construction compounds.

8.1.1 Built form

- Ancillary facilities are to be developed to minimise visual impacts for adjacent receptors;
- Storage areas and associated works are to be located in cleared or otherwise disturbed areas away from the road interface or near to residential receptors;
- Where feasible and reasonable, the elements within construction sites would be located to minimise visual impact, for example materials and machinery would not be visible above temporary screens;
- Site lighting is to be designed to minimise glare issues and light spillage into adjacent areas and generally consistent with the requirements of Australian Standard 4282-1997 Control of the obtrusive effects of outdoor lighting; and
- Fencing should be transparent security fencing with site signage concentrated to the site entry.

8.1.2 Vegetation and landscape

- Existing trees adjacent to the works will be retained and protected where possible to screen construction support sites, minimising clearing where possible;
- Where possible, trees will be trimmed rather than removed. Works would be carried out by a qualified arborist; and
- All areas disturbed by construction and not required for operation of the project are to be restored to existing condition.

8.2 Operational phase mitigation

The following mitigation measures are recommended operational elements for consideration to be integrated into the next phase of design to reduce the landscape and visual impacts of the Project on surrounding viewpoints, as well as its landscape setting.

8.2.1 Site selection

The principle consideration in mitigating potential landscape and visual impacts by a project during operation is through careful site selection.

The proposed location for the Project is separated from highly sensitive receptors such as general residential zones, is within a rural setting and is in close proximity to the existing Barnawartha substation.

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8.2.2 Built form

- Architectural materials - cladding, materials and colour used to mitigate appearance of bulky structures. 'Environmental Green' adopted for structures visible beneath the horizon, to blend with existing vegetation;
- Earthworks – use of landform to integrate the facility components into the surrounding landscape, including planted embankments for additional visual screening. This is subject to operational requirements and fire hazard offsets;
- Inspection and maintenance of security lighting direction to ensure it is directed to the worksite and away from neighbouring land uses; and
- Signage to place on existing or proposed fencing, located away from road interfaces to limit visual distraction of drivers. Where possible, group signage with existing signage to limit visual clutter.

8.2.3 Vegetation and landscape

New landscaping planting to the perimeter of the Site has the objective of minimising visual impacts of the proposal from adjacent properties. A landscape mitigation plan has been prepared (see Appendix D), with screening located to mitigate impacts from sensitive receptors to the sites' southern boundary. A mix of suitable native and indigenous species have been selected to provide screening.

A detailed landscape plan would be prepared prior to any works commencing that is compliant with CFA guidance. The detailed plan would further provide planting specifications, installation and a maintenance plan.

Country Fire Authority (CFA) recommendation is for perimeter vegetation to be kept to a minimum to address fire risk, however, acknowledges the existing vegetation to the northern boundary.

Specific species and placement will be determined through final detailed design and would be dependent on ensuring the planting achieves the intended screen outcome and does not compromise the performance of the system. Planted vegetation would be maintained for the operational period of the development, including replacement of any vegetation which does not survive.

Other planting considerations include the following:

- Early planting works are to be considered to provide a screening buffer that has time to mature before the project is fully operational;
- Placement of screen planting should be located to infill planting on the northern boundary and at key locations to screen Project components from sensitive receptors. This should consider CFA's preference for minimal planting but in optimum locations;
- Low level planting – vegetation to soften the appearance of the Project site wherever possible;
- Perimeter screening – a row of trees and shrubs placed to the property boundary, to assist in blending with the surrounding landscape and screening the Project from sensitive receivers; and
- Ensure planned replanting is protected and not impacted by operation activities, fauna species or other activities. Undertake regular inspections and maintenance of vegetation plantings and rehabilitation.
- Installation size of vegetation screening is dependent on availability. Typically smaller stock (tubestock) size is easier to establish, however installation of plants at 20 litres (around <1m tall depending on species), allow establishment of screening up to 2-3years earlier. The potential timing for screening to establish and begin to provide screening to Project elements are as follows:
  - 20L stock established at 3-5 years with vegetation at mature size around 10years
  - Tubestock established at 5 years with vegetation at mature size around 10-12years.

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9 Conclusion

The Project is located in an area subject to the planning scheme of Indigo Shire Council. There are no specific planning designations attributing any specific landscape or visual value within the Study Area. The proposed Barnawartha Solar Farm is set on land zoned farming, adjacent Murray Valley Highway.

The baseline assessment identified a total of two distinct Landscape Character Types (LCTs) within the Study Area, including:

- LCT 1: Rural landscape - modified environment with cultivated paddocks and farming infrastructure regularly spotted around the vast area, with a moderate absorptive capacity; and
- LCT 2: Industrial area - highly modified with built infrastructure such as large warehouses and car parking areas, with a high absorptive capacity. The Project is not expected to be visible from public areas within this LCT.

The Project is in close proximity to areas under City of Wodonga, in which there are significant landscape overlays of the hill range including Mount Lady Franklin, which contributes to the landscape character of the area.

Key Project components include PV panels, battery storage units and an onsite substation.

There are seven representative viewpoints identified within the Study Area that were assessed to determine visual impacts from surrounding receptors including residents and motorists. One viewpoint (VP7), is a property where the landowner is associated with the Project.

This report has assessed that where the Project is located in the foreground view a moderate adverse visual impact would be experienced during both construction and Year 1 of operation from residential dwellings to the south on Baxter-Whelans Road (VP4 and VP5), due to the proximity and open views experienced from these users of the construction and operational activities. The landowners property on Hermitage Road, viewpoint (VP7), experiences high adverse visual impacts where Project components are in the foreground surrounding the property.

The visual impact experienced during both construction and Year 1 of operation from nearby residential dwellings to the north along Murray Valley Highway/Barnawartha Road (VP1) and west along Bay Road (VP3) would experience a low adverse and negligible rating respectively. The dwellings have existing intervening vegetation and have nearby farm sheds, with which proposed building infrastructure is commensurate. The expanse of the solar panels, although noticeable, are a height at up to 4.7 meters, with views toward them interrupted by retained vegetation.

Although the Project would be visible by motorists travelling along Murray Valley Highway (VP2) and Barnawartha-Howlong Road (VP6), these are arterial and local roads with travelling speeds up to 100Km/hr and as such the road users experience is a short duration that is transient with glimpses between existing intervening vegetation. Consequently, a low adverse visual impact would be experienced during both construction and Year 1 of operation for these arterial road users.

The current site design has considered Project visibility from sensitive residential receptors to the south of the site on Baxter-Whelans Road. The location of Project components has been set back 35 metres from the road to allow space for landscape screening to the Sites southern boundary. This assists in screening views towards the Project, reducing visual impacts to low adverse at year 10 of operation for VP4 and VP5.

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Appendix A

Visual Prominence Rationale

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VISUAL PROMINENCE RATIONALE

The visual prominence of a development can be determined by understanding the extent to which an object is part of a viewer's static field of view.

The measurement of the field of view is based upon the parameters of human vision outlined below. These provide a basis for assessing and interpreting the visual prominence of a development by comparing the extent to which the development will intrude into the central field of vision (both horizontally and vertically).

These horizontal and vertical fields of view are also interlinked to the viewing distance from the development. The methodology is based on the reduction of the visibility of a development in the distance as the field of view reduces (i.e. the increase in distance between a given viewpoint and the development).

Horizontal line of sight

It is generally accepted that the central field of vision for the human eye covers a horizontal angle of approximately 50 degrees to 60 degrees. Within this angle, both eyes observe an object simultaneously creating a degree of overlap, which is the central field of view (refer to Figure A.1). Within the central field of vision, the viewed image is sharp, colours are separately defined and depth perception occurs.

The visual prominence of a development will vary according to the proportion a development occupies the central field of vision.

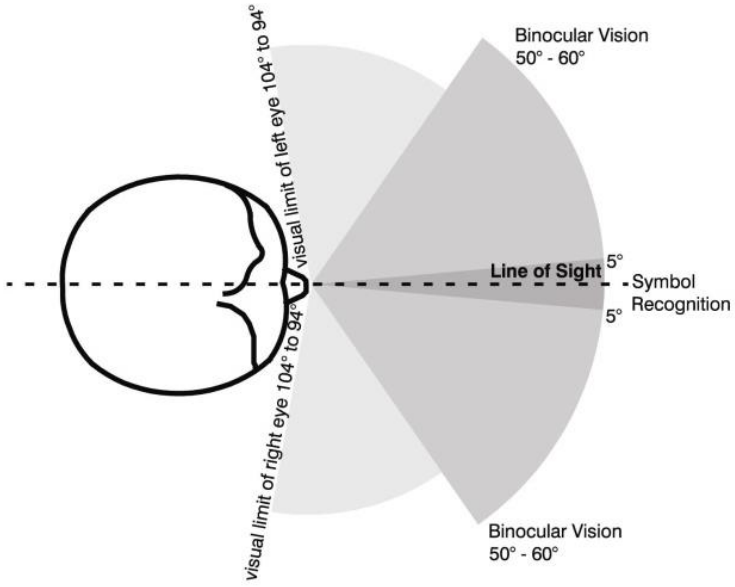

Figure A.1 Horizontal line of sight

Table A.1 outlines the potential visual prominence of a development, dependant upon on how much of the horizontal central field of vision that it occupies.

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Degrees of Field of View occupied	Potential visual prominence – horizontal field of view
Less than 5º	**Insignificant - Low visual prominence** The development would not be highly visible in the view, unless it contrasts strongly with the background.
5º – 30º	**Potentially Noticeable – Moderate visual prominence** The development may be noticeable. The degree that it intrudes on the view would be dependent on how well it integrates with the landscape setting.
Greater than 30º	**Potentially Dominant - High visual prominence** The development would be highly noticeable.

Table A.1 Potential visual prominence based on degrees of horizontal field of view occupied

Vertical line of sight

As for the horizontal line of sight, there is also a vertical central field of view. If we assume that the horizon is 0º then the eye clearly defines colour, field of view and has image sharpness for an angle of approximately 25º upwards and 30º downwards. However, in reality, the typical line of sight for a standing person at ground level is approximately 10º below the horizon line (Refer to Figure A.2).

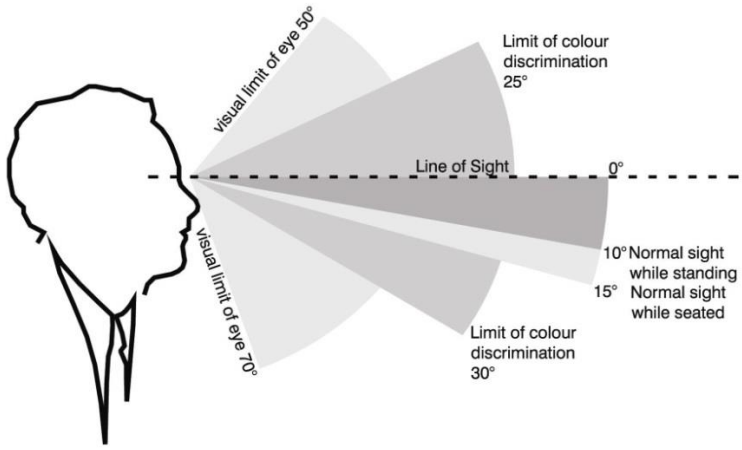

Figure A.2 Vertical line of sight

Objects that occupy a small proportion of the vertical field of view (less than 5^0) are visible but not dominant, particularly when they occur within landscapes that have been modified by human activity.

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Table A.2 demonstrates the potential visual prominence of a development, dependant upon on how much of the vertical central field of vision that it occupies.

Degrees of Field of View occupied	Potential visual prominence – vertical field of view
Less than 0.5º	**Insignificant - Low visual prominence** A small thin line in the landscape and is no longer an easily recognisable element.
0.5º – 2.5º	**Potentially Noticeable - Moderate visual prominence** The development may be noticeable. The degree that it intrudes on the view would increase as distance reduces and be dependent on how well it integrates with the landscape setting.
Greater than 2.5º	**Potentially Dominant - High visual prominence** The development would be highly noticeable, although the degree of visual intrusion would depend on the landscape setting and the width / thickness of the object.

Table A.2 Potential visual prominence based on degrees of vertical field of view occupied

Visual prominence in relation to distance and field of view

These horizontal and vertical fields of view are also interlinked to the viewing distance from the development. The viewing distances, foreground, middleground and background, (refer to Table A.3) have been established based on previous field studies undertaken by Aurecon. The distances also relate to the distances for the land use types in the viewer sensitivity assessment methodology.

Distance from a viewer	Potential visual prominence
> 2.0km (background)	**Insignificant** The visibility of the development would progressively diminish over greater distances of 2km with no visibility beyond 5km due to atmospheric conditions.
Between 0.5km & 2.0km (middleground)	**Potentially Noticeable** The development would be noticeable, reducing with distance. The degree that it intrudes on the view would be dependent on topography and the vegetation within the landscape setting and how well it integrates with the surrounding land-uses.
< 0.5km (foreground)	**Potentially Dominant** The development would be highly noticeable, although the degree of visual intrusion would depend on the landscape setting (where not screened by vegetation or buildings) and the width / thickness of the object.

Table A.3 Potential visual prominence based on distance from a viewer

Figure A.3 illustratively demonstrates how the viewshed of a horizontal object is determined by its height and not so much by its width based on the viewing distance from a development. As a viewer moves further away from a horizontal object the width may still be apparent, however the vertical dimension reduces to insignificance.

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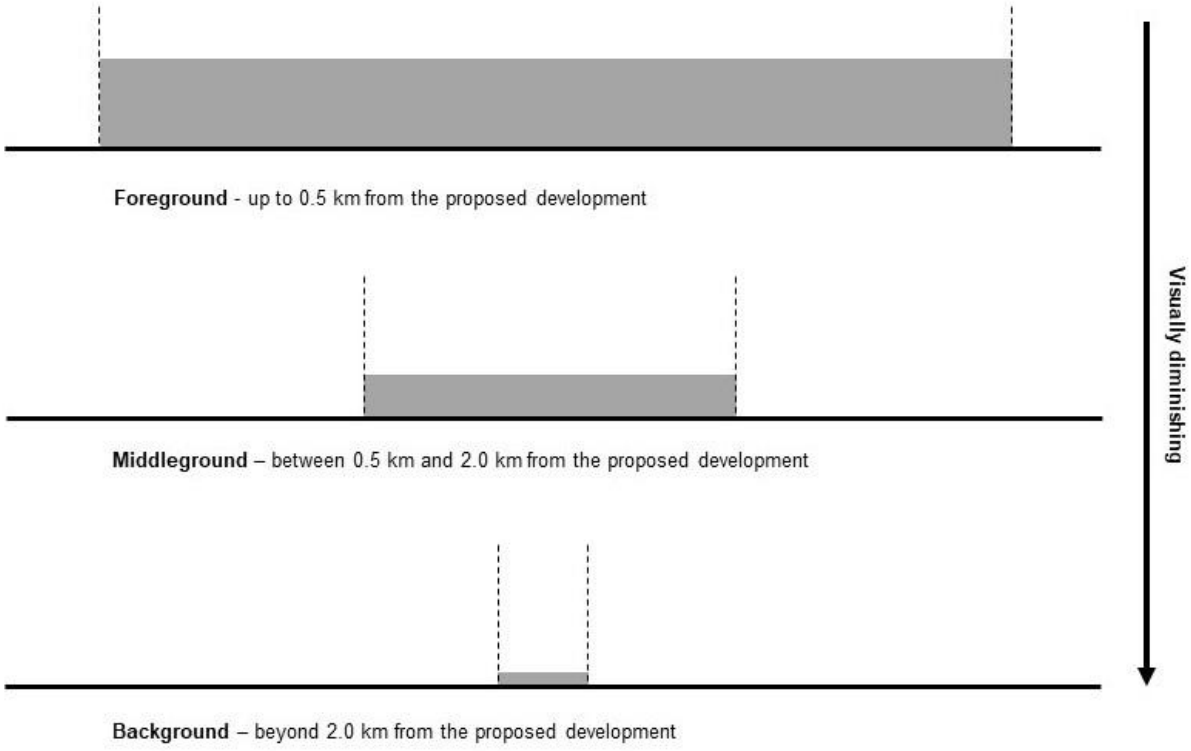

Figure A.3 The reduction in visibility of the horizontal line of sight based on increase in distance from a viewpoint

The same approach can be applied to the vertical field of view. As a viewer moves further away from a vertical object the height may still be apparent, however the vertical dimension reduces to insignificance (refer to Figure A.4).

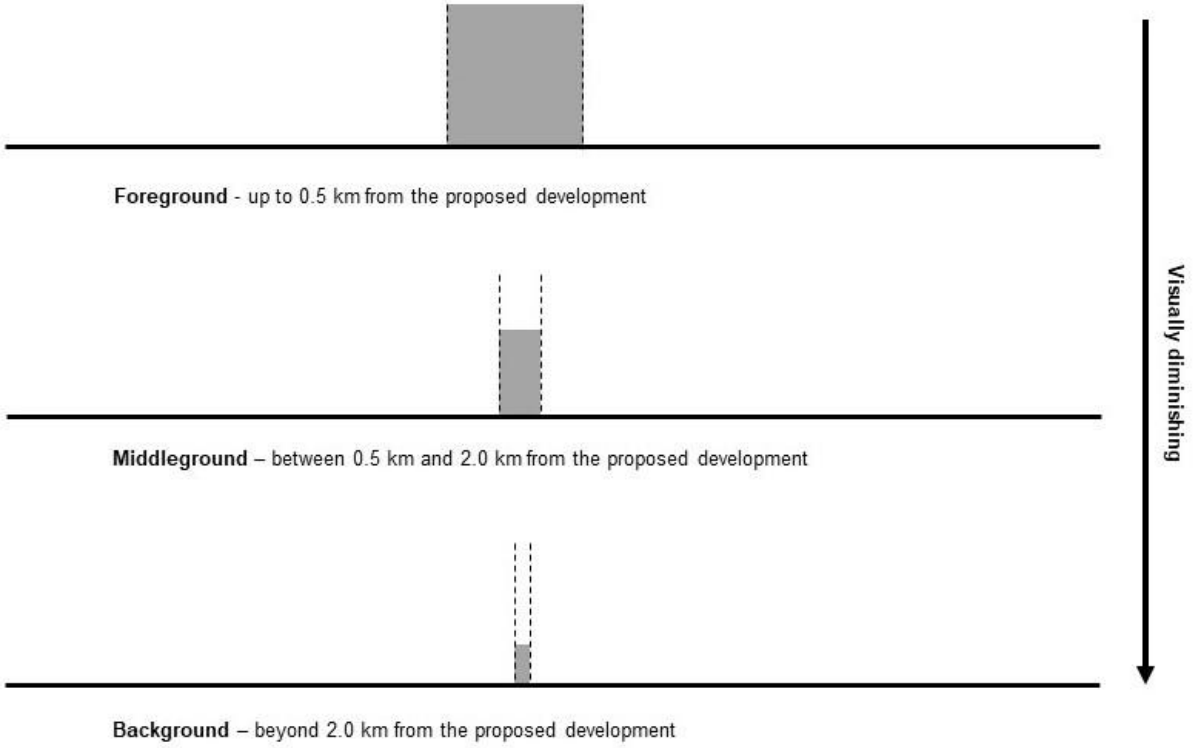

Figure A.4 The reduction in visibility of the vertical line of sight based on increase in distance from a viewpoint

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Appendix B

Guidance Notes for the reduction of Obtrusive Light

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Guidance Note 01/20

Guidance notes for the reduction of obtrusive light

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This guidance note has been revised to reflect the changes in international guidance regarding obtrusive light as detailed in CIE 150:2017 *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations*.[1] It also considers industry comment regarding the assessment and definition of obtrusive lighting.

Good lighting practice is the provision of the right light, at the right time, in the right place, controlled by the right system.

Humanity's invention of artificial light and its application in the external environment has done much to safeguard and enhance our night-time environment but, if not properly controlled, *obtrusive light* (sometimes referred to as light pollution) can present serious physiological and ecological problems.

Obtrusive light – whether it keeps you awake through a bedroom window, impedes your view of the night sky or advisedly affects the performance of an adjacent lighting installation – is a form of pollution, which may also be a nuisance in law and which can be substantially mitigated without detriment to the lighting requirements of the task.

Sky glow, the brightening of the night sky, *glare* the uncomfortable brightness of a light source when viewed against a darker background, *light spill* the spilling of light beyond the boundary of the area being lit and *light intrusion* ("nuisance")[2] are all forms of obtrusive light which may cause nuisance to others, or adversely affect fauna and flora as well as waste money and energy.

Considerations to be made

Think before you light. Is it necessary? What effect could it have on others? Has it the potential to cause a nuisance? How can you mitigate and manage any potential adverse effects from your lighting installation?

There are published standards and guidance for most lighting tasks, adherence to which will help mitigate obtrusive lighting aspects. Organisations from which full details of these standards can be obtained are given later in this Guidance Note.

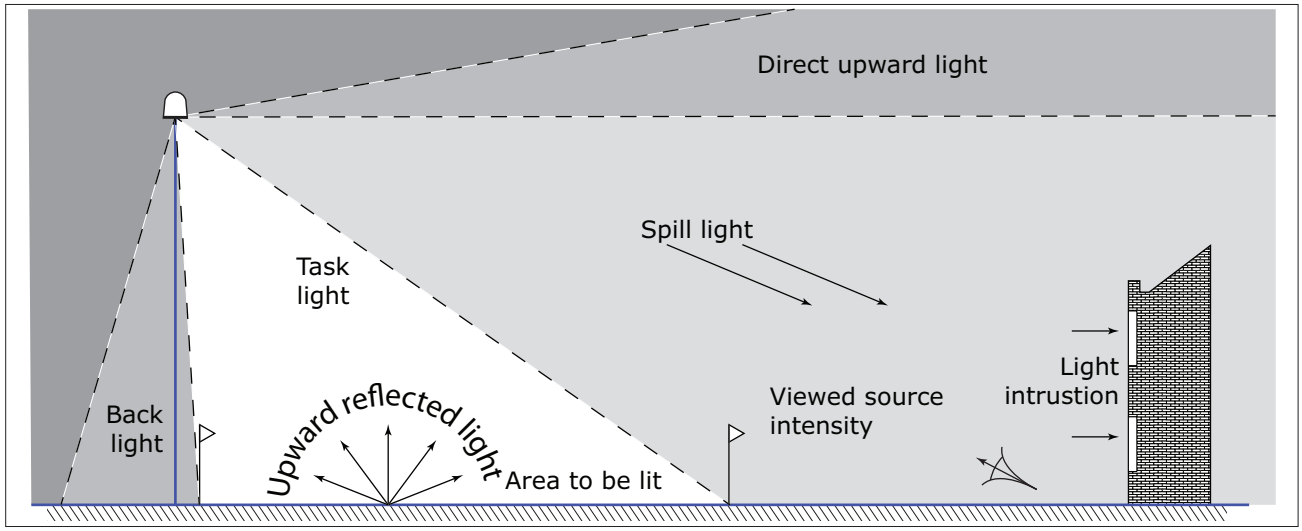

Figure 1: Types of intrusive light

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2 The term light trespass is sometimes used, but trespass is to physically encroach on land and light can't do that, so the term nuisance should always be used.

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For the purpose of this Guidance Note the following two Commission Internationale De L'Eclairage (CIE) documents are specifically referenced; they provide guidance to the mitigation of obtrusive light from exterior lighting installations:

- CIE 150:2017 Guide on the limitation of the effects of obtrusive light from outdoor lighting installations;
- CIE 126-1997 Guidelines for minimizing sky glow

When considering any lighting installation these two documents should be referenced.

Whilst this Guidance Note specifically considers the effects from external lighting installations, the considerations within it can be relevant when considering modern office blocks and shop fronts where the main external facing structure is transparent and light from within the buildings could become a source of illumination to the exterior environment.

"Good Design Equals Good Lighting"

It cannot be stressed sufficiently that employing a competent lighting designer with proven experience in the lighting application being considered will provide a suitable lighting installation where all obtrusive lighting aspects are mitigated[3].

Any lighting scheme consists of three basic elements: a light source, a luminaire (incorporating the optical control system) and a method of installation/mounting.

Light sources (lamps/LEDs)

Remember that the light source output in lumens is not the same as the wattage and that it is the former that is important in combating the problems of obtrusive light.

Most night-time visual tasks are only dependent on light radiated within the visual spectrum. It is therefore not necessary for light sources to emit either ultra-violet or infra-red radiation unless specifically required to do so. The majority of light sources used in external lighting do not contain these wavelengths or where they are present their spectral power is very low.

Research indicates that light from the blue end of the spectrum could have important adverse effects on fauna and flora. The lighting designer should consider the blue light spectral power of the light source and try to balance the needs of the task to be lit with any impact on fauna and flora within the environment.

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Luminaires

The choice of luminaire with the right optical distribution at the right mounting height is critical to minimising light spill and obtrusive light effects while providing the right lighting performance on the task area.

Sky glow is the general diffuse sheen that is visible in the direction of large cities, airports, and industrial complexes. It occurs from both natural and artificial light sources and does not depend exclusively on the lighting design. It also depends on the atmospheric conditions (humidity, aerosols, clouds, haze, atmospheric pollution, etc). Light propagating into the atmosphere either directly from upward directed or incompletely shielded sources, or after reflection from the ground or other surfaces, is partially scattered back towards observers on the ground; the impact being shown in Table 1.

It is therefore important to consider the luminaire, its light distribution, how it is installed, and how it is set up.

For most general sports and area lighting installations the use of luminaires with asymmetric optics designed so that the front glazing is kept at or near parallel to

3 Competency can be determined through membership of a professional lighting body supported by the appropriate qualifications and experience in the application of lighting required.

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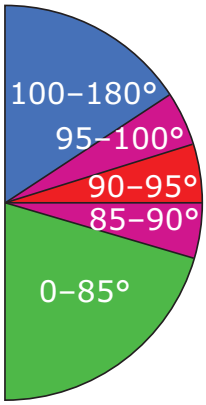

Indicative diagram

Table 1: The effect on the ability to view the night sky at various angles

Angle of light emitted (degrees)	Sky glow effect	Glare effect
100 – 180	Local	Little
95 – 100	Significant	Some
90 – 95	High	High
85 – 90	Significant	High
0 – 85	Minimal	Some

the surface being lit should, if correctly aimed, ensure minimum obtrusive light.

Appendices 1 and 2 in this Guidance Note give more details of how to choose luminaires, and if necessary modify them through the use of louvres and shields.

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Installation

In most cases it will be beneficial to use as high a mounting height as possible, giving due regard to the daytime appearance of the installation.

It should be noted that a lower mounting height is perhaps not better as can be seen from Figures 2a and 2b from CIE 150. A lower mounting height can create a higher level of light spill and require additional lighting points.

Keep glare to a minimum by ensuring that the main beam angle of all luminaires directed towards any potential observer is no greater than 70°. Higher mounting

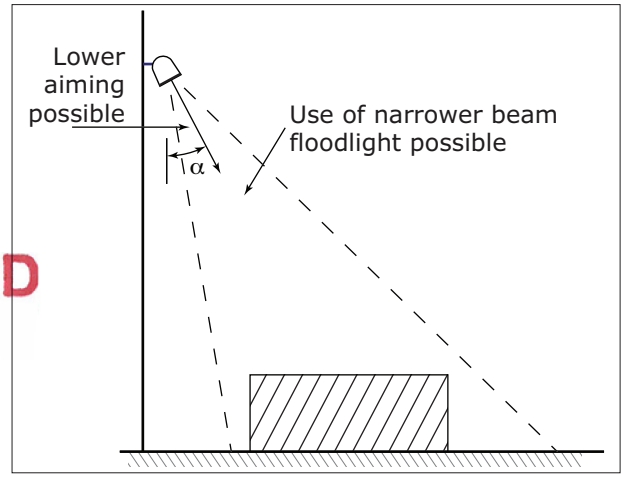

Figure 2a: Higher mounting height – less spill light and glare

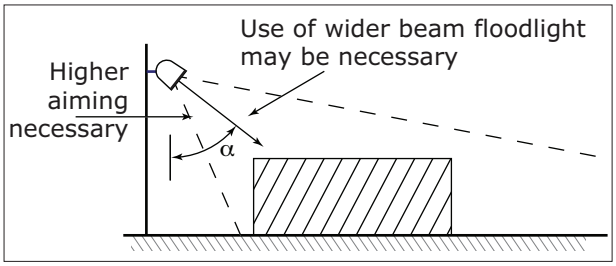

Figure 2b: Lower mounting height – more spill light and glare

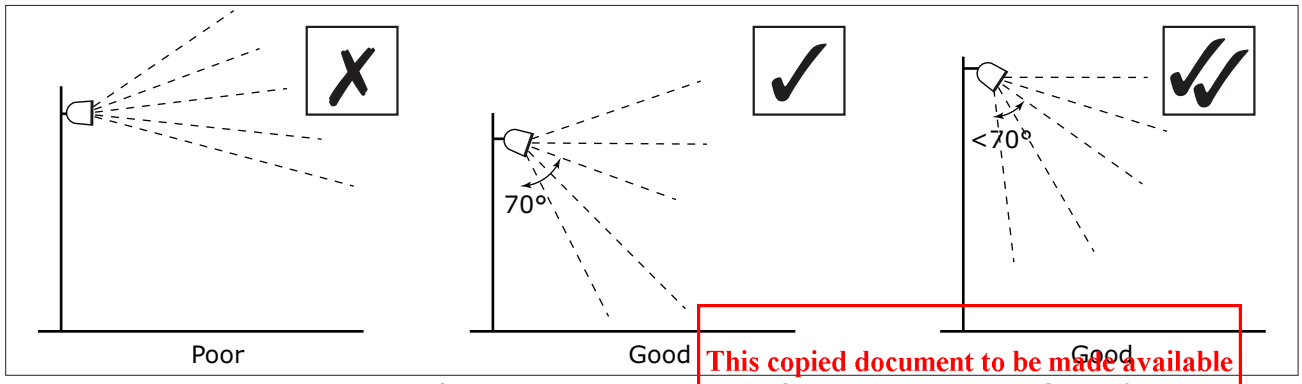

Figure 3 Luminaire aiming angles

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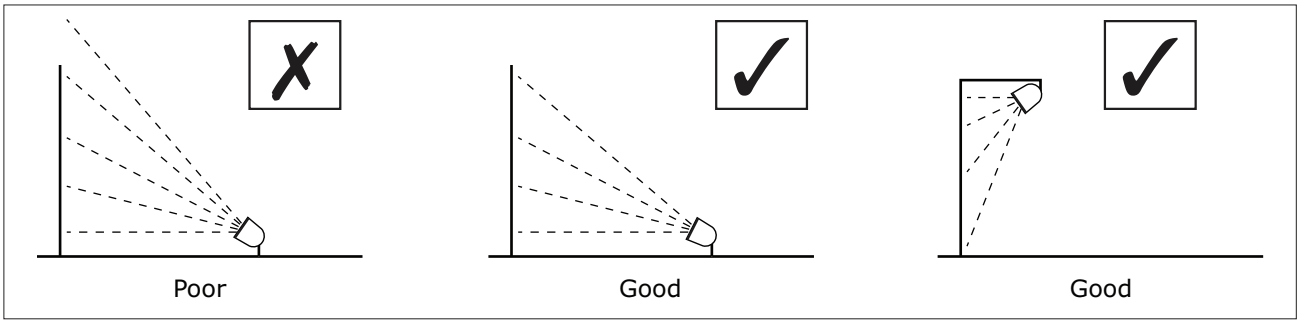

Figure 4 Façade illumination

heights allow lower main beam angles, which can assist in reducing glare.

In areas with low ambient light levels, glare can be very obtrusive, and extra care should be taken when positioning and aiming lighting equipment. With regard to domestic security lighting, the ILP produces an information leaflet GN09:2018 *Domestic exterior lighting: getting it right!* which is freely available from its website.

When lighting vertical structures such as advertising signs, direct light downwards wherever possible. If there is no alternative to up-lighting, as with much decorative lighting of buildings, then the use of luminaires with the correct optical distribution, coupled where required with shields, baffles and louvres, will help minimise spill light around and over the structure.

For road and amenity lighting installations, light near to and above the horizontal should normally be minimised to reduce glare and sky glow (Note the Upward Lighting Ratios (ULR's) advised in Tables 5 and 6). In rural areas the use of full horizontal cut off luminaires installed at 0° uplift will, in addition to reducing sky glow, help to minimise visual intrusion within the open landscape. However, in some urban locations, luminaires fitted with a more decorative bowl and good optical control of light should be acceptable and may be more appropriate.

Clean Neighbourhoods and Environment Act 2005 (CNEA)

The Clean Neighbourhoods and Environment Act 2005 (CNEA) gives local authorities and the Environment Agency additional powers to deal with a wide range of issues by classifying artificial light emitted from defined premises as a statutory nuisance.

The CNEA 2005 amended paragraph 79(1)(fb) of the Environmental Protection Act 1990 to extend the statutory nuisance regime to include light nuisance stating the following:

'artificial light emitted from premises so as to be prejudicial to health or a nuisance'.

Guidance produced on Sections 101 to 103 of the CNEA 2005 by DEFRA (DEFRA, April 2006) extends the duty on local authorities to ensure their areas are checked periodically for existing and potential sources of statutory nuisances including nuisances arising from artificial lighting. Local authorities must take reasonable steps to investigate complaints of such nuisances from artificial light. Once satisfied that a statutory nuisance exists or may occur or recur, local authorities must issue an abatement notice (in accordance with section 80(2) of the Environmental Protection Act 1990), requiring that the nuisance cease or be abated within a set timescale.

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National Planning Policy Framework (NPPF)

The NPPF was introduced as a more concise and useable planning document to aid developers and designers in the design and construction of developments within the UK.

The National Planning Policy Framework 2019 makes little reference to lighting with regard to the control of obtrusive light with section being the only reference, which states:
c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

With regard to the planning aspect, many local planning authorities (LPAs) have already produced, or are producing, policies that within the planning system will become part of their local development framework. For new developments there is an opportunity for LPAs to impose planning conditions related to external lighting, including curfew hours.

National planning policy

The national on-line planning guidance resource looks at when lighting pollution concerns should be considered.

The guidance provides a high-level overview for planners, with links to appropriate documents looking at the subject through seven discussion points:

- What light pollution considerations does planning need to address?
- What factors can be considered when assessing whether a development proposal might have implications for light pollution?
- What factors are relevant when considering where light shines?
- What factors are relevant when considering when light shines?
- What factors are relevant when considering how much the light shines?
- What factors are relevant when considering possible ecological impacts of lighting?
- What other information is available that could inform approaches to lighting and help reduce light pollution?

It is to be hoped that whilst the guide does not specifically require it planners will consider the application of artificial light and consult with lighting designers. The planners can then be advised on the planning conditions that might be applicable for each project and review any submissions to determine if the planning conditions have been met.

The Scottish Executive has published a design methodology document (March 2007) entitled "*Controlling Light Pollution and Reducing Lighting Energy Consumption*" to further assist in mitigating obtrusive light elements at the design stage.

Environmental zones

It is recommended that local planning authorities specify the environmental zones given in Table 2 for exterior lighting control within their development plans.

Design guidance

The following limitations based upon CIE150 may be supplemented or replaced by an LPA's own planning guidance for exterior lighting installations. As lighting design is not as simple as it may seem, you are advised to consult and/or work with a competent professional lighting designer when considering any exterior lighting.

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Table 2: Environmental zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

Notes:

1. Where an area to be lit lies on the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone.
2. Rural zones under protected designations should use a higher standard of policy.
3. Zone E0 must always be surrounded by an E1 Zone.
4. Zoning should be agreed with the local planning authority and due to local requirements a more stringent zone classification may be applied to protect special/specific areas.
5. SQM (Sky Quality Measurements) referenced by the International Dark-Sky Association (IDA), the criteria for E0 being revised in mid 2019 but not retrospective.
6. Astronomical observable dark skies will offer clearer views of the Milky Way and of other objects such as the Andromeda galaxy and the Orion Nebula.
7. Although values of SQM 20 to 20.5 may not offer clear views of astronomical dark sky objects such as the Milky Way, these skies will have their own relative intrinsic value in the UK.

Table 3 (CIE 150 table 2): Maximum values of vertical illuminance on properties.

Light technical parameter	Application conditions	Environmental zone				
		E0	E1	E2	E3	E4
Illuminance in the vertical plane (E_v)	Pre-curfew	n/a	2 lx	5 lx	10 lx	25 lx
	Post-curfew	n/a	<0.1 lx*	1 lx	2 lx	5 lx

Note:

* If the installation is for public (road) lighting then this may be up to 1 lx.

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Recommended maximum values of light parameters for the control of obtrusive light

Limitation of illumination on surrounding properties

Light intrusion/nuisance

Limits apply to nearby dwellings/premises or potential dwellings/premises and specifically windows; the values are the summation of all lighting installations.

Spill light

Table 3 can also be considered for the management of spill light; however, designers must consider the task performance requirements of any adjacent lit areas and ensure that any spill light does not adversely affect these performance parameters as this could affect their safe use. This may result in a need to minimise spill and intrusive lighting values to less that might be expected for the environmental zone within which the installation lies.

Limitation of bright luminaires in the field of view.

The limits for the luminous intensity of bright luminaires are dependent on the viewing distance *d*, (between the observer and the bright luminaire(s)) and the projected area A_p, of the bright part of the luminaire in the direction of the observer.

Table 4 shows the maximum values for the luminous intensity of luminaires in designated directions where views of bright surfaces of luminaires are likely to be a nuisance to occupants of premises or from positions where such views are likely to be maintained, that is, not momentary or short-term.

Considerations to aid the application of Table 4 and the assessment process.

a) The assessment of A_p for observers can prove difficult and will vary for all observer positions and distances. To aid this assessment values of A_p corresponding to the geometric mean diameter of each luminaire group have been extracted from CIE 150 Annex C and included within Table 4. These areas can be considered for an assessment of likely A_p in the observer direction to calculate a maximum luminous intensity value.
b) The above information is applicable for the consideration of a single luminaire but where two or more luminaires are located in close proximity to each other that to the observer they appear as a single light source then the assessment shall be undertaken based upon the combined bright surfaces of luminaires (A_p) in the direction of the observer or, from positions where such views are likely to be maintained.
c) In installations that involve mast lighting the luminaires will often be viewed against the night sky. The contrast between the background sky and the bright surface areas of the luminaires can be considerable. In such installations the curfew levels set for each environmental zone shall be applied with the exception that such installations within an E4 zone will be designed to suit the curfew requirements of an E3 zone.

Limitation of the effects on transport systems

Limits apply where users of road networks are subject to a reduction in the ability to see essential information. CIE 150 2017; Table 5 gives values that are for relevant positions and for viewing directions in the path of travel.

This assessment does not just apply to road lighting installations but to any installation where luminaires positioning falls under the above definition.

Limitation of sky glow

See Tables 6 and 7

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Table 4 (CIE 150 table 3 (amended)): Limits for the luminous intensity of bright luminaires[4].

Light technical parameter	Application conditions	Luminaire group (projected area A_P in m^2)					
		$0<A_P \leq 0.002$	$0.002<A_P \leq 0.01$	$0.01<A_P \leq 0.03$	$0.03<A_P \leq 0.13$	$0.13<A_P \leq 0.50$	$A_P>0.5$
Maximum luminous intensity emitted by luminaire (I in cd)	E0						
	Pre-curfew	0	0	0	0	0	0
	Post-curfew	0	0	0	0	0	0
	E1						
	Pre-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	2,500
	Post-curfew	0	0	0	0	0	0
	E2						
	Pre-curfew	0.57 *d*	1.3 *d*	2.5 *d*	5.0 *d*	10 *d*	7,500
	Post-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	500
	E3						
	Pre-curfew	0.86 *d*	1.9 *d*	3.8 *d*	7.5 *d*	15 *d*	10.000
	Post-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	1,000
	E4						
	Pre-curfew	1.4 *d*	3.1 *d*	6.3 *d*	13 *d*	26 *d*	25,000
	Post-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	2,500
Aid to gauging A_p		2 to 5cm	5 to 10cm	10 to 20cm	20 to 40cm	40 to 80cm	>80cm
Geometric mean of diameter (cm)		3.2	7.1	14.1	26.3	56.6	>80
Corresponding A_p representative area (m^2)		0.0008	0.004	0.016	0.063	0.251	>0.5

Notes:

1. d is the distance between the observer and the glare source in metres;
2. A luminous intensity of 0 cd can only be realised by a luminaire with a complete cut-off in the designated directions;
3. A_p is the apparent surface of the light source seen from the observer position
4. For further information refer to Annex C of CIE 150
5. Upper limits for each zone shall be taken as those with column $A_p>0.5$

Limitations of the effect of over-lit building façades and signs

Table 8 provides recommendations regarding luminance values that provide visibility in order that a balanced urban lighting master plan can be considered and such lighting does not cause negative impacts such as a continuous increase in the lighting levels (ratcheting) between buildings and within areas and light pollution.

Illuminated advertising signage should be assessed as advised in the ILP's Professional Lighting Guide *The brightness of illuminated advertisements*, (PLG 05)

4 Amended based upon the approach taken by NSVV Nederlandse Stichting Voor Verlichtingskunde (Dutch: Dutch Foundation for Illumination; The Netherlands) and to consider CIE 150 Annex C Table C.2

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Table 5 (CIE 150 table 4): Maximum values of threshold increment and viewing direction in the path of travel.

Light technical parameter	Road classification*			
	No road lighting	M6/M5	M4/M3	M2/M1
Veiling luminance† (L_V)	0.037 cd/m^2	0.23 cd/m^2	0.40 cd/m^2	0.84 cd/m^2
Threshold increment	15% based on adaption luminance of 0.1 cd/m^2	15% based on adaption luminance of 1.0 cd/m^2	15% based on adaption luminance of 2.0 cd/m^2	15% based on adaption luminance of 5 cd/m^2

Notes:

* Road classifications as given in CIE 115:2010

† The veiling luminance values specified in this table are based upon on a permissible TI value of 15%

Definitions:

TI The measure of disability glare (the reduction in visibility caused by intense light sources in the field of view) expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare.

L_V The luminance that would need to be superimposed on a scene in object space to reduce the scene's contrast by an amount equal to the added retinal illuminance from scattered light on the scene's retinal image. It is most commonly used to describe the contrast-reducing effect of a glare source in the field of view.

Table 6 (CIE 150 table 5): Maximum values of upward light ratio (ULR) of luminaires.

Light technical parameter	Environmental zones				
	E0	E1	E2	E3	E4
Upward light ratio (ULR)/%	0	0	2.5	5	15

Note:

This does not take into account the effect of light reflected upwards from ground that also contributes to sky glow. This is the traditional method to limit sky glow and is suitable to compare different single luminaires.

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For illuminated advertising signs the aim should be to achieve the limits advised in PLG05.

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Table 7 (CIE 150 table 6): Maximum values of upward flux ratio of installation (of four or more luminaires).

Light technical parameter	Type of installation	Environmental zones				
		E0	E1	E2	E3	E4
Upward flux ratio (UFR)/%	Road	n/a	2	5	8	12
	Amenity	n/a	n/a	6	12	35
	Sports	n/a	n/a	2	6	15

Notes:

Table 7 allows the effect of both direct and reflected upward components of a whole installation to be taken into account. The factor being the upward flux ratio (UFR) and CIE 150 suggests that table 7 is used for all installations consisting of four or more luminaires.

Clauses 6.4.2 and 6.4.3 of CIE 150:2017 describe the calculation methods for both ULP and UFR.

Light emitted just above the horizontal in a zone between 90o and 110o is extra critical for sky glow in large open areas around observatories. An additional measure in these areas limits the luminous intensities (I_{90} – I_{110}) as follows:

- between 90° and 100° < 0.5 cd/1000lm;
- between 100° and 110° 0 cd.

Table 8 (CIE 150 table 7): Maximum permitted values of average surface luminance (cd/m^2).

Light technical parameter	Application conditions	Environmental zones				
		E0	E1	E2	E3	E4
Building façade luminance (L_b)	Taken as the product of the design average illuminance and reflectance divided by π	< 0.1	< 0.1	5	10	25
Sign luminance (L_s)	Taken as the product of the design average illuminance and reflectance divided by π, or for self-luminous signs, its average luminance.	< 0.1	50	400	800	1.000

Note:
The values apply to both pre- and post-curfew, except that in zones 0 and 1 the values shall be zero post curfew. The values for signs do not apply to signs for traffic control purposes.

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Relevant publications and standards

British Standards

- BS 5489-1:2013 *Code of practice for the design of road lighting – Part 1 Lighting of roads and public amenity areas*;
- BS EN 13201-2:2015 *Road lighting. Part 2: Performance requirements*;
- BS EN 13201-3:2015 *Road lighting. Part 3: Calculation of performance*;
- BS EN 13201-4:2015 *Road lighting. Part 4: Methods of measuring lighting performance*;
- BS EN 12193:2018 *Light and lighting. Sports lighting*;
- BS EN 12464-2:2014 *Lighting of work places. Outdoor work places*;
- PD CEN TR 13201-1:2014 *Road lighting. Guidelines on selection of lighting classes*.

CIE publications

- CIE 001 *Guidelines for minimizing urban sky glow near astronomical observatories*;
- CIE 094-1993 *Guide for floodlighting*;
- CIE 112-1994 *Glare evaluation system for use within outdoor sport and area lighting*;
- CIE 115:2010 *Lighting of roads for motor and pedestrian traffic*;
- CIE 126:1997 *Guidelines for minimizing sky glow*;
- CIE 129:1998 *Guide for lighting exterior work areas*;
- CIE 136:2000 *Guide to the lighting of urban areas*;
- CIE 150:2017 *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations*;
- CIE 169:2005 *Practical design guidelines for the lighting of sport events for colour*.

ILP publications

- PLG04 *Guidance on undertaking environmental lighting impact assessments*;
- PLG05 *The brightness of illuminated advertisements*;
- PLG06 *Guidance on installation and maintenance of seasonal decorations and lighting column attachments*
- GN09 *Domestic exterior lighting: getting it right!*

SLL/CIBSE Publications

- LG01 *The industrial environment* (2018);
- LG04 *Sports lighting*;
- LG06/16 *The exterior environment*;
- LGLOL *Guide to limiting obtrusive light*.

NB: These notes are intended as guidance only and the application of the values given in the various tables should be given due consideration along with all other factors in the lighting design. Lighting is a complex subject with both objective and subjective criteria to be considered. The notes are therefore no substitute for professionally assessed and designed lighting, where the various and maybe conflicting visual requirements need to be balanced.

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Acknowledgements

Allan Howard – WSP (Chair)

Peter Raynham – UCL

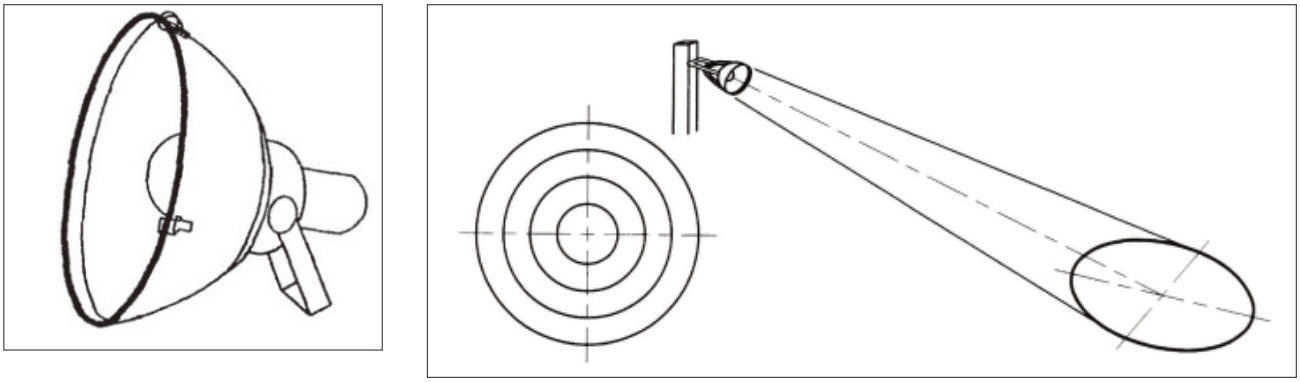
Dan Oakley – South Downs National Park

Appendix 2 images – acdc

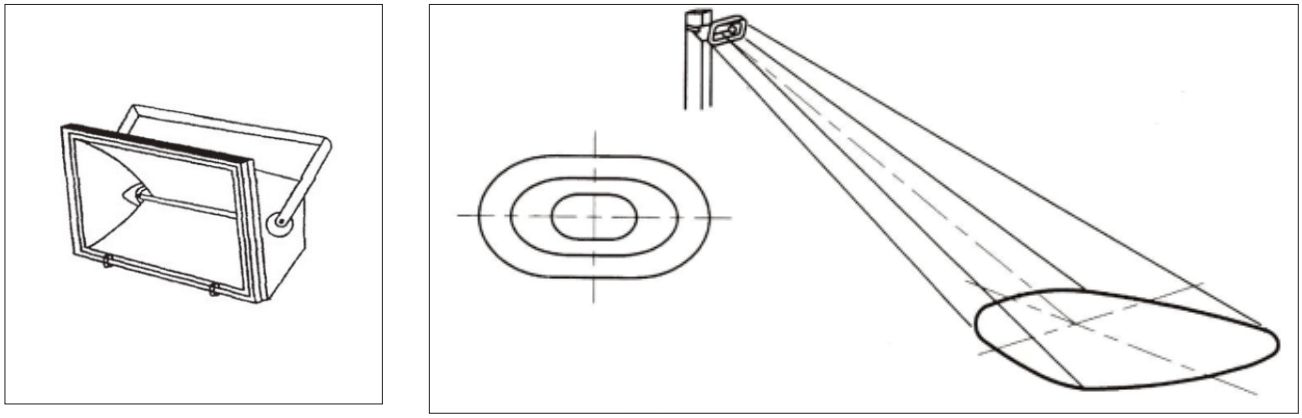
Appendix 1

Outdoor luminaire classification system

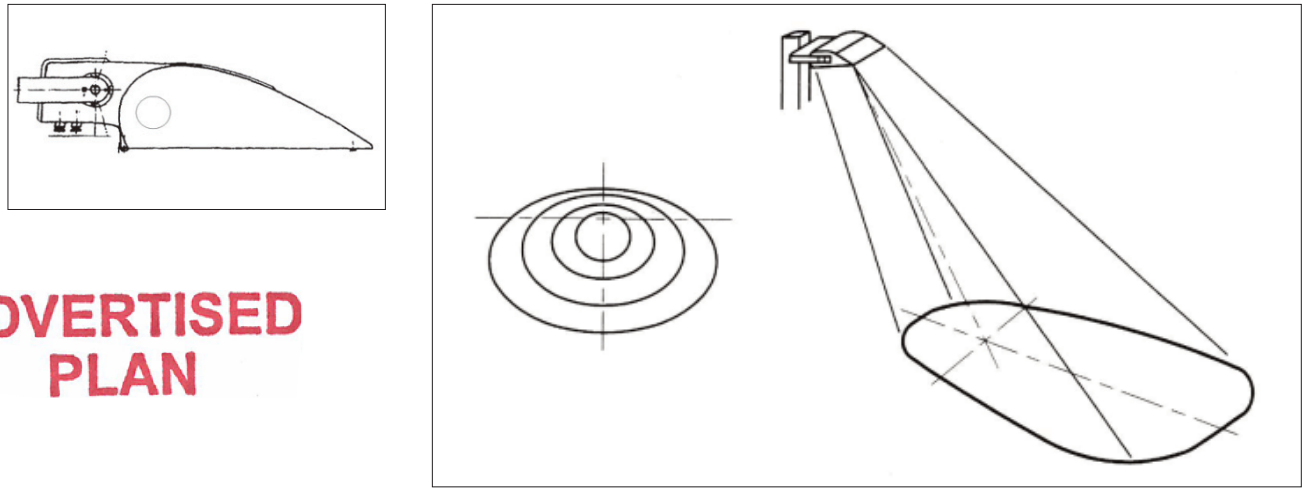
Based upon CIE 150:2017 and for the purpose of this and associated documents the following figures illustrate the luminaire classification (CIE 150:2017)



Type A: Floodlight/projector producing a symmetrical beam



Type B: Floodlight/projector producing a fan-shaped beam



Type C: Floodlight/projector producing a double asymmetric distribution in the vertical plane

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Appendix 2

Illustrations of luminaire accessories for limiting obtrusive light

Luminaire with cowl, hood and shield

With louvre

With cowl

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Appendix C

Indicative substation and buildings facility layout

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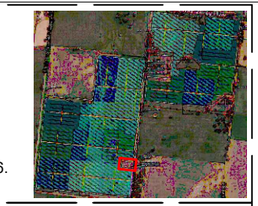
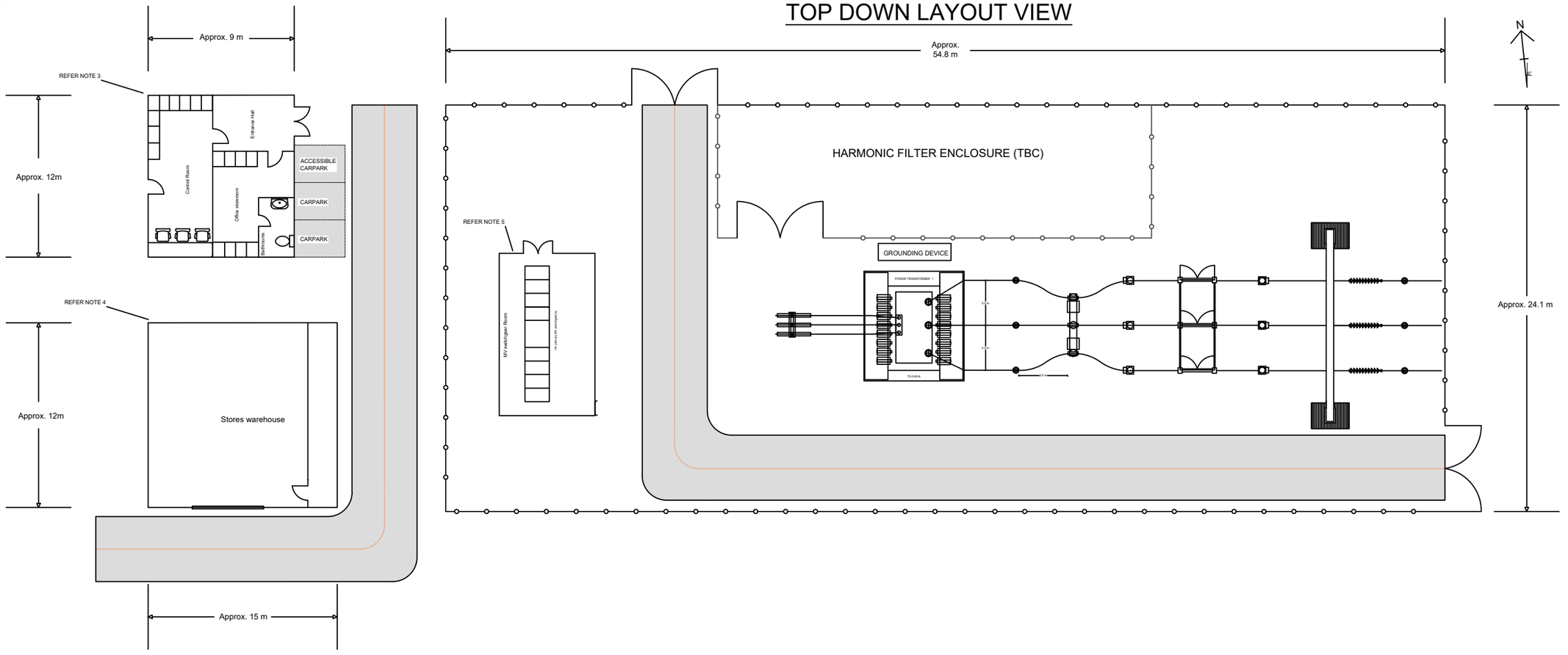
LOCATION

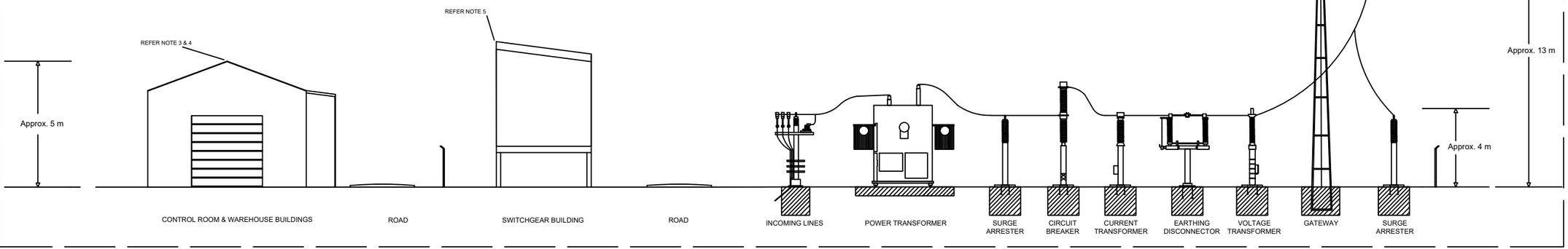
LOCATION OF SUBSTATION AND BUILDINGS WITHIN OVERALL SITE PLAN. REFER BARNSF-GN-LAY-0226.



TOP DOWN LAYOUT VIEW



SIDE PROFILE/ELEVATION VIEW (VIEW FROM SOUTH)



General Notes

1. INDICATIVE DRAWING, LAYOUT AND DIMENSIONS ONLY. DETAILED DESIGN PROCESS AND TENDERING NOT YET COMMENCED. NOT TO BE USED FOR ANY PURPOSE OTHER THAN PLANNING APPROVAL.
2. GENERAL CHARACTERISTICS: Arrangement: Line to transformer High voltage: 66.0 kV Medium voltage: 33.0 kV
3. REFER TO DWG T2Q01143-L-001 & 003 FOR INDICATIVE O&M BLD DESIGN
4. REFER TO DWG T2Q01143-L-004 FOR INDICATIVE WAREHOUSE DESIGN
5. REFER TO DWG J0456_L_001_SHT_02_REV_0 FOR INDICATIVE SWITCHROOM DESIGN
6. OUTDOOR LIGHTING AS REQUIRED.
7. SUBSTATION AND BUILDINGS AS INDICATIVELY SHOWN IN TOP DOWN VIEW WILL BE POSITIONED WITHIN 100X50M AREA RESERVED IN BARNSF-GN-LAY-0226.

LEGEND:

- Surge Arrester
- Current Transformer
- Circuit Breaker
- Voltage Transformer
- Disconnector
- Fence
- Gate

No.	Revision/Issue	Date
1	Original	14 FEB 2022
2	Minor bld design updates	10 MAR 2022
3	Updated layout, carspace	29 MAR 2022

Firm Name and Address

WIRSOL YOUR PARTNER IN RENEWABLE ENERGY

Wirsol Energy
201/39 East Esplanade, Manly, NSW, Australia, 2095

ARP Australian Solar

Project Name and Address

BARNAWARTHA SOLAR FARM

INTERSECTION HERMITAGE RD AND BAXTER-WHELANS RD, BARNAWARTHA, VICTORIA, AUSTRALIA 3688

Drawing number	Sheet
BARNSF-GN-GAD-0209-V3	1 of 1
Drawing title: Indicative Substation and Buildings facility layout	
Scale: NOT TO SCALE	

Appendix D

Landscape Mitigation Plan

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LEGEND:

- Project area
- Existing trees to be retained and protected
- Project area
- Indicative tree planting
- Tree Protection Zone (TPZ)
- Fences
- Solar field
- Mounting structure
- Roads
- Water tank
- CFA direction to water tank sign
- Business identification sign
- Medium voltage trenches
- Medium voltage lines
- Existing Ausnet overhead line
- Substation, switchroom, building/facility

Planting Schedule

CODE	Latin name	Common name	Vegetation Type	Height	Width	Spacing
		TREE MIX				
EUC.BLA	*Eucalyptus blakelyi*	Blakely's Red-gum	Large tree	10-25m	2-4m	1 per 5m
EUC.MEL	*Eucalyptus melliodora*	Yellow Box	Large tree	10-25m	4-10m	1 per 5m
EUC.POL	*Eucalyptus polyanthemos*	Red Box	Large tree	10-25m	4-10m	1 per 5m
ACA.IMP	*Acacia implexa*	Lightwood	Medium tree	4-10m	4-10m	1 per 5m
EXO.CUP	*Exocarpos cuppressiformis*	Cherry Ballart	Medium tree	3-10m	3-6m	1 per 5m
		SHRUB MIX				
ACA.PAR	*Acacia paradoxa*	Hedge Wattle	Shrubs	1-5m	2-5m	1 per 3m
BUR.SPI	*Bursaria spinosa ssp. Spinosa*	Sweet Bursaria	Shrubs	1-5m	2-3m	1 per 3m
CAS.ARC	*Cassinia arcuata*	Drooping Cassinia	Shrubs	1-5m	2-3m	1 per 3m

TREE MIX

Blakly's Red-gum
Eucalyptus blakeyi

Yellow Box
Eucalyptus melliodora

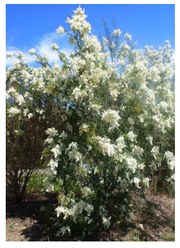
Red Box
Eucalyptus polyanthemos

Lightwood
Acacia implexa

Cherry Ballart
Exocarpos cuppressiformis

SHRUB MIX

Hedge Wattle
Acacia paradoxa



Sweet Bursaria
Bursaria spinosa ssp/ Spinosa

Drooping Cassinia
Cassinia arcuata

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CLIENT	REV	DATE	REVISION DETAILS	APPROVED

SCALE	SIZE
1:750	A1

DRAWN: B. PEREZ-TORRES
DESIGNED: N. LAMB
REVIEWED: N.LAMB

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE
2022

PROJECT: BARNAWARTHA SOLAR FARM
LANDSCAPE AND VISUAL ASSESSMENT

TITLE: LANDSCAPE LAYOUT

DRAWING No. 5206189 – 0000 – DRG – AA – 01 – A

PROJECT No.	AREA	TYPE	DISC	NUMBER	REV
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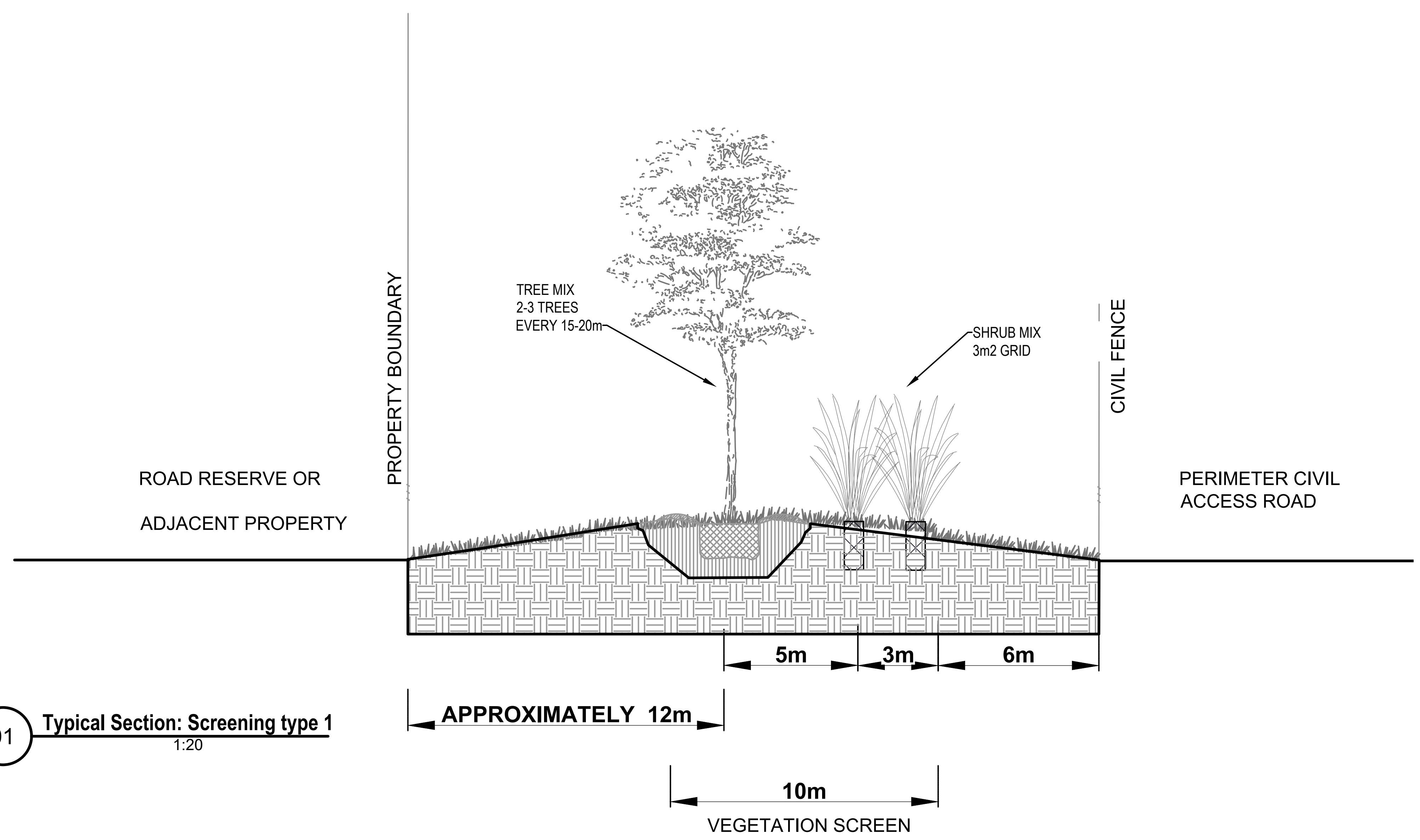
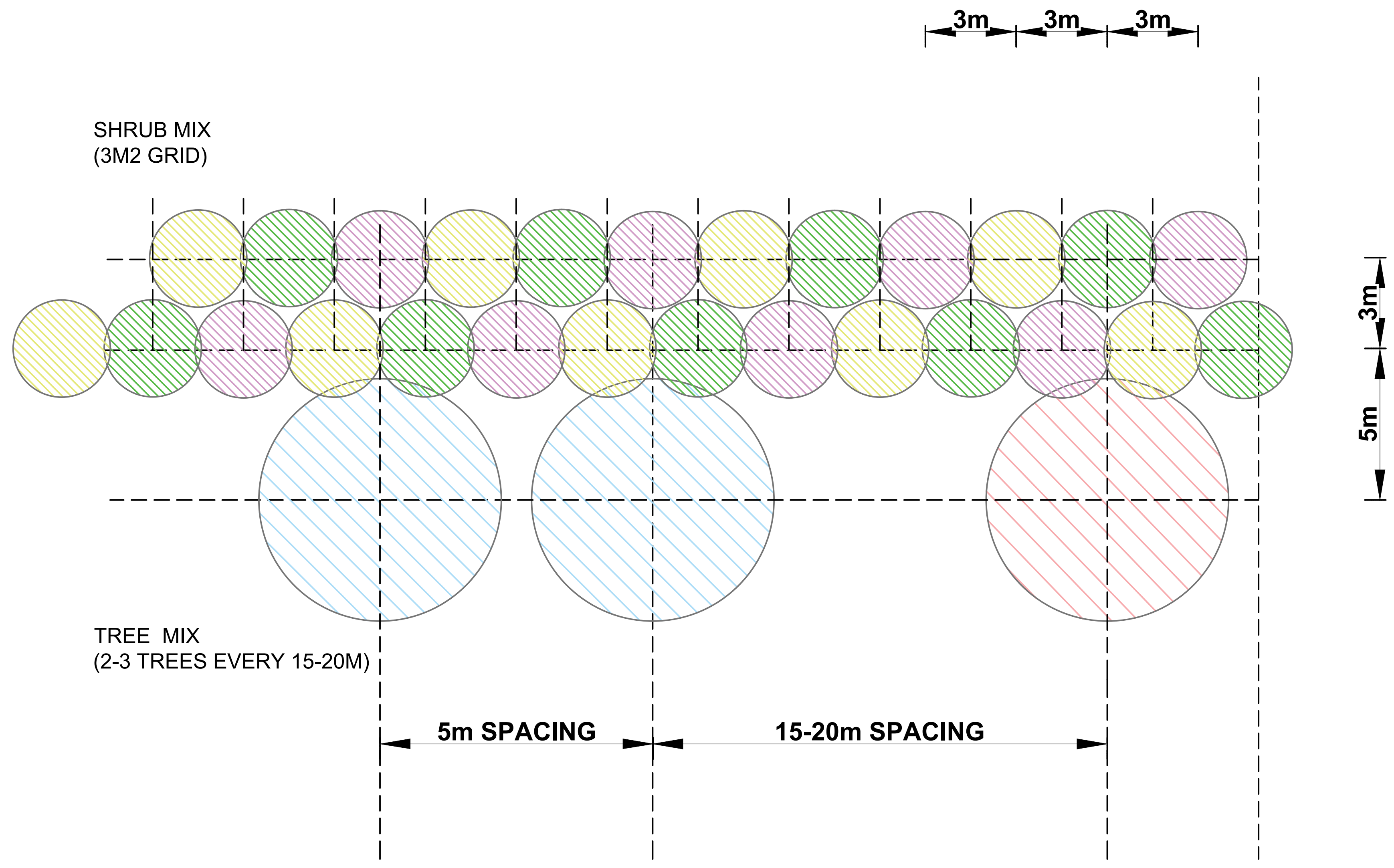
PLAN



01 Typical Section: Screening type 1
1:20



02 Typical Plan: Screening layout
1:20

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SCALE	SIZE
1:20	A1

DRAWN: B. PEREZ-TORRES
DESIGNED: N. LAMB
REVIEWED: N.LAMB

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DATE
2022

PROJECT: BARNAWARTHA SOLAR FARM
LANDSCAPE AND VISUAL ASSESSMENT

TITLE: LANDSCAPE LAYOUT

DRAWING No.	PROJECT No.	AREA	TYPE	DISC	NUMBER	REV
	5206189	0000	DRG	AA	02	A

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DRAFT

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