The Sizewell C Project

6.3 Volume 2 Main Development Site

Chapter 2 Description of the Permanent Development

Appendix 2B Lighting Management Plan

Revision: 1.0

Applicable Regulation: Regulation 5(2)(a)

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Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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1. Lighting management plan for construction and operational sites

1.1 Introduction

a) Purpose

1.1.1 The purpose of this Lighting Management Plan (LMP) is to outline the operation and maintenance procedures for the control of artificial light emissions associated with the construction and operation of Sizewell C power station, to enable safe working whilst addressing planning and environmental considerations.

1.1.2 The purpose of this LMP is to ensure that the external lighting provided on the construction and operational sites of Sizewell C power station provides safe lighting for the staff on-site and is functional to allow the safe construction and operation, but is also both energy efficient and designed as far as reasonably practicable to minimise its impact on the surrounding environment. It should be noted that internal lighting of buildings does not form part of this document.

b) Scope

1.1.3 The LMP is limited to the area within the main development site boundary and is therefore not applicable to any of the associated developments or existing power station facilities. It has been broken down into three sections in this report.

- **Section 1.2**: Site Context. This section will look at the existing environmental conditions (predominantly landscape, visual and ecological) within and around the Sizewell C development site and provide the baseline lighting conditions. A summary of relevant legislation, standards, good practice guidelines and policies will be discussed.
- **Section 1.3**: Construction Lighting Management Plan. This section will look to identify the tasks requiring lighting during the construction phase, appropriate levels of illumination when required and detail possible control and mitigation measures.

- **Section 1.4**: Operational Lighting Management Plan. This section will look to identify the tasks requiring lighting during the operational phase, appropriate levels of illumination when required and detail possible control and mitigation measures.

1.1.4 During the construction phase, external lighting at the main development site must be installed, operated and maintained in general accordance with the controls and limits set in **Section 1.3** of this document, save to the extent that alternative details are submitted by the undertaker and approved by the local planning authority. During the operational period, the same applies to **Section 1.4** of this document.

1.1.5 A description of development at the main development site is set out in **Chapter 2** and **Chapter 3** of **Volume 2** of the **Environmental Statement** (Doc Ref. 6.3).

1.2 Site context

a) Introduction

i. Outline

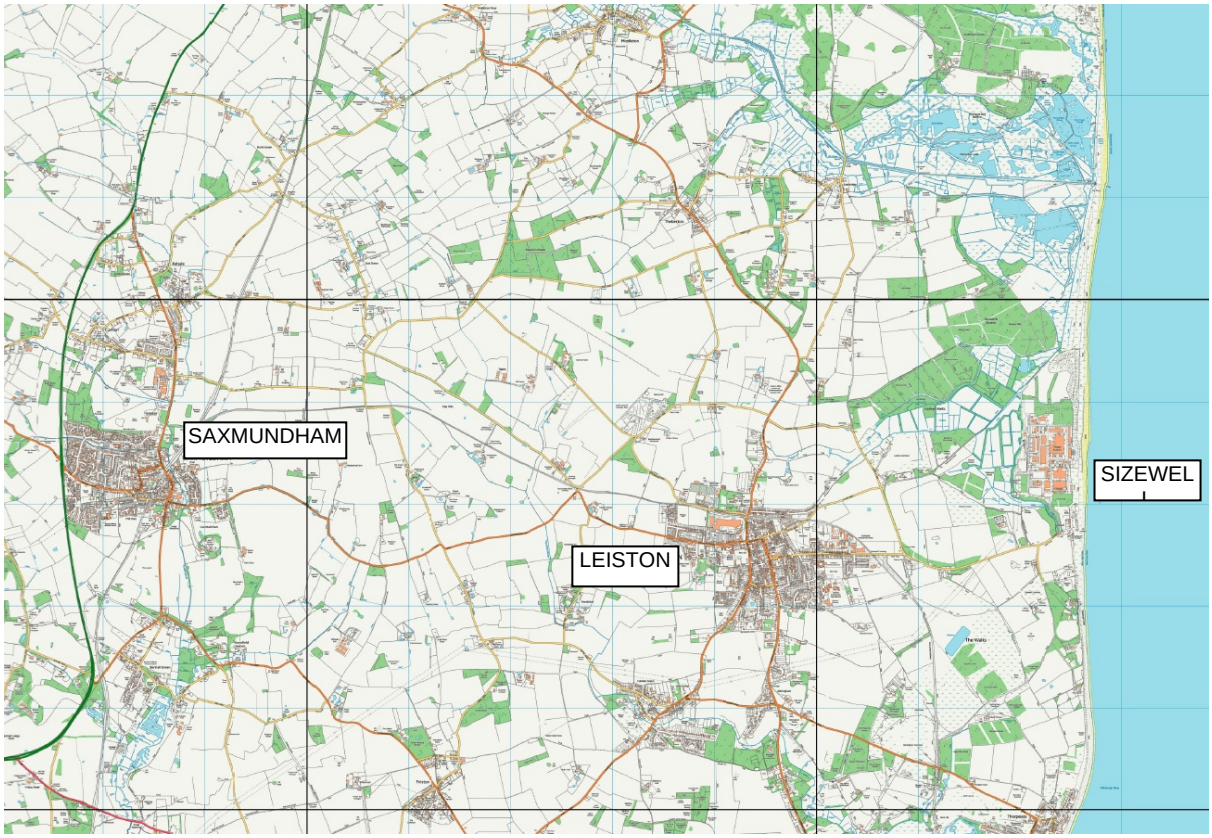
1.2.1 This section will look at the existing environmental conditions (predominantly landscape, visual and ecological) within and around the Sizewell C development site and provide the baseline lighting conditions. A summary of relevant legislation, standards, good practice guidelines and policies will be discussed.

ii. Site location

1.2.2 The development site boundary is shown in **Chapter 1** of this volume of the **Environmental Statement (ES)** (Doc Ref. 6.3).

1.2.3 The site is located to the north of the existing Sizewell B power station, approximately 500 metres (m) north of the hamlet of Sizewell, and 2 kilometres (km) north-east of the town of Leiston, at its closest point. Its location is approximately halfway between the towns of Felixstowe and Lowestoft see **Plate 1.1** and within the civil parish of Leiston, East Suffolk district and the county of Suffolk.

Plate 1.1: Location of Sizewell in East Suffolk



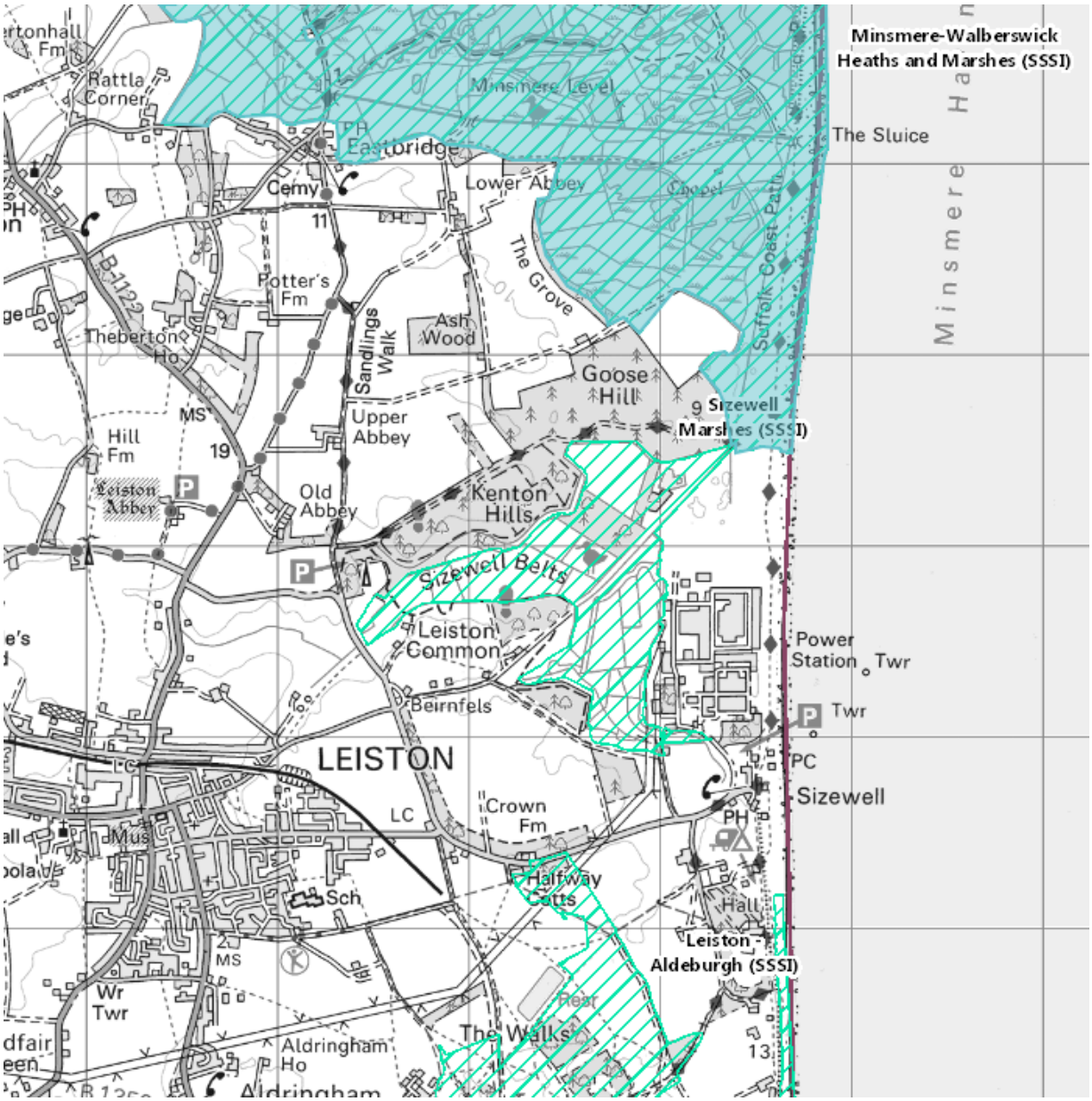
1.2.4 The North Sea is located adjacent to the eastern boundary of the site, with the Sizewell Belts ponds and drainage ditches located adjacent to the west and south of the site. Leiston Beck and Minsmere New Cut are located west of the main development site and Sizewell B. Parts of the main development site lie within Flood Zone 3, although are protected by existing flood defences.

1.2.5 There are a number of statutory environmental designations within the site. The majority of the onshore portion of the site is located within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB). The main development site is located in the Suffolk Coast and Heaths National Character Area which is a predominantly low-lying landscape characterised by productive agricultural areas.

1.2.6 Approximately 2.9 hectares (ha) of habitat would be temporarily lost from the Sizewell Marshes Site of Scientific Special Interest (SSSI) and would

then be restored following the construction phase. Approximately 7ha of permanent land take would occur from the SSSI. The site also borders Minsmere to Walberswick Special Protection Area (SPA) and Ramsar site. The Minsmere to Walberswick Heaths and Marshes Special Area of Conservation (SAC) and SSSI are located to the north-eastern boundary of the site, as shown in **Plate 1.2**.

Plate 1.2: Sites of Special Scientific Interest close to Sizewell [source:



http://magic.defra.gov.uk]

1.2.7 The northernmost boundary of the site is to the north of Ash Wood and south of Lower Abbey. At its southernmost extreme the site includes the land to the east of Eastlands Industrial Estate. The site is currently predominantly agricultural and commercial forestry land.

1.2.8 Land to the east of Eastlands Industrial Estate will be required temporarily for construction and for construction workers accommodation purposes. This part of the site comprises three arable fields to the east of Leiston bounded by Valley Road to the north, Lover's Lane to the east and King George's Avenue to the south. The western boundary is defined by a single rail track forming part of the Saxmundham – Leiston branch line, which serves the existing railhead in Leiston (Sizewell Halt).

1.2.9 The coastal strip within the site is characterised by a vegetated engineered embankment, known as Bent Hills and a lower vegetated bund which together form the sea defences to the existing Sizewell power stations. East of the lower bund is a shingle beach which shelves into the offshore portion of the site which includes the Sizewell A intake and outfall headworks structures. The site includes land within and adjacent to the Sizewell B secure perimeter which is characterised by structures associated with the existing operational Sizewell B power station, parking areas, access infrastructure, ancillary structures and overhead power lines and pylons. Buildings are arranged on an axial alignment and the area has a planned and industrial character. The coastal beach vegetation supports nationally scarce plant species such as sea pea and sea-kale and at Sizewell Marshes SSSI, wetland plant communities of national importance, including fen meadow dominated by blunt-flowered Rush, ditches with diverse aquatic plant assemblages and reedbed.

iii. The surrounding area

1.2.10 The area surrounding the site is rural, with agriculture utilising a significant portion of the gently rolling landscape. There are a number of other villages located nearby, including Eastbridge and Theberton approximately 500m and 1.2km, respectively, to the north-west at the closest point. The coastal towns of Thorpeness and Aldeburgh are located 3km and 6km, respectively, further south, with Dunwich and Southwold 4km and 12km, respectively, to the north. Ipswich is some 36km to the south-west.

1.2.11 Arable farmland is the predominant land use in the wider area with relatively large geometric fields defined by hedges and tree belts. Also present are areas of pasture, for example in the vicinity of Upper Abbey Farm; pockets of acid grassland and heathland; wet woodland, freshwater grazing marsh and reedbeds; and areas of conifer plantation, notably at Goose Hill.

1.2.12 Sizewell Belts is partly enveloped by the site to the north, east and west. This landscape is characterised by freshwater grazing marsh and a large part of the area is designated as the Sizewell Marshes SSSI. The Sizewell Marshes SSSI comprises a large area of lowland, unimproved wet meadows, for which it is designated, located in a low-lying basin of deep fen peat. The Sizewell Marshes SSSI site also contains an extensive network of ditches.

1.2.13 There are seven non-statutory local designated Country Wildlife Sites (CWS) within a 2km radius of the site, including the Sizewell Levels and associated areas CWS, and the Suffolk Shingle Beaches CWS. The main ecological habitats within the site are agricultural farmland with large areas of conifer plantation and smaller areas of deciduous woodland, acid grassland and heathland, with newly created acid grassland and reedbed at Aldhurst Farm.

1.2.14 To the east of the site lies the Suffolk coast. The shoreline in this area is characterised by stretches of shingle ridges, pebble and sand beaches and vegetated dunes.

1.2.15 For a detailed assessment of the landscape character within and around the site, please refer to **Chapter 13** of this volume**.**

b) Legislation, policy and guidance

i. National & local policy

1.2.16 The National Planning Policy Framework (NPPF) encourages sustainable development and by encouraging good design, planning policies and decisions should limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation. It also identifies that pollution is anything that affects the quality of land, air water or soils, which might lead to an adverse impact on human health, the natural environment or general amenity. Pollution can arise from a range of

emissions including smoke, fumes, gases, dust, steam, odour, noise and light.

1.2.17 Local and Regional Planning Policies that relate to lighting have been listed in **Chapter 13** of this volume**,** Night Time Landscape and Visual Appraisal.

ii. The need to light

1.2.18 Light pollution & nuisance – People need light to see and artificial lighting has become an essential requirement for construction and the safe operation of a nuclear power station. It is provided to encourage a safe environment for a range of activities including providing safe outdoor work places, driving, cycling, walking and sporting activities. It is also used to enhance the environment by means of decorative and flood-lighting of areas, features and buildings.

1.2.19 Whilst it is recognised that lighting needs to be provided, the incorrect use of such light can become a problem, causing a nuisance and affecting the environment by unwanted light intruding into properties, as well as wasting energy and therefore money. It can also have an impact on the wider environment, including on the night sky, visual amenity and influencing wildlife behaviours. Appropriate measures need to be taken where possible to limit these effects.

1.2.20 The operators of the proposed power station are required to consider the health and safety and security of those who work within the area. Consequently the need for lighting of both the construction site phase and the operational site is justified even within an SSSI and AONB site and an area of dark landscape. In fact, the operators of the proposed power station have a legal duty of care to ensure a safe workplace is provided.

1.2.21 The Workplace (Health, Safety and Welfare) Regulations 1992, as enforceable under the Health and Safety at Work Act 1974, maintain that safe lighting must be provided in all premises, including outdoor places, for all workplace activities, which include those carried out during construction and operation of the power station.

iii. How much light is required

1.2.22 The level of lighting depends upon the task to be undertaken to ensure that it can be performed safely. In general, national bodies including British Standards, The Institution of Lighting Professionals (ILP) and The

Chartered Institution of Building Services Engineers (CIBSE) prescribe required lighting levels.

1.2.23 It is important that any exterior lighting installation does not over-light, controls energy consumption and avoids light pollution or spill wherever practicable.

iv. Light pollution

1.2.24 Light pollution is a term that describes the release of light that serves no useful purpose as it falls outside the required area.

v. Sky glow

1.2.25 The release of light into the night sky, brightening the horizon, creates what is known as sky glow (as can be seen over most towns and cities) and reduces the enjoyment of the night sky by reducing the visibility of stars.

vi. Glare

1.2.26 Another form of pollution is glare, this is where a direct view of the light source presented to the viewer is a visual distraction and may present a hazard depending upon the intensity of the light source and the distance to the viewer.

vii. Legislation controlling light pollution

1.2.27 The Environmental Protection Act 1990 was revised on the 6th April 2006 by a supplementary section of the Clean Neighbourhoods and Environmental Act 2005 (CNEA) adding “artificial light emitted from premises as to be prejudicial to health or a nuisance” to a list of statutory nuisances.

1.2.28 Artificial light emitted from an airport, harbour premises, railway premises, tramway premises, a bus station and any associated facilities, a public vehicle operating centre, a goods vehicle operating centre, a light house or a prison are exempt from these changes. It should be noted that Sizewell C does not fall into any of the exempt premise types.

1.2.29 Other premises would also comply with the legislation where the operator employs “best practicable means” to prevent, or to counteract the effects of any light nuisance in respect to:

- Artificial light emitted from industrial, trade or business premises; or
- The artificial light (not being light to which the above applies) is emitted by lights used for the purpose only of illuminating an outdoor relevant sports facility.

1.2.30 It should be noted that highway lighting installations are not included as part of the CNEA, and therefore cannot be deemed as a statutory nuisance. However, the issues relating to artificial lighting and its potential effects on the environment and health of individuals is a topic of constant discussion within the highway lighting industry and manufacturers and designers alike employ good standard industry practices to reduce or minimise the effects of artificial lighting.

viii. Preventing light nuisance

1.2.31 Through the careful consideration and selection of lighting equipment at the planning and design stage it is possible to ensure that the required lighting levels for the various tasks that will be undertaken in the different areas of both the construction and operational areas of the site can be achieved whilst controlling light pollution.

c) Lighting baseline condition

i. Existing Sizewell A and B lighting

1.2.32 The Sizewell C development site lies within an area of intrinsically dark skies with the only other source of significant lighting in the immediate vicinity being that of the existing Sizewell A and B power stations.

Plate 1.3: Typical view of existing lighting at Sizewell A & B Power stations

1.2.33 The lighting infrastructure on the Sizewell A and B sites, illustrated on **Plate 1.3**, includes:

- Highway lighting, typically lighting columns;
- Security and operations lighting, comprising of columns, mobile flood lighting towers and building mounted luminaires; and
- Lighting emitted from buildings.

1.2.34 Within the existing Sizewell A and B sites there is a mixture of light sources comprising;

- Low Pressure Sodium (SOX) lamps (orange in appearance);
- High Pressure Sodium (SON) lamps (golden in appearance);
- Light Emitting Diodes (LEDs) a white light source; and
- Fluorescent and compact fluorescent lamps a white light source.

1.2.35 For a detailed assessment of the lighting on the existing Sizewell A and B sites refer to **Annex 2B.3**.

ii. Baseline lighting environment

1.2.36 In order to obtain a night time assessment of any lighting on the landscape and visual receptors, the site was visited by members of the landscape team from LDA Design between 9 February 2016 and 20 March 2019

between the hours of 17:00hrs and 20:45hrs to record views to illustrate the level of existing illumination. Night time viewpoints are summarised in **Table 1.1** and are shown in more detail in **Chapter 13** of this volume, and are also discussed in **Appendix 13B**: Night time landscape and visual appraisal.

iii. Viewpoint locations

Table 1.1: Locations of night time viewpoints

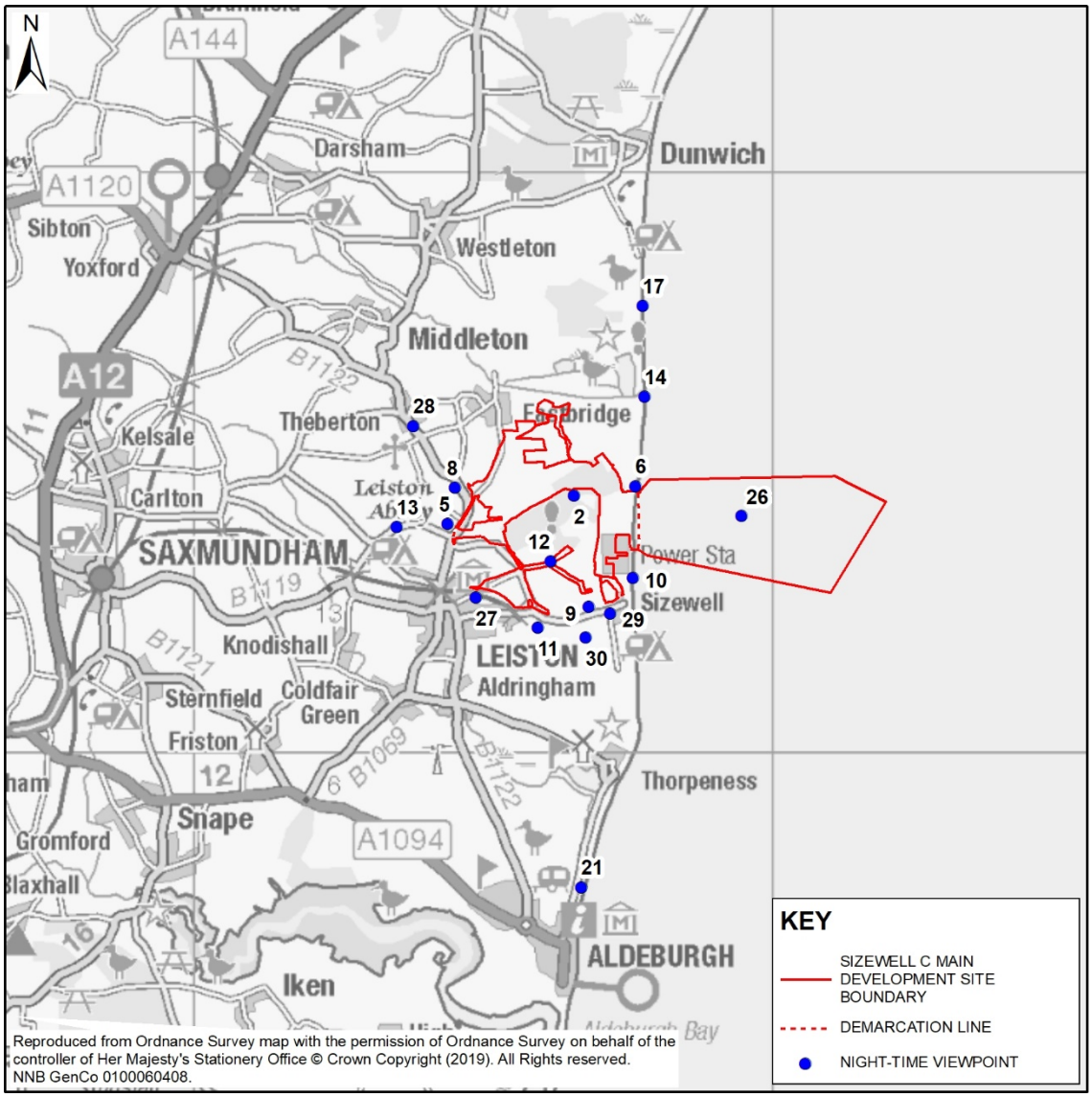
Viewpoint Number (LDA Reference)	Viewpoint Descriptive	Viewpoint OS Co-ordinates	Date Viewpoint Photograph Taken	Time Photograph Taken
Viewpoint 2 (R2)	Permissive path at Kenton Hills.	646563 E 264432 N.	27/02/2019	18:40
Viewpoint 5 (R5)	Footpath south of Leiston Abbey.	644377 E 263946 N.	27/02/2019	20:50
Viewpoint 6 (R6)	Suffolk Coast Path east of Goose Hill.	647623 E 264593 N.	10/02/2016	20:50
Viewpoint 8 (R8)	Footpath north of Leiston Abbey.	644508 E 264568 N.	27/02/2019	20:35
Viewpoint 9 (R9)	Sizewell Gap south of Greater Gabbard Sub-Station.	646816 E 262514 N.	27/02/2019	20:00
Viewpoint 10 (R10)	Suffolk Coast Path and Sandlings Walk east of Hill Wood.	647573 E 263015 N.	27/02/2019	19:15
Viewpoint 11 (R11)	Junction of footpaths south west of Halfway Cottages.	645933 E 262157 N.	16/02/2016	18:30
Viewpoint 12 (R12)	Bridleway south east of Reckham Lodge.	646156 E 263298 N.	09/02/2016	18:30
Viewpoint 13 (R13)	Abbey Lane east of Cakes and Ale Caravan Park.	643501 E 263893 N.	16/02/2016	20:45
Viewpoint 14 (R14)	Suffolk Coast Path at Minsmere Sluice.	647781 E 266137 N.	10/02/2016	19:00
Viewpoint 17 (R17)	National Trust Dunwich Coastguard Cottages car park.	647743 E 267703 N.	24/02/2016	19:00
Viewpoint 21 (R21)	Aldeburgh beach car park.	646689 E 257683 N.	15/02/2016	17:00
Viewpoint 26	1800m directly east of	649452 E	23/02/2016	18:50

Viewpoint Number (LDA Reference)	Viewpoint Descriptive	Viewpoint OS Co-ordinates	Date Viewpoint Photograph Taken	Time Photograph Taken
(R26)	Sizewell power stations.	264084 N.		
Viewpoint 27 (R27)	Footpath, Valley Road Allotments, Leiston.	644870 E 262678 N.	27/02/2019	20:15
Viewpoint 28 (R28)	Footpath south of Theberton.	643788 E 265632 N.	27/02/2019	20:15
Viewpoint 29 (R29)	Sandlings Walk at Home Farm.	647184 E 262405 N.	20/03/2019	19:25
Viewpoint 30 (R30)	Junction of Footpaths, The Walks.	646762 E 261985 N.	27/02/2019	19:40

1.2.37 The view point locations were selected from the Principal Viewpoints for the Landscape and Visual Assessment, provided in **Chapter 13** of this volume and **Appendix 13B** of this volume.

1.2.38 Night viewpoints are shown in **Plate 1.4** in blue.

Plate 1.4: Viewpoints including night-time viewpoints



iv. Overview of existing lighting conditions

1.2.39 From inspection of the seventeen night-time locations, four locations have been chosen as representative samples of the surrounding site, giving good context and capturing the landscape character and environmental constraints. The selection of these four key locations for lighting receptors has been based on professional lighting judgement. These four key

locations are located north, east, south and west of the proposed development site. These locations are Viewpoint 14 (R14) (North), Viewpoint 26 (R26) (east), Viewpoint 30 (R30) (south) and Viewpoint 13 (R13) (west). In addition, viewpoints 2 (R2) and 12 (R12) have been selected for their views across the Sizewell Marshes / Belts SSSI site. The key lighting receptor locations are discussed below.

Plate 1.5: Viewpoint 14 (R14) Suffolk Coast Path at Minsmere Sluice (North)

1.2.40 Viewpoint 14 is located approximately 1km from the Sizewell C development site boundary. The existing Sizewell A and B power stations to the centre of **Plate 1.5** can clearly be seen along with sky glow from the nearby towns.

Plate 1.6: Viewpoint 26 1800m directly east of Sizewell power stations (East)

1.2.41 Viewpoint 26 is located approximately 1.8km off shore within the Sizewell C development site boundary. The existing Sizewell A and B power stations can clearly be seen in centre **Plate 1.6**.

Plate 1.7: Viewpoint 30 Junction of Footpaths, The Walks (South)

1.2.42 Viewpoint 30 is located approximately 0.95km from the Sizewell C development site boundary. The existing Sizewell A and B power stations can clearly be seen in centre of **Plate 1.7**.

Plate 1.8: Viewpoint 13 Abbey Lane east of Cakes and Ale Caravan Park (West)

1.2.43 Viewpoint 13 is located approximately 1.0km from the Sizewell C development site boundary. The existing Sizewell A and B power stations can clearly be seen in centre of **Plate 1.8**.

Plate 1.9: Viewpoint 2 Permissive path at Kenton Hills

1.2.44 Viewpoint 2 is located approximately 0.15km from the closest Sizewell C development site boundary and overlooks the Sizewell Marshes / Belts SSSI site. As can be seen on **Plate 1.9,** this is an intrinsically dark view with little or no visible light from the existing site.

Plate 1.10: Viewpoint 12 Bridleway south east of Reckham Lodge

1.2.45 Viewpoint 12 is located on the Sizewell C development site boundary and overlooks the Sizewell Marshes SSSI. The existing Sizewell A and B power stations can be seen to the right of **Plate 1.10**.

1.2.46 As can be seen from the viewpoints above, the existing Sizewell A and B power stations do provide a source light spillage on what is an intrinsically dark landscape. The existing light spillage from Sizewell A & B Power stations is due in part to age and type of lighting equipment used to illuminate the existing sites. Poor mounting configurations of the luminaires also add to the light spillage and skyglow. There are several instances where individual or clusters of luminaires are causing direct glare to the observer. Improvements to the lighting on the existing site could be made to reduce light spillage from the existing site but does not form part of this report.

d) Environmental considerations

i. General

1.2.47 There are various environmental considerations that need to be taken into account when considering the installation of exterior lighting. These are the direct energy usage, the visual impact of the lighting equipment during the day, the effect of light spillage on surrounding areas, the spill of light into the night sky, and the effects on human receptors, animal, plant life and surrounding landscape.

1.2.48 The above mentioned factors will vary depending on the location of the proposed lighting installation and can also vary within a site.

1.2.49 The Institution of Lighting Professionals (ILP) document "GN01: Guidance notes for the reduction of obtrusive light (2020)" and International Commission on Illumination CIE 150: 2017, establish five Environmental Zones, as provided in **Table 1.2**. Each zone has a different approach to the provision of external lighting. These zones establish 'Obtrusive Lighting Limitations for External Lighting Installations' and include the effects of 'Sky Glow' and maximum values of vertical illuminance on properties. The document also includes 'limits for the luminous intensity of bright luminaires'; the potentially obtrusive direction of light outside the area being lit.

Table 1.2: ILP GN01 Maximum values of vertical illuminance on properties

Light Technical Parameter	Application Conditions	Environmental Zones				
		E0	E1	E2	E3	E4
Illuminance in the vertical plane (Ev).	Pre-curfew	n/a	2lx	5lx	10lx	25lx
	Post-curfew	n/a	<0.1lx*	1lx	2lx	5lx

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

1.2.50 The limits published within these documents set upper performance levels above which the lighting would be considered as a nuisance within each environmental zone. Curfews are normally applied after a locally agreed hour when the lighting levels may be reduced or switched off.

1.2.51 In general, the effect of distance from the lighting source / installation has the effect of reducing the lighting levels falling on a surface, but has little effect regarding source intensity which tends to be more affected by the background against which it is viewed. In basic terms, a bright torch shining towards an observer will appear brighter when the background it is viewed against is darker than it would, say, in a town or city centre which is likely to have high background lighting levels.

1.2.52 The five environmental zones are defined as detailed in **Table 1.3**.

Table 1.3: ILP environmental zones classification

Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark	UNESCO starlight reserves, IDA dark sky

Zone	Surrounding	Lighting Environment	Examples
			parks.
E1	Natural	Intrinsically dark.	National parks, Areas of Outstanding Natural Beauty etc.
E2	Rural	Low district brightness.	Village or relatively dark outer suburban locations.
E3	Suburban	Medium district brightness.	Small town centres of suburban locations.
E4	Urban	High district brightness.	Town/city centres with high levels of night-time activity.

1.2.53 The environmental zones are normally grouped as E1/E2 and E3/E4 and are considered as rural and urban respectively.

1.2.54 Based upon the lighting baseline condition, the information above and the limits within **Table 1.2**, the area of development is considered to be in an intrinsically dark area and, as such, any lighting installed should be designed to meet the limitations laid out for an E1 Environmental Zone.

1.2.55 **Sections 1.3** and **1.4** of this report set out the lighting strategy during the construction and operational phases of the proposed power station.

ii. Flora and Fauna

1.2.56 From the point of view of the impact of artificial lighting on wildlife, there have been a number of reports published over the years with the main focus being on bats, however a document that looks at the broader wildlife is 'Wildlife and Roads, The Ecological Impact' which incorporates a section regarding 'The ecological effects of road lighting on wildlife' by A. Outen. He has investigated the general impact of artificial lighting on wildlife and in conclusion has found that the colour temperature of the light source used is significant to its impact on the wildlife.

1.2.57 Outen's research shows that the use of:

- Low Pressure Sodium (SOX) light sources, an orange monochromatic source, has a negligible affect;

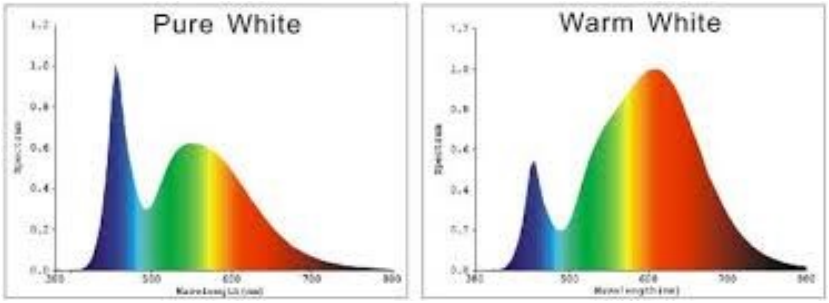
- High Pressure Sodium (SON) lighting, a more golden light source, has minimal effect and attracts insects;
- White Lighting (Metal Halide, CDO, CPO, PLL,) has a significant effect on wildlife, disrupting its 24 hour cycle in part due to the high ultra-violet (UV) content of the light to which insects in particular are very sensitive.

1.2.58 Additional research carried out by many others has shown that the disturbance of insects in relation to the use of artificial lighting has a knock-on effect to the 24 hour patterns of other wildlife such as birds and bats.

1.2.59 The development of LEDs as a viable lighting technology has led to this technology becoming an energy-efficient alternative to the conventional light sources more commonly associated with highway and exterior lighting installations. LED technologies with higher energy efficiencies, long life and colour rendering properties are a viable and cost-effective alternative. However, research into the effects of such light sources on bats is in its infancy and no definitive answers can be formed as to how light produced by an LED light source affects bats. It is known that bats are affected by light sources that have high UV levels, and broad spectrum lights, particularly those with high blue light content, and these should be avoided or their use kept to a minimum where practicable to minimise their effects.

1.2.60 It should be noted that very few light sources utilised in exterior lighting actually emit UV, UVa or UVb, and those emissions are normally filtered out by the lamps' glass envelope or the glazing on the lantern / optics. Focus is therefore on the blue content within the spectrum of a light source and the effect this may have.

Plate 1.11: Colour spectral charts for cool and warm LEDs (note the difference in blue content)



iii. Bats

1.2.61 The following section provides some general guidance on bats and artificial lighting; more specific site management and mitigation measures are provided in later sections of this report.

1.2.62 The Institution of Lighting Professionals (ILP) in collaboration with the Bat Conservation Trust have recently published GN 08/18 Bats and artificial lighting in the UK, Bats and the built environment series. This document is aimed at lighting professionals / designers, planning officers, developers, bat workers / ecologists and anyone who specifies lighting. It is intended to raise the awareness of the impacts of artificial lighting on bats and suggests mitigation measures for various scenarios, rather than to replace a site-specific ecological and lighting assessment / management plan.

1.2.63 As further research has been carried out, our understanding of how artificial lighting impacts bats is ever increasing. Some of the key findings are:-

- Artificial lighting is thought to increase the chances of predation and so bats may modify their behaviour.
- Different types of luminaires and light sources emit different spectrums of light. See **Plate 1.11**. This has an impact on the amount of insects that will be drawn to the light source.
- Illumination of a bat roost can cause disturbance and may result in the colony abandoning the roost or even becoming entombed within it.
- Illumination of the entrance to a bat roost may delay bats from emerging and will potentially shorten foraging times.

- Lighting may also impact on flight paths and commuting routes
- Lighting in addition to disturbance at the roost may also affect feeding behaviour. There are two elements to this a) certain light sources attract a range of insects and this may alter foraging habits. b) the presence lit conditions may act as a barrier to movement.
- Illumination of drinking resources such as water ways, ponds and cattle troughs can stop bats from drinking.
- Some impacts on bat migration have also been studied.

1.2.64 In summary, artificial lighting does have an effect on all species of bats to a greater or lesser extent for all their night time activities. Where bats are present or likely to be present, a professional ecologist's advice should be sought and the lighting designed to mitigate any impacts as far as practically possible.

iv. Lighting Design Considerations Where Bats Are Present

1.2.65 As previously stated the operators of the proposed power station have a legal duty of care to ensure a safe work place is provided during construction and operation. As a consequence, artificial lighting will be required; light pollution, obtrusive light and its effect on flora and fauna in the surrounding environment must also be considered

1.2.66 The first question that has to be answered is "Do I need to light it?". If so, then the lighting should be designed under the principal of Ultra Efficient Lighting (UEL) which means that the right light will be provided at the right time, in the right place, controlled by the right system. This is effectively broken down as follows:

- Right light – look to the correct application of the lighting standards which define the required lighting levels dependent upon the tasks being undertaken and the level of activity. This also looks to the use of the right light source which should be as energy efficient as possible and will include due consideration of LED lighting whilst also taking due consideration of the mitigation requirements for the impact of the light source on bats, wildlife and the wider environment as previously identified.
- Right time – the standards permit light levels to be changed dependent upon use, i.e. when activity levels fall then the light levels

can be redefined. With respect to this development, the lighting will need to be in situ for construction workers and plant operatives, and to provide security during the hours of darkness to ensure safe navigation within the site and surrounding compounds both during the construction and operation.

- Right place – ensuring that only the tasks which need to be lit are illuminated, reducing spill and obtrusive light. This is achieved through the careful consideration of luminaires and how they are mounted / installed.
- Right system – the most energy-efficient lighting installation requires a suitable control system that could also permit monitoring and its remote operation (dependent on the operating parameters).

1.2.67 A key element where bats are present is the type of light source employed. Lighting professionals have a palette of sources available to them ranging from the 'old' High Pressure Sodium (golden) lamps through to metal halide and now LEDs, and many more. These sources all have different spectra and thus, from a human perspective, different abilities to render (replicate) colours accurately. This is described as their colour rendering index (CRI), illustrated on **Plate 1.12**; denoted Ra, and measured on a scale of 0 to 100, the CRI indicates how well a source replicates colours based upon day-light conditions: a score of 0 being no colour rendering through to 100 being (equivalent to) daylight.

Plate 1.12: Colour rendering index (CRI)

1.2.68 **Table 1.4** gives indicative colour-rendering recommendations for various areas and tasks.

Table 1.4: Indicative colour rendering index recommendations

Area	Application	Minimum Ra
Roads/footways	Walkways exclusively for pedestrians.	20
Roads/footways	Traffic areas and roads for slow moving vehicles, max 6mph (e.g. trucks & excavators).	20
Roads/footways	Regular vehicular traffic (max 25mph).	20
Roads/footways	Pedestrian passages, vehicular turning. Loading and unloading points.	20
Outdoor working & storage areas.	Short-term handling of large units & raw materials, loading & unloading of solid bulk goods.	20
Outdoor working & storage areas.	Continuous handling of large units and raw materials, loading & unloading of freight lifting and descending location for cranes, open loading platforms.	20
Outdoor working & storage areas.	Reading of addresses, covered loading platforms, use of tools, ordinary reinforcement and casting tasks in concrete plants.	20
Outdoor working & storage areas.	Demanding electrical, machine and piping installations, inspection. (use local lighting).	60
Security	vehicle storage areas, industrial yards and storage areas; vehicle storage areas element mould, timber and steel storage, building foundation hole and working areas on sides of the hole at building sites etc.	20
Security	Checkpoints	80
Security	Gatehouses	80

1.2.69 These days, with the wider use of LEDs, the use of white light sources with an Ra>60 is more common.

1.2.70 With the introduction of LED light sources, we also need to understand Colour Temperature, which is a measure (in degrees Kelvin) of how 'warm' (2000 to 3000k) or 'cool' (4000 to 6000k) the colours appear, as shown in **Plate 1.13** below. The higher colour temperature sources appear cooler with a higher blue light content.

Plate 1.13: Colour rendering examples; cool white to warm white

1.2.71 Research across Europe is showing that amber light has a negligible effect on wildlife. We are therefore starting to see certain suppliers of LED products presenting a more wildlife- friendly product in which the blue wavelength is minimised, and the light has a more golden / amber feel to it, whilst still providing good colour rendering and performance.

v. Summary of impacts of light types on bats

1.2.72 Studies continue to look at the comparative impacts of different light sources on different bat species and behaviours. However, **Table 1.5** extracted from 'Bats and Lighting – Overview of Current Evidence and Mitigation' (2014) provides a good summary of what is known of existing light sources and the likely effects on bats and their behaviours. This table should be used as a guide and general summary only as research is always ongoing.

1.2.73 **Plate 1.14** is an extract from 'Bats and Lighting – Overview of Current Evidence and Mitigation' and provides a good guide for the impacts of light types on bats as identified in **Table 1.5**.

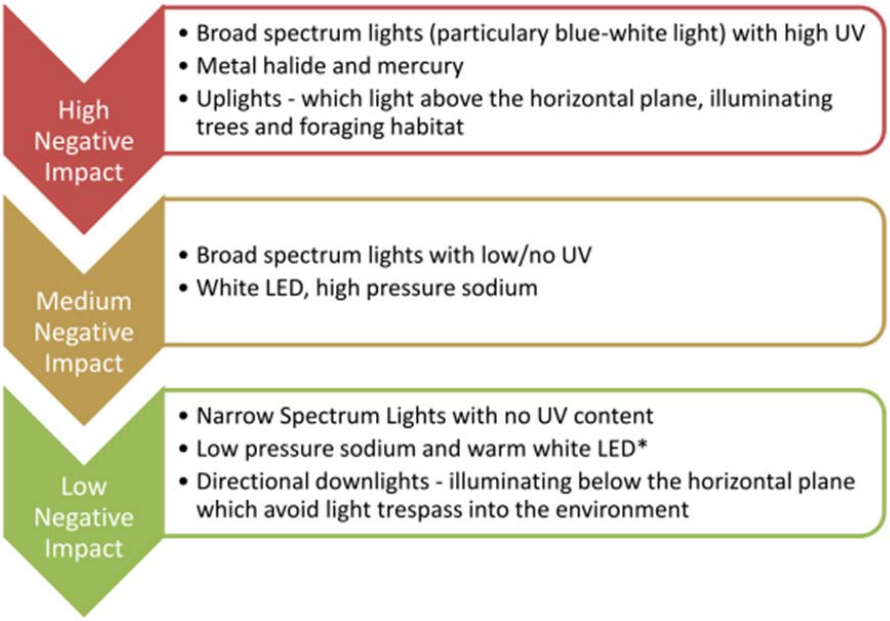


Plate 1.14: Relative impact of types of lights on bats (guidance only)

*Low relative attractiveness for insects compared to white light and therefore minimal impact on bats insect prey (Eisenbeis 2009)

Table 1.5: Extracted from 'Bats and Lighting – Overview of Current Evidence and Mitigation'

Light type	Species	Impact	Evidence
White LED.	Rhinolophus hipposideros and Myotis spp.	Reduced activity and special avoidance of commuting routes.	"Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats" (Ref. 1.1)
Warm white LED.	Unknown at present.	Unknown – though likely to have less impact on light-sensitive species than white light types.	
Low pressure sodium.	Nyctalus noctula.	Increased activity and foraging.	"Bats and streetlamps. The Bats Magazine" (Ref. 1.2)
	Pipistrellus spp.	No significant increase in activity compared to	"The Switch from Low-Pressure Sodium to Light

Light type	Species	Impact	Evidence
		dark areas.	Emitting Diodes Does Not Affect Bat Activity at Street Lights" (Ref. 1.3)
High pressure sodium.	Rhinolophus hipposideros and Myotis spp.	Reduced activity and spatial avoidance of commuting routes; delayed commuting time.	"Street lighting disturbs commuting bats. Current biology" (Ref. 1.4) "Bats and development: with a particular focus on the impacts of artificial lighting" (Ref. 1.5)
	Pipistrellus spp., Nyctalus noctula, Eptesicus serotinus	Increased activity and foraging.	"Bats and streetlamps. The Bats Magazine" (Ref. 1.2)
Compact fluorescent.	Unknown at present.	Unknown – though likely to have a similar impact on light sensitive species as other white light types.	
Mercury vapour lamps.	P. pipistrellus and Pipistrellus spp., Eptesicus spp.	Increased activity ("Seasonal use of illuminated areas by foraging northern bats" (Ref. 1.6)) recorded increased activity of Eptescius nilssoni (a species not present in the UK) at mercury vapor lamps in Sweden in spring.	"Abundance of Pipistrellus pipistrellus and Pipistrellus kuhlii foraging at street-lamps" (Ref. 1.7) "Street lamps and the feeding ecology of insectivorous bats. Symposium of the Zoological Society London" (Ref. 1.8)

1.3 Construction lighting Management plan

i. Lighting Objectives

1.3.1 The primary objective of lighting during the construction phase is to provide illumination for construction activities providing a safe working environment in the absence of natural light, allowing workers and site traffic to safely

undertake various construction-related tasks and to provide security lighting.

1.3.2 As discussed earlier, the Sizewell C site sits in a sensitive environment and is considered to be within an E1 Environmental Zone, as defined in **Table 1.3**. The site also supports a valuable assemblage of bats. The required lighting therefore needs to be designed to minimise impact on the surrounding environment.

1.3.3 The objectives of this section of the LMP are to achieve the following:

- provide a safe working environment, meeting statutory requirements and standards;
- allow 24hr working (when required);
- provide site security lighting; and
- mitigate the impact of artificial lighting on the surrounding environment as far as reasonably practicable.

ii. Required Lighting Levels

1.3.4 Due to the dynamic nature of a construction site, there will be the need for different levels of illumination needed for certain tasks or stages in the construction process in order to provide a safe working environment. Some areas will require suitable task lighting while other areas will require a level of ambient lighting.

1.3.5 Task lighting – Task lighting will typically be provided for construction activities and the required levels will vary depending upon the type of activity being undertaken. For example, clearance, excavation and loading typically requires an average of 20 lux, whereas undertaking fine work such as framework element mounting, light reinforcement work, wooden mould and, electric piping and cabling typically require an average of 100 lux or more. There are various standards with various lighting levels which set out the required lighting levels for the various tasks that will need to be undertaken and these can be found in **Annex 2B.1** of this document. The most appropriate standard shall be used. Task lighting will also be required at security check points to allow the inspection of vehicles entering and exiting the site. It shall be the responsibility of the appropriate Contractor to undertake the design of any required task lighting making sure it meets with

the required standards and the recommendations/restrictions set out within this LMP and is submitted to NNB GenCo for approval prior to installation.

1.3.6 Ambient lighting – Ambient lighting will be constant and typically be provided to aid the safe navigation for areas such as access roads, footpaths, car parks contractors' compounds and accommodation areas. Typical levels will be an average of 5 to 30 lux, depending on the area to be lit. There are various standards which set out the required lighting levels for the various tasks that will need to be undertaken and these can be found in **Annex 2B.1** of this document. The most appropriate standard shall be used. Where ambient lighting is identified as 'required', it will be implemented whenever natural light levels are insufficient.

iii. Areas to be lit and Associated Activities

1.3.7 For the construction phase, the zones detailed in **Table 1.6** have been identified, along with the associated activity or task being undertaken that requires lighting. For details of the zones, please refer to **Figure 2B.1**.

Table 1.6: Construction zones and activity/tasks being undertaken

Zone	Description	Activity / Task	Comments
Zone A	Main construction area.	Construction of the permanent operational site.	Task and ambient lighting will be required in this area.
Zone B	Temporary construction area – common user facilities, contractor compounds and other yards.	Temporary construction and fabrication areas for various elements of the power station construction. This area also includes roads and car parks.	Task and ambient lighting to specific lighting levels within the temporary construction area will be required at various periods during the construction programme. Ambient lighting will mainly be limited to the roads and car parks but may also include areas of contractor's compounds.
Zone C	Temporary construction area – borrow pit and stockpiles.	Temporary excavation and bulk storage areas to facilitate the power station construction.	Task lighting will be required exceptionally when there is a requirement to carry out material movements or essential maintenance in hours of darkness. There will typically be no ambient lighting in these areas, as they

Zone	Description	Activity / Task	Comments
			are expected to be used infrequently during hours of darkness. Any fixed lighting in these areas will only operate when there is a requirement to access the area.
Zone D	Temporary construction area – accommodation campus.	Temporary accommodation for workers during power station construction, including roads, footpaths and car parks.	Ambient lighting will be required.
Zone E	Temporary construction area – site entrance hub.	Parking facilities, temporary buildings, security facilities and freight management.	Task and ambient lighting will be required in this area. Task lighting should be localised to the task being undertaken. Ambient lighting will mainly be limited to the roads and car parks.
Zone F	Roundabout, junctions and level crossing.	New permanent interfaces with the public highway and level crossing of the railway line.	The lighting in these areas will be based on highway and network rail design standards.
Zone G	No fixed lighting.	These areas typically provide ecological buffers between construction activity and retained habitats.	If any lighting is required in these areas it should be short duration (if unavoidable) and be pre-agreed with the on-site ecology team, and be comprising of temporary equipment of an agreed type(s).
Zone H	Railway infrastructure.	New rail spur to the construction site.	Task lighting will be localised to the task being undertaken.
Zone I	Rail inspection area.	Security and access control area on the railway track.	Task and ambient lighting will be required in this area. Task lighting should be localised to the task being undertaken. Ambient lighting will mainly be limited to a security level.
Zone J	Sizewell B Relocated Facilities.	Relocation of certain facilities associated with Sizewel B	Task lighting will be localised to the task being undertaken.
Zone K	National Grid land	Substation and pylon works	Task lighting will be localised

Zone	Description	Activity / Task	Comments
			to the task being undertaken.

b) Mitigation Measures

i. General Construction Phase Mitigation Measures

1.3.8 A range of mitigation measure are available to address the potential impact from the construction phase lighting. These range from equipment choice, use of site topography and competent design and site management.

1.3.9 The following mitigation measures shall be adopted for both fixed and temporary lighting:

- adopt the lowest safe lighting levels possible for task being undertaken;
- limit the hours of lighting where practicable;
- use a luminaire with good optical control;
- use the lowest possible mounting for the luminaire based on the required level of illumination needed for the task being undertaken;
- direct luminaires into the area to be lit (light from the boundary inwards);
- ensure the luminaire is mounted at zero degrees to the horizontal and avoid any tilt;
- if required, make use of manufacturers' supplied custom louvres; and
- provide local control for the lighting so it may be switched off when not required.

1.3.10 In addition to the physical equipment, lighting should be placed such that it makes use of the existing and proposed topography.

- Keep mounting heights lower than fences and bunding, where practicable.
- Position equipment so it is not visible to sensitive receptors by using natural screening.

1.3.11 All lighting installations would be designed by a competent lighting professional that ideally meets the ILP competency requirements, and who is at least a member of the ILP and is accredited to the Engineering Council as I.Eng or greater.

1.3.12 Prior to first use of any lighting on-site during the construction phase, the lighting shall be inspected and verified by SZC Co. to ensure it has been installed as per the design and the specified equipment and optics are installed.

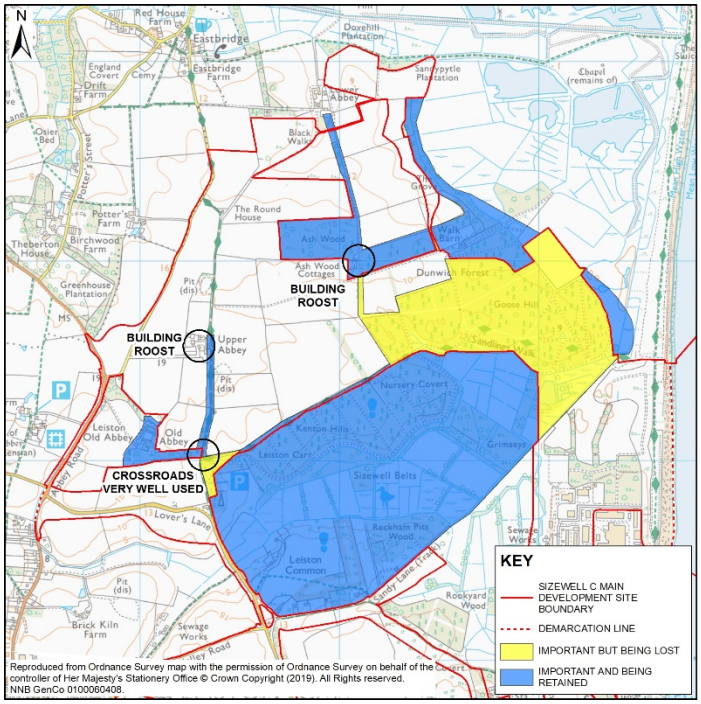
1.3.13 The lighting installation shall be periodically inspected during the site operations to ensure the correct aiming directions are maintained throughout the life of the installation. If any equipment is found to be incorrectly aligned, modifications shall be made to ensure it is restored to 'as designed' and, if required, re-inspected. This monitoring procedure shall ensure that, during the time the site is occupied, the levels of lighting are maintained in accordance with current best practice and standards whilst ensuring the potential impact associated with the introduction of temporary lighting on identified receptors is controlled and minimised as far as practicably possible.

c) Sensitive Areas

i. Bat sensitive areas

1.3.14 As previously mentioned in this document, there are several areas within and adjacent to the main development site that are particularly important for bat roosting and foraging and are shown in **Plate 1.15**.

Plate 1.15: Areas important for bats



1.3.15 There are a large number of trees that provide conditions suitable for roosting bats, which together comprise the 'roost resource'. This includes trees that are confirmed to have been used as roosts, notably within Ash Wood, Kenton Hills, The Grove, Leiston Abbey. Buildings at Upper Abbey Farm and Ash Wood Cottages also support roosts. There are also several commuting routes / flight paths along bridleway E-363/019/0, north from Ash Wood (Black Walks) and the Grove, and east-west along the northern edge of Kenton Hills. The junction (Known as The Crossroads) of the Upper Abbey Bridleway and Leiston Old Abbey, adjacent to Fiscal Policy is also well used. Areas of greatest value to foraging bats varies between seasons and years, but include Ash Wood and areas to the north, part of the Upper Abbey bridleway, Leiston Old Abbey, Kenton Hills/Nursery Covert, rides within Goose Hill, and Sizewell Marshes SSSI.

1.3.16 Parts of Goose Hill and Sizewell Marshes SSSI will be within the construction footprint, and all retained areas adjacent to the site boundary shall be kept as dark as reasonably practicable.

1.3.17 Where foraging routes and flight paths interconnect over the temporary construction area where reasonably practicable these connecting areas

shall be left dark. Where lighting in these areas has been deemed necessary the lighting shall be switched off when not required.

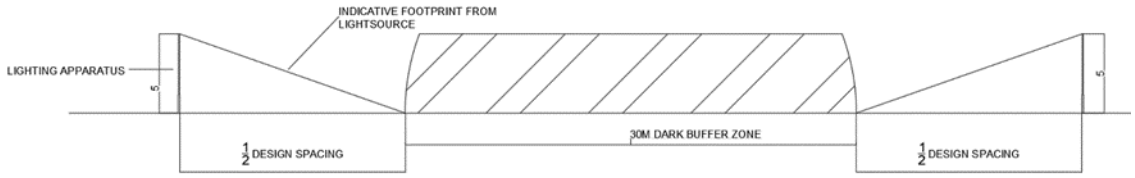
ii. Lighting mitigation measures to be adopted in proximity to bat roosts & commuting routes / flightpaths

1.3.18 Where lighting in proximity to a bat roost or commuting route/flightpath is unavoidable then, in addition to the points made in the Mitigation Measures section, the following additional mitigation measures shall be adopted for both fixed and temporary lighting:

- use a light source that has a narrow spectrum with no UV content;
- use a warm colour temperature (2700K and below); and
- use a tuneable LED luminaire.

1.3.19 Where the interconnected network crosses a lit area these areas shall be kept dark by introducing a gap in the lighting design where safe to do so. For example, if they are dissected by a road, a gap of approximately 30m will be left beyond the design spacing of any lighting. Where lighting is proposed parallel to commuting routes / flightpath a 10m buffer zone will be left. **Plate 1.16** shows the 30m dark buffer zones.

Plate 1.16: Creation of 30m buffer zones



iii. Indicative lighting levels for bat sensitive areas during construction phase

1.3.20 Three areas where bat activity is known to occur have been selected and indicative lighting models have been produced to illustrate what level of lighting likely to occur on these areas if the mitigation measures are followed. At this time generic luminaires have been used and are modelled for the worst case scenario. This is the first day of operation, when there has been no loss of light due to lumen depreciation or dirt build up on the

luminaire and with no mitigation measures in place, such as shields and baffles.

1.3.21 The three areas are listed below and shown on **Plate 1.17**:

- Area 1 – Bridleway 19 adjacent to the proposed campus.
- Area 2 – Southern edge of temporary construction area, Kenton Hills.
- Area 3 – SSSI crossing.

Plate 1.17: Location of indicative areas of lighting for areas of bat activity

1.3.22 Area 1 the Bridleway 19 is situated to the north west of the construction site area with the proposed campus to the west and stockpile areas to the east. The bridleway will remain as a green corridor and no fixed lighting is planned for it. It has been identified that bats use the bridleway as an important commuting and foraging route.

1.3.23 An indicative lighting model has been prepared for a section of the bridleway to show the lighting levels that may occur on the bridleway.

1.3.24 The lighting levels have been calculated on the following planes:

- Calculation 1 – Horizontal illuminance at ground level on carriageway within the Campus.
- Calculation 2 – Horizontal illuminance at ground level on the bridleway.
- Calculation 3 – Vertical illuminance on the hedgerow east side of the bridleway from ground level to 20m above ground level directed towards the campus.

1.3.25 The calculated values are summarised in **Table 1.7** below.

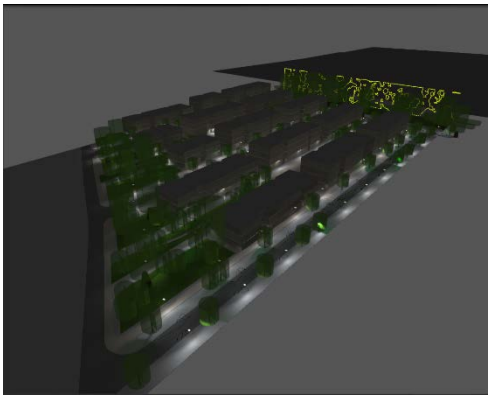
Table 1.7: Area 1 – Bridleway 19 – indicative lighting levels

Grid Location	Average Illuminance (lux)	Minimum Illuminance (lux)	Maximum illuminance (lux)	Comments
Calculation 1	6.76 lux	0.008 lux	110 lux	No masking of areas.
Calculation 2	0.003 lux	0.001 lux	0.005lux	--
Calculation 3	0.096 lux	0.001 lux	0.18 lux	--

NOTE: At the time of preparing this Lighting Management Plan no detailed designs for the campus area have been undertaken so the proposed lighting is for indicative purposes only and will be subject to a detailed design

1.3.26 **Plate 1.18** and **Table 1.7** show how the bridleway can be maintained as a dark buffer zone whilst still providing the required lighting levels for the accommodation campus.

Plate 1.18: Indicative lighting model for accommodation campus with the Bridleway maintained as a dark route



1.3.27 Area 2, the southern edge of temporary construction area, Kenton Hills is situated to the east of the rail terminal and north of Sizewell Levels and it is proposed the areas will be used as contractor compounds. The existing hedge line that runs from east to west and forms the boundary to Kenton Hills has been identified as an important bat foraging route.

1.3.28 An indicative lighting model has been prepared for a section of the proposed contractors compounds and rail terminal area.

1.3.29 The lighting levels have been calculated on the following planes:-

- Calculation 1 – Horizontal illuminance Platform / terminal area 1.
- Calculation 2 – Horizontal illuminance Platform / terminal area 2.
- Calculation 3 – Horizontal illuminance sample area of contractors compound 1.
- Calculation 4 – Horizontal illuminance sample area of contractors compound 2.
- Calculation 5 – Horizontal illuminance Kenton Hills south of proposed 5m bund.
- Calculation 6 – Vertical illuminance on the hedgerow on east side of compound 1 from ground level to 20m above ground level directed towards the compound.

- Calculation 7 – Vertical illuminance on the hedgerow on west side of compound 2 from ground level to 20m above ground level directed towards the compound.
- Calculation 8 – Vertical illuminance on north side of 5m bund.

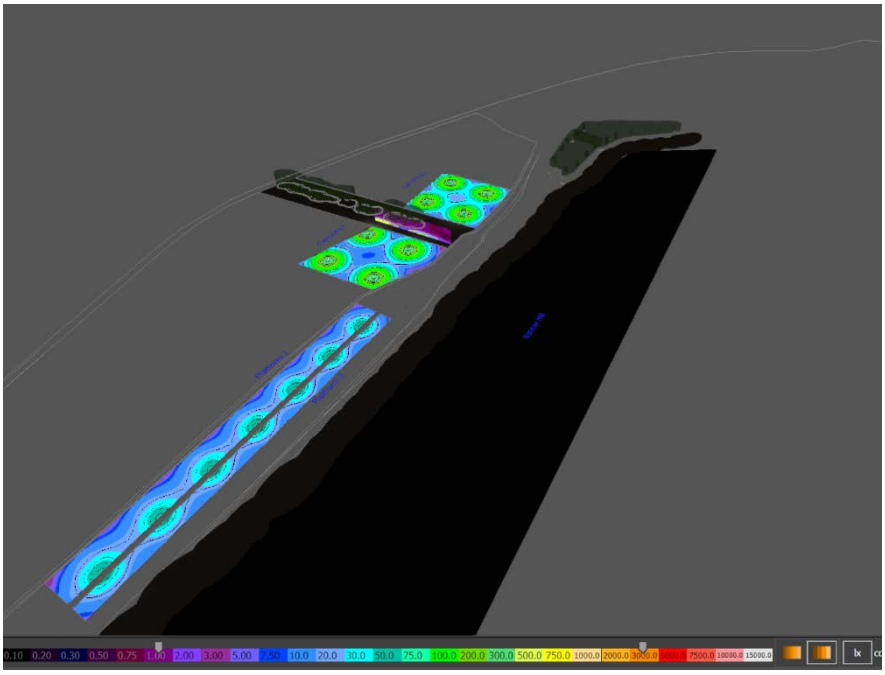
1.3.30 The calculated values are summarised in **Table 1.8**.

Table 1.8: Area 2 – Southern edge of temporary construction area, Kenton Hills – indicative lighting levels

Grid Location	Average Illuminance (lux)	Minimum Illuminance (lux)	Maximum illuminance (lux)	Comments
Calculation 1	25.5 lux	3.38 lux	66.6 lux	
Calculation 2	25.9 lux	5.66 lux	66.0lux	
Calculation 3	107.0 lux	0.38 lux	486.0 lux	Working level of light from temporary light towers.
Calculation 4	115.0 lux	0.53 lux	475.0 lux	Working level of light from temporary light towers.
Calculation 5	0.00 lux	0.00 lux	0.003 lux	
Calculation 6	3.68 lux	0.047 lux	42.7 lux	The maximum figure is at a height of no greater than 5m ABGL.
Calculation 7	2.80 lux	0.00 lux	23.3 lux	The maximum figure is at a height of no greater than 5m ABGL.
Calculation 8	0.92 lux	0.00 lux	13.5 lux	This grid is from behind platforms to compound 2.

1.3.31 **Plate 1.19** and **Table 1.8** show how the southern edge of temporary construction area, Kenton Hills, can be maintained as an intrinsically dark area whilst still providing the required lighting levels for the contractor's compounds.

Plate 1.19: Indicative lighting model for southern edge of temporary construction area, Kenton Hills



1.3.32 Area 3 the SSSI crossing is situated to the north of the proposed main construction site and is bounded on the east by the North Sea / Beach and to the west Sizewell Marshes SSSI. The marshes have been identified as an important bat foraging area with a culvert for bat movements being designed into the SSSI crossing.

1.3.33 An indicative lighting model has been prepared for a section of the proposed SSSI crossing.

1.3.34 The lighting levels have been calculated on the following planes:

- Calculation 1 – Horizontal illuminance on SSSI crossing roads.
- Calculation 2 – Horizontal illuminance on SSSI marshes.

1.3.35 The calculated values are summarised in **Table 1.9**.

Table 1.9: Area 3 – SSSI crossing – indicative lighting levels

Grid Location	Average Illuminance (lux)	Minimum Illuminance (lux)	Maximum illuminance (lux)
Calculation 1	121.0 lux	0.074 lux	198.0 lux
Calculation 2	0.68 lux	0.00 lux	18.4 lux

1.3.36 **Plate 1.20** and **Table 1.9** show how the SSSI marshes area can be maintained as an intrinsically dark area whilst still providing the required lighting levels for the construction site entrance and crossing point.

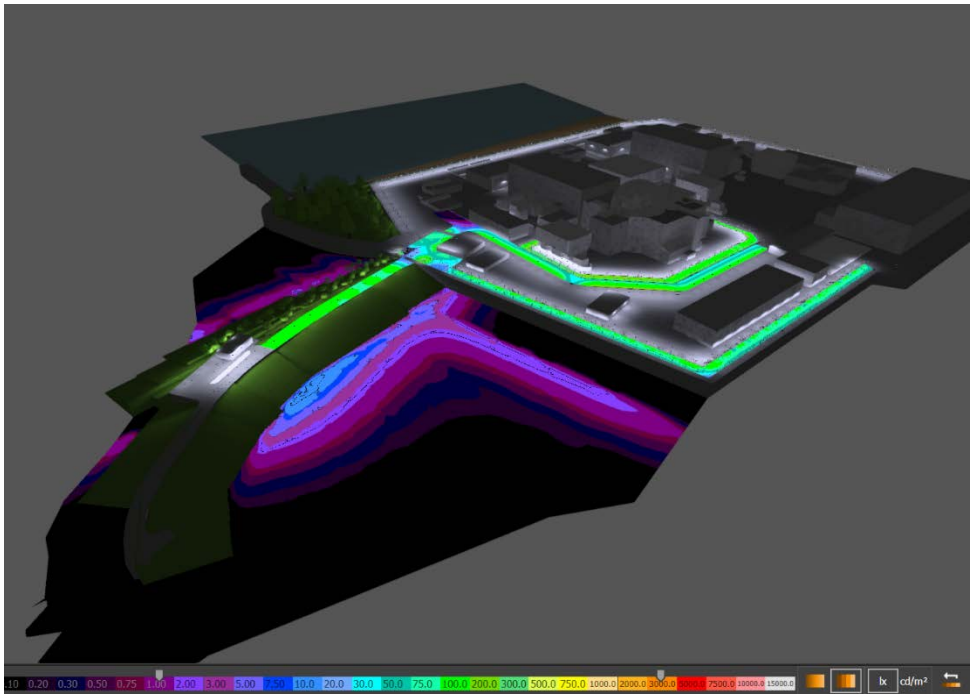


Plate 1.20: Indicative lighting model for SSSI crossing

1.3.37 The Lighting designer shall have regular dialogue with the ecologist at all points of the design process for all areas that have been identified as areas of significant wildlife activity.

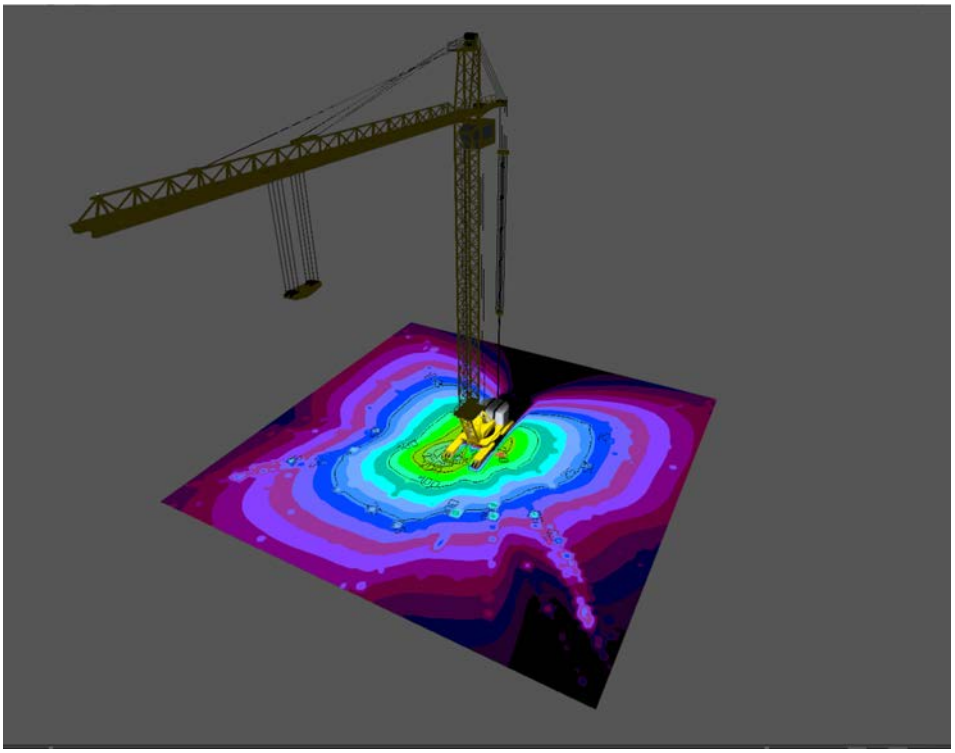
iv. Tower Cranes, Batching Plants & Site Buildings

1.3.38 The construction phase will require the use of tower cranes, batching plants and other temporary site buildings. To mitigate the impact that these may have on the night sky, the following measures should be put in place.

- Tower cranes – No illumination to be mounted above 12m ideally kept as low as possible, other than that required for safe operation and obstacle avoidance.
- Tower cranes – No illuminated operator boards to be fixed to the structure.
- Tower cranes – Any illumination that is required for the crane during operational times for safety to be switched off when crane is not in use with the exception of obstacle-avoidance lighting.
- Tower cranes – Light-coloured paint finishes to be avoided to reduce reflectivity; matt paint to be used, a dark blue matt finish would have a minimal impact.
- Batching plants – No illumination to be mounted above 8m, other than that required for the safe operation of the plant.
- Batching plants – No illuminated operator boards to be fixed to the structure.
- Batching plants – Any illumination that is not in constant use during operational times and is not needed for safety to be switched off.
- Batching plants – Light-coloured paint finishes to be avoided to reduce reflectivity; matt paint to be used.
- Site buildings – Any lighting attached to site buildings should be full cut-off and fitted with shield / louvres if required.
- Site buildings – Light coloured paint finishes to be avoided to reduce reflectivity; matt paint to be used.

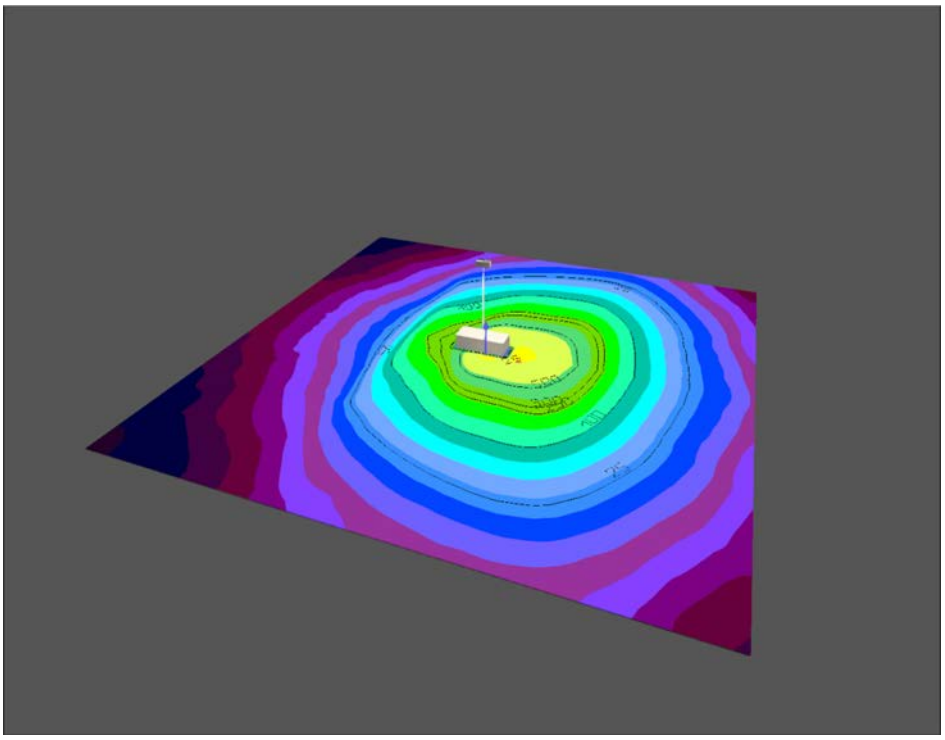
1.3.39 **Plate 1.21** shows an example of a typical tower crane with six luminaires mounted at approximately 12m and the lighting levels achieved.

Plate 1.21: Indicative lighting model for typical tower crane lighting.



1.3.40 **Plate 1.22** below shows an example of a typical mobile lighting tower rig with four luminaires mounted at approximately 9m and the lighting levels achieved.

Plate 1.22: Indicative lighting model for typical mobile lighting tower rig

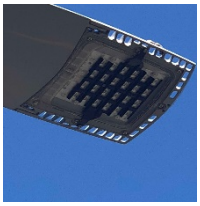


d) Lighting Equipment & Controls

i. Luminaires

1.3.41 When required, the chosen lighting equipment shall meet the requirements set out in 3.5.3 1.4.7of this document. **Table 1.10** gives examples of acceptable products and installations that can be used, and examples of equipment and installations that are not acceptable and will not be used.

Table 1.10: Examples of acceptable and unacceptable lighting equipment

Acceptable Products / Installations		Unacceptable Products / Installations	
	Example of a good LED flat glass full cut-off luminaire with good optical control. For column mounting.		Example of old Lamp technology with poor optical control and luminaire tilted.
	Example of a good LED flat glass full cut-off luminaire with good optical control and custom shield. For column mounting.		Example of a poorly shielded luminaire that will still produce upward light. Replacement is a better option.
	Example of a good LED flat glass full cut-off area luminaire. For column or building / surface mounting.		Example of poorly installed and aimed area luminaires.
	Example of a good LED flat glass full cut-off area luminaire with hood. For column or building / surface mounting.		Example of extreme source intensity glare from poorly installed area luminaires.
	Example of a good LED flat glass full cut-off luminaire with good optical control. For building / surface mounting.		Example of bad building / surface mounting luminaire with no optical control.

Acceptable Products / Installations		Unacceptable Products / Installations	
	Example of a good cut-off LED bollard lighting.		Example of bollard lighting with poor optical control .
	Example of portable site lighting unit with well positioned luminaires.		Example of bad portable balloon-type lighting with no control of upward light.

ii. Control

1.3.42 All lighting installed shall have some form of control to suit the tasks being undertaken and ensure energy is not wasted with lights being in operation 24hrs a day.

1.3.43 Task lighting – In general task lighting will only be used during specific times at specific locations and will typically be provided by portable units which will have manual switching. If the units are to be in place for a prolonged period it would be beneficial for the unit to have a photo electric control cell which will automatically turn the lighting on at dusk and off again at dawn when natural lighting levels have increased or reached pre-determined levels.

1.3.44 Ambient lighting – Ambient lighting will be more permanent and will be required to operate dusk to dawn, so the most suitable method of control will be via a photo electric control cell possibly with pre-programmed dimming or via a central management system (CMS).

1.3.45 Access control points – At access control points there will be the need to boost the ambient lighting when there is the need to undertake an inspection etc. This would best be controlled via a local switch either at the

check point or in a control centre. It is important to consider the light source when instant boost lighting is required as most light sources other than LED will need some form of run up time to reach full output.

1.4 Operational Phase Lighting Management Plan

i. Lighting Objectives

1.4.1 The primary objective of lighting during the operational phase is to provide illumination for the safe operation of the power station facility and provide a safe working environment in the absence of natural light allowing workers and site traffic to safely navigate the site and to provide security lighting.

1.4.2 As discussed earlier, the Sizewell C site sits in a sensitive environment and has been assessed as being with in an E1 Environmental Zone. The site also supports a valuable assemblage of bats. The required lighting therefore needs to be designed to have minimal impact on the surrounding environment.

1.4.3 Post-construction, parts of the site will be restored, providing valuable habitat to a range of species, including bats. Therefore, any lighting for the operational phase needs to be designed to have minimal impact on the surrounding environment and receptors.

1.4.4 The objectives of this section of the LMP shall be to achieve the following:

- Provide a safe working environment, meeting statutory requirements and standards.
- Allow 24hr working (when required).
- Provide site security lighting.
- Mitigate the impact of artificial lighting on the surrounding environment.

ii. Areas to be lit and Associated Activities

1.4.5 For the operational phase, the zones detailed in **Table 1.11** have been identified along with the associated activity or task being undertaken as requiring lighting. For details of the zones please refer to **Figure 2B.2**.

Table 1.11: Operational zones and activity/tasks being undertaken

Zone	Description	Activity / Task	Comments
Zone A	Fences	Illumination of permanent security fences, allowing detection of perimeter activity.	Permanent ambient lighting will be required in these areas to specific security levels with a high uniformity.
Zone B	Vehicle search areas.	Illumination of security check points with additional task lighting to carry out security searches of vehicles entering or leaving the site.	Permanent ambient lighting will be required in these areas to specific security levels. There will be additional task lighting to allow vehicle inspections.
Zone C	Internal roads and hard standings.	Lighting to all such areas inside the security fence, as necessary to operate the power station.	Permanent ambient lighting will be required in these areas. It should be noted that hard standings are likely to be used as laydown areas during power station maintenance outages. Although infrequent (typically 12-18 month intervals), additional temporary lighting may be provided during these times to increase illumination above the usual ambient levels.
Zone D	Car park.	Permanent car park to the north of the power station.	Permanent ambient lighting will be required in this area.
Zone E	BLF access road.	The access road to the BLF will not normally be illuminated. On the occasions when the BLF is in use, lighting necessary for the safe movement of people and vehicles will be provided on both the BLF access road and the BLF itself.	Task lighting will be provided when required and will be locally controlled.
Zone F	Roundabout	New permanent interface with the public highway.	The lighting in this area will be based on highway design standards.
Zone G	Access road.	The access road to the power station.	No Illumination.

Zone	Description	Activity / Task	Comments
Zone H	External roads.	Private external roads outside the security fence where illumination is required for safety and security reasons.	The lighting in these areas will be based on highway design standards.
Zone J	Sizewell B Relocated Facilities	General lighting related to the operation of the permanent facilities.	Any lighting in this area will be in accordance with the SZB RF Volume II Technical Appendices 3.1 Lighting Strategy, provided in **Annex 2B.3** of this volume (Doc Ref. 6.3).
Zone K	National Grid land	General security and task related flood lighting.	General lighting around the perimeter fence and within the National Grid substation for the purposes of security and to provide adequate lighting levels for access and inspection of equipment; and Task related flood lighting within the National Grid substation which may be necessary from time to time during repair/maintenance activities.

iii. Required Lighting Levels

1.4.6 The lighting design criteria for each of the zones discussed above shall be as scheduled below.

1.4.7 Zone A fences –

Security fence lighting levels will need to comply with those set out by the (NNB) Operational Security Team and as summarised in **Table 1.12**.

Table 1.12: (NNB) Operational Security Team fence lighting levels

Location	Minimum Average Lux Level Normal Operation	Lighting Uniformity Normal Operation	Minimum Point Lux Level Emergency Operation	Lighting Uniformity Emergency Operation
Perimeter fence – Sterile zone between fences	5	0.33	N/A	N/A
HSA fence – Clear zone either side of fence	5	0.33	N/A	N/A
Interim fence – as required	5	0.33	N/A	N/A

1.4.8 Zone B Vehicle Search Areas – The requirements for good security lighting is set out in the CIBSE Lighting Guide 1: The Industrial Environment. Section 4.5 is summarised in **Table 1.13**.

Table 1.13: Checkpoint & gatehouse lighting levels summary

Area, Task or Activity	Minimum Average Lux Level	Lighting Uniformity	Glare Rating GRL	Colour Rendering Index Ra
Checkpoint	150	0.40	45	20
Gatehouses	200 (dimmable).	0.40	16	20

1.4.9 For zones listed in **Table 1.11**, with the exception of zones A, B, F and G, the required lighting levels for these areas are set out in BS EN 12464-2:2014 Lighting of Workplaces Part 2 Outdoor Work Places. Reference should be made to the specific tables listed within that document, but **Table 1.14** provides a summary of the relevant levels required.

Table 1.14: BS EN 12464-2:2014 Lighting of Workplaces, Summary of Lighting Levels

Area, Task or Activity	Minimum Average Lux Level	Lighting Uniformity	Glare Rating GRL	Colour Rendering Index Ra
Walking exclusively for pedestrians.	5	0.25	50	20

Area, Task or Activity	Minimum Average Lux Level	Lighting Uniformity	Glare Rating GRL	Colour Rendering Index Ra
Pedestrian movements within electrically safe areas.	5	0.25	50	20
Internal Roads – Traffic areas for slowly moving vehicles (max. 10 km/h), e.g. bicycles, trucks and excavators.	10	0.40	50	20
Medium traffic parking areas.	10	0.25	50	20
Inspection areas.	50	0.40	50	20
Servicing areas.	100	0.40	45	40

b) Mitigation Measures

i. Operational Phase Mitigation Measures

1.4.10 A range of mitigation measure are available to address the potential impact from the construction phase lighting. These range from equipment choice, use of site topography and competent design and site management.

1.4.11 The following mitigation measures shall be adopted for both fixed and temporary lighting.

- Adopt the lowest safe lighting levels possible for task being undertaken.
- Limit the hours of lighting where practicable.
- Use a high quality luminaire with good optical control.
- Use the lowest possible mounting for the luminaire based on the required level of illumination needed for the task being undertaken.
- Direct luminaires into the area to be lit (light from the boundary inwards).
- Ensure the luminaire is mounted at zero degrees to the horizontal and avoid any tilt.
- If required make use of manufacture supplied custom shields.

- Provide local control for the lighting so it may be switched off when not required.

1.4.12 In addition to the physical equipment, lighting should be placed such that it makes use of the existing and proposed topography:

- Keep mounting heights lower than fences and bunding, where possible.
- Position equipment so it is not visible to sensitive receptors by using natural screening.

1.4.13 All lighting installations should be designed by a competent lighting professional that ideally meets the ILP competency requirements, and who is at least a member of the ILP and is accredited to the Engineering Council as I.Eng or greater.

1.4.14 Prior to the use of any lighting on-site during the operational phase the lighting shall be inspected and signed off by the designers to ensure it has been installed as per the design and the specified equipment and optics are installed.

1.4.15 During routine lighting maintenance activities the lighting installation shall be inspected to ensure the correct tilt angles and aiming directions are maintained throughout the life of the installation. If any equipment is found to be incorrectly aligned modifications will be made to ensure it is restored to as designed and if required re-inspected. This monitoring procedure will ensure that during the time the site is occupied the levels of lighting in the required areas on-site are maintained in accordance with current best practice and standards whilst ensuring the potential impact associated with the introduction of lighting on identified receptors is controlled and minimised as far as practicably possible.

c) Sensitive Areas

i. Bat sensitive areas

1.4.16 All habitats adjacent to the operational site, notably but not limited to Sizewell Marshes SSSI should be kept as dark as reasonably practicable.

ii. Lighting mitigation measures to be adopted in proximity to bat commuting routes / flightpaths

1.4.17 The best mitigation when considering lighting in the proximity of a bat roost or commuting routes / flightpath is avoidance where reasonably practicable

1.4.18 Where lighting is unavoidable then, in addition to the points made in the Mitigation Measures section, the following additional mitigation measures where reasonably practicable shall be adopted for both fixed and temporary lighting:

- Use a light source that has a narrow spectrum with no UV content.
- Use a warm colour temperature.
- Use a tuneable LED luminaire.

iii. Operational site buildings

1.4.19 The operational site will have a mixture of buildings of varying heights and materials. To help mitigate the impact that these may have on the night sky the following measures should be put in place.

- Site buildings – Any lighting attached to site buildings should be fully cut off (emitting no light above the horizontal).
- Site buildings – Where reasonably practicable avoid light coloured paint finish to reduce reflectivity.

d) Lighting Equipment & Controls

i. Luminaires

1.4.20 The lighting design for the operational site will use a mixture of high-quality highway luminaires and area projector luminaires. All luminaires used will be capable of having manufacturer shields or louvers fitted if required.

ii. Control

1.4.21 All lighting installed shall have some form of control to suit the tasks being undertaken and ensure energy is not wasted (lights should not be left on continuously).

1.4.22 Task lighting – In general, task lighting will only be used during specific times at specific locations and will have manual switching.

1.4.23 Ambient lighting – Ambient lighting will be permanent and will be required to operate dusk to dawn, so the most suitable method of control will be via a photo electric control cell which will automatically turn the lighting on at dusk and off again at dawn, when natural lighting levels have fallen or reached pre-determined levels.

1.4.24 Access control points – At access control points, there will be the need to increase the ambient lighting when there is the need to undertake an inspection etc. This would best be controlled via a local switch, either at the check point or in a control centre. It is important to consider the light source when an increase in the lighting level is required, as most light sources other than LED will need some form of run-up time to reach full output.

1.4.25 A Lighting Strategy was prepared and submitted as part of the SZB RF Town and Country Planning Act application and is still valid, with the exception of the footbath between the outage car park at Pillbox Field and the Coronation Wood development area. This footpath was proposed to be lit to ensure pedestrians had a safe and secure access route to and from the car park in hours of darkness. However, this footpath is no longer proposed. The Lighting Strategy is attached as **Annex 2B.3** of this volume (Doc Ref. 6.3) and the Relocated Facilities from part of this application for development consent.

References

1.1 Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats. Global Change Biology - Stone, E.L., Jones, G. & Harris, S. (2012)

1.2 Bats and streetlamps. The Bats Magazine - Rydell, J. & Baagoe, H.J. (1996)

1.3 The Switch from Low-Pressure Sodium to Light Emitting Diodes Does Not Affect Bat Activity at Street Lights - Baker 1994

1.4 Street lighting disturbs commuting bats. Current Biology - Stone, E.L., Jones, G. & Harris, S. (2009)

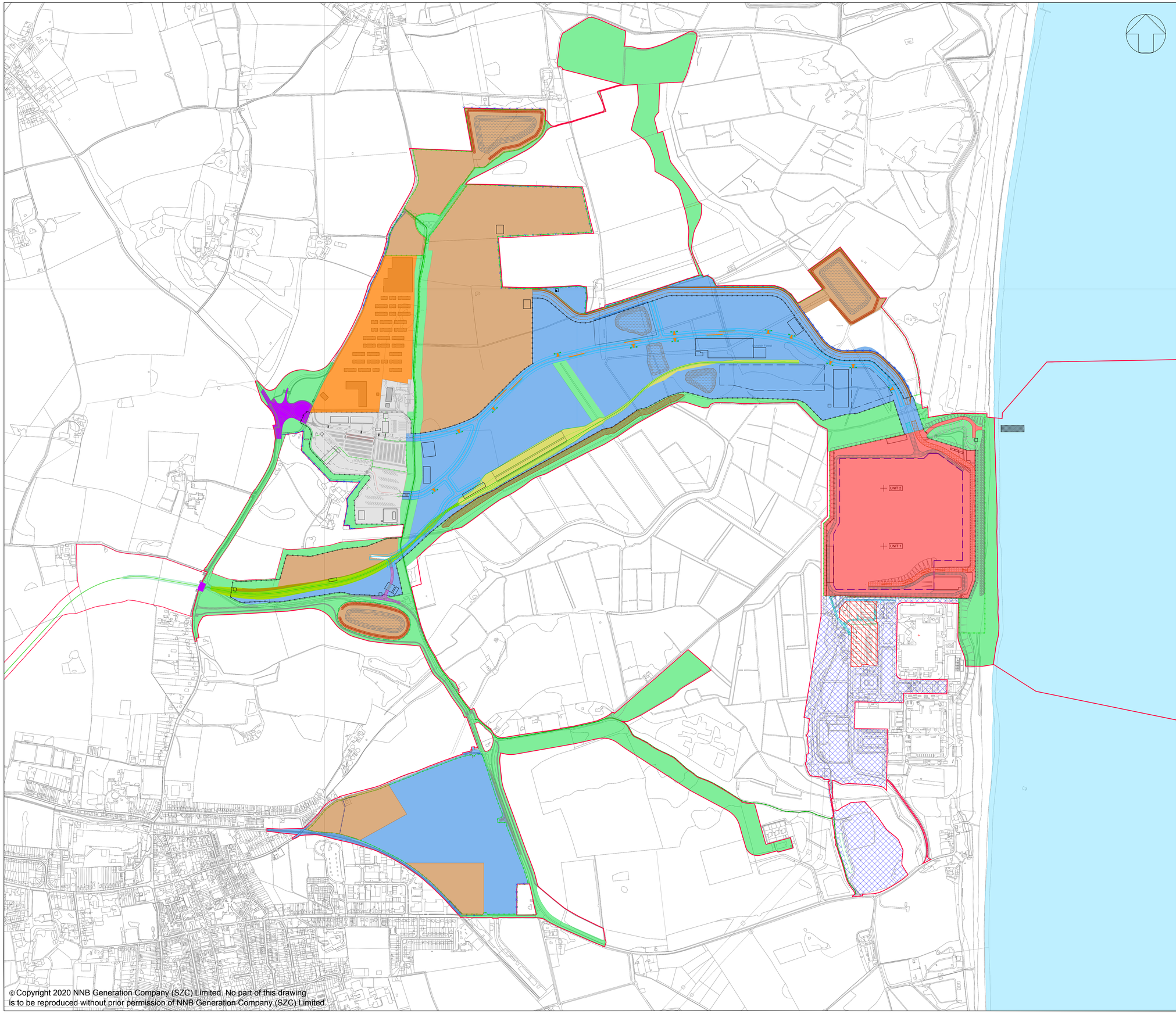
1.5 Bats and development: with a particular focus on the impacts of artificial lighting. PhD, PhD Thesis, School of Biological Sciences, University of Bristol - Stone, E.L. (2011)

1.6 Seasonal use of illuminated areas by foraging northern bats Eptesicus - Rydell, J. (1991)

1.7 Abundance of Pipistrellus pipistrellus and Pipistrellus kuhlii foraging at street-lamps. Myotis - Haffner, M. & Stutz, H.P. (1985/86)

1.8 Street lamps and the feeding ecology of insectivorous bats. Symposium of the Zoological Society London - Rydell, J. & Racey, P.A. (1995)

VOLUME 2, CHAPTER 2, APPENDIX 2B LIGHTING MANAGEMENT PLAN FOR CONSTRUCTION AND OPERATIONAL SITES, FIGURES 2B.1 - 2B.2



NOTES:

1. SITE LAYOUT SHOWN IS INDICATIVE.

KEY:

LIGHTING LEVELS KEY

	DESCRIPTION
	ZONE A MAIN CONSTRUCTION AREA
	ZONE B TEMPORARY CONSTRUCTION AREA - COMMON USER FACILITIES, CONTRACTOR COMPOUNDS & OTHER YARDS
	ZONE C TEMPORARY CONSTRUCTION AREA - BORROW PITS & STOCK PILES
	ZONE D TEMPORARY CONSTRUCTION AREA - ACCOMMODATION CAMPUS
	ZONE E TEMPORARY CONSTRUCTION AREA - SITE ENTRANCE HUB
	ZONE F ROUNDABOUT, JUNCTIONS & LEVEL CROSSING
	ZONE G NO FIXED LIGHTING
	ZONE H RAILWAY INFRASTRUCTURE
	ZONE I RAIL INSPECTION AREA
	ZONE J SZB RELOCATED FACILITIES
	ZONE K NATIONAL GRID LAND

GENERAL KEY

SIZEWELL C MAIN DEVELOPMENT SITE BOUNDARY.

NOT PROTECTIVELY MARKED

DOCUMENT:

SIZEWELL C
ENVIRONMENTAL STATEMENT
VOLUME 2
APPENDIX 2B
LIGHTING MANAGEMENT PLAN

DRAWING TITLE:

INDICATIVE LIGHTING LEVELS (CONSTRUCTION)

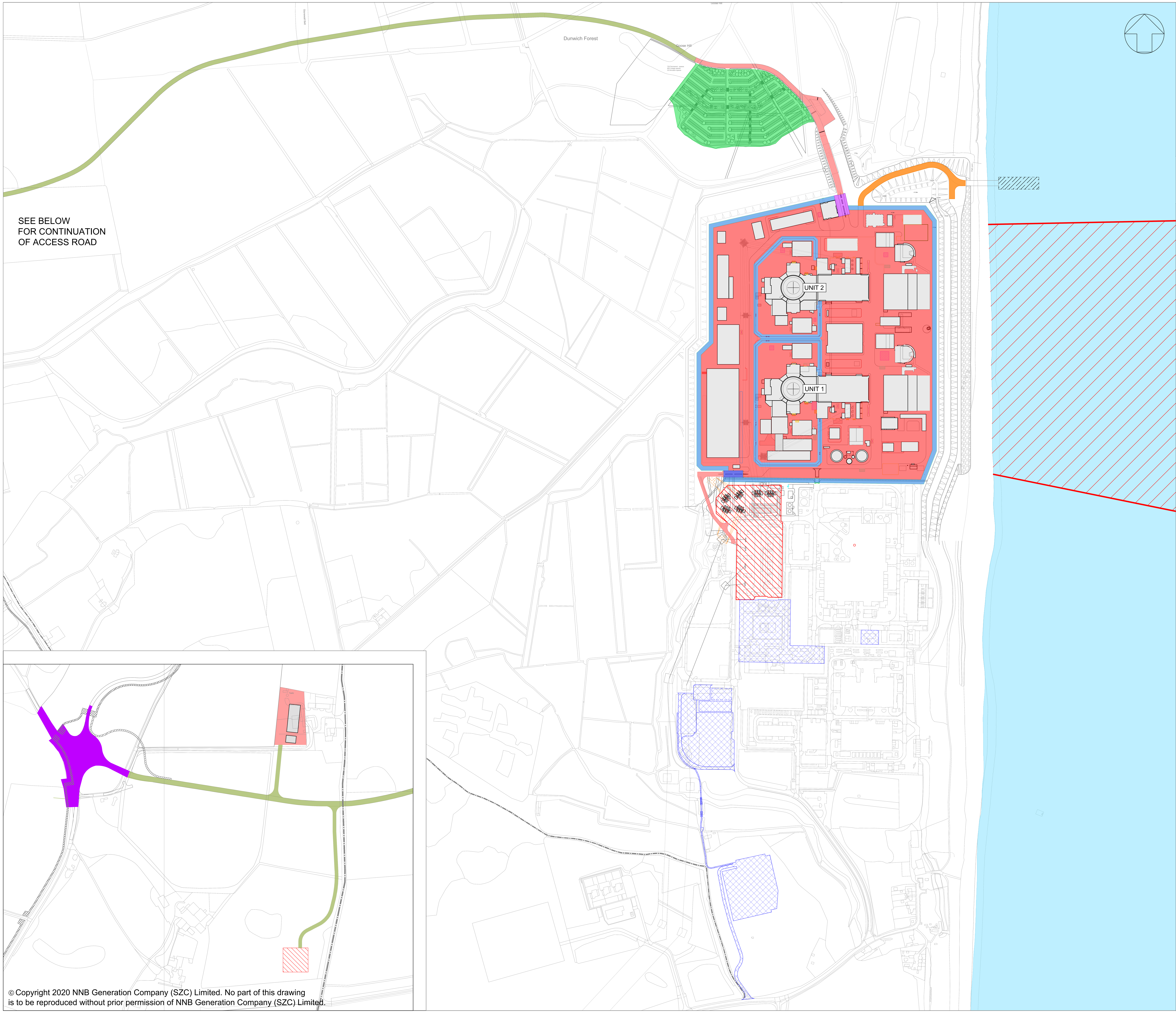
DRAWING NO:

FIGURE 2B.1

DATE:	DRAWN:	SCALE:
JAN 2020	SB	1:5000@A0

SCALE BAR:

100m 0 100 200 300m
SCALE IN METRES
1:5000



NOTES:

1. SITE LAYOUT SHOWN IS INDICATIVE.

KEY:

LIGHTING LEVELS KEY

	DESCRIPTION
	ZONE A FENCES
	ZONE B VEHICLE SEARCH AREAS
	ZONE C INTERNAL ROADS & HARDSTANDINGS
	ZONE D CAR PARK
	ZONE E BLF ACCESS ROAD
	ZONE F ROUNDABOUT
	ZONE G ACCESS ROAD
	ZONE H EXTERNAL ROADS
	ZONE J SIZEWELL B RELOCATED FACILITIES
	ZONE K NATIONAL GRID LAND

NOT PROTECTIVELY MARKED

DOCUMENT:
SIZEWELL C
ENVIRONMENTAL STATEMENT
VOLUME 2
APPENDIX 2B
LIGHTING MANAGEMENT PLAN

DRAWING TITLE:
INDICATIVE LIGHTING LEVELS (OPERATION)

DRAWING NO:
FIGURE 2B.2

DATE:	DRAWN:	SCALE:
JAN 2020	SB	NTS

SCALE BAR:

VOLUME 2, CHAPTER 2, APPENDIX 2B LIGHTING MANAGEMENT PLAN FOR CONSTRUCTION AND OPERATIONAL SITES, ANNEX 2B.1 LEGISLATION AND GUIDANCE DOCUMENTS

Annex 2B.1 Legislation and Guidance Documents

1.1 Legislation

a) Health and Safety at Work Act 1974

1.1.1 The Workplace (Health, Safety and Welfare) Regulations 1992, as enforceable under the Health and Safety at Work etc. Act 1974, maintain that safe lighting must be provided in all premises, including outdoor places, for all workplace activities, which include those carried out during construction and operation of the power station.

1.1.2 The primary aim of the lighting strategy is to ensure a safe working environment is maintained in the absence of adequate natural light.

b) Environmental Protection Act 1990

1.1.3 The Environmental Protection Act 1990 was amended by a supplementary section to the Clean Neighbourhoods and Environment Act 2005, adding “artificial light emitted from premises so as to be prejudicial to health or a nuisance” to the list of statutory nuisances. This change does not apply to artificial light from lighthouses, prisons, airports, harbours and railway or tramway premises, nor to street lighting for public service or goods vehicles, however it will be applicable to the external lighting from the development site.

1.1.4 The lighting strategy will comply with relevant British Standards and best practice guidelines prepared by the Chartered Institution of Building Services Engineers, the Institution of Lighting Professionals, and the International Dark-Sky Association to minimise obtrusive light and ensure compliance with the Environmental Protection Act.

c) Wildlife and Countryside Act 1981 and Conservation of Habitats and Species Regulations 2017

1.1.5 All species of bat are protected by the Wildlife & Countryside Act 1981 (as amended) and by the Conservation of Habitats and Species Regulations (2017).

1.1.6 Of relevance in relation to lighting, in both it is unlawful to disturb bats, thus lighting in the vicinity of roosts, flight lines and foraging areas within and adjacent to the development needs to be carefully designed.

1.2 British Standards

1.2.1 The design criteria for the lighting strategy should use the following British Standards as demonstration of best practice.

a) BS EN 12464-2:2014 Light and lighting – Lighting of workplaces Part 2: Outdoor Work Places

1.2.2 To enable people to perform outdoor visual tasks efficiently and accurately, especially during the night, adequate and appropriate lighting has to be provided. The degree of visibility and comfort required in a wide range of outdoor work places is governed by the type and duration of activity.

1.2.3 This standard specifies requirements for lighting tasks in most outdoor work places and their associated areas in terms of quantity and quality of illumination.

1.2.4 Tables scheduling areas, tasks and activities relevant to this development are as follows:

- Table 5.1 – General requirements for areas.
- Table 5.3 – Building sites.
- Table 5.7 – Industrial sites and storage areas.
- Table 5.9 – Parking areas.
- Table 5.11 – Power, electricity, gas and heat plants.
- Table 5.12 – Railways and tramways.

b) BS 5489-1:2013 Code of practice for the design of road lighting Part 1: Lighting of roads and public amenity areas

1.2.5 This standard gives recommendations on the general principles of road lighting, gives recommendations on aesthetic and technical aspects, and advises on statutory provisions, operations and maintenance.

1.2.6 It gives recommendations for the design of lighting for all types of highways and public thoroughfares, including those specifically for pedestrians and cyclists, and for pedestrian subways and bridges.

1.2.7 The standard will be used to ensure that statutory design criteria are met where the primary roads in the development site interface with the surrounding public road network.

c) CEN/TR 13201-1 Road lighting - Part 1: Selection of lighting classes

1.2.8 This document specifies the lighting classes set out in EN 13201-2 and gives guidelines on the application of these classes. To do this, it includes a system to define an outdoor public traffic area in terms of parameters relevant to lighting. To assist in the application of classes, it suggests a practical relationship between the various series of lighting classes, in terms of comparable or alternative classes.

1.2.9 It also gives guidelines on the selection of the relevant area to which the lighting classes from EN 13201-2 and the calculation grids and procedure from EN 13201-3 should be applied.

1.3 Guidance

a) Lighting in the Countryside: Towards Good Practice, 1997

1.3.1 Lighting in the Countryside: Towards Good Practice was issued by the then Department of the Environment in 1997. The purpose of the Good Practice guide is to provide practical advice on the prevention and control of lighting impacts and it identifies a number of objectives that should be considered when developing the lighting strategy.

b) The Society of Light and Lighting (SLL) Lighting Handbook, 2009

1.3.2 The SLL Lighting Handbook provides further guidance behind the specific requirements of the British Standards and also identifies other sources of technical information.

c) Institution of Lighting Professionals (ILP) GN01: Guidance notes for the reduction of obtrusive light, 2011

1.3.3 The ILP guide specifically identifies the sources of obtrusive lighting and provides further explanation of the British Standard requirements, it is referenced in many planning requirements.

d) Institution of Lighting Professionals (ILP) Guidance Note 8 Bats and Artificial Lighting

1.3.4 This guidance note supersedes the previous 2009 guidance and goes into depth about lighting levels and colour temperature impacts on different bat species. It is intended to raise awareness of the impacts of artificial lighting on bats but also the potential solutions to avoid and reduce this harm.

e) Bats and Lighting: Overview of current evidence and mitigation, 2013

1.3.5 The Bats and Lighting Research Project raises awareness of the impact of lighting on bats and suggests mitigation measures for various scenarios.

f) Safety in docks Approved Code of Practice and guidance, 2014

1.3.6 The Docks Regulations 1988 were revoked in April 2014 because the duties had been replaced by equivalent requirements in more modern legislation. This publication contains guidance on duties under the Health and Safety at Work etc. Act 1974 and its relevant statutory provisions that are specific to the docks industry. The guidance on lighting will be of relevance to the Beach Landing Facility (BLF) at the Sizewell C site.

g) International Dark-Sky Association (IDA)

1.3.7 Dark Sky policy refers to the aims of the International Dark-Sky Association with regards to the avoidance of light pollution. The IDA's goals are to be effective in stopping the adverse environmental impact on dark skies by building awareness of the problem of light pollution and of the solutions.

1.3.8 IDA describes light pollution as any adverse effect of artificial light including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste. The IDA has a number of policy initiatives and collates technical information identifying best practice for avoiding light pollution.

VOLUME 2, CHAPTER 2, APPENDIX 2B LIGHTING MANAGEMENT PLAN FOR CONSTRUCTION AND OPERATIONAL SITES, ANNEX 2B.2 GLOSSARY OF TERMS & ABBREVIATIONS

Annex 2B.2 Glossary of terms & Abbreviations

Terms

Term	Definition
Colour rendering.	Colour rendering (as per BS EN 12665:2002) Effect of an illuminant on the colour appearance of objects by conscious or subconscious comparison with their colour appearance under a reference illuminant.
Glare	Glare is a visual sensation caused by excessive and uncontrolled brightness. It can be disabling or simply uncomfortable.
Illuminance	Quotient of the luminous flux (dϕ) incident on an element of the surface containing the point, by the area (dA) of that element. Equivalent definition: Integral, taken over the hemisphere visible from the given point, of the expression Unit: L x cos ᵉ x dΩ. Where L is the luminance at the given point in the various directions of the incident elementary beams of solid angle dΩ; and ᵉ is the angle between any of these beams and the normal to the surface at the given point. Unit Lx (lux) or lumens per metre2 (lm/m2).
Illuminance uniformity.	Ratio of minimum illuminance to average illuminance on a surface. Note: Use is also made of the ratio of minimum illuminance to maximum illuminance, in which case, this should be specified explicitly.
Lamp	Light source made in order to produce optical radiation, usually visible. Note: This term is also sometimes incorrectly used for certain types of luminaires.
LED	A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it.
Light pollution.	The spillage of light into areas where it is not desired.
Luminaire	Apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply. Note: The term 'light fitting' is deprecated.
Maintained illuminance (Em or Eav).	Value below which the average illuminance on the specified area should not fall. It is the average illuminance at the time during which maintenance should be carried out. Unit: Lx (Lux) or lm/m2.

Term	Definition
Minimum illuminance.	Lowest illuminance at any relevant point on the specified surface. Unit: Lx or lm/m2 Note: The relevant points at which the illuminances are determined shall be specified in the appropriate application standard.
Obtrusive / Nuisance light.	Light, outside the area to be lit, which, because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information, e.g. at signal lights.

a) Abbreviations

Abbreviation	Definition
AONB	Area of Outstanding Natural Beauty.
CRI	Colour Rendering Index.
IDA	International Dark-Sky Association.
ILP	Institution of Lighting Professionals.
LMP	Lighting Management Plan.
SLL	Society of Light and Lighting.
SSSI	Site of Special Scientific Interest.

VOLUME 2, CHAPTER 2, LIGHTING MANAGEMENT PLAN FOR CONSTRUCTION AND OPERATIONAL SITES, ANNEX 2B.3 SIZEWELL B RELOCATED FACILITIES LIGHTING STRATEGY

VOLUME II:
TECHNICAL APPENDICES

3.1 Lighting Strategy

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CONTENTS

TABLES

FIGURES

1. INTRODUCTION

1.1.1 This document sets out the lighting strategy for specific buildings and infrastructure which constitute the Sizewell B Relocated Facilities project (the 'Proposed Development'). The lighting strategy is informed by operational (end user) requirements which include provision of a safe, flexible and secure work place, and by environmental considerations and constraints which are underpinned by planning policy.

1.1.2 The strategy establishes overarching design principles, referencing where applicable best practice guidance; and provides a technical design solution for each facility based on these broad principles. The strategy is focused on the operational lighting design with reference to both internal and external lighting treatment; however, it does not cover temporary construction lighting requirements which are described in the Construction Method Statement.

1.2 Proposed Development Overview

1.2.1 The Proposed Development plans to relocate existing Sizewell B Power Station facilities that are currently located to the north of the Sizewell B site and centrally within the existing Sizewell B Power Station itself.

1.2.2 As part of the relocation, upgraded facilities will be provided to comply with current regulations and standards. The relocation of the facilities will also facilitate the use of the land on which they are currently located for the possible future Sizewell C Power Station National Infrastructure Project.

1.2.3 The planning application is submitted as a hybrid planning application, with the formal description of development as follows:

- In outline, comprising a Visitor Centre (maximum 2,000sq.m GEA) and a maximum of 9,500sq.m (GEA) of floorspace to provide administration, storage, welfare and canteen facilities with all matters reserved apart from access.
- In full, for the demolition of the existing Outage Store, Laydown Area, Operations Training Centre, Technical Training Facility, Visitor Centre, and Rosery Cottage garage; removal of technical training and pool car park (63 spaces), Coronation Wood car park (21 spaces), Visitor Centre car park (16 spaces) and northern outage car park (576 spaces); meantime use of the Technical Training Centre as an interim Visitor Centre followed by its demolition; and erection of new (all floorspace in GEA) Outage Store (2,778sq.m), Laydown Area (11,990sq.m) including New Western Access Road, Yardman's Office (23sq.m), Training Centre (4,032sq.m), Rosery Cottage garage (30sq.m), Replacement Car Park (2,363sq.m) providing 112 spaces, and Outage Car Park (15,525sq.m) providing (576 spaces) including new access road (and alternative access to bridleway), footpath and amended junction at Sizewell Gap; and associated landscaping earthworks/recontouring, tree felling and boundary treatment.

1.2.4 Within the Sizewell B Power Station Security Perimeter, a location has been identified for the proposed Outage Store and an 'Outline Development Zone' has been identified

for the administration, storage, welfare and canteen facilities. Outside of the Sizewell B Power Station Security Perimeter, locations have been identified for the proposed Training Centre, Visitor Centre, Laydown, Outage and Replacement Car Parks and a new circulatory access road referred to as the Western Access Road.

1.3 Lighting Strategy Areas of Focus

1.3.1 This Lighting Strategy focusses on two key development areas which are located to the south and west of the Sizewell A and Sizewell B power stations (the 'Sizewell Power Station complex') respectively (see **Figure 1.1**). These comprise:

- **Coronation Wood Development**: Proposed Car Park, Laydown Area, Western Access Road, Training Centre and Visitor Centre
- **Pillbox Field**: Outage Car Park and associated vehicular and pedestrian accesses

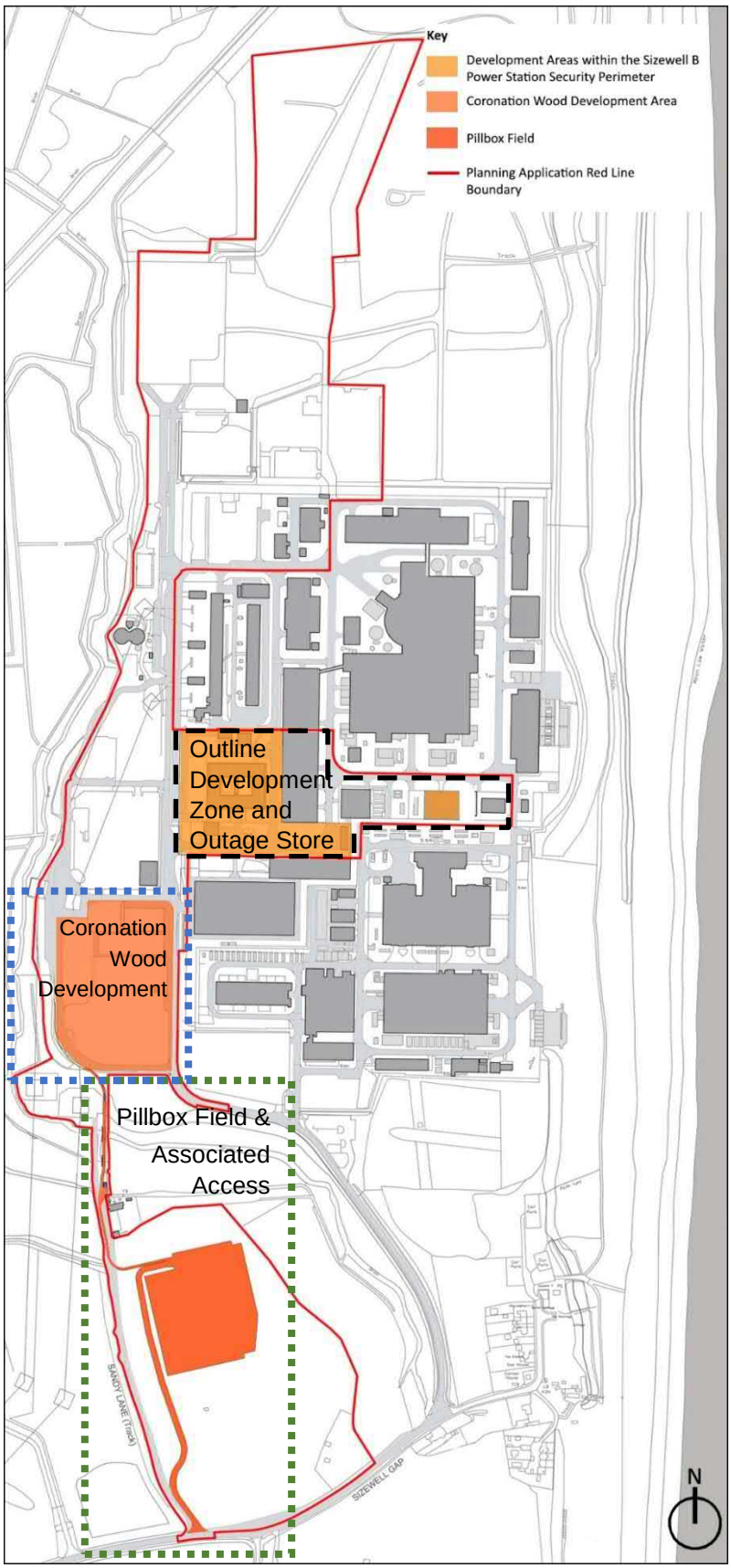


Figure 1.1: Coronation Wood Development and Pillbox Field Setting

1.3.2 A fuller description of the Proposed Development for both areas is included in **Sections 5.3 and 5.4** of this document.

1.3.3 These two areas are located outside of the exiting Sizewell B Power Station site perimeter (within which there are already high levels of lighting provision) and occupy land within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB) and adjacent to the Sizewell Marshes Site of Special Scientific Interest (SSSI). Neighbouring areas also support recreational uses and private dwellings. The need to minimise obtrusive light emissions whilst maintaining a safe, functioning working environment is therefore a primary strategy consideration for both these areas.

1.3.4 A full assessment of lighting impacts arising from the Proposed Development is set out in the accompanying **Environmental Statement** which has informed this Lighting Strategy.

1.3.5 Finally, a summary on the approach to lighting for the Outline Development Zone and Outage Store (located within the existing Sizewell B Power Station Security Perimeter) is also provided in **Section 5.5**, albeit only internal lighting is required.

2. EXISTING LIGHTING CONTEXT

2.1.1 As a basis for the lighting design on this project, this strategy has defined the Environmental Zones for the two areas in line with ***ILP GN01 Guidance Notes for the Reduction of Obtrusive Light*** (see **Table 2.1** for specific criteria):

- **Coronation Wood** – Zone E3, Suburban (small town Centres or suburban locations).

  This is based on the Site's proximity to the Sizewell Power Station complex. The Site's proximity to the AONB and SSSI remains a key factor in how the design has been developed.

- **Pillbox Field** – Zone E1, Natural (National Parks, Areas of Outstanding Natural Beauty, etc).

  This categorisation is based on the fact that, unlike Coronation Wood, Pillbox Field is seen in isolation from the existing Sizewell Power Station complex and lies within an undeveloped rural setting (albeit adjacent to the Greater Gabbard and, under construction, Galloper sub-stations), in close proximity to the Sizewell Marshes SSSI.

- **Outline Development Zone and Outage Store** – Zone E4, Urban (Town/city centres with high levels of night time activity).

  This is based on the high density of industrial facilities and comprehensive lighting within the existing Sizewell B site perimeter.

Table 2.1: Lighting Pollution Criteria

Area	Environmental Zone	Light Intrusion (into windows) E_{ave} (Lux)		Luminaire Intensity, I (Candelas)		Sky Glow ULR (Max %)	Building Luminance Pre-Curfew
		Pre-curfew	*Post-curfew*	*Pre-curfew*	*Post-curfew*		*Average, L [cd/m²]*
Pillbox Field	E1 – Intrinsically dark landscapes	2	0 (1*)	2,500	0	0	0
Coronation Wood Development	E3 - Suburban	10	5	10,000	1,000	5.0	10
Outline Development Zone and Outage Store	E4 - Urban	25	5	25,000	2,500	15	25

2.1.2 A brief description of the existing lighting environment is set out here; consideration of context and baseline conditions is important in informing the design strategy. A comprehensive description of the lit environment and its impact is provided in the accompanying **ES Chapter 7: Landscape and Visual Impact Assessment** (LVIA).

2.1.3 The Sizewell power station complex is well-illuminated, reflecting operational requirements to maintain a safe, functioning and secure environment at night. Lighting infrastructure is distributed across all operational areas and includes highway lighting, typically as free standing columns; security and operational lighting, comprising free standing columns, mobile flood lighting or building mounted luminaires; and internal building lighting associated with both administrative buildings and operational buildings. In addition to static lighting, the light emitted from moving vehicles within and accessing the Sizewell power station complex is apparent.

2.1.4 The removal of Coronation Wood as part of the Proposed Development is a key design consideration. The vegetated boundary which will be maintained along the western and southern Site boundary provides a screen to the existing development and intercepts some light spill.

2.1.5 Pillbox Field lies within the AONB and was taken out of agricultural production. The field and adjacent roads (Sizewell Gap) and rights of way on Sandy Lane are not lit. The illuminated buildings of both Sizewell A and Sizewell B Power Stations which rise above perimeter woodland blocks provide a backdrop to Pillbox Field in some views from the south. There are a number of isolated light sources within the neighbouring coastal and agricultural landscape.

3. LEGISLATION, POLICY AND GUIDANCE

3.1.1 The key planning policies which guide the lighting design strategy for the Proposed Development are set out here. This references both national and local planning policy. The design principles set out in **Section 4** of this report indicate how the strategy has responded to policy guidance.

a) National Planning Policy

3.1.2 The **National Planning Policy Framework [Ref. 2]** encourages sustainable development and by encouraging good design. Planning policies and decisions should limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation. It also identifies that pollution is anything that affects the quality of land, air, water or soils, which might lead to an adverse impact on human health, the natural environment or general amenity. Pollution can arise from a range of emissions, including light.

b) Local and Regional Planning Policy and Guidance

3.1.3 Local planning policy and guidance which is most relevant to lighting design and lighting impacts is contained within the following documents:

- Development Management Policy DM26
- Suffolk Coast and Heaths AONB Position Statement-Obtrusive Lighting in the Suffolk Coast and Heaths Area of Outstanding Natural Beauty
- Suffolk Coastal District Local Plan - Core Strategy and Development Management Policies – Development Plan Document: Development Management Policy DM26 – Lighting
- Suffolk Coast and Heaths AONB Management Plan 2013 – 2018 (2013); Suffolk Coast and Heaths AONB Partnership
- Suffolk Landscape Character Assessment

3.1.4 Local planning policy **[Ref. 3 Ref. 4]** recognises the need to deliver well-designed lighting schemes which are suitable for their required purpose and provide the minimum light levels needed for a specific task or use. Policy seeks to ensure that the polluting effects of lighting – manifest in the form of light spill, light glare and sky glow – are addressed through appropriate embedded design including, where appropriate, adoption of control mechanisms and other forms of mitigation. Policy also seeks to safeguard landscape and ecological receptors (as well as human receptors) from impacts of light pollution.

3.1.5 Potential impacts of light pollution on the Suffolk Coast and Heaths AONB is an important consideration. The **AONB Management Plan [Ref. 5]** establishes that the lack of light pollution (amongst other factors) is a key contributor to the special character of the area; similarly, the low light pollution levels which give rise to predominantly dark skies within the AONB are recognised as an indicator of tranquillity. The AONB Position Statement on obtrusive lighting **[Ref. 6]** does not preclude lighting as part of development in the AONB but seeks to ensure that lighting is kept to a

minimum and is appropriate to its purpose. The Position Statement also points to industry guidance to inform lighting design (this is discussed in the following section).

4. DESIGN DRIVERS AND PRINCIPLES

4.1.1 This section sets out the design drivers for the lighting proposals and establishes a set of high level design principles which have informed the design development process.

4.2 Design Drivers

4.2.1 The design drivers which feed into the design principles are set out below. These drivers are focussed on ensuring that tasks which require lighting can be undertaken in a safe manner; that light pollution is controlled as far as practicable and that the scheme is as sustainable as possible in terms of energy consumption, maintenance and cost.

- Facilitate safe and efficient use of the space;
- Facilitate efficient and effective security monitoring of space;
- Minimise obtrusive light spill into sensitive landscape and ecological areas;
- Minimise the energy consumption of the installation;
- Minimise maintenance requirements of installation; and,
- Minimise the life cost of delivering the above.

4.3 Design Principles

4.3.1 These principles are cognisant of the requirements set out in planning policy which seek to deliver good and efficient design and minimise obtrusive light on landscape, visual and ecological receptors. They are also aligned with specific operational requirements which ensure lighting is suitable for its purpose and creates a safe working environment.

a) External lighting design

- Set lighting away from the Site boundaries as far as practicable to minimise light spill into the neighbouring landscape;
- Minimise the mounting height of the luminaires and any tilt angles; try to maintain horizontal mounting arrangements of luminaires;
- Provide luminaires of the flat glass construction with zero direct upward light, to reduce sky glow and glare from the luminaires;
- Provide luminaires with good optical control and sharp cut-off to minimise the reflectance from buildings;
- Provide luminaires of as low a wattage and mounting height as practically possible;
- Minimise the mounting of luminaires to illuminate the fascia's of buildings;
- Where practicable, direct lighting into the Site rather than directing light outwards – this will need to consider the specific security requirements and provisions;

- Where luminaires may be mounted on buildings roofs illuminating the immediate roof area/plant and escape/exit doors, provide cowls/shields to the luminaires to minimise any direct light spill or direct views of the luminaires;
- Consider where necessary the switching off of the lighting installation to reduce the impact of the Site lighting on the wider environment and energy usage;
- If necessary, provide asymmetric lighting, or cowls/baffles to reduce light spill or direct views of the light source from outside the Site; and,
- Where practicable, provide additional screening within the Site to minimise light spill into the neighbouring landscape. This may include appropriate fencing or vegetation screening.

b) Internal lighting design

- Internal building areas requiring lighting should, as far as practicable, be at a level below the retained tree lines on the western boundary to maximise the screening function of this vegetation;
- As far as practicable, minimise the extent of windows (and internal lighting) on western elevations to reduce visibility of lights from surrounding areas beyond the Site boundary;
- Consider, where necessary, the switching off of the lighting installation to reduce the impact of the Site lighting on the wider environment and energy usage;
- Provide luminaires of as low a wattage as practically possible;
- Consider use of louvres or blinds (including automated systems) to intercept light spill from visible windows; and,
- Internal lights fixtures should be designed to minimise the time working at height.

5. DESIGN SOLUTION OVERVIEW

5.1.1 This section describes the proposed solutions for the Coronation Wood and Pillbox Field areas based on work undertaken in the Concept Design Stage. In addition to describing the proposed design solution, design options that were considered but not adopted are also recorded. This is in order to ensure the rationale and justification of the lighting proposal is fully documented. The detailed lighting design shall be in accordance with the technical specifications detailed in the appendices of this document.

5.2 External Design Solution Light Sources and Luminaires

5.2.1 Lighting for all the external redeveloped areas will be delivered from LED sources. LED sources have been selected as they provide more precise light control than alternative sources (such as Sodium lamps) in addition to their increased efficiency and longevity. This will facilitate reductions in upward light spill and views of light sources, which is a key factor to minimising light pollution into the SSSI. demonstrates the benefits of using LED sources in controlling light spill.

Figure 5.1: LED (left hand side) and Sodium (right hand side) Light Sources for Comparison

5.2.2 The equipment efficiency target proposed is challenging, but facilitates mid-range equipment selections from all the major manufacturers. Lighting equipment will deliver ‘good’ colour rendering (rather than ‘excellent’) being at least RA70. This will enable the installation efficiency to be increased whilst still providing light quality that is fit for purpose. The light colour will be neutral white (4000K) – warm white (3000K) to best match the incumbent lighting stock on the Site.

5.2.3 Luminaires will be selected to reflect the environment they are located in, and the activities undertaken about them. The luminaires' optical system shall not allow any direct light above the horizontal plane (Full Cut-off and Cut-Off in **Figure 5.3**); this will reduce light pollution into the adjacent areas but also improve the efficiency of the installation by lessening wasted light. The external equipment will be highly water resistant and will offer impact resistance.

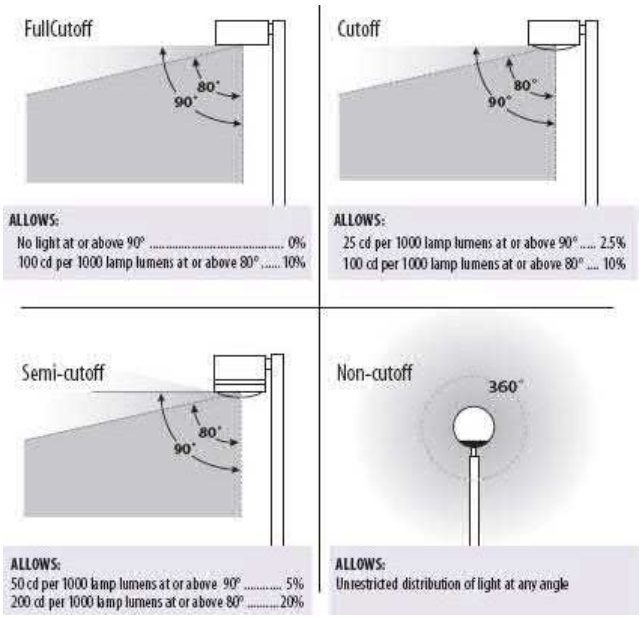


Figure 5.2: Horizontal Plane Light Cut-Off Proposed for Lighting Solutions (Full Cut-Off)

5.2.4 Luminaires will generally be asymmetric (i.e. an unequal distribution about one or more axes). Asymmetric lighting minimises the light levels in a particular direction (as shown by the example in **Figure 5.3**), and is considered a more efficient, best-practice approach to minimising light spill into adjacent areas, rather than specifying traditional mitigation measures such as baffles/cowls.

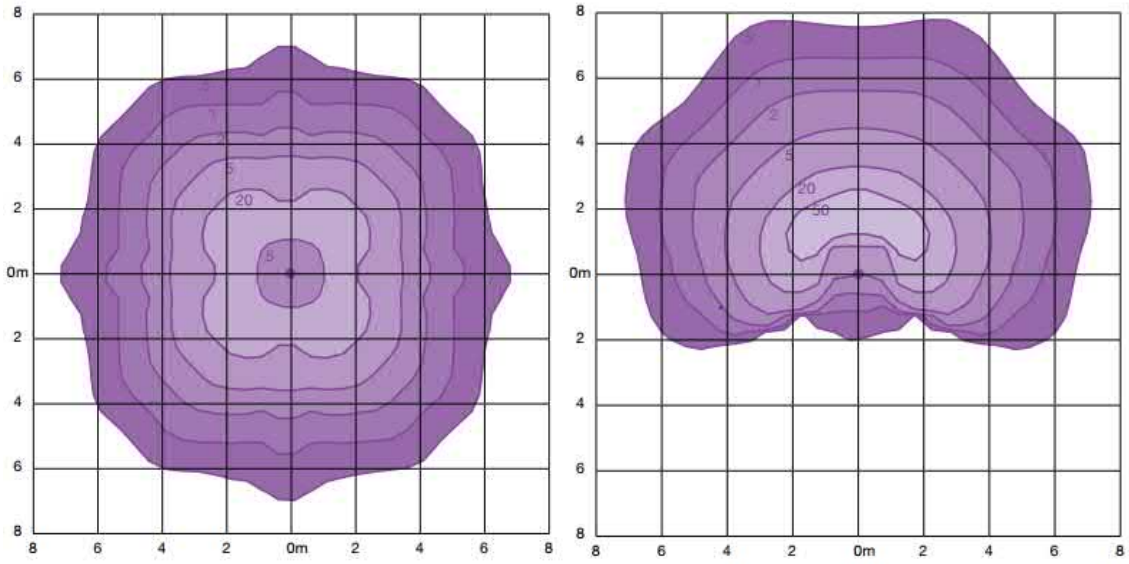


Figure 5.3: Example of Isolux Plots for Symmetric (LHS) and Asymmetric Luminaires (RHS)

5.3 Coronation Wood Development Overview

5.3.1 The Coronation Wood Development will compromise the Western Access Road, permanent car parking areas (main Proposed Car Park including for the Training Centre and Visitor Centre), the Laydown Area, and Training Centre and Visitor Centre buildings, as well as associated pedestrian routes (see **Figure 5.4** and **Figure 5.5**).

5.3.2 The laydown area is intended to be used in both operational and outage periods. The Coronation Wood Development Area is located at the South-West perimeter of the existing Sizewell B power station and therefore mostly seen against the backdrop of the existing Sizewell power station complex buildings. A portion of the Site is underneath overhead lines and therefore subject to height restrictions.

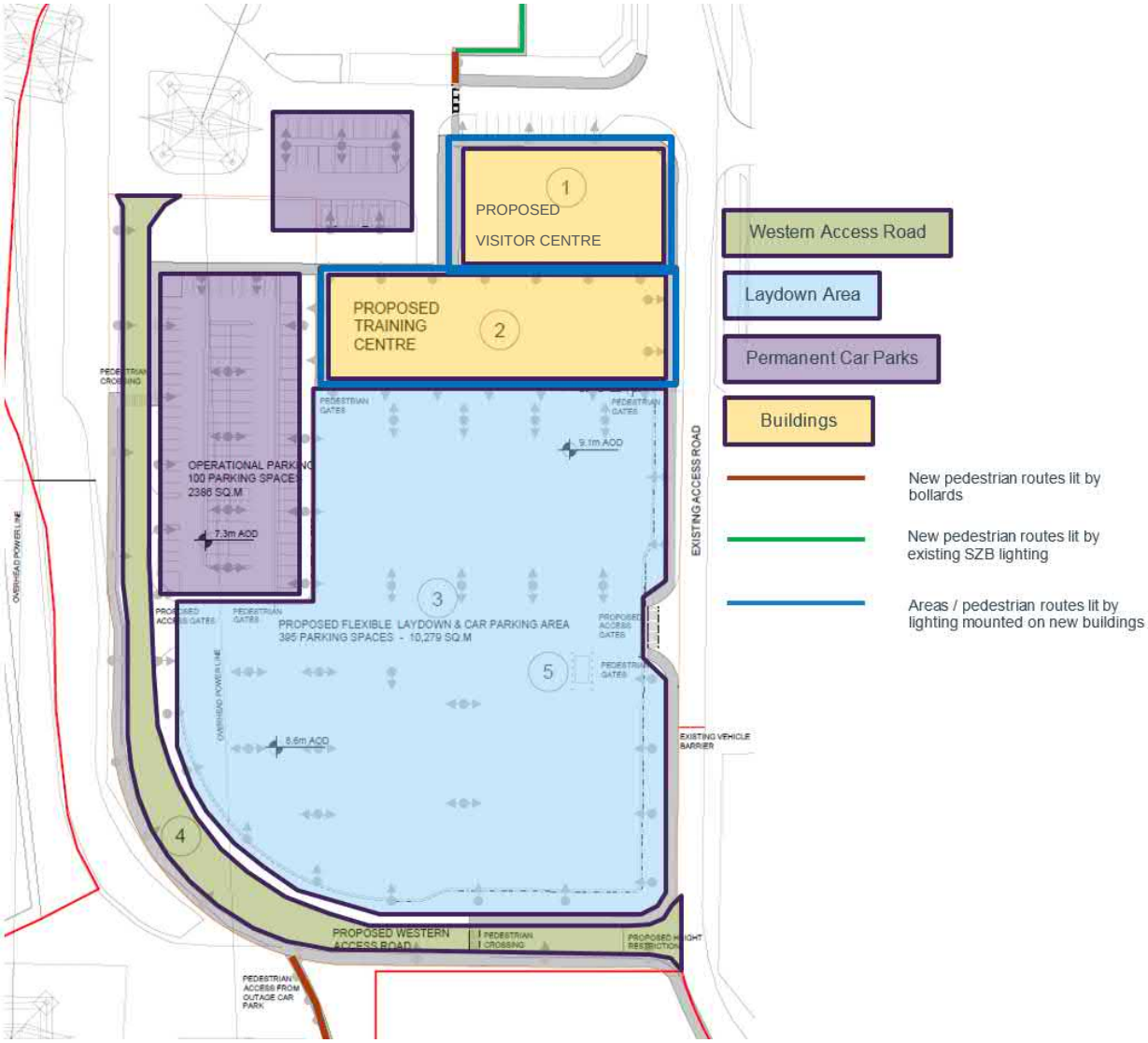


Figure 5.4: Plan of the Coronation Wood Development Area

Figure 5.5: CGI Representation of the Proposed Coronation Wood Development

5.3.3 The proposed activities and key design drivers for the external areas in the Coronation Wood Development are set out in **Table 5.1**.

Table 5.1: Proposed Activities and Design Drivers for Coronation Wood Development External Areas

Area	Proposed Activities	Key Lighting Design Considerations
Laydown Area	Required to accommodate a range of activities. The principal period of activity in the Laydown Area will be during plant outages or development / construction projects but some items will be stored permanently. Occasional out-of-hours (including 24-hour) working will be required, principally during plant outages. Activities within the Laydown Area may include: • Bulk material storage/ sorting • Scaffold, transformer, and spares laydown • Turbine hood storage • Fabrication, including temporary cover • Mobile workshops (containerised units or similar) • ISO container laydown (limit 6m stacked)	Provide sufficient lighting to undertake required tasks in a safe and secure manner. Minimise light pollution in the AONB and into SSSI, and visual impact of lighting scheme. Provide a comprehensive lighting control system to ensure that: areas of the laydown not being used at that time can be switched off; and, areas that are being used have the ability to increase the task lighting. Maximise the flexibility of the Laydown Area by minimising the permanent fixtures (e.g. lighting columns).

Area	Proposed Activities	Key Lighting Design Considerations
	• Temporary accommodation/office. (limit 6m-stacked) • Skips- non contaminated construction waste • Plant storage and parking and use (forklift, telehandler, mobile crane, tractor) • HGV overnight/ parking • Contractor/ visitor Parking overflow	Proximity of 400kV overhead lines in western extent of the laydown.
Western Access Road	Route for vehicular traffic	Provision of sufficient lighting levels outside of daylight hours to comply with relevant road standards. Minimise light pollution in the AONB and into SSSI, and visual impact of lighting scheme. Proximity of 400kV overhead lines in western extent of the laydown.
Car Parks	Car parking for users of the Coronation Wood buildings, because principally users will have regular vehicles (cars).	Provision of sufficient lighting levels outside of daylight hours to comply with relevant standards. Proximity of 400kV overhead lines in western extent of the laydown.
Pedestrian Routes	Pedestrian access along designated walkways, paths and circulation routes to/from/within the Coronation Wood Development.	Provision of sufficient lighting levels outside of daylight hours to comply with relevant standards. Minimise light pollution into SSSI and visual impact of lighting scheme.

5.3.4 A summary of the Coronation Wood Development lighting design solution for each area is presented in **Table 5.2**. The detailed lighting plan, performance specification and lighting calculation isolux plots are included in the appendices of this document.

Table 5.2: Proposed External Lighting Solutions for Coronation Wood Development

Area	Proposed Solution	Example of Proposed Optic
Laydown Area	Illuminated to 100 lux, dimmable to 20 lux. Asymmetric lanterns mounted on a combination of 8 metre and 4 metre columns (4m columns within the areas constrained by the proximity of the 400kV overhead power lines). Lighting of laydown area to be specific to the tasks being undertaken at the	 Holophane or similar

Area	Proposed Solution	Example of Proposed Optic
	time (noting that there are a range of activities that could be undertaken within this location). Task lighting to be localised and controlled to provide sufficient levels to undertake the activity in hand, prioritising safety and security. Lighting in areas with no activity have the means to be (and is likely to be) switched off.	
Western Access Road	Illuminated to 7.5 lux. 4 metre columns with Road Optic. Automatic switching of the installation based on time and daylight availability. Lux levels to always be maintained to minimum levels required for road usage.	 Holophane or similar
Car Parks	Illuminated to 20 lux. Asymmetric lanterns mounted on 4 metre columns. Automatic switching of the installations based on time and daylight availability. Lux levels to always be maintained to minimum levels required for uncovered parking areas.	 Holophane or similar
Pedestrian Routes	Illuminated to 20 lux. Lighting sources for new pedestrian routes will depend on their locations within the development area. The route from Pillbox Field will be lit by bollards on the walkways and surface-mounted lights over the footbridges – when the Outage Car Park is not in use, this route will not be lit.	

Area	Proposed Solution	Example of Proposed Optic
	Bollards will also be used to light the steps down to the Western Car Park. The route alongside the Western Access Road will be lit by the road lighting itself. Pedestrian crossings will have lighting columns positioned in close proximity to provide minimum required levels as per relevant standards. The routes around the Training Centre and Visitor Centre will be lit by lighting mounted externally on these buildings which will have automatic switching of the installation based on time and daylight availability. The route provided through the south-east corner of the Western Car Park will be illuminated by the existing lighting columns within the car park.	Thorlux Probe XL or similar 

a) Laydown Area Design Considerations and Alternative Options

5.3.5 The Laydown Area proposed lighting solution has been developed to respond to the design considerations previously listed. The solution allows for the maximum flexibility in use of the area, whilst minimising the impact to the SSSI and within the wider AONB.

5.3.6 Lighting calculations have been carried out to assess the likely effect of task lighting on the surrounding area. The Laydown Area has been modelled as illuminated to: 20 lux (minimum level for uncovered parking areas), 50 lux and 100 lux, with roads lit to 7.5 lux, walkways lit to 20 lux and car parks lit to 20 lux. Detailed performance specifications are included in the appendices of this document. To provide some context for the 100 lux maximum task lighting illumination level, the required average illumination level for a top flight football pitch is 500 lux. It is considered unlikely that the Laydown Area will be illuminated at the maximum levels for a concerted period of time outside of outages.

5.3.7 The calculations show that there is no direct light emitted above horizontal (as expected based on the specification of the luminaires). As luminaire tilts are limited to 5 degrees, there will be no glare from luminaires beyond the Site. Light spill at ground level to 0.5lux has been calculated – this is the equivalent level to a scene illuminated by starlight. As expected, as the Laydown Area brightness increases the 0.5 lux perimeter expands. At 100 lux the maximum distance of 0.5 lux from the Site perimeter is 50m, this reduces to 30m lux at 50 lux and 20m at 20 lux.

5.3.8 However, with any illumination option there is no light spill beyond the local SSSI site boundary, as can be seen by the isoline plot extracts in **Figure 5.6** (full plots can be found in the appendices).

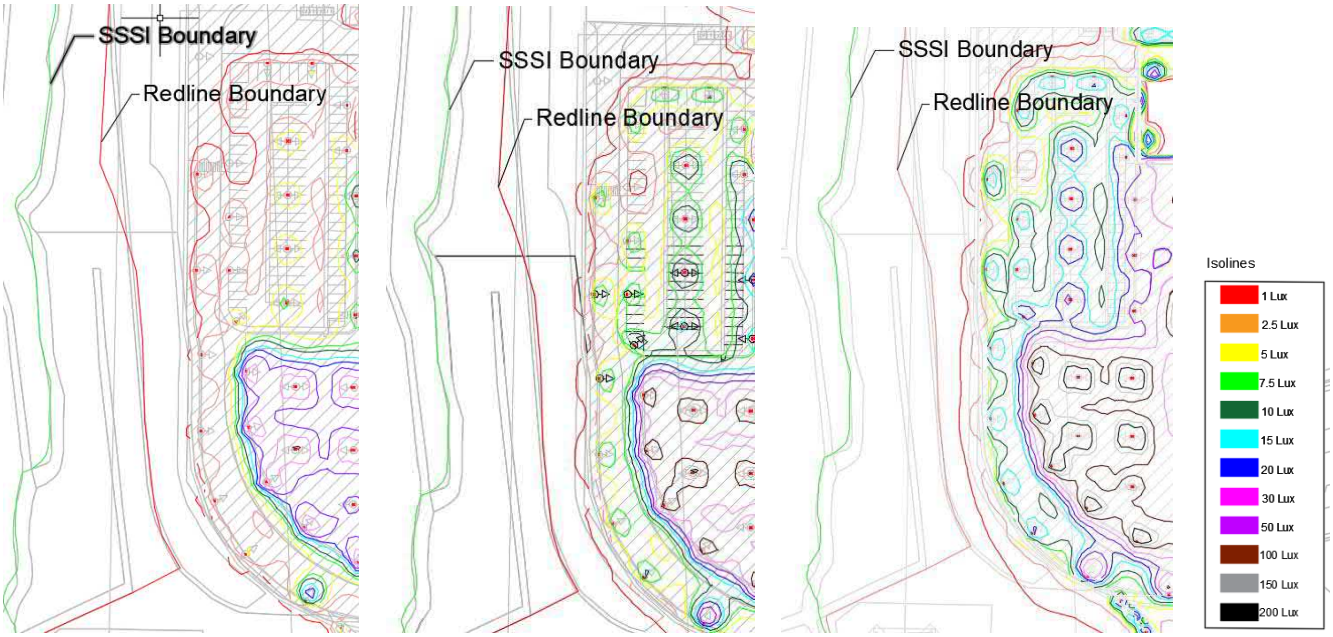


Figure 5.6: LHS – Isoline Calculation Result Extract for Laydown Area at 20% output; Middle - 50% output; RHS - 100% output

5.3.9 Alternative lighting options considered for the Laydown Area are listed in **Table 5.3**.

Table 5.3: Alternative Laydown Area Lighting Options Considered

Alternative	Considerations	Examples
Temporary Lighting Columns	A temporary-only lighting design was ruled out as it is recognised that certain equipment will be permanently stored in the Laydown, and therefore the design needed to deliver sufficient lighting for safe and secure operations on an ongoing basis. As such, a laydown design using a combination of temporary and permanent columns was considered. The proposed concept was to create a basic arrangement of permanent columns delivering a minimum required lighting level for safety and security. Supplementary, temporary columns would then be erected when additional task lighting was required. This solution could be delivered using temporary luminaires supplied with dedicated generators or temporary columns contacted to a permanent infrastructure. This solution was ruled out due to high impacts to working practices (onerous on storage, maintenance, placement, availability, risk of spillages during re-fuelling) and the potential increased risk of impact to the SSSI and wider AONB (incorrectly positioned luminaires could be inadvertently directed towards the SSSI, whereas fixed luminaires would not pose such a risk in this regard).	 

Alternative	Considerations	Examples
Raise and Lower Columns	The feasibility of using collapsible columns was reviewed, so that lighting equipment could be lowered when not required. This was ruled out as it was considered to be an ineffective solution - the collapsed columns would occupy large quantities of space making the area unusable and unsafe. Furthermore the hinged columns are not intended to be lowered for long periods and are therefore only adequately weather tight when erected.	
Permanent, Static, 4 metre columns	An installation composed of low height permanent columns was assessed (4m is a standard industry column height). A potential advantage to this option was that it could offer a solution in which the system was available to be used immediately and had a lower impact to the surrounding environment (as the columns would be low relative to the remaining vegetation). This solution was not further developed as assessments showed that the low column height would severely limit maximum column spacing resulting in an inefficient use of the laydown area due to the high quantities of luminaires. Conversely, in order to achieve a reasonable spacing the lantern heads would need to be excessively titled from horizontal which would result in unacceptable light spill into the SSSI.	
Permanent, Static, 6 metre columns	As a design development from the 4m columns, 6m columns (again, standard industry height) were modelled outside of the overhead power lines constrained areas. As expected, increasing the column height resulted in a reduction to the numbers of columns as they could be spaced further apart. Regarding their visual impact, 6 m columns would be more visible from off site, however the 4m columns are unlikely to be shielded from view by existing vegetation. As such, the decision to use 8m columns was taken as this maximised the column spacing (and minimise number of columns) and therefore the laydown flexibility, without significantly adding to the visual impact of the 4m or 6m options.	

b) Western Access Road Design Considerations and Alternative Options

5.3.10 The Western Access Road lighting solution has been developed in line with the design considerations listed previously. 4m columns deliver the minimum required illumination to the road (and pedestrian walkways) whilst ensuring sufficient clearance from the 400kV overhead power lines. The asymmetric luminaires specified will ensure that light spill behind the fixtures towards the SSSI will be minimised. Safety and security are the key design drivers for the road lighting. The road lights will be automatically controlled to turn on outside of daylight hours.

5.3.11 As indicated in **Figure 5.7**, the western extent of the Coronation Wood Development will include a 2m high hit-and-miss timber fence. This fence will provide a physical barrier to prevent light pollution into the wider AONB and SSSI from oncoming moving vehicle headlights.

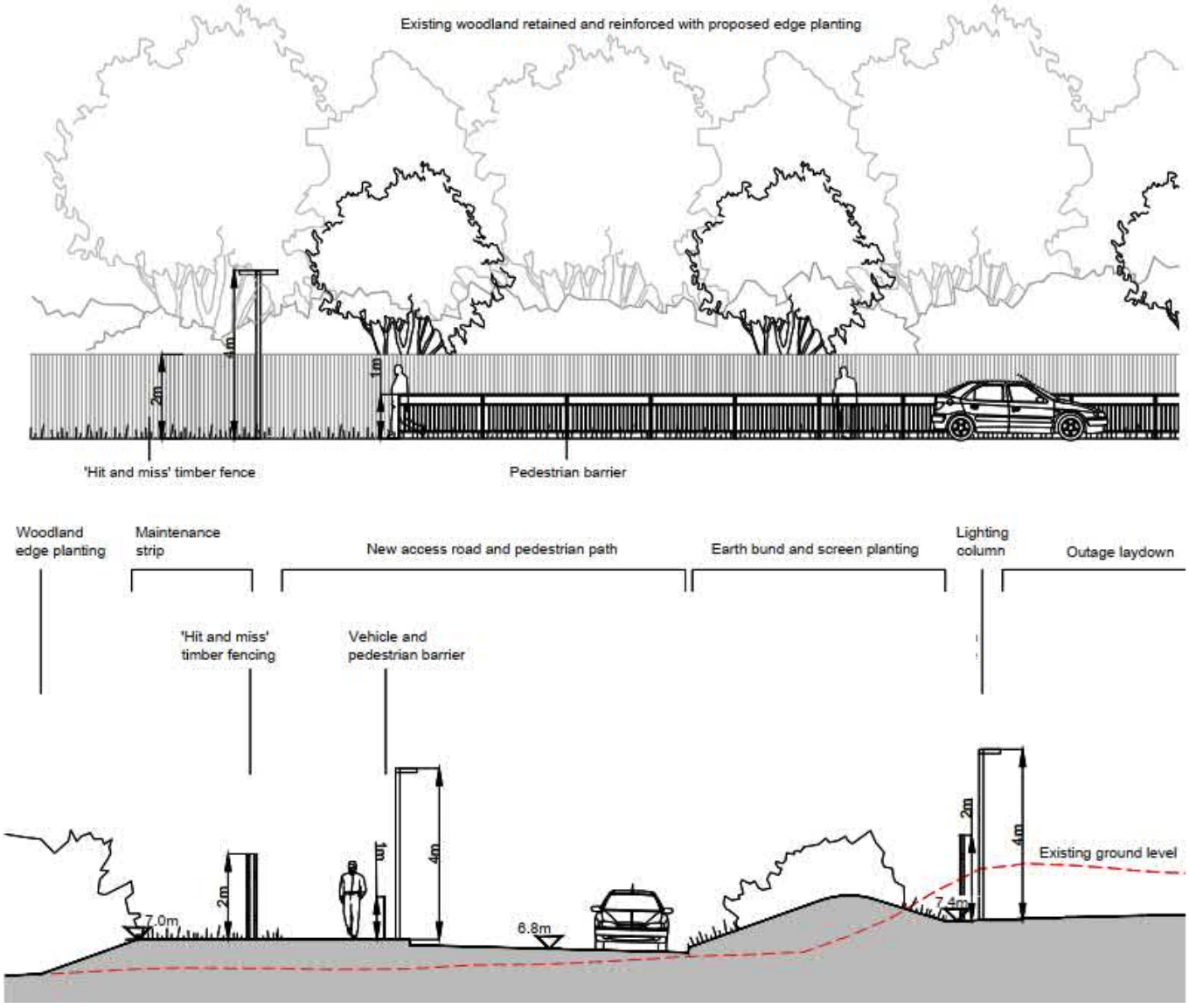


Figure 5.7: Elevation and Section of Proposed Coronation Wood Design in Vicinity of the Western Access Road

Table 5.4: Alternative Western Access Road Lighting Options Considered

Alternative	Considerations	Examples
No alternative options considered – the road safety requirements, alongside the constraints of the overhead power lines has led to the proposed design solution.		

c) Car Park Design Considerations and Alternative Options

5.3.12 The Proposed Car Park lighting solution has been developed in line with the design considerations listed previously. 4m columns deliver the required illumination for uncovered car park usage whilst ensuring sufficient clearance from the 400kV overhead power lines. The predominant type of vehicle using the car parks will be standard cars, so 4m columns will provide sufficient light in the vehicle circulation routes when the car parks are full.

Table 5.5: Alternative Car Park Lighting Options Considered

Alternative	Considerations	Examples
No alternative options considered – the constraint of the overhead power lines and requirement for permanent lighting has led to the proposed design solution.		

d) Lighting Considerations for Buildings within the Coronation Wood Development

5.3.13 The visual impact of lighting from the proposed Training Centre and Visitor Centre is discussed here. Whilst the two buildings are at different stages of design development (the Training Centre to detailed planning stage and the Visitor Centre to outline), in relation to the buildings, the proposed Coronation Wood layout and building orientations have been informed by the design drivers listed in **Section 4.3**. A representation of the two buildings can be seen in **Figure 5.8**.

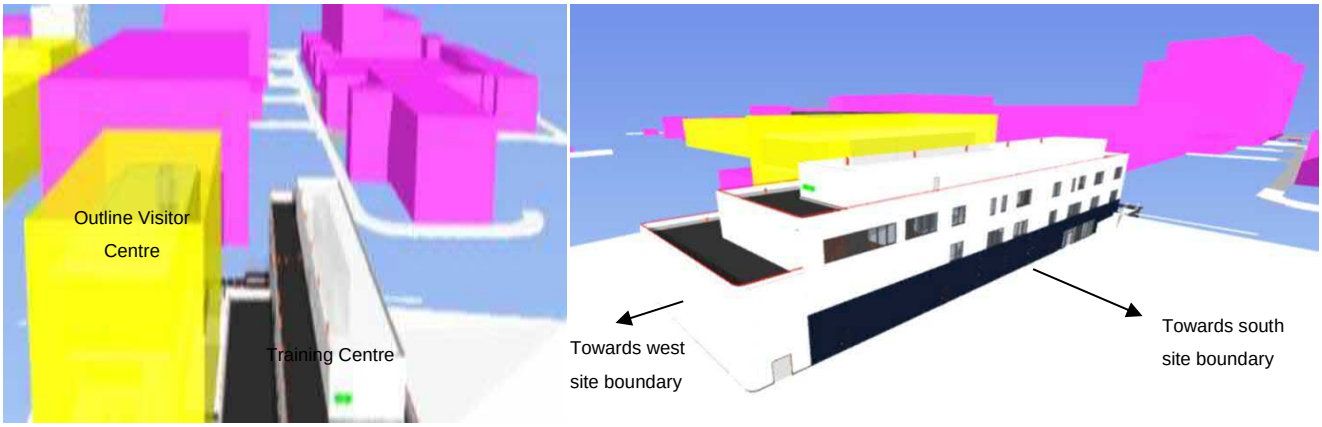


Figure 5.8: Model of the Training Centre in Relation to the Outline Visitor Centre

5.3.14 To address the potential of light spill into the adjacent SSSI and AONB and general lighting visual impact, the following measures have been taken:

5.3.15 Both buildings have been orientated so that their shorter facades face the western site boundary (which is closest in proximity to the SSSI, and also likely to be more prominent in off-Site viewpoints regarding light impact). The façade of the Training

Centre has been designed without windows, thus eliminating the potential of light spill. The design for the Visitor Centre is yet to be developed, however it would plan to minimise windows on the upper floors of the building recognising the sensitivities of introducing light sources at higher levels (and feasibly the lower levels too), and then look at possible mitigation options (louvres or similar). **Figure 5.9** indicates considerations for the western elevations of both buildings.

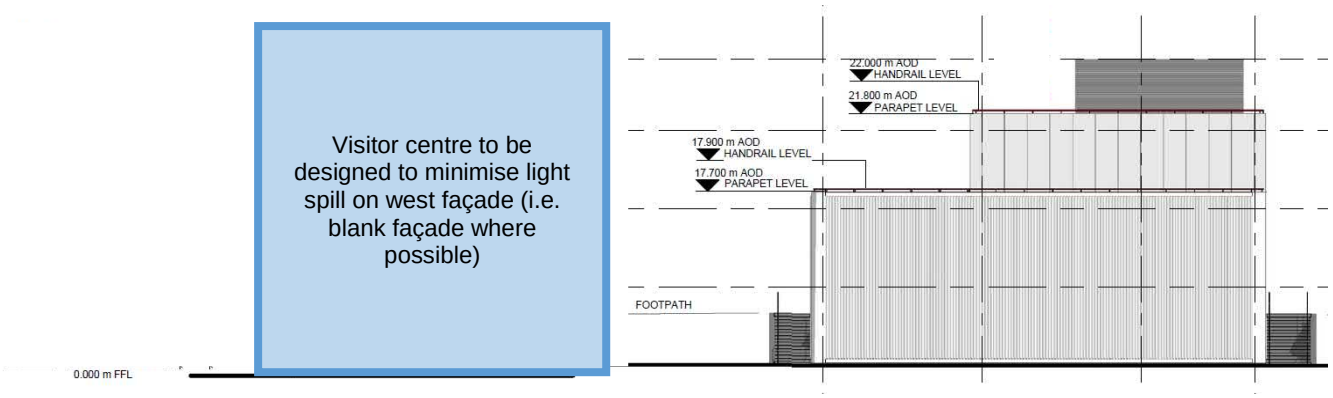


Figure 5.9: Training Centre (RHS) and adjacent Visitor Centre (Outline) Western Elevation

- Light spill from the south façade of the Training Centre's internal lighting will also add to the lighting visual impact of the building. As such, mitigation measures such as motion sensors and blinds are proposed to be incorporated into the design – this will ensure that the impact of lighting from within the buildings is controlled.
- Views of the Visitor Centre's south façade will generally be blocked by the Training Centre.
- Lights mounted externally will generally be to provide light for pedestrian circulation routes. These lights will be positioned as low as is feasible to provide the necessary lighting levels, whilst being positioned to minimise glare towards the west and south Coronation Wood site boundaries.

5.4 Pillbox Field

5.4.1 Pillbox Field is to be the location for a proposed Outage Car Park for Sizewell B power station. The Outage Car Park will provide spaces for 576 vehicles. Vehicles will access the car park from the south via the existing but modified junction from Sizewell Gap onto Sandy Lane. Past this junction, vehicles will turn into Pillbox Field along the Outage Car Park access track, and will enter the car park area on the north-west side.

5.4.2 Pedestrians will then access the main Coronation Wood Development (as detailed in **Section 5.3**) via a footpath and via footbridges to cross a watercourse.

5.4.3 The Outage Car Park is only to be used during outages, when the station operates a 12 hour shift pattern. There will therefore be high volumes of traffic entering and exiting the car park twice a day during the outage period. It is important to carefully consider the lighting scheme in the context of these concentrated periods of pedestrian and

vehicle movements. Conversely, the lighting scheme and any mitigation needs to be sensitive to the current rural nature of the Site within the AONB, and cognisant of the close proximity to the SSSI boundary which the pedestrian footpath runs close to on either side.

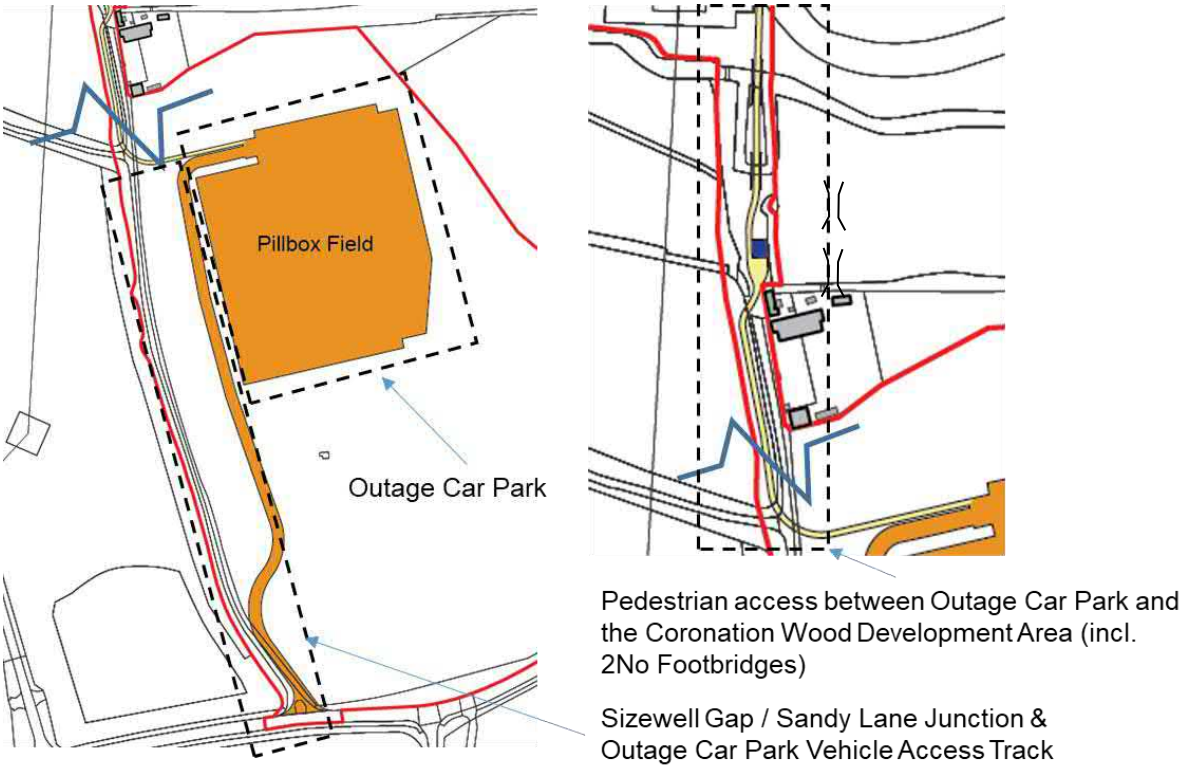


Figure 5.10: Pillbox Field Proposed Outage Car Park Plan

Figure 5.11: CGI Representation of Pillbox Field Design

5.4.4 The proposed activities and key design drivers for the Pillbox Field areas are set out in **Table 5.6**. complex

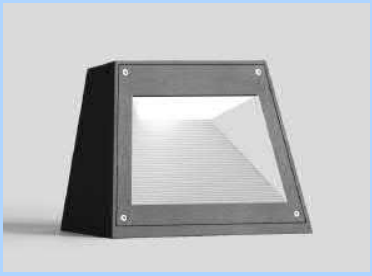
Table 5.6: Proposed Activities and Design Drivers for Pillbox Field

Area	Proposed Activities	Key Lighting Design Considerations
Outage Car Park	Parking for vehicles during outages only. The typical vehicles using the car park are more likely to be commercial vans than standard cars. Vehicle movements will be significant at shift changeover.	Pedestrian safety. Visual impact of solution in the context of the AONB. Certainty of the availability of lighting solution in the case of an unplanned outage - vary occasionally but are, in their nature, not forecastable.
Sandy Lane / Sizewell Gap Road Junction and route to car park access track	Vehicular access from the public road into the Outage Car Park. This junction marks the start of a public bridleway along Sandy Lane. Vehicle access to Rosary Cottages.	Non-vehicular user safety (horses, cyclists, pedestrians). Vehicular safety.
Footpath between Outage Car Park and Coronation Wood Development	Outage workforce pedestrian route to Sizewell B Power Station Site (linking to Coronation Wood Development).	Pedestrian safety. Minimising light spill due to close proximity of the SSSI on both sides of the pathway.
Footbridges	Outage workforce pedestrian route to Station over watercourses.	Pedestrian safety. Minimising light spill into watercourse.

5.4.5 A summary of the Pillbox Field lighting design solution for each area is presented in **Table 5.7**. The detailed lighting plan and lighting calculation isolux plots are included in the appendices of this document.

Table 5.7: Proposed External Lighting Solutions for Pillbox Field

Area	Proposed Solution	Example of Proposed Optic
Outage Car Park	Illuminated to 20 lux. Asymmetric lanterns mounted on 6 metre columns. Automatic switching of the installations based on time and daylight availability, but lights will have central control to be switched off outside of outages. When in use, lux levels to be maintained to minimum levels required for uncovered parking areas.	 Thorlux Starguard or similar
Sandy Lane / Sizewell Gap Road Junction and Access Track	Proposed to be unlit.	N/A

Area	Proposed Solution	Example of Proposed Optic
Footpath between Outage Car Park and Coronation Wood Development	Illuminated to 20 lux. 1 metre high asymmetric lighting bollards. Automatic switching of the installations based on time and daylight availability, but lights will have central control to be switched off outside of outages. When in use, lux levels to be maintained to minimum levels required for pedestrian footpaths.	 Thorlux Probe XL or similar
Footbridges	Illuminated to 20 lux. On-ground luminaire. Automatic switching of the installations based on time and daylight availability, but lights will have central control to be switched off outside of outages. When in use, lux levels to be maintained to minimum levels required for pedestrian footpaths.	 BEGA or similar

b) Outage Car Park Design Considerations and Alternative Options

5.4.6 A number of options were reviewed in detail for the Outage Car Park lighting, before the concluding on the 6m permanent column solution. These options are summarised in **Table 5.8**.

Table 5.8: Alternative Outage Car Park Lighting Options Considered

Alternative	Considerations	Examples
No Lighting	The starting point for the lighting options was to challenge whether or not any lighting was required in the first place i.e. minimum visual impact. The main consideration for this was the pattern of car park usage - close to 600 vehicles will use this car park, and the usage pattern would be highly concentrated to the timing of the shift change over (leading to significant vehicle movements). Vehicle users are likely to access equipment from their vehicles (standing in the vehicle circulation areas when opening car/van boots), as well as walking to the footpath to gain access	N/A

Alternative	Considerations	Examples
	to the main site. On the grounds of pedestrian safety, the no lighting option was ruled out.	
Temporary Columns	Recognising that the outage car park would be used infrequently (for up to three months every 18 months for planned outages but also for unplanned outages), consideration was given to a temporary lighting solution in order to minimise visual impact. A temporary solution presents similar challenges to those considered in Coronation Wood - high impacts to working practices (onerous on storage, maintenance, placement, availability, risk of spillages during re-fuelling) and the potential increased risk of impact to the AONB and SSSI (incorrectly positioned luminaires could be inadvertently directed towards the SSSI, whereas fixed luminaires would not pose such a risk in this regard). The assurance of availability of a temporary column solution was one of the key factors in ruling this option out.	
Raise and Lower Columns	Similar to Coronation Wood, the feasibility of using collapsible columns was reviewed, so that lighting equipment could be lowered when not required – this would have the benefit of reducing visual impact when the car park was not in use. This was ruled out as the hinged columns are not intended to be lowered for long periods and are therefore only adequately weather tight when erected. They could pose a health and safety risk to workers carrying out any maintenance work on the car park when in their lowered state.	
Permanent, 1m Lighting Bollards	Minimising the visual impact of a permanent lighting solution led to the option of 1m lighting bollards being considered. The lighting output of the bollards was shown to be limited when modelled (as expected because a car park would not normally be a design application for this type of luminaire). The issue was shown to be more significant when modelling a line of parked vehicles – zero lighting levels were predicted in the vehicle circulation lanes. This solution was therefore ruled out on the grounds of pedestrian safety.	

Alternative	Considerations	Examples
Permanent, Static, 4 metre columns	As the design options moved towards a permanent installation, the option of very low height permanent columns was assessed (4m is a standard industry column height). Larger column spacing was not a design driver as it was for the Laydown Area in Coronation Wood. A potential advantage to this option was that it could offer a solution in which the system was available to be used immediately. The solution was not adopted on the grounds of pedestrian safety based on the low light levels modelled in the vehicle circulation lanes (see further detail in main body of this report).	

5.4.7 Once the decision was taken to introduce a permanent solution, one of the key design considerations was linked to the type of vehicles expected to use the car park. In comparison to the Operation Car Park in Coronation Wood, it is much more likely that the majority of vehicles using the Outage Car Park will be commercial vans.

5.4.8 There will be high levels of vehicle movements at shift change over, and vehicle users are likely to access equipment from their vehicles (standing in the vehicle circulation areas when opening car/van boots/doors). This led to a requirement for sufficient lighting of the vehicle circulation lanes to ensure that pedestrians can be seen at a distance by oncoming traffic.

5.4.9 The concentrated vehicle usage coupled with the likely large number of tall vans meant that of the permanent lighting options assessed (1m bollards, 4m lighting columns, and 6m lighting columns), only the 6m columns provided sufficient light levels in the vehicle circulation lanes. Lighting calculations have modelled a line of vans to demonstrate the lighting levels in this scenario, but the options are pictorially represented in **Figure 5.12**.

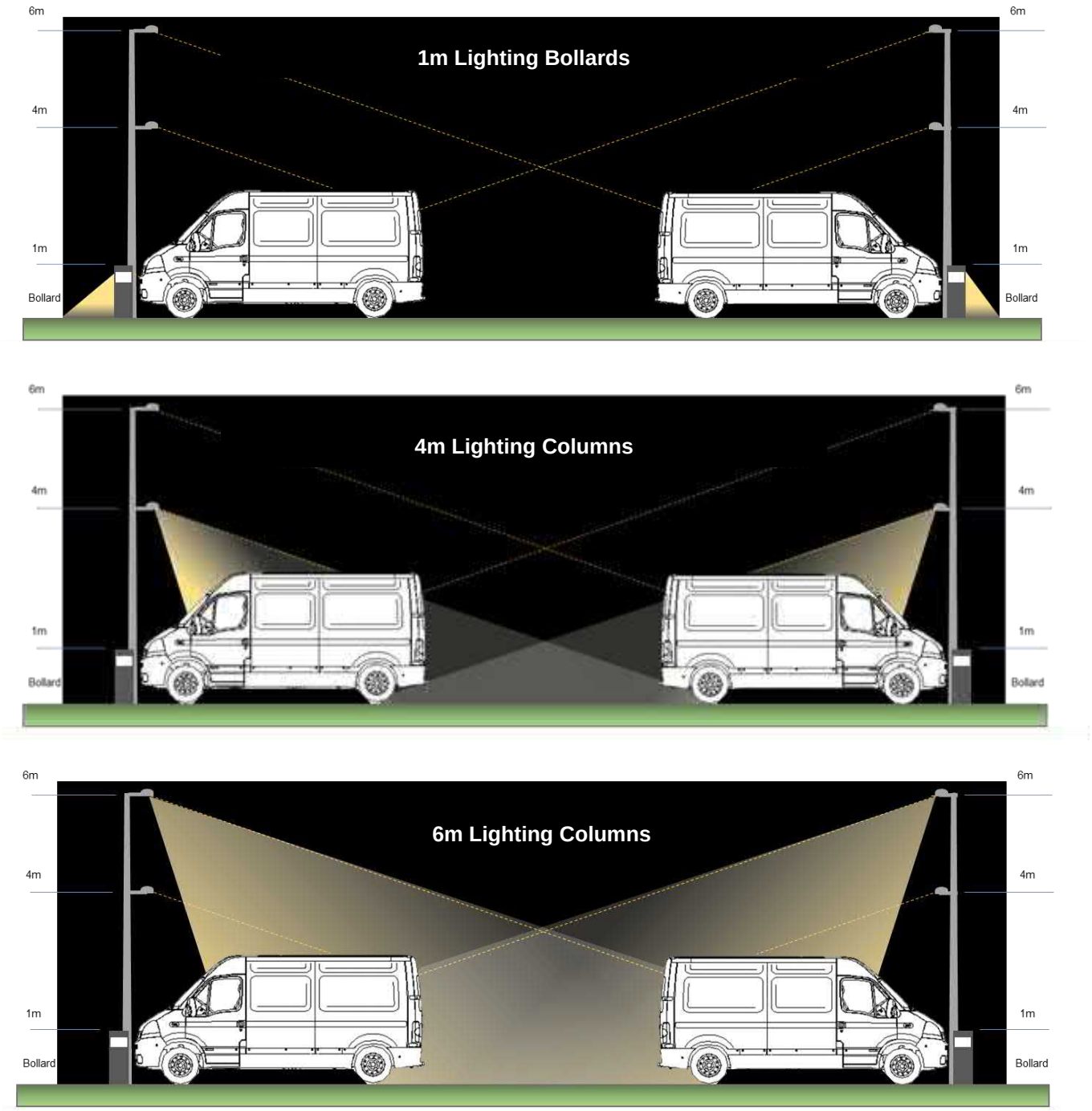


Figure 5.12: Permanent Outage Car Park Lighting Options Considered

5.4.10 The landscaping design for Pillbox Field has responded to the Outage Car Park surface level and proposed lighting solution. A proposed woodland and heathland scrub planting scheme (as shown in **Figure 5.13**) is intended to provide a screening function for the car park and the permanent lighting features when in use.

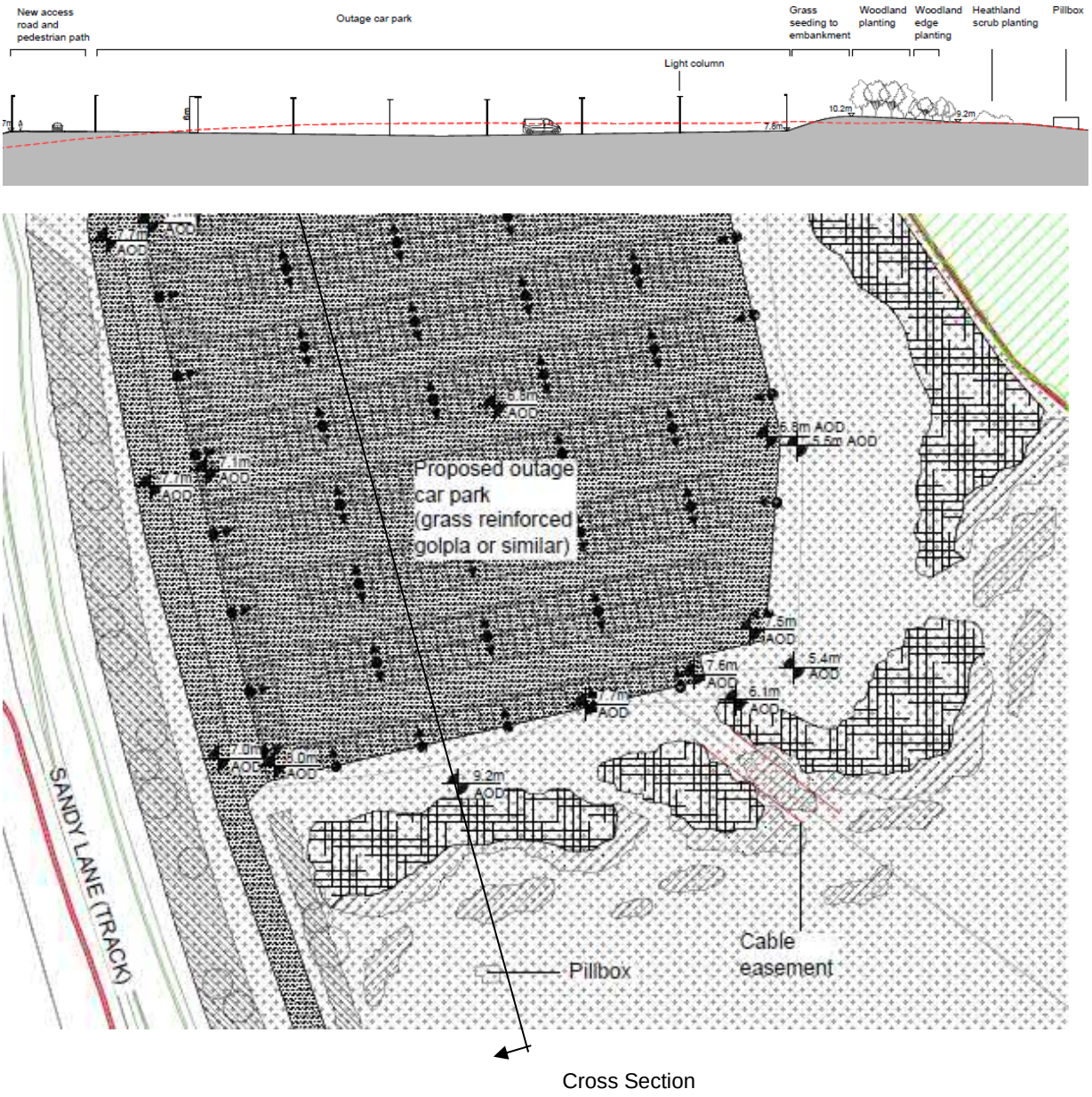


Figure 5.13: Pillbox Field Landscaping Proposal

c) Sandy Lane / Sizewell Gap Junction Design Considerations and Alternative Options

5.4.11 The design of the modified road junction and access into Pillbox Field has taken into account relevant highways standards and is shown in **Figure 5.14**. The design proposes to retain the road junction's current unlit status. In addition, no lighting is proposed for the vehicle access track from the junction to the Outage Car Park itself.

5.4.12 The existing bridleway is designed to be separate from the road users up to where vehicles will cross into Pillbox Field itself. When the Outage Car Park is operational, around the times of shift change, it is proposed that a traffic marshal will be in place at this entrance point to monitor vehicles going into the field, and to marshal the crossing for the bridleway users.

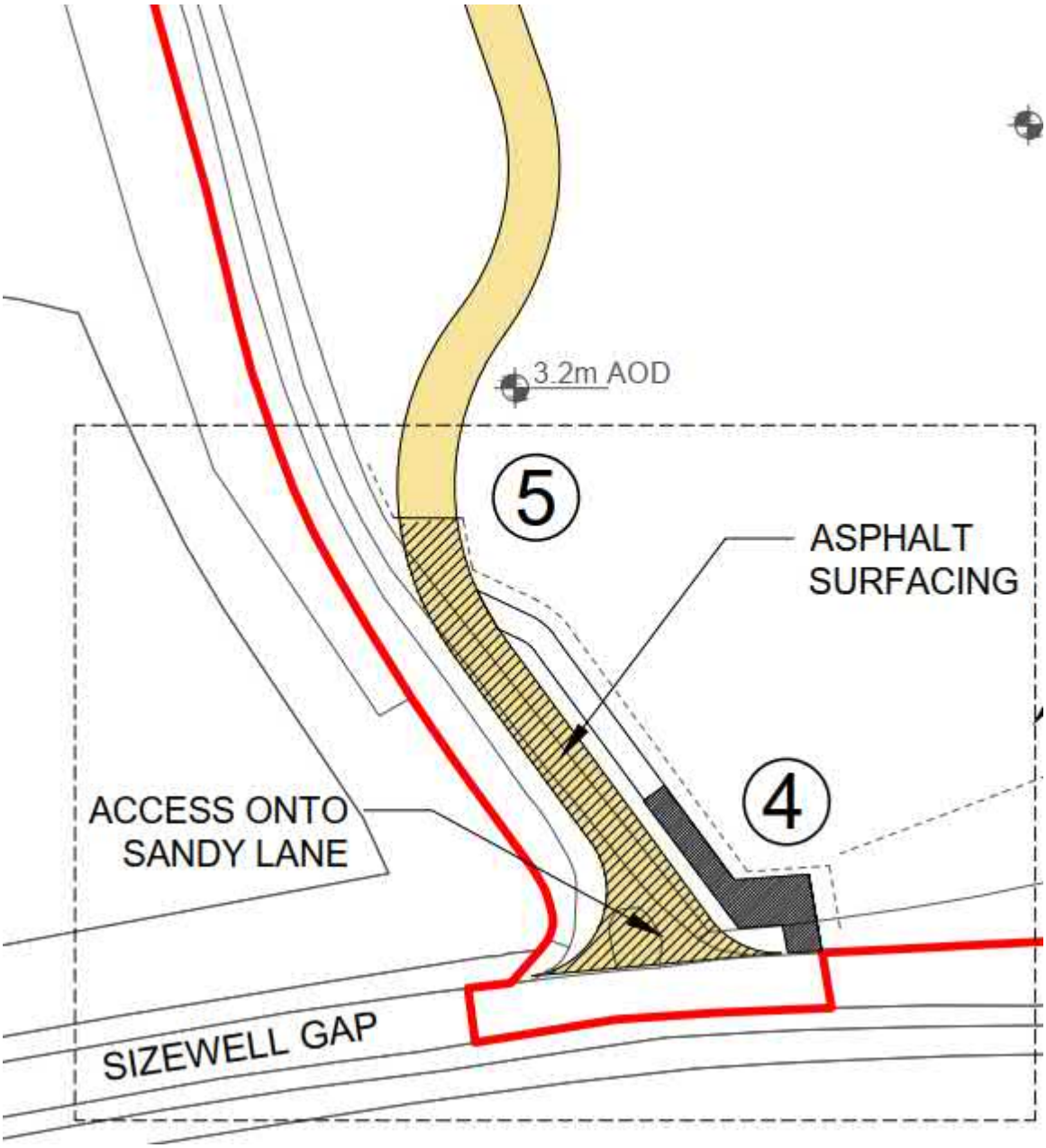


Figure 5.14: Sizewell Gap / Sandy Lane Road Junction and Route of Outage Car Park Access Track

d) Footpath between Outage Car Park and Coronation Wood Development - Design Considerations and Alternative Options

5.4.13 The footpath is proposed to be lit to ensure pedestrians have a safe and secure access route to and from the Outage Car Park during the hours of darkness. The 1m lighting

bollard solution for the path has been proposed as it satisfies the minimum pedestrian lighting levels whilst minimising the lighting impact to the adjacent SSSI. As noted in **Section 5.2**, luminaires will generally be asymmetric, and the bollards proposed here are no exception. **Figure 5.15** provides a representation of how the bollards will look in the context of a rural setting, as well as highlighting the effectiveness of asymmetric luminaires (particularly important for the SSSI context).

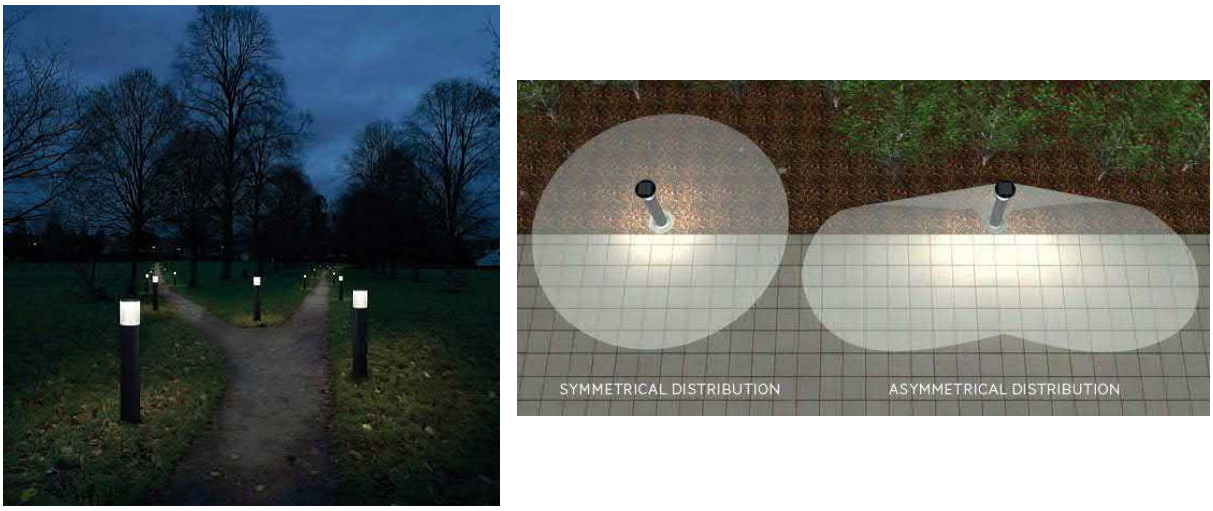


Figure 5.15: CGI Representation of Bollards Used on a Rural Pathway Setting

5.4.14 **Figure 5.16** provides an indication of how close the SSSI boundary is to the pathway. In the isoline plot, the bollards have not been modelled as asymmetric (this function is not available), and therefore the indication of light intrusion beyond the SSSI boundary is not representative of the expected design outcome with asymmetric luminaires, which intrude less on areas outside the pathway itself.

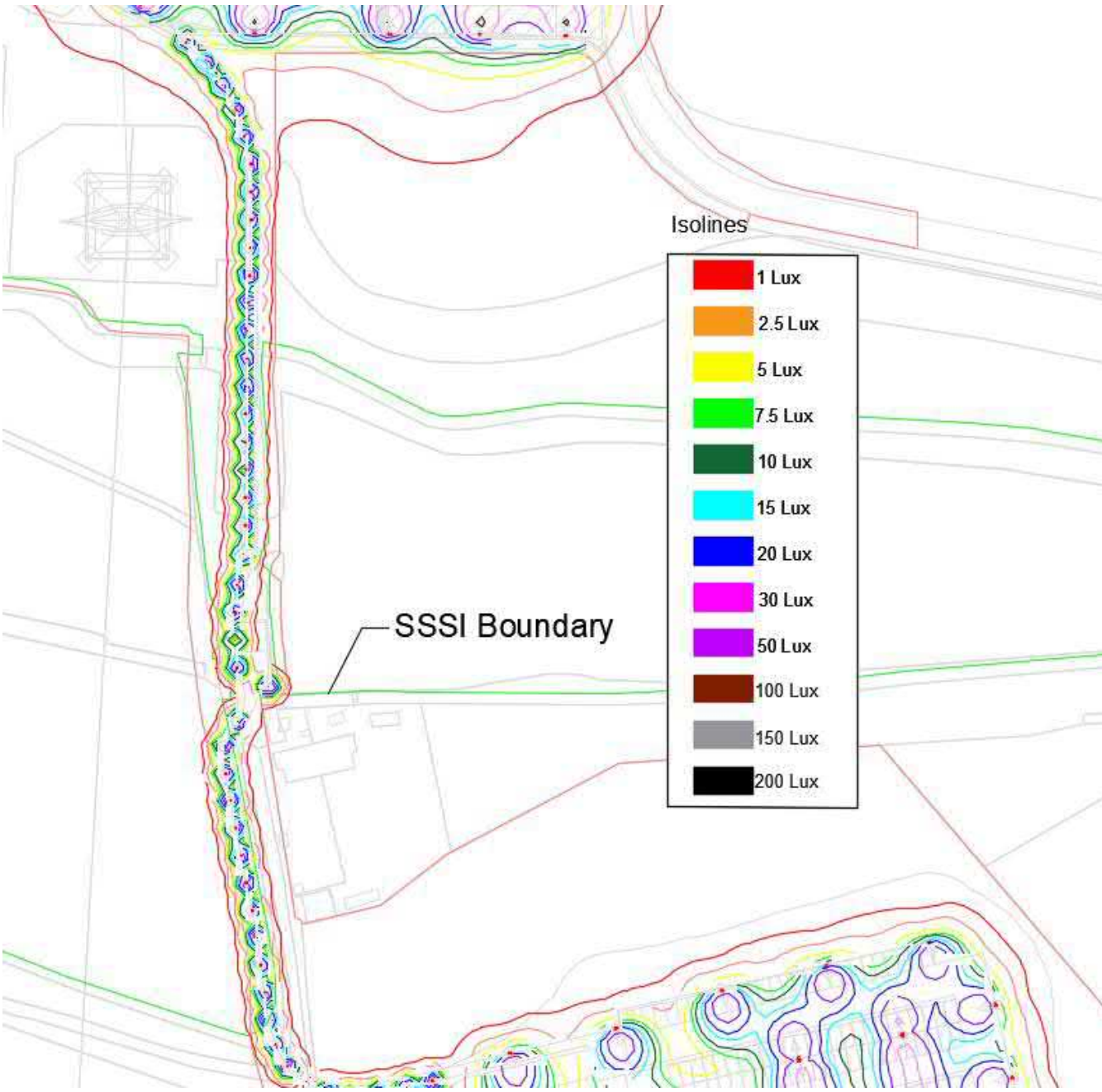


Figure 5.16: Extract of Isoline Plot for Access Pathway

5.4.15 Alternative lighting options considered for the Outage Car Park are listed in **Table 5.9.**

Table 5.9: Alternative Access Footpath Lighting Options Considered

Alternative	Considerations	Examples
No Lighting	Ruled out on the grounds of pedestrian safety.	N/A
Low Level Permanent Lighting Columns	Considered to introduce a greater visual impact on the surrounding area and SSSI than the bollard solution, therefore ruled out.	

a) Footbridges - Design Considerations and Alternative Options

5.4.16 The footpath is proposed to be lit to ensure pedestrians have a safe and secure access route. The key design consideration that has resulted in the proposed solution of ground-mounted luminaires is the proximity of the watercourse. Animals using watercourses may be particularly sensitive to light pollution, and so the proposed solution ensures this is absolutely minimised.

5.4.17 **Figure 5.17** and **Figure 5.18** provide visualisations on how this lighting option will look.

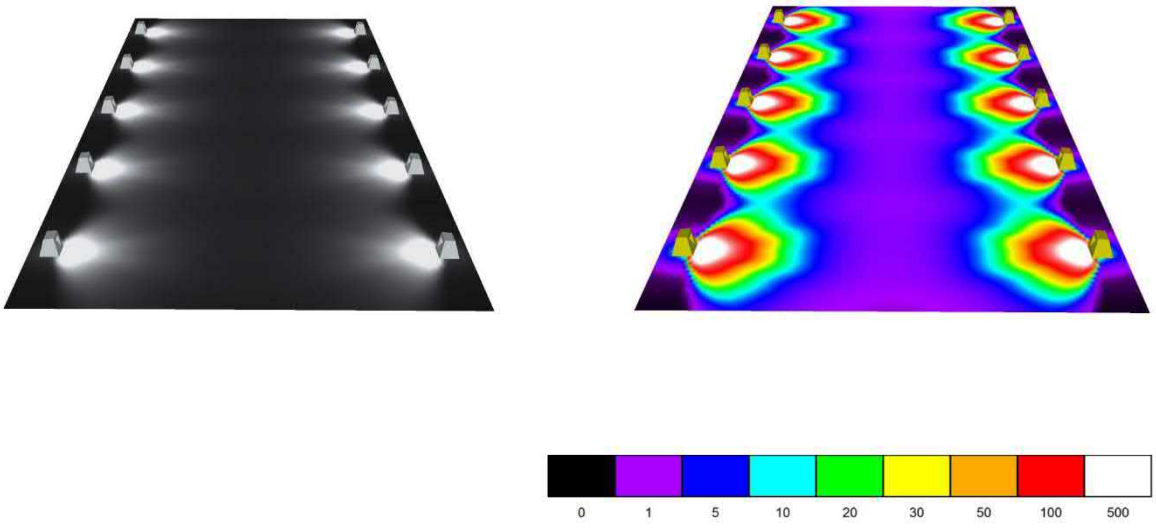


Figure 5.17: LHS - Lighting Effect; RHS - Pseudo colour image showing illuminance

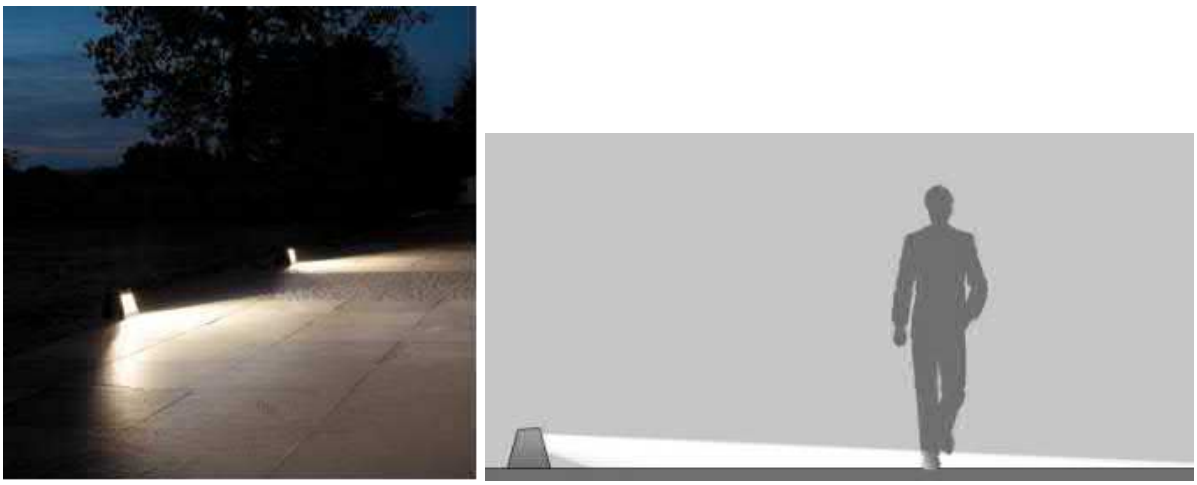


Figure 5.18: LHS - Image of specified bridge light RHS – Indication of ground-mounted illuminance in section

5.5 Outline Development Zone and Outage Store

5.5.1 For the facilities proposed within the Sizewell B Power Station site perimeter, external and internal facility lighting will adhere to the applicable design drivers and principles noted in **Section 4**. The lighting design will, however, recognise the industrial nature of the immediate surroundings meaning fewer design sensitivities than compared to the off-site development areas of Coronation Wood and Pillbox Field.

5.5.2 Additional external lighting for these facilities will not be significant due to the existing external lighting levels within the Sizewell B Power Station Security Perimeter. Any external lighting designed will be in keeping with the on-site setting.

5.5.3 Internal lighting will be provided to the requisite levels to undertake planned tasks within the facilities. A number of the facilities are industrial in nature and will have low levels of glazing.

REFERENCES

Ref. 1 Overarching National Policy Statement for Energy (EN-1) (2011) Department of Energy and Climate Change

Ref. 2 The National Planning Policy Framework (2019) Department for Communities and Local Government

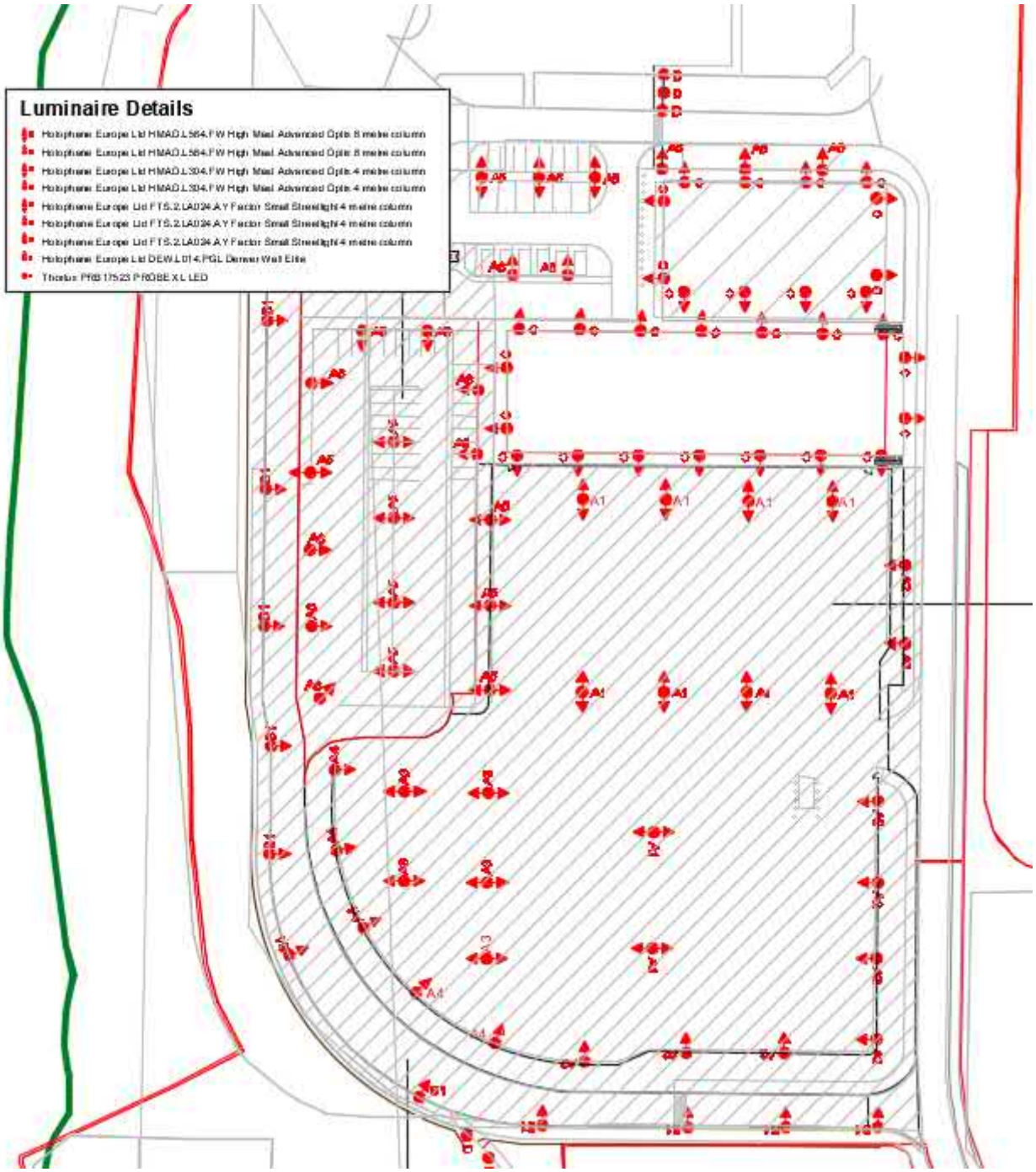
Ref. 3 Suffolk Coastal District Local Plan - Core Strategy and Development Management Policies – Development Plan Document: Development Management Policy DM26 – Lighting

Ref. 4 Suffolk Coastal Local Plan Final Draft Plan: Policy SCLP10.3: Environmental Quality

Ref. 5 Suffolk Coast and Heaths AONB Management Plan 2013 – 2018 (2013); Suffolk Coast and Heaths AONB Partnership

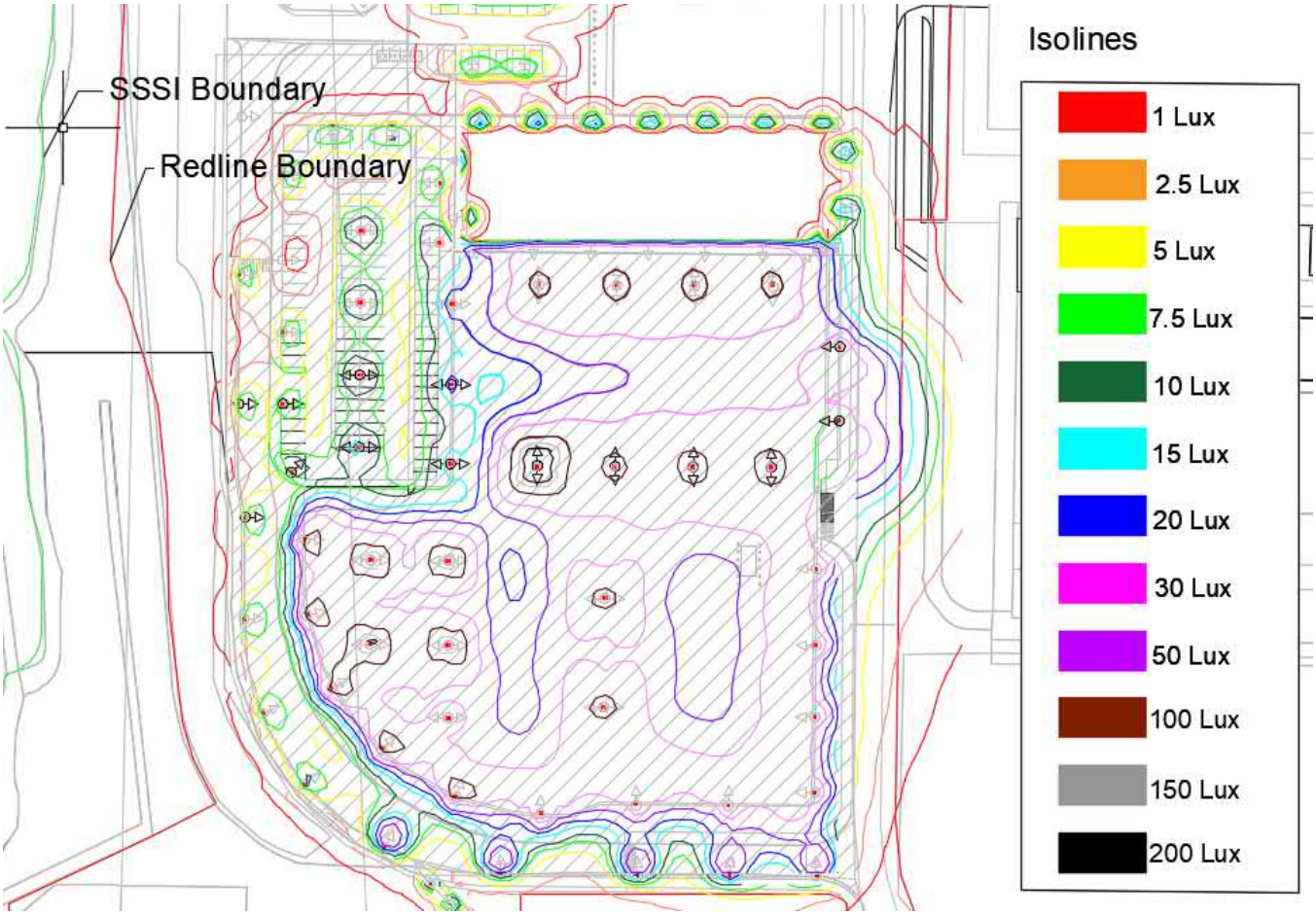
Ref. 6 Suffolk Coast & Heaths AONB Position Statement (April 2016) Obtrusive lighting in the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (2016); Suffolk Coast and Heaths AONB Partnership

APPENDIX 1A CORONATION WOOD LIGHTING PLAN



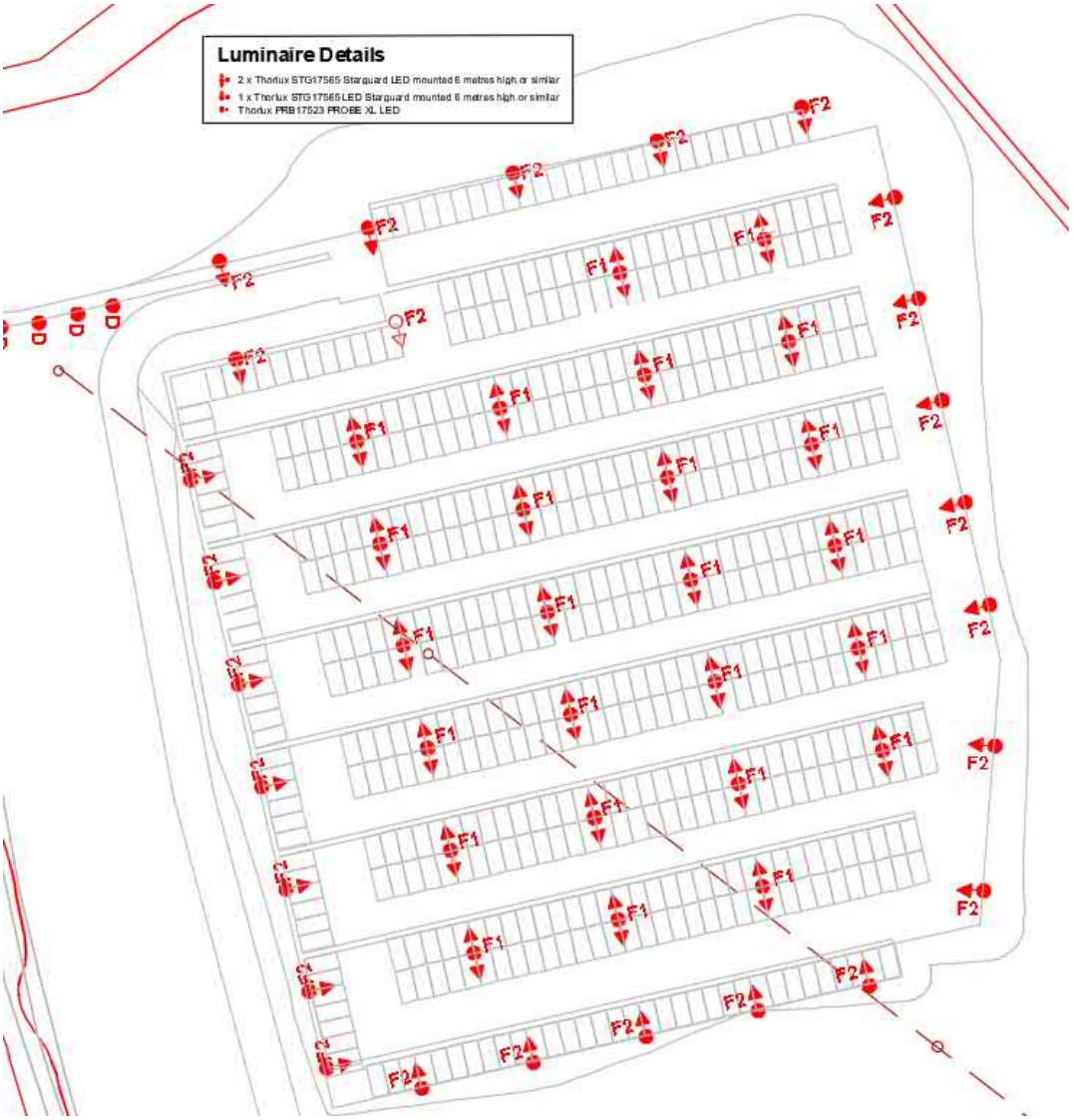
Calculation Results for Laydown Area at 100 lux (100% output); Western Access Road at 10 lux; Car Parks and Pedestrian Footpaths at 20 lux

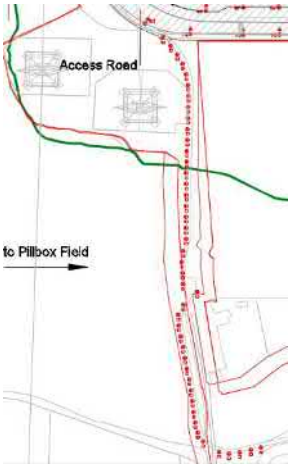
Calculation Results for Laydown Area at 50 lux (50% output); Western Access Road at 10 lux; Car Parks and Pedestrian Footpaths at 20 lux



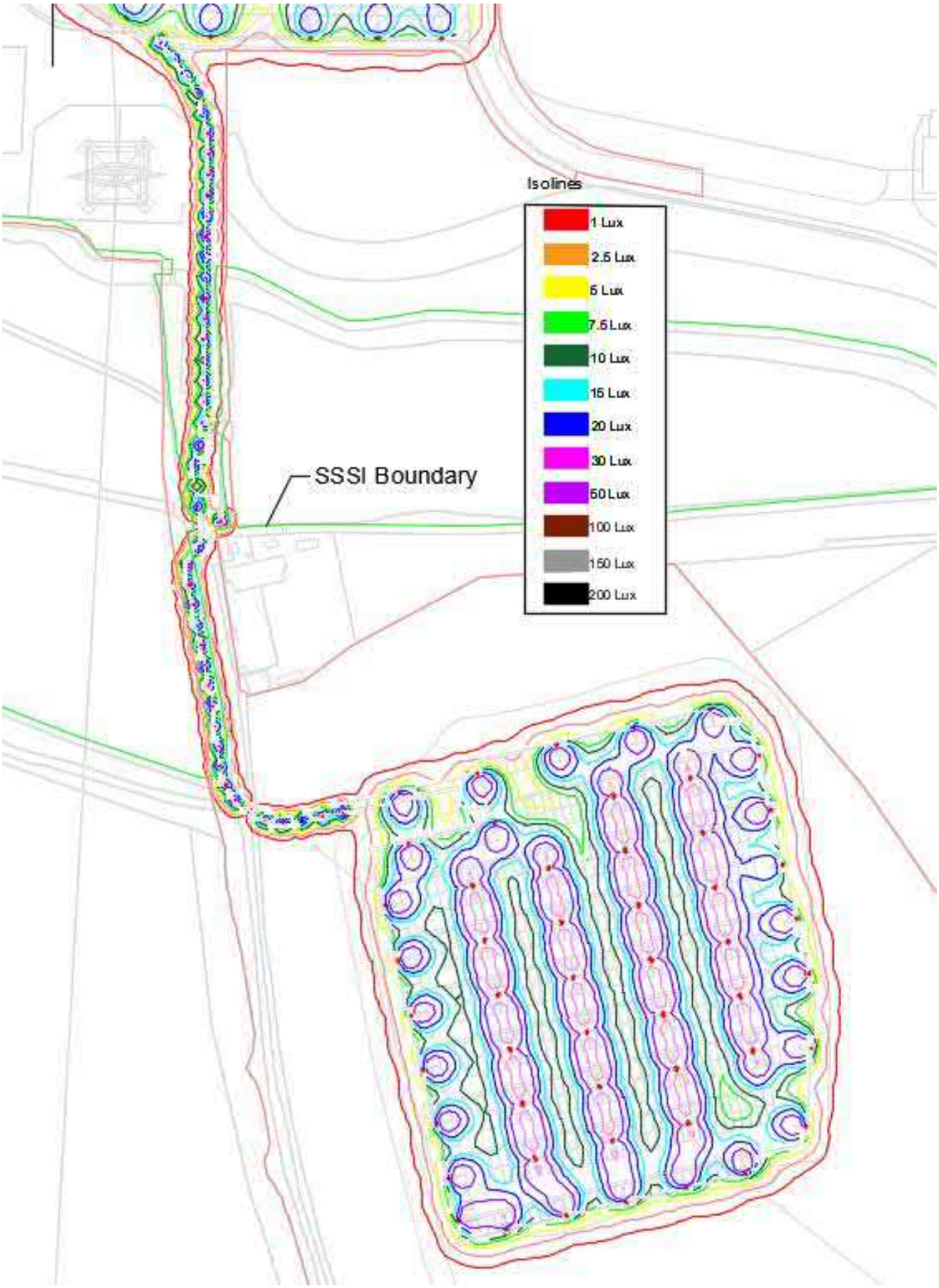
Calculation Results for Laydown Area at 20 lux (20% output); Western Access Road at 10 lux; Car Parks and Pedestrian Footpaths at 20 lux

APPENDIX 1B PILLBOX FIELD LIGHTING PLAN





Calculation Results for Pillbox Field Lighting Scheme at 100% Output



APPENDIX 1C LIGHTING SPECIFICATIONS

Table 0.1: Applicable Design Standards

Publisher	Standard reference	Document title	Legislative / Guidance
Health and Safety Executive	-	Health and Safety at Work etc. Act 1974 (including all amendments in force up to the time of issue of this report)	Legislative
Her Majesty's Government (HMG)	-	Clean Neighbourhoods and Environment Act 2005	Legislative
British Standards Institute	BS 12464-2:2007	Light and lighting — Lighting of work places Part 2: Outdoor work places	Guidance
British Standards Institute	BS EN 5489-1:2012	Code of Practice for the design of road lighting Part 1: Lighting of roads and public amenity areas	Guidance
Society of Light and Lighting	LG6	Lighting for the Outdoor Environment	Guidance
Institute of Lighting Professionals	GN01:2011	Reduction of Obtrusive Light	Guidance

Table 0.2: Lighting Performance Specification

Area	Maintenance Value, $\bar{E}_m$ (Lux)	Minimum Uniformity Ratio, U_o	Minimum Colour Rendering Index, R_a
Uncovered parking areas	20	0,2	70
Laydown areas	100*	0.25	70
Walkways exclusively for pedestrians	20	0,2	70
Regular vehicle traffic (max. 40 km/h)	7.5	0,40	70

Table 0.3: LED Criteria

Description	Criteria
Light Source	LED
Energy efficiency	100 luminaire lumens/Circuit Watt
MacAdams factor	SDCM: 5
Colour rendering	Ra>70

Description	Criteria
Colour temperature	3000 - 4000K
Control Gear	High Frequency
Design Life	L70/B50 @ 50,000 @ 25ºC

Table 0.4: Luminaire Criteria

Description	Criteria
IP rating	65
IK rating	10
Design Life	20 years
Direct flux cut-off	0º (no light above horizontal)
Max aiming tilt	10º
Column finish	Galvanised

Table 0.5: Maintenance Activities

Description	Maintenance Frequency
Luminaire Cleaning	5 years (if not exposed to rain)
Bulk lamp and gear replacement	10 years (50,000 hrs of use)*
Bulk luminaire replacement	20 years*
Bulk column replacement	20 - 30 years (dependant on environment)

APPENDIX 1D LUMINNAIRE DATASHEETS

PROBE & PROBE-XL

IP66 BOLLARD LUMINAIRES

IP66 IK10 CE LED

SPECIFICATION

- Surface or root mounted accessories
- Integral control gear
- Fused mains terminal block
- Fitted with 4000K or 5700K LEDs

PROBE

- Low glare, round top bollard, aluminium construction finished black
- Clear polycarbonate cover

PROBE-XL

- High efficiency flat top bollard, aluminium construction finished black
- Linear prismatic polycarbonate cover

RANGE

LED	PROBE VERSION	PROBE-XL 790mm VERSION	PROBE-XL 1040mm VERSION	APPROX. kg
24W - 4000K	PRB 17521L	PRB 17522L	PRB 17523L	9.8
24W - 5700K	PRB 14443L	PRB 14530L	PRB 14442L	9.8

CIRCUIT TYPE - L - non-dimming (LED)

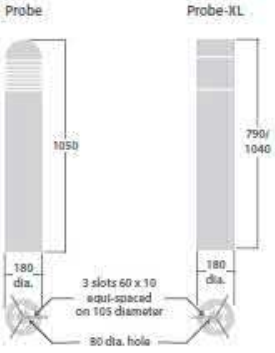
LED CHARACTERISTICS

Ra	°K	L80/B10	LL/CW
70	4000/ 5700	60K	Probe 10.7 / Probe-XL 32.8

P/U	%	R/Rx	PF
P	>85	R	>0.95

For LED characteristics explanation see www.thorlux.com/led-characteristics

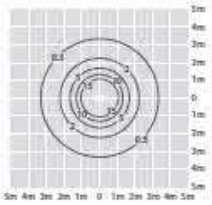
DIMENSIONS



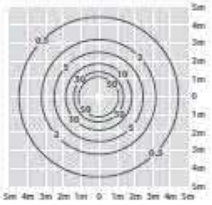
ACCESSORIES

DESCRIPTION	CAT. No.
500mm root mounting extension	PRB 12128
Mounting adaptor for cast concrete	PRB 12129

PHOTOMETRIC GUIDE



PROBE - 24W LED
Initial lux levels at ground
Luminaire Lumen Output:
24W = 3101m



PROBE-XL - 24W LED - 1040mm VERSION
Initial lux levels at ground
Luminaire Lumen Output:
24W = 9501m

STARGUARD

ZERO UPWARD LIGHT, AREA AND ROADWAY LUMINAIRES

IP65 CE TC-T SON-T MBI-T LED

WINDAGE - 0.10m²

SPECIFICATION

- Corrosion-resistant and fire-retardant GRP moulded body - light grey finish
- Clear toughened/safety glass cover
- Aluminium heat sink ensures cool running of control gear and LEDs for optimum life in high ambient temperatures
- ZERO upward light pollution
- High elevation peak beam angle for outstanding area coverage relative to mounting height
- High beam efficiency with low glare
- Pole top or wall mounted versions (LED version features a universal mounting bracket)
- Photocell option
- Fitted with lamp
- LED versions fitted with 4000K or 5700K LEDs

LED CHARACTERISTICS

Ra	°K	L70/B10	LL/CW
70+	4000/5700	100K	98.3

P/U	%	R/Rx	PF
P	>90	R	>0.90

For LED characteristics explanation see www.thorlux.com/led-characteristics

LED RANGE

LED	4000K VERSION	5700K VERSION	APPROX. kg
62W ■	STG 17565L	STG 16354L	11.8
140W ■	STG 17566L	STG 16355L	11.8

LAMP RANGE

LAMP	WALL MOUNTED VERSION	APPROX. kg	POLE TOP VERSION	APPROX. kg
High pressure sodium lamps				
150W SON-T	STG 10912	10.3	STG 11000	10.5
250W SON-T	STG 10913	10.8	STG 11001	11.0
Metal halide lamps - compatible with high pressure sodium control gear				
150W MBI-T ▲	STG 10909	10.3	STG 10997	10.5
250W MBI-T ▲	STG 10910	10.8	STG 10998	11.0
Compact fluorescent lamps				
42W TC-T ●	STG 13428J	7.1	STG 13426J	7.3
57W TC-T ●	STG 13429J	7.1	STG 13427J	7.3

CIRCUIT TYPE - J - non-dimming (HF fluorescent) / L - non-dimming (LED)

IMPORTANT: DO NOT USE LAMPS WITH AN INTERNAL STARTING DEVICE

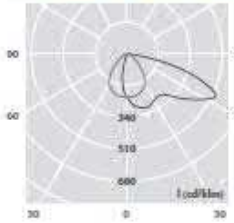
NOTE: Pole top versions - Mounting pots or crossarms are required for this luminaire and must be ordered separately

▲ Venture Whitelux 4000K fitted

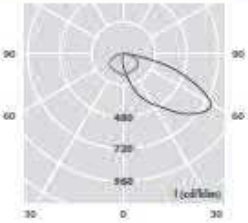
● 4000K lamp fitted

■ Universal mounting bracket suitable for wall or pole mounting

PHOTOMETRIC GUIDE

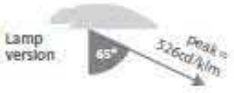


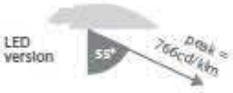
250W SON-T / 28000lm / 8m mounting height



140W LED 8m mounting height

Luminaire Lumen Output:
62W = 6555lm
140W = 14745lm



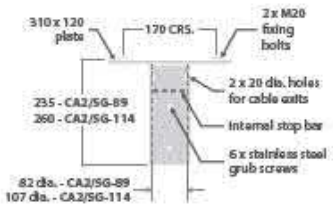


OPTIONS

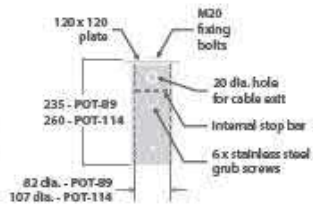
DESCRIPTION	SUFFIX	EXAMPLE
Photocell	PC	STG 17565LPC

COLUMN ACCESSORIES

Twin Back to Back Floodlight Mounting Crossarm (for Starguard only) CA2/SG versions



Single Floodlight Mounting Pot



POT-89 or **CA2/SG-89** - fits over 76 dia. shaft 4, 5 and 6m columns

POT-114 or **CA2/SG-114** - fits over 101 dia. spigot insert on 8 and 10m columns

MOUNTING BRACKETS - Lamp version

Wall mounting bracket

Pole top mounting bracket

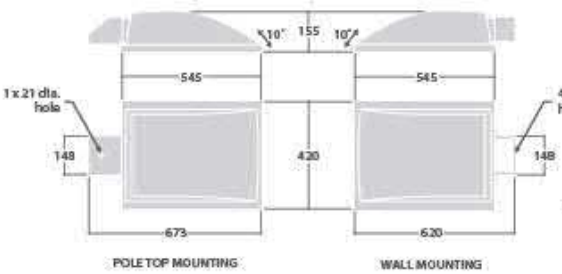
MOUNTING BRACKET - LED version

Universal mounting bracket - Wall position

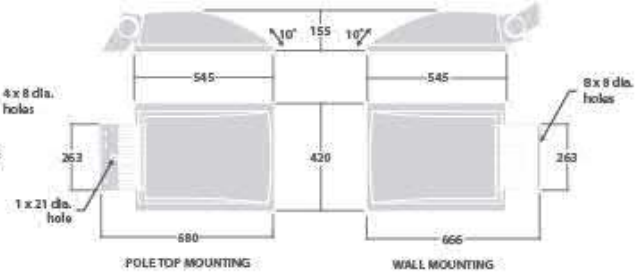
Universal mounting bracket - Pole top position

DIMENSIONS

LAMP VERSION



LED VERSION




HOLOPHANE
AcuityBrands.
Expanding the boundaries of lighting™
FACTOR™
FACTOR™
SMALL
factor™ & factor™small

FACTOR™ and FACTOR™ Small from Holophane, are dedicated LED luminaires that deliver a variety of efficient lumen per watt packages with excellent optical performance. With their precision engineered optics and sleek body design - perfect for dissipating heat away from the LEDs and extending the luminaire life, FACTOR & FACTOR Small give the complete cost saving solution for street lighting environments. With a range of delivered lumen packages equivalent from 35W to 150W ceramic metal halide lamps, FACTOR & FACTOR Small deliver efficient sustainable lighting solutions that have the flexibility to meet today's and tomorrow's lighting requirements.

FACTOR & FACTOR Small's design ensures cool operation that keeps it running for the long haul.

optics / light source

> Lumen package of between 2000 - 17000 lumens
> Two dedicated street lighting optics

applications

> S-Class, ME-Class, Pedestrian Areas, Residential Areas and Car Parks

approvals

Complies with EN60598

CE

IP65 light engines

TA: Rated for -40°C to 40°C

For further information please visit the Holophane website www.holophane.co.uk

Typical Luminaire Performance

Configuration	Delivered Lumens	Power Consumption	Drive Current	Rated Life of LED Module (L70B50 @Tq 15°C)*
FACTOR				
FTR.LA144	14154	105W	525mA	100,000+ hrs
FTR.LA174	17056	140W	700mA	100,000+ hrs
FACTOR Small				
FTS.LA024	2359	17W	525mA	100,000+ hrs
FTS.LA034	2873	23W	700mA	100,000+ hrs
FTS.LA054	4629	35W	525mA	100,000+ hrs
FTS.LA064	5584	47W	700mA	100,000+ hrs
FTS.LA074	7077	52W	525mA	100,000+ hrs
FTS.LA084	8474	70W	700mA	100,000+ hrs
FTS.LA124	11722	100W	1050mA	100,000+ hrs

Note: Data is correct at time of print.

* For other life metric data in line with IEC PAS62722-2-1 and 62717 contact your Holophane Representative for details.

Two sizes to deliver a variety of lumen packages

Tool less trigger latch entry

10 LED Board – LA024 & LA034 versions

External fins to dissipate heat

specification

The 'finned' luminaire body, designed to dissipate heat, is manufactured from high pressure die cast aluminium that conforms to EN1706 AC-46500. A die cast aluminium door with tool less trigger latch allows access to the gear compartment concealing the IP65 control gear and connectors. The IP65 LED optical modules, with individual lenses, are mounted directly to the cast aluminium housing and wired in series. A thermal transfer interface is sandwiched between the LED module(s) and high grade aluminium housing to transfer heat away from the LEDs and dissipate through the 'finned' housing for cooling. FACTOR & FACTOR Small have been specifically designed for side entry mounting suitable for 42mm side entry. Option of 60mm version is available with code .SE60.

features and benefits

Sleek Design with tool-less access

> FACTOR & FACTOR Small's diecast aluminium housing acts as its primary heat sink. Its longitudinal fins employ conductive cooling techniques to dissipate heat away from the key LED components and extend luminaire life.

> A die-cast trigger latch allows easy tool less access into the luminaire during installation and maintenance visits.

Exceptional Performance

> Offering four lumen packages ranging from 2000lm to 17000lm with efficiencies of up to 139 lpw (Lumens Per Watts).

> Two optimised roadway distributions (asymmetric and long & narrow) delivered by quality LEDs and bespoke UV stabilised optics

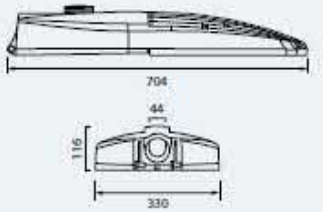
> LED light engines with 0% ULOR ensuring night time friendly.

Fully Maintainable Performance

> Single tool-less latch access to the luminaire ensures straightforward entry to the luminaire at installation and maintenance.

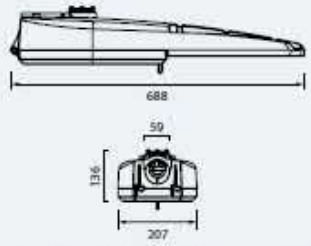
> Unique IP65 rated LED light engines that are interchangeable ensuring a futureproof and maintainable LED luminaire.

Factor (FTR) dimensions in mm



Factor is suitable for 42mm side entry as standard. The option of 60mm side entry is available with option code .SE60.

Factor Small (FTS)

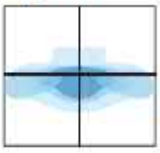


Factor Small is suitable for 42mm side entry as standard. The option of 34mm or 60mm side entry is available with option codes .SE34 or .SE60.

light distribution

Asymmetric

Long & Narrow



weight

Factor	12.0 kg
Factor Small	7.0 kg

windage (effective projected area)

Factor	0.084 m²
Factor Small	0.071 m²

Note: The specifications of the Holophane luminaire and columns represents typical values. All descriptions, illustrations, drawings and specifications in the Holophane catalogue and website represent only general particulars of the goods to which they apply and shall not form part of any contract. The company reserves the right to change specifications at its discretion without prior notification or public announcement.

Factor (FTR)

Typical spacing
36m spacing mounted at 6m

typical spacing

> Designed to S4, BSEN13201 P2, 2003
> 6m mounting height, 2 lanes, 10m road width with 2m setback.
> Achieving 36m max spacing with 0.22 uniformity.

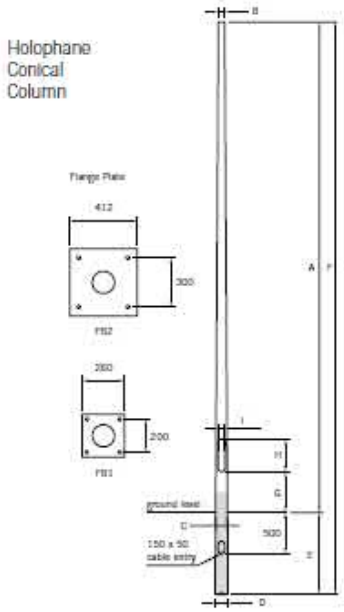
Factor Small (FTS)

Typical spacing
32m spacing mounted at 6m

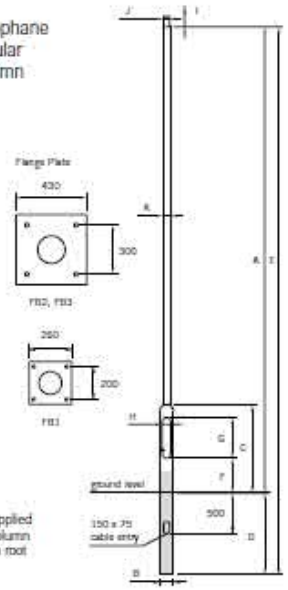
typical spacing

> Designed to S4, BSEN13201 P2, 2003
> 6m mounting height, 2 lanes, 10m road width with 2m setback.
> Achieving 32m max spacing with 0.25 uniformity.

Holophane Conical Column



Holophane Tubular Column



All columns are supplied with Earthing on column doors and Bitumen coat as a standard.

Holophane Conical Column

Height (m)	Nominal Height	Top Diameter	Base Diameter	Root End Diameter	Planting Depth	Overall Length	Door to Ground	Door Opening Length	Door Opening Width	Weight kg*	Bending Moment Nm
drawing ref	A	B	C	D	E	F	G	H	I		
3m std	3000	76	127	141	800	3800	425	400	85	33.68	5040
4m std	4000	76	118	126	800	4800	425	400	85	39.08	3830
4m hd	4000	76	133	144	800	4800	425	400	85	40.08	5640
5m std	5000	76	128	136	800	5800	425	400	85	49.45	4900
5m hd	5000	76	147	158	800	5800	425	400	85	51.65	6960
6m std	6000	76	138	148	1000	7000	425	400	85	65.84	5800
6m hd	6000	76	161	175	1000	7000	425	400	85	67.39	8070
8m std	8000	76	158	170	1200	9200	425	500	100	119	11920
8m hd	8000	76	189	206	1200	9200	425	400	85	124.45	18000

* Exclusion TBC

Code	Height	Flange Plate	Bolt
HELC.FS1	3-5m Poles	FB1	M18 x 400
HELC.FS2	6-8m Poles	FB2	M24 x 500

Holophane Tubular Column

Height (m)	Nominal Height	Base Diameter*	Base Height	Planting Depth	Overall Length	Door to Ground	Door Opening Length	Door Opening Width	Spigot Length*	Spigot Diameter*	Shaft Diameter*	Weight kg*	Bending Moment Nm
drawing ref	A	B	C	D	E	F	G	H	I	J	K		
3m std	3000	140	1075	800	3800	425	500	100	–	–	76	28.42	TBC
4m std	4000	140	1075	800	4800	425	500	100	–	–	76	32.96	6500
4m hd	4000	168	1250	800	4800	425	500	100	130	76	89	61.6	9865
5m std	4700	140	1075	800	5500	425	500	100	–	–	76	36.13	6200
5m hd	4700	168	1075	800	5500	425	500	100	130	76	89	50.7	9865
6m std	5700	140	1075	1000	6700	425	500	100	–	–	76	42.69	6000
6m hd	5700	168	1075	1000	6700	425	500	100	130	76	89	60.07	9550
8m std	7700	168	1250	1200	8900	500	600	115	130	76	89	77.30	10100
8m hd	7700	168	1250	1200	8900	500	600	115	250	102	114	96.32	14000

* Exclusion TBC

Code	Height	Flange Plate	Bolt
HELB.FS1	3-5m Poles	FB1	M18 x 400
HELB.FS2	6-8m Poles	FB2	M24 x 500

Flange Plate and J-Bolt information will be confirmed at time of order due to the necessity in ensuring the correct plate and J-Bolts are supplied.

std – Standard **hd** – Heavy Duty

Column type to be confirmed at time of order as this is based on luminaire weight, windage and geographical location.


HOLOPHANE
AcuityBrands.
Expanding the boundaries of lighting™
HMAO
High Mast Advanced Optix
LUX
Awards 2015
WINNER
HMAO
LED


HMAO
High Mast Advanced Optix

LUX Awards 2015 WINNER

The High Mast Advanced Optix (HMAO) luminaire has been engineered for new and retrofit high mast applications. With the latest in high-efficiency LED technology it provides a complete lighting solution for the simplest through to the most complex area lighting applications.

The specially engineered optical modules come with a full range of distribution options to meet the highest performance standards and deliver outstanding visibility and uniformity.

For over 120 years Holophane has enjoyed an enviable reputation throughout the world for expertise, quality and innovation in lighting. From the earliest days, when the company pioneered its famous glass refractor, the Holophane name has been ever present as a leader in the field of luminaire and lighting design. HMAO is a continuation of this proud tradition.

optics / light source

> Fully soak tested light engines ensuring LED reliability
> 70 CRI
> 4000°K colour temperature
> Three lumen packages available (30,000, 44,000 & 58,000)

approvals

Complies with EN60598

CE

Ta -20°C to 30°C

For further information please visit the Holophane website www.holophane.co.uk

Durability
Performance
Reliability

Typical Luminaire Performance

Configuration	Delivered Lumens	Power Consumption	Drive Current	Rated Life of LED Module (L70B50 @Tq 25°C)
HAL.L304	c.30,000	252W	1.05Amp	100,000
HAL.L444	c.44,000	376W	1.05Amp	100,000
HAL.L584	c.58,000	490W	1.05Amp	100,000

Note: Data is correct at time of print.

Holophane's optical design

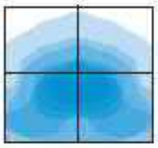
In this very competitive environment, it is becoming increasingly important to reduce operating costs and improve efficiency. Holophane is your expert when it comes to delivering the most efficient lighting solutions to help you achieve that goal.

Taking advantage of the most advanced technologies available, you can achieve an energy saving of up to 66% over existing installations. Holophane's High Mast Advanced Optix (HMAO) helps you to reduce installation and long term maintenance costs.

light distribution

Square (SQ)

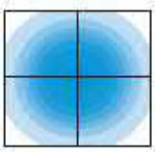
Forward throw (FW)



Asymmetric (AY)

Long & narrow (NR)

Symmetric (SY)



Glass Refractor

The major advantage of glass over aluminium or plastic is its low electrostatic charge, which makes it less attractive to dust and dirt accumulation over time. A glass refractor has a much lower light depreciation over time than either aluminium or plastic, fewer luminaires are required, significantly reducing installation, operating and maintenance costs.

Self Cleaning Effect

The glass optics & the vertical ventilation slots in the heat-sink chassis work together in creating a self-cleaning optic. The heat generated by the LEDs helps to channel cooler and denser air across the low static optical glass surface thus preventing the settling of dust particles and enhancing the lumen maintenance of the luminaire.

Advanced Optical Control

By combining the latest in LED technology with our advanced glass refractor optic we are able to break up the image of the LEDs with a PrismGlow effect. This reduces the glare normally associated with individual LEDs and eliminates hot stops on the working environment thus creating a more uniformed vertical and horizontal lighting solution.

< Ventilated optical housing

specification

specification

The luminaire shall consist of six, nine or twelve prismatic glass refractors manufactured from borosilicate glass to ensure longevity and minimise dirt depreciation. Each glass lens houses a multi die LED 'chip on board' and creates individual optical pods. Each optical pod is housed in a fully ventilated and finned housing manufactured from aluminium to maximise heat transfer. The electrical housing consists of two castings containing the drivers, 10kV surge protection and electrical termination. The luminaire chassis and electrical housing utilises all three heat transfer mechanisms of conduction, convection and radiation to ensure that the multi die 'chip on board' LED's and electronic drivers are thermally managed. Mounting is via the four bolt side arm mounting with +/-5 degree tilt and suitable for 42mm and 60mm.

applications

Freight Terminals
Industrial Facilities
Car Parks/Truck Stops
Ports and docks
Airports
Motorways
Toll Plazas

weight/windage

23kg / 0.120m^2

TA

-20°C to 30°C

features and benefits

Thermally Managed Solution

> Utilises convection and conduction to thermally manage the LEDs ensuring longer life and high delivered lumen outputs to replace 400-1000 watt metal halide systems.

> Gear housing designed to maximise heat dissipation, via conduction, from critical electronic components to ensure that they are run as cool as possible to deliver a long system life.

Exceptional Optical Performance

> Glass refractor technology which delivers a wholly luminous effect that accurately controls the output of the LEDs, reduces glare with its 'PrismGlow' and delivers excellent uniformity.

> Rotatable optical assembly providing on site alignment of distributions to specific lighting requirements and ensuring equal weight distribution on existing mast head frame.

> Five dedicated distributions designed for all types of retrofit or new installations where high mounting is required.

Enhanced Lumen Maintenance

> Glass optics ensure a low electrostatic charge which make it less attractive to dust and dirt accumulation over time so improving dirt depreciation over time.

> Ventilated luminaire chassis works together with the glass optics to create self-cleaning system which enhances the lumen maintenance of the luminaire over time.

Installation Flexibility

> Suitable for side entry mounting via the integrated four bolt mounting system which also offers 0 or 5 degree tilt.

Customer benefit expressed in numbers on a new build and retrofit installation

retrofit

Design Parameters

> Designed to EN 12464-2:2014
> Target of 30 lux
> 30m mounting height in a 1000m grid
> Designed to 8000 hours

Product Used

32 High Mast Advanced Optix
> Luminous flux: c44,000
> Luminous efficiency: 118 lpw

32 1000MH Luminaire
> Luminous flux: c67,000
> Luminous efficiency: 62 lp/W

Benefits

> 66% year 1 energy savings
> Improved light control
> Horizontal/vertical uniformity improved

Year 1 energy consumption

HMAO		1000W MH
32	No of Luminaires	32
32	Eav (lux)	31
0.597	Uniformity	0.552
12.03	Total Power Load kW	34.72
£4,831	Year 1 Energy	£13,940

new build

Design Parameters

> Designed to EN 12464-2:2014
> Target of 30 lux
> 30m mounting height in a 1000m grid
> Designed to 8000 hours

Product Used

26 High Mast Advanced Optix (HMAO)
> Luminous flux: c58,000
> Luminous efficiency: 118 lpw

26 Equivalent LED High Mast Luminaire
> Luminous flux: c56,000
> Luminous efficiency: 93 lp/W

Benefits

> 19% year 1 energy savings
> 20% improvement in uniformity
> Improved vertical illumination
> Low glare

Year 1 energy consumption

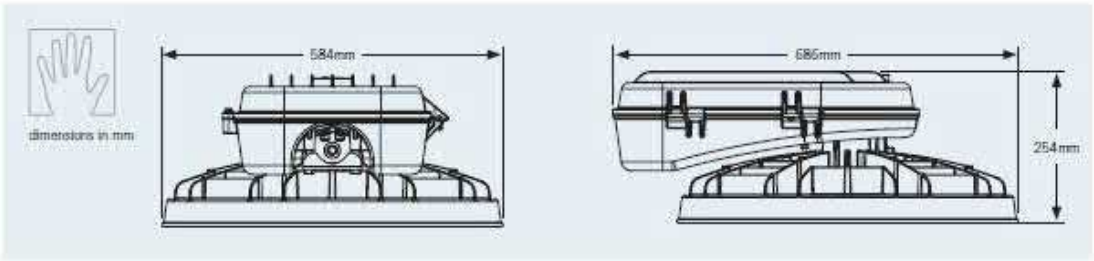
HMAO		Equivalent LED high mast luminaire
26	No of Luminaires	26
30	Eav (lux)	30
0.779	Uniformity	0.651
13.00	Total Power Load kW	15.86
£5,220	Year 1 Energy	£6,368

* Designed to EN12464-2:2014 ref 5.4

Rotatable optical assembly

Four bolt mounting suitable for 42mm and 60mm side entry

Hinged upper casting



47.16 · Technical amendments reserved

BEGA Lichttechnische Spezialfabrik
Hennenbusch · D - 58708 Menden

BEGA

Product data sheet — Surface-mounted floodlight

IP 67 10

77 791

Project · Reference number

Date

Application
LED luminaire for glare-free illumination of floor surfaces from an extremely low mounting height.
For the illumination of forecourts, gateways and ways in private and public facilities.

Product description
Luminaire made of aluminium alloy, aluminium and stainless steel
Clear safety glass
Silicone gasket
Luminaire with mounting plate for bolting onto a foundation or an anchorage unit
2 inner screw cable glands complete with cone-thrust collar, gaskets and dummy plugs, suitable for through-wiring of mains supply cable of ø 9 - 15 mm max. 5 × 2.5
Connecting terminal and earth conductor terminal 2.5
LED power supply unit
220-240 V 0/50-60 Hz
DALI controllable
A basic isolation exists between power cable and control line
Safety class I
Protection class IP 67
Dust-tight and protection against temporary immersion
Impact strength IK09
Protection against mechanical impacts < 10 joule
10 – Safety mark
CE – Conformity mark
Weight: 2.6 kg

Lamp

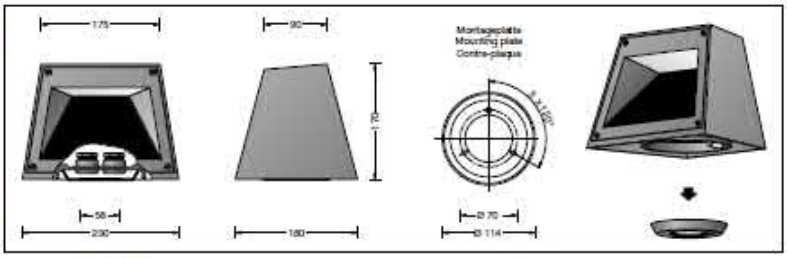
Module connected wattage	8.2 W
Luminaire connected wattage	11.2 W
Rated temperature	t_a = 25 °C
Ambient temperature	$t_{a\,max}$ = 50 °C

77 791

Module designation	2 x LED-0233/840
Colour temperature	4000 K
Colour rendering index	R_a > 80
Module luminous flux	1130 lm
Luminaire luminous flux	340 lm
Luminaire luminous efficiency	30,4 lm/W

77 791 K3

Module designation	2x LED-0233/830
Colour temperature	3000 K
Colour rendering index	R_a > 80
Module luminous flux	1130 lm
Luminaire luminous flux	340 lm
Luminaire luminous efficiency	30,4 lm/W



Lifetime of the LED
Ambient temperature t_a = 15 °C
– at 50,000 h: L90B10
– at > 500,000 h: L70B50

Ambient temperature t_a = 25 °C
– at 50,000 h: L80B10
– at 277,000 h: L70B50

max. ambient temperature t_a = 50 °C
– at 50,000 h: L70B50
– at 66,000 h: L70B50

Article No. 77 791
Colour temperature 4000 K.
Also available with 3000 K on request.
4000 K – article number
3000 K – article number + **K3**

Colour graphite or silver
graphite – article number
silver – article number + **A**

Accessory
70 894 Anchorage unit
Anchorage unit with mounting flange made of galvanised steel.
Total length 400 mm.
3 stainless steel mounting screws M 6.
Pitch circle ø 70 mm.

For the accessories a separate instructions for use can be provided upon request.

Light distribution

LIST OF ABBREVIATIONS

Abbreviation	Term
AONB	Area of Outstanding Natural Beauty
GN	Guidance Note
LED	Light Emitting Diode
LVIA	Landscape and Visual Impact Assessment
SSSI	Site of Special Scientific Interest
ULR	Upward Light Ration of the Installation

GLOSSARY

Abbreviation	Term
Curfew	time during which stricter requirements (for the control of obtrusive light) will apply; often a condition of use of lighting applied by a government controlling authority, usually the local government
Diversity	ratio of minimum illuminance (luminance) to maximum illuminance (luminance) on (of) a surface
Glare Rating Limit	upper limit of glare by the CIE Glare Rating system
Maintained Illuminance	value below which the average illuminance on the specified surface is not allowed to fall
Obtrusive Light	which because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information
Spill Light	light emitted by a lighting installation which falls outside the boundaries of the property for which the lighting installation is designed
Task Area	partial area in the work place in which the visual task is carried out. For places where the size and/or location of the task area are unknown, the area where the task may occur is the task area
Upward Light Ratio	proportion of the flux of the luminaire(s) that is emitted above the horizontal, when the luminaire(s) is (are) mounted in its (their) installed position and attitude