BURO HAPPOLD

Wellcome Trust Genome Campus

Lighting Strategy

0049941-BHE-XX-XX-RP-LI-1040

0049941

24 February 2022

Revision P04

P04

24/02/2022

Revision	Description	Issued by	Date	Checked
P00	Draft issue for comment	N.J	26.10.21	F.J.R
P01	Revised Layout Plans	N.J	11.11.21	F.J.R
P02	Draft Issue for comment	N.J	19.11.21	F.J.R
P03	Issued for approval	N.J	25.11.21	F.J.R
P04	Updated to address comments	N.J	24.02.22	F.J.R

https://burohappold.sharepoint.com/sites/049941/Shared Documents/Specialist Lighting/04_Reports/0049941 - Wellcome Trust - Lighting Strategy- P04c.docx

author	**Noah Jones**
date	**24/02/22**
approved	**Farhad Rahim**
signature	
date	**24/02/22**

..

Contents

1 Executive summary 6

1 Project Description 8

Project Site Location 8

Existing baseline lighting conditions 10

2 Regulatory framework, Lighting standards, legislation, and guidance 11

Legislative framework 11

Planning policy 11

International Dark-Sky Association 11

Impact of light pollution on ecology 12

Sensitive receptors 13

3 Lighting Criteria 15

Statutory Legislation 15

Main Building Services Related Guidance Documentations 15

Installation 15

Construction Task Lighting 15

4 The Institute of Lighting Professionals (ILP) notes for the reduction of obtrusive light GN01:21 16

Reduction of light pollution 16

Lighting Environmental Zones 16

Environmental Zone E2 19

5 Lighting strategy 20

Lighting strategy objectives 20

Lighting principles 20

Colour Rendering Index (CRI) 20

Correlated Colour Temperature (CCT) 20

Intensity21

Mounting height and shielding 21

Integrated shielding 21

Integrated and external shielding 21

Roadways and circulation route lighting strategy 22

Primary Roads and Secondary Roadways 23

Pedestrian and Cycle Routes 23

Car Parks 25

Luminaire typologies 26

Lighting Controls 27

Astronomical timeclock 27

Photocells 28

Motion sensors 28

Programmable control systems 28

Conclusion **29**

Existing Conditions 29

Summary 29

Glossary

Term	Definition
Ave	Average value
Colour Rendering (Ra)	An indicator of how accurately colours can be distinguished under different light sources. The colour rendering index (measured in Ra) compares the ability of different light sources to render colours accurately. This measures the ability of a light source to render colours naturally, without distorting the hues seen under a full spectrum radiator (like daylight). The colour rendering index (CRI) ranges from 0 to 100. Colour rendering index CRI
Colour Temperature	The colour temperature provides an indication of the light colour and is expressed in Kelvin (K). Lamps are generally rated between 2700K (warm), 4000K (neutral) and 6500K (cool). Unit: kelvin, K.
Control Gear	A 'package' of electrical or electronic components including ballast, power factor correction capacitor and starter. High frequency electronic control gear may include other components to allow dimming, etc.
Curfew	A time defined by the local authority when outdoor lighting is reduced or switched off.
Glare	The uncomfortable brightness of a light source against a darker background which results in dazzling the observer or may cause nuisance. Condition of vision in which there is discomfort or a reduction in the ability to see significant objects, or both, due to an unsuitable distribution or range of luminance.
Glare Rating (GR)	Glare Rating values may be calculated for sports and area lighting applications to indicate the amount of glare present for an observer within the lighted area. GR values range from 10 to 90 (regardless of US or Metric units), where a value of 10 indicates unnoticeable glare and a value of 90 indicates unbearable glare. For most applications, the CIE (International Commission on Illumination) recommends that the maximum amount of glare allowed should be less than 45 to 55, depending on the application.
Horizontal Illuminance (E, Eh)	Illuminance incident on the horizontal surface. Unit: lux (lx) = lm/m^2 Symbol: E, Eh
Illuminance	The amount of light falling on a surface of unit area. The unit of illuminance is the lux, equal to one lumen per square metre. Unit: lux (lx) = lm/m^2
LED	Light Emitting Diode used as a light source. Solid-state semiconductor device that converts electrical energy directly into light of a specific colour or even white light.
Light Output Ratio (LOR)	Ratio of the total light emitted by a luminaire to the total light output of the lamp(s) it contains measured at standard operating conditions.
Light Spill	The unwanted spillage of light onto adjacent areas which may affect sensitive receptors, particularly residential properties and ecological sites.
Light Trespass	The spilling of light beyond the boundary of a property which may cause nuisance to others, particularly when spilling into windows of neighbouring properties.
Lumen	Unit of luminous flux, used to describe the amount of light produced by a lamp or falling on a surface.
Lumen Depreciation	The decline in the light output of a light source during its lifetime.
Luminaire	The correct term for a light fitting. An apparatus which controls the light from a lamp and includes all components for fixing and protecting the lamps or light source, as well as connecting them to an electrical supply.
Maintained Illuminance (luminance)	Value below which the average illuminance on the specified surface is not allowed to fall. The maintained illuminance is specified at the end of the maintenance cycle, taking into consideration the maintenance factor. It is one of the main specification elements for the lighting designer. In the various slighting standards, the maintained illuminance is specified for various areas/activities. Unit: lux. Symbol: Em. (Eave)
Maintenance Factor	Correction factor used in lighting design to compensate for the rate of lumen depreciation, caused by lamp ageing (lumen depreciation and lamp failure) and dirt accumulation (luminaire and environment). It determines the maintenance cycle needed to ensure that illuminance does not fall below the maintained value.
Sky Glow	The upward spill of light into the sky which can cause a glowing effect and is often seen above cities when viewed from a dark area.
Source Intensity	This is the brightness of the source of the luminaires and applies to each source in the potentially obtrusive direction, outside of the area being lit.
Uniformity Ratio	Ratio of the minimum over the average illuminance for a specified area (Emin/Eave). When defined as such, the uniformity ratio is also the ratio of the minimum over the maximum illuminance for a specified surface area (Emin/Emax).
Vertical Illuminance	Illuminance incident on the vertical surface. Unit: lux (lx) = lm/m^2 Symbol: Ev

1 Executive summary

Buro Happold's Specialist Lighting team has been appointed to provide a site wide lighting strategy for the Wellcome Trust Genome Campus Development.

An initial outline lighting strategy was submitted as part of the outline planning application (this established a broad framework). A site wide strategy is required under Condition 24 (and annex E) of the outline permission – this document addresses that requirement and progresses the outline strategy to provide high level principles for each component of the development.

This site wide lighting strategy is developed to further detail the initial outline lighting strategy, parameters and design criteria submitted for planning addressed within the Environmental Statement Volume 1 Chapter 11, Section 11.2, Environmental Statement, Volume II, Appendix 11.1 Baseline Night-time Photography and Appendix 11.2 Outline Lighting Strategy, November 2018.

The site wide lighting strategy and principles provide the parameters and design criteria, from which detailed lighting designs shall be developed and adhere. Specific lighting details, detailed design and lighting assessment for individual areas will be further set out in subsequent Design Codes and Reserved Matters Application.

The development consists of a mixture of predominantly research facilities buildings and residential properties together with commercial and retail buildings. Please refer to the site wide illustrative masterplan for further details.

The proposed external lighting strategy shall maintain the rural character of the existing and surrounding areas of the development. Consideration of the existing environmental conditions and ecology are accounted to ensure these are maintained and protected and existing sensitive receptors local to the site and areas adjacent the site boundary is addressed.

The lighting designs for the roadways, car parks and shared vehicular, pedestrian and cycle routes, shall be illuminated to those of the British Standards, regulations and recommendations of best practice and maintained by the development.

The lighting for areas of public realm and communal space within the residential areas shall create ambient setting with low level lighting and safe use of spaces.

The following information provides a strategy of the statutory lighting requirements together with recommendations and best practice for implementing the external lighting requirements for the development.

A design criterion is derived to address the various external elements required to be illuminated with lighting classifications noted for roadways, access routes, shared pedestrian and cycle paths, public realm and external spaces within the site boundary. The design criteria will form the based upon which the finial lighting performance and implementation for the site shall be adhered.

Parameters are provided, to limit obtrusive light and light pollution onto surrounding areas and the night sky, together with considerations for the protection and maintenance of local ecology and the surrounding environment.

The information and data within this report is produced to support and further progress the design stages for implementation of the external lighting for the site.

The main risk relating to potential impact from the external artificial lighting from the proposed development is identified below:

Existing ecological and environmental sensitive receptors.

Areas of natural woodland and wildlife habitats.

Residential Properties.

Consideration for internal lighting is assumed to have negligible impact based upon adherence of design standards and construction, in line with those noted within the Environmental Lighting Statement and the statutory requirements, standards and recommendations for internal lighting, to include but not limited to those of British Standards Institute (BS), Health and Safety Executive (HSE), Institute of Lighting Professionals (ILP) and CIBSE Society of Light and Lighting (SLL).

Details of the interior lighting, if required, are to be provided during the future developed design stages and construction process for the buildings.

Revision of Environmental Lighting Classification

Environmental Impact Assessment Position Update

This Site Wide Lighting Strategy is submitted in accordance with the Genome Wellcome Campus Expansion Outline Planning Application (OPA).

A comprehensive Environmental Impact Assessment (EIA) was undertaken as part of the OPA in 2018 and was subject to an update in the form of an Addendum submitted in 2019.

The EIA establishes the baseline conditions in relation to the outline application site and assesses the impact of the proposed development. The lighting impact assessment, as part of the EIA, analysed the lighting conditions of the existing environment and Proposed Development and assesses the significance of the effects in relation to sensitive receptors within the Site and in the local vicinity. The likely effects of lighting on residential and ecological receptors are reported in and conclusions on the likely effect is summarised.

The assessment of effects is based on the assumption that lighting installations would be designed in line with the principles of the Outline Lighting Strategy which is appended to the ES.

Updates to Baseline Conditions

The ILP Guidance recommends that the immediate environment is classified systematically according to Environmental Zone Criteria for light nuisance into windows (measured in Lux). Since the original EIA was undertaken in 2018 the baseline conditions in terms of the Environmental Zone classification have been updated. Previously the Expansion land was categorised as an E1 Environmental Lighting Zone condition (natural). Based upon updated observations and data on existing conditions, with the prevalent levels of current sky glow being a contributing factor. The magnitude of sky glow for the area of development being within the region of 20.83, which falls within a Bortle Scale rating of Class 4, equating to an area of rural/suburban transition as per an E2 zoning classification by the ILP. The Environmental Lighting Zone for the Expansion land is now considered to be E2 (rural) – still a low brightness lighting environment.

Completed Development

With the update to the baseline conditions, the completed development will be located within an E2 zone, and with a low level of brightness, any development incorporating artificial light would have an impact on the night time scene.

The Outline Lighting Strategy submitted with the OPA and used as a basis to inform the EIA included design targets that were set to achieve compliance with ILP Guidelines category E1 at the Site boundary for the Expansion Land. This current Site Wide Lighting Strategy, notwithstanding the re-categorisation to an E2 zone, seeks to retain the same principles for the high sensitivity receptors with specific lighting treatments applied to address these areas identified as further detailed in section 2.

Assessment of effects

The areas previously identified to be maintained as unilluminated will continue to be so and with carefully implemented new lighting installations taking account of sensitive receptors, the effects of light spill and glare (luminaire source intensity) are considered to be negligible. Therefore, the re-categorisation to an E2 zone is not considered to affect the assessment undertaken in the original EIA as the same approach to mitigation including retention of unilluminated areas and the use of lighting with suitable mitigation measures to limit light spill in areas of sensitive receptors, will be maintained.

Conclusion

The categorisation of the Expansion land has been changed from an E1 (natural) Environmental Zone to an E2 zone. This is to reflect more recent data and observations.

The approach to mitigation as originally set out in the OPA and as evolved in this current Site Wide Lighting Strategy, remains the same with the areas identified as 'unilluminated' being retained and specific lighting conditions applied to areas affecting sensitive receptors. Therefore, this change is not considered to affect the EIA and lighting assessment previously undertaken.

The site Wide strategy sets out principles to be applied at detailed stages of design. When reserved matters applications are brought forward, specific lighting details, lux levels and lighting contours will be provided to demonstrate that the proposed lighting is acceptable and in accordance with the site wide principles.

1 Project Description

Project Site Location

The proposed site is located in Hinxton and approximately 9 miles south of Cambridge. The proposed site occupies the area of land between the section where the A11 and A1301 converge south of Hinxton.

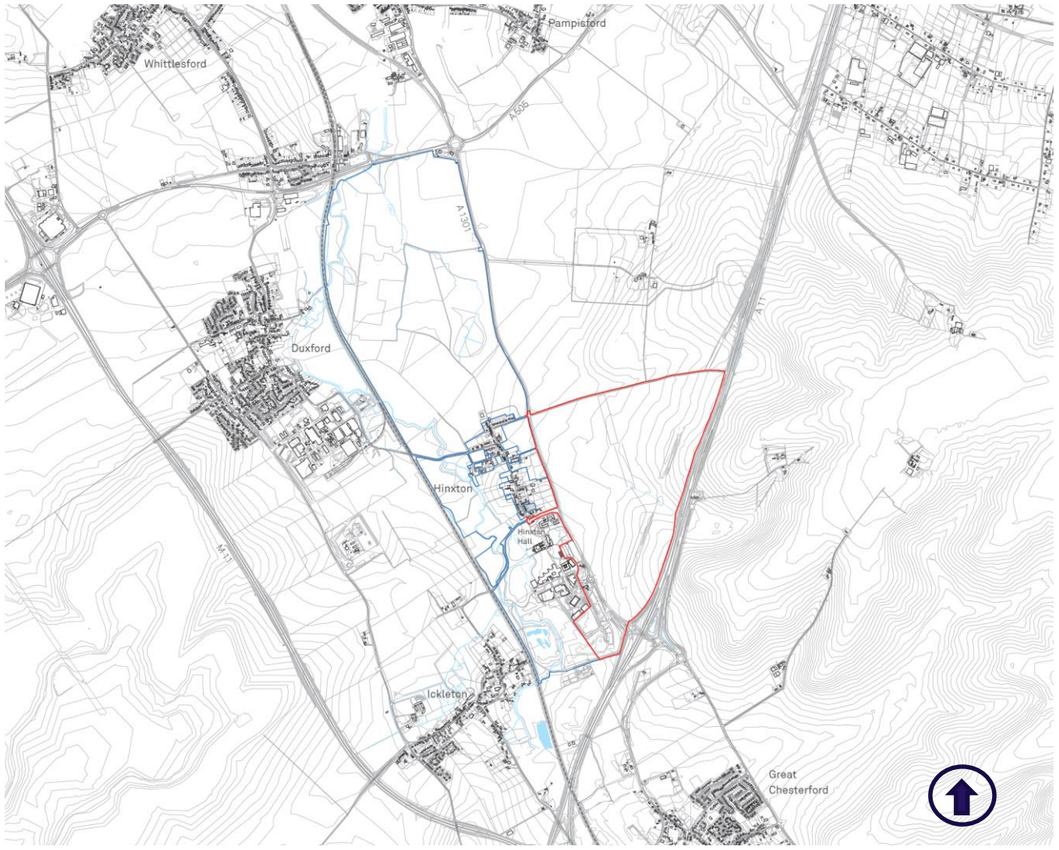


Figure 1—1 Site Location – Image Arup

The site (highlight in red boundary (fig 1.1) is assessed to be within E2 Environmental Zone lighting classification to which the external lighting shall comply. The classification of lighting environmental zone, reflects rural setting of the proposed development, predominately located within a relatively dark area with a very low brightness. This area only experiences subtle illumination from street lighting near the Stumps Cross interchange between the M11 and the A1301.

Figure 1 -2 Illustrative Master Plan – Image Arup.

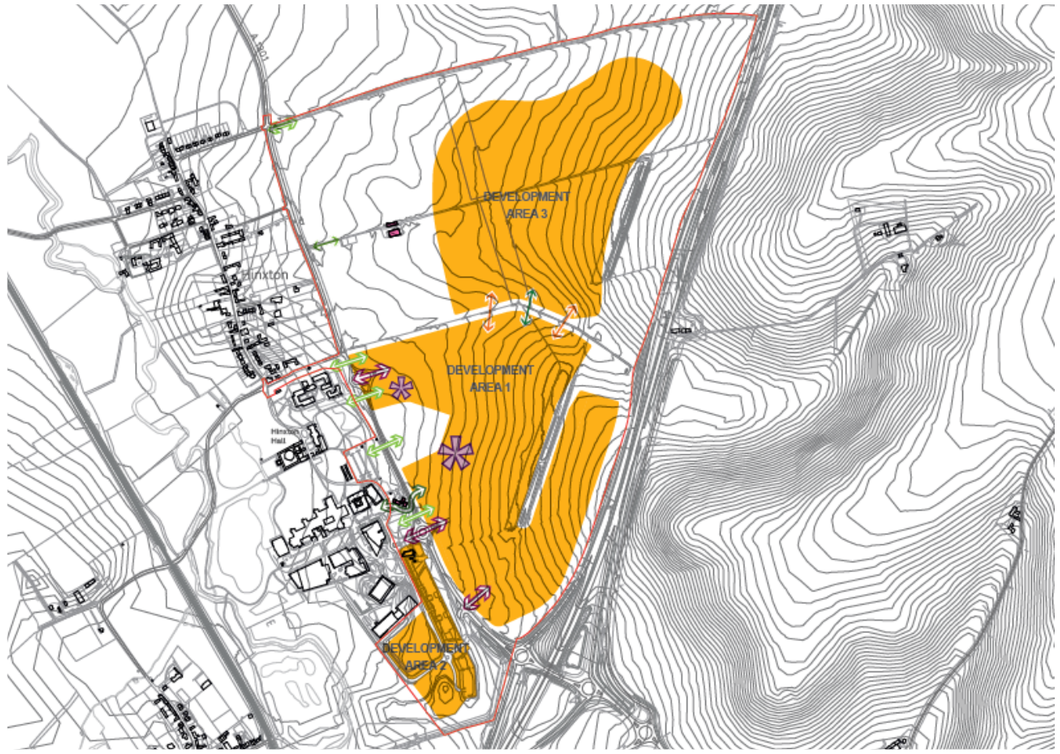


Figure 1—3 Development Zones Image – Arup.

The proposed development comprises of 3 development areas DA1, DA2 and DA3, as note on Figure 1.3.

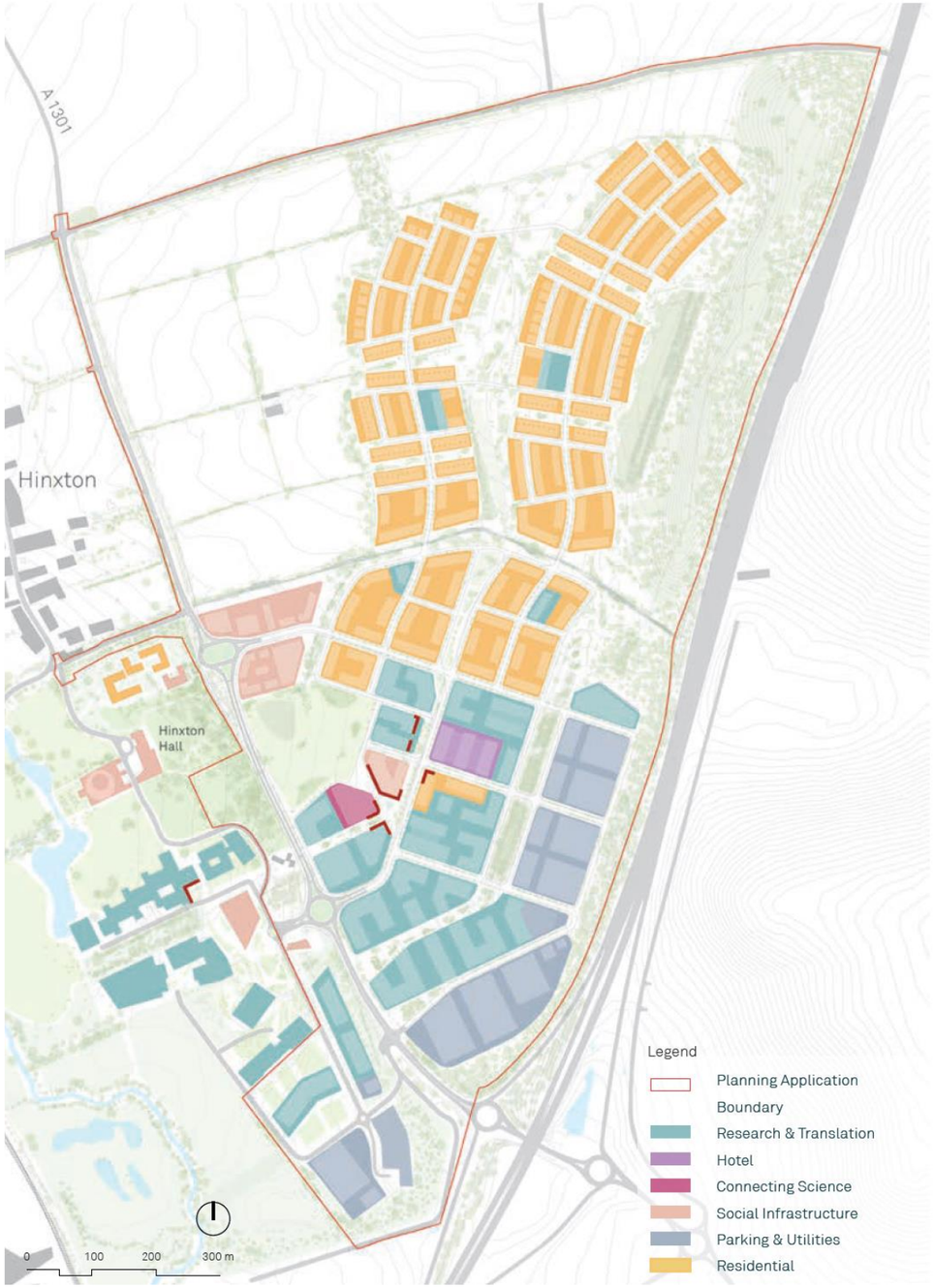


Figure 1—4 Site road and access routes and connections.

Development Areas 1 shall consist of research facilities building, commercial and residential properties, together with car parking facilities. Development area 2, currently comprising an external car park and vacant land of the existing campus includes for development of research facility buildings. Development Area 3 consisting predominately of residential properties.

Figure 1.4 illustrates the various typologies of buildings proposed for the development.

This report provides detailed site wide lighting principles for areas DA1 and DA3, with an outline design criterion for area DA2 for further development. DA2's position within the existing campus means that it has a framework within which to be brought forward and integrate. Lighting design in this area will respond to this context, as well as ensuring it complements the wider strategy for DA1 and DA3.

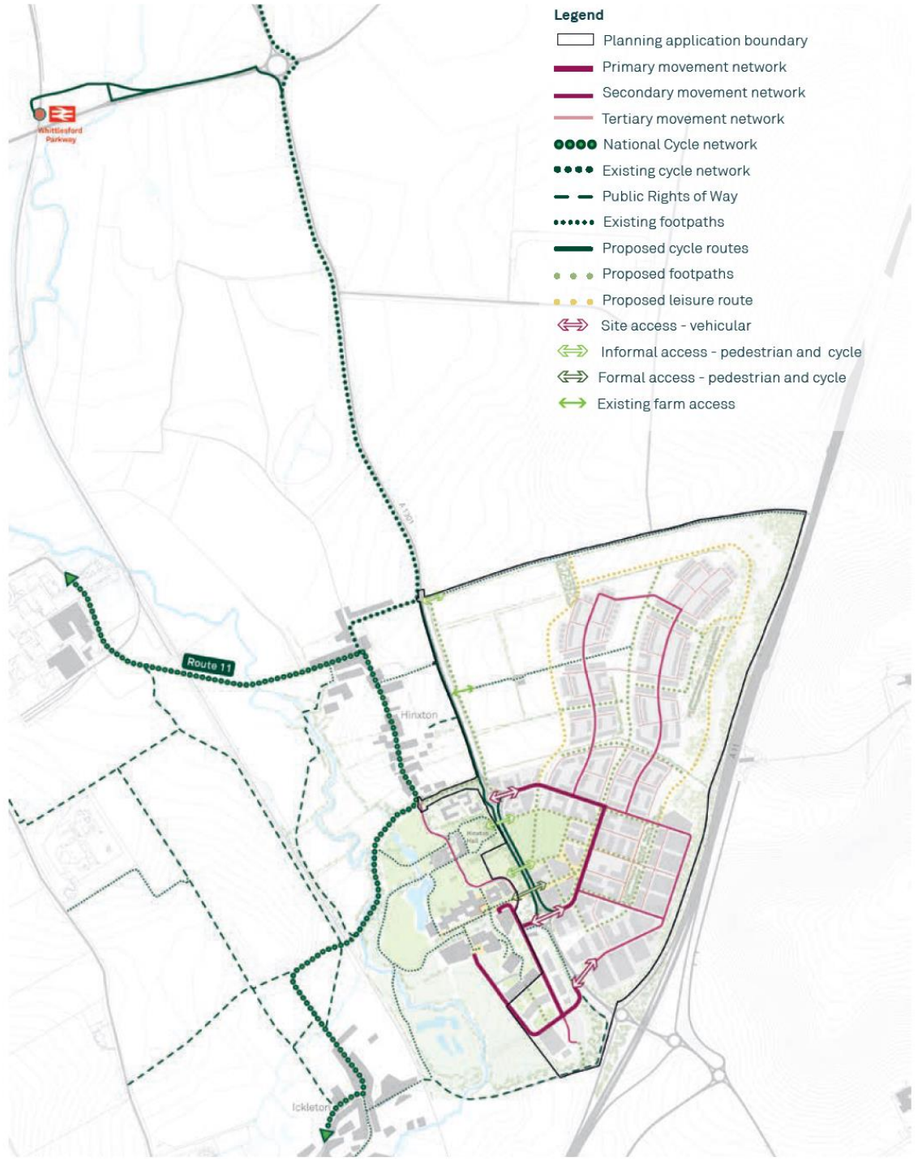


Figure 1—5 Site road and access routes and connections.

Figure 1.5 illustrates the main of access routes and connections with the existing roadways infrastructure for the development.

The lighting strategy addresses the illumination criteria and requirements for each of the above classifications further detailed in Section 5.

Existing baseline lighting conditions

The site is subject to existing sources of artificial light contained in the existing car park, internal access roads, and from and around the Existing Campus buildings. The lighting condition at the Site is also influenced by street lighting from the A1301. Therefore, the Site is described as a low brightness lighting environment more aligned to a sensitively illuminated rural setting (E2 Environmental Zone).

Hinxton village is considered to have relatively dark lighting conditions with generally dispersed instances of illumination with a environmental zone assessed to be within Zone E2 classification. The roadway illumination along High Street, the A1301 (near the Stumps Cross) and illumination contained within the Existing Campus being those of light sources in local proximity to the site.

Please refer to Environmental Statement, and Volume II, Appendix 11.1 Baseline Night-time Photography for further details.

2 Regulatory framework, Lighting standards, legislation, and guidance

Legislative framework

In terms of legislation the Clean Neighbourhoods and Environment Act (CNEA) 2005 (Department for Environment, Food and Rural Affairs (Defra), 2005) gives local authorities and the Environment Agency additional powers to deal with a wide range of issues by classifying light pollution as a statutory nuisance.

The statutory nuisance regime does not include light emitted from light sources which are used for transport purposes and other premises where high levels of light are required for safety and security reasons.

It is expected that the following sources are most prone to cause potential effects of nuisance:

- Domestic security lights
- Commercial security lights
- Domestic decorative lighting
- Exterior lighting of buildings and decorative lighting of landscapes
- Laser shows / sky beams / light art.

Considerations relating to the proposed development being initially identified as following:

- Industrial and commercial security lights
- Industrial and commercial external operational lights
- Exterior lighting of buildings.

Planning policy

The National Planning Policy Framework (NPPF) by the Ministry of Housing, Communities and Local Government which seeks to minimise the negative effects of artificial lighting.

Paragraph 185 of the NPPF states, *"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.*
In doing so they should ; b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation".

NPPF is supported by Planning Practice Guidance (PPG), which provides further guidance and makes the following references to light pollution:

- Paragraph 001 (Reference ID 31-001-20191101) Artificial lighting needs to be considered when a development may increase levels of lighting or would be sensitive to prevailing levels of artificial lighting. Artificial light provides valuable benefits to society, including through extending opportunities for sport and recreation, and can be essential to a new development. However, for maximum benefit, it is important to get the right light, in the right place and for it to be used at the right time.

Artificial light is not always necessary. It has the potential to become what is termed 'light pollution' or 'obtrusive light', and not all modern lighting is suitable in all locations. It can be a source of annoyance to people, harmful to wildlife and undermine enjoyment of the countryside or the night sky, especially in areas with intrinsically dark landscapes. Intrinsically dark landscapes are those entirely, or largely, uninterrupted by artificial light. National parks and nature reserves can serve as good examples, particularly where they support habitats for native nocturnal animals".

- Paragraph 001 (Reference ID: 31-002-20191101) states, *"Is a proposal likely to have a significant impact on a protected site or species? This could be a particular concern where forms of artificial light with a potentially high impact on wildlife and ecosystems (e.g. white or ultraviolet light) are being proposed close to protected sites, sensitive wildlife receptors or areas, including where the light is likely to shine on water where bats feed".*

- Paragraph 002 (Reference ID: 31-001-20191101) states, *"Light intrusion occurs when the light 'spills' beyond the boundary of the area being lit. These adverse effects can usually be avoided with careful lamp and luminaire selection and positioning".*

- Paragraph 003 (Reference ID: 31-001-20191101) states, *"The use of lighting only when the light is required can have a number of benefits, including minimising light pollution, reducing energy consumption, reducing harm to wildlife, and improving people's ability to enjoy the night sky. Impacts on sensitive ecological receptors throughout the year, or at particular times (e.g. during bird migrations) may be mitigated by the design of the lighting or by turning it off or down at sensitive times".*

- Paragraph 005 (Reference ID: 31-001-20191101) of the PPG considers the character of the area and surrounding environment with reference to how these may affect what is an appropriate level of lighting for that type of development proposed. It cautions to avoid glare and an appropriate selection of lighting so that it fulfils its purpose without over-lighting.

International Dark-Sky Association

The International Dark-Sky Association is an organisation that provides guidelines for the creation of dark-sky reserves around the world. Its aim is to preserve and protect the night-time environment and our heritage of dark skies through environmentally responsible outdoor lighting. **Although it is not the aim to obtain recognition from International Dark-Sky Association (IDA), it is important to follow the principles established by this organisation in order to reduce light pollution and generate a night-sky friendly environment.**

The general lighting principles of the IDA should be followed to ensure good lighting that reduces light pollution and its impact on dark skies. Some of the principles established are as follows:

- New lighting should not adversely degrade the sky quality beyond the immediate area to be lit.
- Angle light downward. No unnecessary light above or near the horizontal.
- Luminaires should be aimed towards where the light is needed, carefully considering the spill on the natural environment and neighbouring properties.
- Luminaires should be switched off when not needed. The use of smart control systems is highly recommended.
- Do not over illuminate
- Avoid bright white and cooler temperature LED's (anything above 3000K)
- Install luminaires at lowest possible height to achieve lighting levels

Figure 2—1 - Example of luminaire types approved by the IDA - (Source IDA)

Impact of light pollution on ecology

The IDA guidance notes also contain information about the impact of light pollution in other areas. The impact of light pollution is not only confined to the visibility of stars at night and obtrusive light. It also affects the following wildlife to include the following considered applicable to the site:

The IDA guidance notes also contain information about the impact of light pollution in other areas. The impact of light pollution is not only confined to the visibility of stars at night and obtrusive light. It also affects the following wildlife to include the following considered applicable to the site:

Bats

As nocturnal specialists, most bat species are susceptible to artificial light. Due to the decline in numbers, all bat species are protected by the Wildlife & Countryside Act (1981) and the Conservations Regulations (1994). This makes it illegal to kill, capture or disturb bats, obstruct access to roosts or damage/destroy roosts. Lighting in the vicinity of bat roosts causing disturbance could constitute an offence. When working in an area where there are bat habitats, developers should:

- Refer to Ecological report for identification of sensitive locations for bat habitats and roosting
- Not directly illuminate bat roosts
- Avoid illuminating foraging areas and route

Birds

Evidence shows that artificial light can reduce sleep in birds, which disrupts the long-term circadian rhythm that dictates the onset of breeding. Birds are likely to be disrupted by changes to insect behaviour due to artificial lights. In general:

- Do not directly illuminate important areas for nesting birds.

Refer to Ecological report for identification of sensitive locations nesting birds.

Invertebrates

Moths attracted to lights are a familiar sight. Artificial light, particularly blue UV rich, significantly impacts invertebrates, disturbing feeding, breeding and movement which may reduce and fragment populations. It is estimated that a third of insects that are attracted to lights will die as a result of their encounter. Evidence also shows that pollination rates in illuminated plans can be reduced by 62% - (Knop et al 2017. Nature 548). In general:

- Avoid illuminating water or reflective surfaces
- Do not illuminate ecologically sensitive areas
- Use colour temperature, CCTs of less than 3000K
- Use narrow band minimal UV source

Sensitive receptors

From survey observations, all receptors that have been identified are considered to have adapted to a fairly unchanged lighting condition since the introduction of the Existing Campus in 1993. This means the residents and ecosystem have adapted to a very low to low brightness district with pockets of illumination around existing infrastructure.

Sensitive receptors identified specific to the site are noted below. Please refer to the Environmental Statement for further details.

Receptor ID (See Figure 11.1)	Receptor (type)	Distance from Site Boundary	Reason Identified as a Receptor
R1	Residential properties along North End Road (Human)	Distance approx. 100-200m	Potential direct views into the Site may experience potential effects of vertical light trespass, luminaire source intensity (glare) and effects of skyglow for indirect views.
R2	Residential properties within Hinxton (Human)	Distance approx. 100-200m	Potential effects of vertical light trespass, luminaire source intensity (glare) for homes with direct view of the Site, and effects of skyglow for indirect views.
R3	Hinxton Village (Residential & Heritage: Conservation Area)	Distance approx. 100-200m	Potential effects of skyglow with indirect views of the Site.
R4	Ickleton Village	Distance approx. 300m	Potential direct views into the Site may experience potential effects of luminaire source intensity (glare) and effects of skyglow for indirect views.
R5	River Cam + River Corridor (Biodiversity)	Distance approx. 100-200m	Potential effects of external lighting on wildlife habitats and species that use the River Cam.
R6	Wellcome Wetlands Nature Reserve	Distance approx. 100-200m	Potential effects of external lighting affecting wildlife habitats and species that use the area as habitat.
R7	Bats	Within Site Boundary	Potential effects of external lighting affecting wildlife habitats and species that use the Site as habitat or for foraging.
R8	Badgers	Within Site Boundary	Potential effects of external lighting affecting wildlife habitats and species that use the Site as habitat or for foraging.
R9	Barn Owl	Within Site Boundary	Potential effects of external lighting affecting wildlife habitats and species that use the Site as habitat or for foraging.

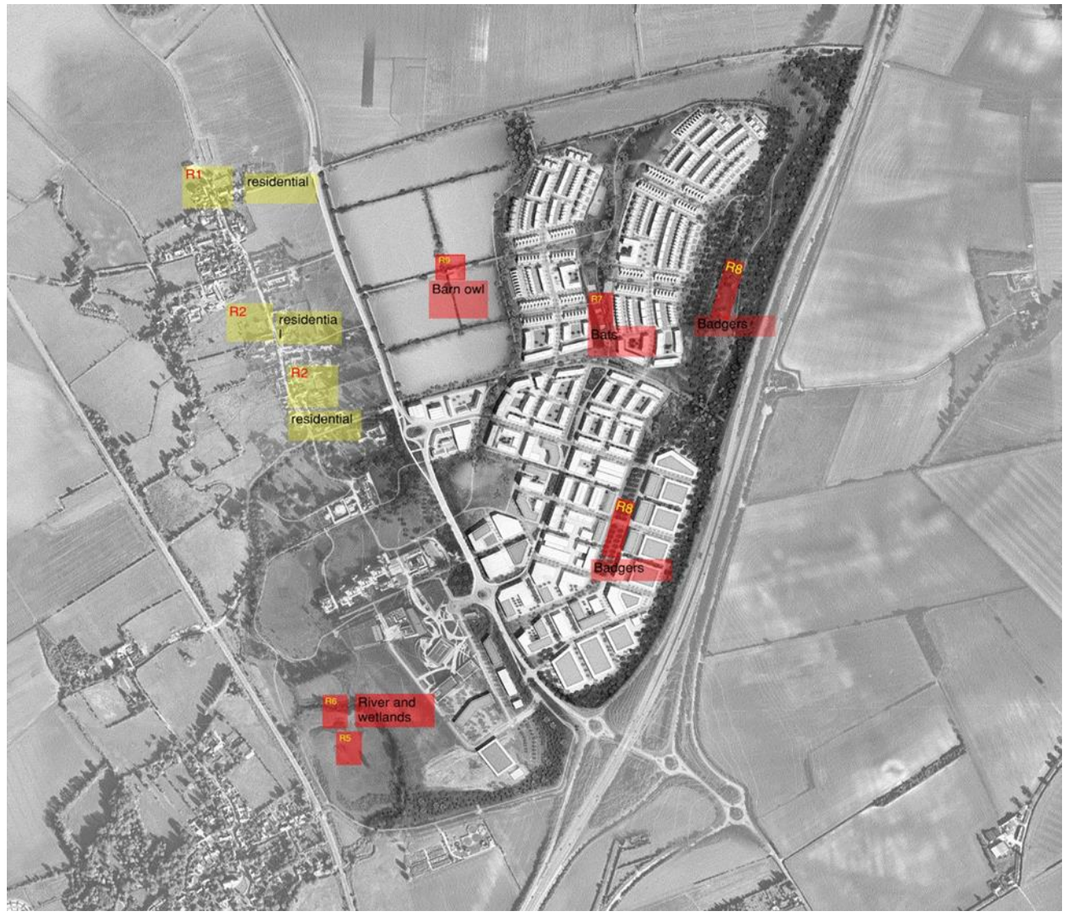


Figure 2—2 Sensitive receptors identified in the area

The areas of sensitive receptor are highlighted on figure 1-5. The location of sensitive receptor R9 (Barn Owl habitat) is to remain unilluminated and lighting emissions directed towards the location to be mitigated.

The location of sensitive receptors and those within the green corridors shall be maintained unilluminated during hours of darkness to preserve habitats. Areas as the those located within the close proximity to the developed areas shall have considered lighting applications to ensure mitigate of undue light spill. Direct light distributed shall be limited and be within the permissible levels applicable as noted for the lighting environmental classification by the ILP for Zone E2 areas.

Figure 2—3 Routes with lighting considerations for sensitive receptors.

Figure 2-3, above illustrates areas of sensitive areas and areas of development within close proximity to areas to be maintained dark and unilluminated. Where the application of lighting for the development is with close proximity or potential impact onto these areas. The lighting shall include for suitable mitigation measure and designed to limit any light spill or obtrusive light to be within permissible levels are directed by the ILP GN01:21.

The lighting measure to mitigate light spill is further described within section 5, and include element such a luminaire shielding, luminaires with well controlled light distribution to illumination only areas required to be illuminated and restriction of any upward light.

3 Lighting Criteria

The external artificial lighting for the Proposed Development shall be based on British design standards and the relevant guidance and codes.

These include: -

Statutory Legislation

- BS EN 5489-1:2020 Road Lighting
- BS EN 5489-2:2016 Lighting of tunnels
- BS EN 13201- 1/2/3/5 2015/2014 Road Lighting
- BS EN 12464-2: Outdoor workplaces
- BS EN 60598-1: 2004 – Luminaire General requirement
- Electricity at Work Regulations
- Health and Safety at Work Act

Main Building Services Related Guidance Documentations

- CIBSE Lighting Guides LG6 – The outdoor Environment
- CIBSE – SLL Code for Lighting
- CIBSE LG14 – Control of electric lighting
- CIBSE LG15 – Transport Buildings
- BRE DG498: Selecting lighting controls
- BRE IP2/99: Photoelectric control of lighting design
- CIE Publication 126 (1997) - Guidance for minimizing sky glow
- CIE Publication 129 (1998) - Guide for lighting exterior work areas
- CIE Publication 150 (2017) - Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting

Installation

- CIE Publication 154 (2003) - The Maintenance of outdoor lighting systems (2003)
- CIE Publication 136 (2000) – Guide to the lighting of urban areas
- CIBSE - SLL Code for Lighting
- GN01:2021 ILP Guidance Notes for reduction of obtrusive light
- Secured by Design – Guidance for lighting against crime
- PL G04 Guidance on undertaking Environmental Lighting Impact assessment
- International Dark Sky Association – Recommendation for the protection of night dark skies.

Construction Task Lighting

During construction, mobile task lighting will be used to illuminate areas under construction during the hours of darkness. Directional luminaires will be used to limit unwanted light spill. These will be directed away from sensitive residential and ecological receptors.

Construction site lighting outside normal working hours will be restricted to the minimum required for safety and security.

4 The Institute of Lighting Professionals (ILP) notes for the reduction of obtrusive light GN01:21

Reduction of light pollution

The Institute of Lighting Professionals (ILP) has produced the '*Guidance Notes for the Reduction of Obtrusive Light* (Guidance Note GN01:20), along with the '*SLL Code for Lighting 2012*' provide guidance for local authorities with a recommendation that they are incorporated at the local plan level. The guidance defines various forms of light pollution and describes a series of environmental zones and how to provide external lighting in each of these zones to mitigate unwanted light. The ILP guidance notes provide suitable criteria against which the effects of artificial lighting can be assessed and have been used in this assessment

The main potential issues with artificial lighting within a site of this environmental context are:

- poorly controlled sources.
- where light is not directed into the required area and is lit with excessive amounts of light; and
- where an area is lit too brightly for its purpose, and excess light is reflected upwards.

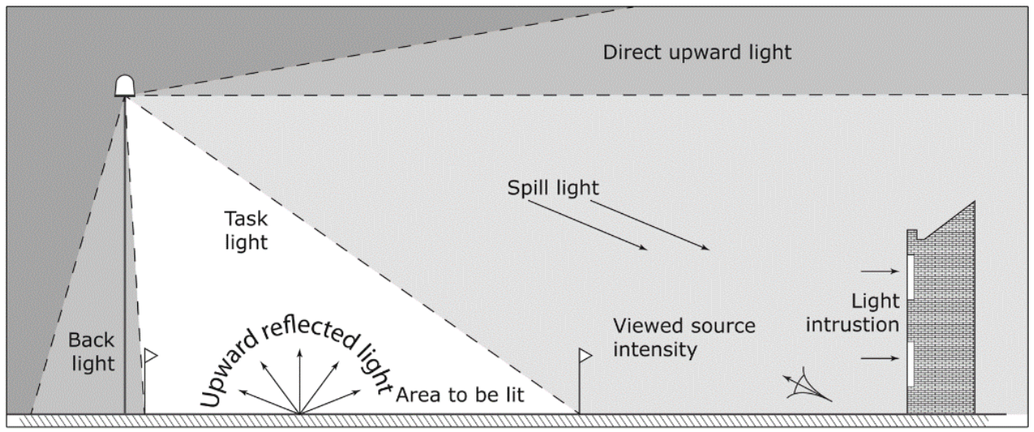


Figure 4—1 Types of obtrusive light – (Source: ILP GN01/21)

Figure 5—1 illustrates the key characteristics of the implementation of artificial lighting designs for a development – 'Useful Light' (as required for functional use), 'Spill Light', and 'Light Trespass' (Light that is not wanted or required. This light may be a nuisance to others, a waste of energy, and an unnecessary source of greenhouse gases).

A description of definitions is detailed below:

- **Sky Glow:** The upward spill of light into the sky which can cause a glowing effect and is often seen above cities when viewed from a dark area.
- **Light Spill:** The unwanted spillage of light onto adjacent areas which may affect sensitive receptors, particularly residential properties, and ecological sites.
- **Glare:** The uncomfortable brightness of a light source against a dark background which results in dazzling the observer, which may cause nuisance to residents and a hazard to road users.
- **Light Trespass:** The spilling of light beyond the boundary of a property which may cause nuisance to others, particularly when spilling into windows of neighbouring properties.
- **Source Intensity:** This is the brightness of the source of the luminaires and applies to each source in the potentially obtrusive direction, outside of the area being lit.
- **Luminance –** this is the maximum luminance of any illuminated or self-luminous surface as seen from any potentially obtrusive direction.
- **Building Luminance:** This is the amount of light on the façade of the building being built with reference to the exterior luminaires used to light it. This is being measured to ensure the building suits the general district lighting and avoid over lighting and excessive visible brightness.

The main potential issues with artificial lighting within a site of this environmental context are, poorly controlled sources, where light is not directed into the required area to be lit and excessive amounts of light, where an area is lit too brightly for its purpose and excess light is reflected upwards.

The preliminary lighting assessment criteria used is the 'ENV-P.1.7 Light Pollution' document, which refers to the 'Guidance Notes for the Reduction of Obtrusive Light' produced by the ILP, states that, *'Humanity's invention of artificial light and its application in the external environment has done much to safeguard and enhance our night-time environment but, if not properly controlled, obtrusive light (sometimes referred to as light pollution) can present serious physiological and ecological problems'.*

Lighting Environmental Zones

The classification of Lighting Environmental Zones in the UK is established within the documents GN01/21 'Guidance notes for the reduction of obtrusive light' published by the Institute of Lighting Professionals (ILP). This document forms the basis and criteria which the permissible levels of light spill and light pollution are dictated within the UK.

As with any new development, there is a risk that the proposed lighting strategy may have a negative impact on the surrounding environment and residents, in terms of light spillage, brightness or glare. The identification of four environmental zones have been established as a basis for outdoor lighting regulations.

The environmental zone rating can be used to help ensure that the lighting goals of an environment are appropriately defined and met, considering the context and relevant surroundings

Table 4—1 Extract table 2 on guidance for the reduction of obtrusive lighting – (Source: ILP GN01/21)

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

The proposed development has been subdivided into different Lighting Environmental Zones that will set the conditions for the lighting in the external areas with the main purpose of protecting the natural environment and neighbouring communities. The area of proposed development is assessed to be within a Lighting Environmental Zone E2.

Table 4—2 Extract table 3 on guidance for the reduction of obtrusive lighting – (Source: ILP GN01/21)

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

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

Table 4—2 denotes the maximum values of vertical illuminance permissible spill light onto and adjacent property and specifically windows with Zone E2 being applicable to the applicable environmental zone category for the proposed development.

Table 4—3 Extract table 4 on guidance for the reduction of obtrusive lighting – (Source: ILP GN01/21)

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

Light technical parameter	Application conditions	Luminaire group (projected area A_p in m²)					
		$0<A_p \leq 0.002$	$0.002<A_p \leq 0.01$	$0.01<A_p \leq 0.03$	$0.03<A_p \leq 0.13$	$0.13<A_p \leq 0.50$	$A_p > 0.5$
Maximum luminous intensity emitted by luminaire (I in cd)[5]	E0 Pre-curfew Post-curfew	0 0	0 0	0 0	0 0	0 0	0 0
	E1 Pre-curfew Post-curfew	0.29 d 0	0.63 d 0	1.3 d 0	2.5 d 0	5.1 d 0	2,500 0
	E2 Pre-curfew Post-curfew	0.57 d 0.29 d	1.3 d 0.63 d	2.5 d 1.3 d	5.0 d 2.5 d	10 d 5.1 d	7,500 500
	E3 Pre-curfew Post-curfew	0.86 d 0.29 d	1.9 d 0.63 d	3.8 d 1.3 d	7.5 d 2.5 d	15 d 5.1 d	10.000 1,000
	E4 Pre-curfew Post-curfew	1.4 d 0.29 d	3.1 d 0.63 d	6.3 d 1.3 d	13 d 2.5 d	26 d 5.1 d	25,000 2,500

Table 4—3 denotes the maximum permissible intensity emitted by a luminaire for the related environmental zone. Values for Zone E2 being applicable to the proposed development.

denotes the maximum permissible intensity emitted by a luminaire for the related environmental zone. Values for Zone E2 being applicable to the proposed development.

Table 4—4 Extract table 6 & 7 on guidance for the reduction of obtrusive lighting – (Source: ILP GN01/21) denote the maximum permissible upward light ration of luminaires.

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

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

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

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

Table 4—5 Extract table 8 on guidance for the reduction of obtrusive lighting – (Source: ILP GN01/21)

Table 8 (CIE 150 table 7): Maximum permitted values of average surface luminance

Light technical parameter	Application conditions	Environmental zones				
		E0	E1	E2	E3	E4
Building façade luminance (L_b)	Taken as the product of the design average illuminance and reflectance divided by π	< 0.1 cd/m²	< 0.1 cd/m²	5 cd/m²	10 cd/m²	25 cd/m²
Sign luminance (L_s)	Taken as the product of the design average illuminance and reflectance divided by π (pi), or for self-luminous signs, its average luminance	< 0.1 cd/m²	50 cd/m²	400 cd/m²	800 cd/m²	1.000 cd/m²

Table 4—5 denotes the maximum permissible values of average surface luminance. Applicable for both pre-curfew and post-curfew.

Figure 4—6 Existing environmental lighting zones

The area within the red line boundary on above plan Figure 4—6 is assessed to be within a E2 Lighting environmental classification based on the ILP classification of areas. Areas to be maintained unilluminated are highlighted together with areas of the development which shall adhere to lighting parameter set out by the ILP GN01:21.

The areas of proposed development and surrounding landscape is dominated by farmed arable fields, with occasional hedgerows, small area of woodland.

The area of proposed development is assessed to be within Lighting Environmental Zone E2 (Sparsely inhabited rural area)The proposed development would maintain the same environmental zoning and those of the surrounding areas. No change in classification is envisaged.

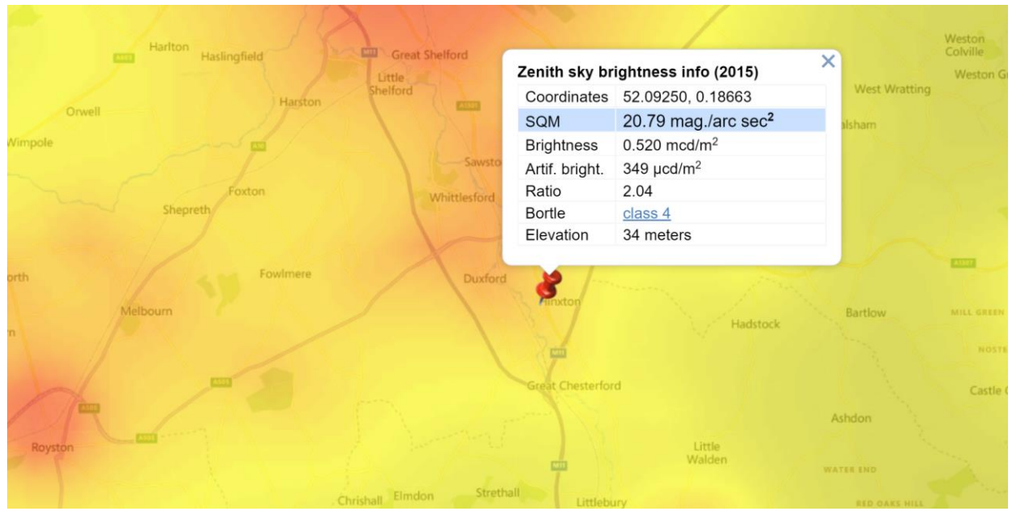


Figure 4—7 Existing environmental lighting zones image: www.lightpollutionmap.info

The area appears predominately unilluminated during hours of darkness. The Zenith sky brightness of the area of proposed development is accessed to be within a Bortle Scale Figure 5—3 classification of Class 4 - rural/suburban transition, visible elements to include clouds lit in distance and large objects.

The application of the proposed lighting strategy would ensure the surrounding areas outside the proposed development's boundary, would be maintained within their existing environmental lighting zone and light spill limited to within the permissible allowances recommended by the ILP.

Table 5—6 Lighting design criteria for environmental lighting zones – (Source: ILP GN01/21)

Environmental Zone	Sky Glow ULR (Max %)	Maximum values of vertical illuminance on properties		Luminaire Intensity I (cd)		Building Luminance (pre-curfew)
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Average L (cd/m2)
E0	0	0	0	0	0	0
E1	0	2	0	2500	0	0
E2	2.5	5	1	7500	500	5
E3	5	10	2	10,000	1000	10
E4	15	25	5	25,000	2500	25

The ILP GN01/21 informs on the maximum permissible levels of light spill into windows of adjacent properties, before and after the curfew time, based on which environmental zone the development is located in. illustrates the various lighting design criteria associated with meeting the recommendations set out in achieving lighting compliance.

The applicable zones for the proposed development are noted as follows:

Environmental Zone E2

These environmental zones are applied to mitigate the glow coming from the development and neighbouring communities to protect the natural areas that are to be conserved and enhanced. The aim is also to mitigate lighting in such a way that no lighting sources (lamps) are visible from animal habitats, as well as to reduce glow and minimise glare to create a comfortable and safe environment for visitors and the local flora and fauna.

5 Lighting strategy

Lighting strategy objectives

The proposed development is an innovative proposal that seeks to make efficient use of energy production. The lighting strategy embodies this main objective by being considered as an important aspect for the whole development.

The lighting shall be appropriate to the local context and mitigate lighting impacts on to identified sensitive receptors, natural habitats, neighbouring occupiers, and the wider landscape.

Project specific objectives are noted below, in figure 5.1, accompanied with lighting applications which can contribute towards the achievement of these objective:

Table 5—1 Evaluation of development objectives and Lighting strategy response.

Development Objectives (for the external areas)	Lighting Strategy Objectives
Operational Lighting	Lighting shall provide the necessary levels of illumination to permit users and workers to have safe and secure access and perform tasks for the designated areas within the site. The following criteria shall be applicable for the location and selection of luminaires: • Reduce the amount of light spillage onto the adjacent natural environment • Reduce the amount of light spillage onto the night sky • Have accurate optics to direct light where is strictly necessary • Have accurate glare control accessories and appropriate shielding to minimise light spillage and glare where required. • Have smart control systems that allow the client and operator to minimise waste following the spirit of the development.
Well-being and safety of employees and the local community	The following principles shall be adopted for the implementation of the exterior lighting. • Be designed to provide an overall sense of security supporting both active and general passive surveillance. Lighting should provide adequate recognition and modelling of people where required. • Support the needs of all people visiting, working, and passing through after dark. Design measures must include the avoidance of high contrasts, direct and reflected sources of glare, and confusing upward lighting. • Be designed to keep a safe environment. The positive definition of potential hazards such as level changes and borders, and the adequate illumination of areas where pedestrians are likely to encounter moving vehicles should take priority in the lighting design for the external areas of the development.

Lighting principles

Colour Rendering Index (CRI)

The Colour Rendering Index provides an objective indication of the ability of a light source to render the colours of various objects faithfully, in comparison with a natural light source. The higher values of colour rendering provide a more accurate visual perception of the natural colour of an element or material.

The general colour rendering index Ra has been introduced to specify the colour rendering properties of a light source. The maximum value of Ra is 100. This figure decreases with decreasing colour rendering quality.

It is important for visual performance and the feeling of comfort and well-being that colours of objects and of human skin are rendered naturally, correctly and in a way that makes people look attractive and healthy.

In principle, exterior lighting applications do not have the same requirements as interior environments in terms of colour rendition. Values of 60-70 CRI are common for exterior lighting schemes.

As technology progresses, the light quality of LEDs improves rapidly. Long-standing high-quality lighting manufacturers now provide a minimum of CRI 80 for outdoor products. Figure 5.1 below provide an indication of the visual difference between the variations in CRI quality.

Figure 5—1 Differences between CRI levels

Correlated Colour Temperature (CCT)

The colour temperature of light is based upon the metric measurement in units of Kelvin. Colour temperature is communally reference as ‘warm’, ‘neutral’ and ‘cool’ and these generally refer to the below values noted.

Warm - 3000K and below

Natural – 3000K to 4000K

Cool – 4000K and above

Artificial simulation of natural daylight generally perceived at 6500K. The figure 5.2 and 5.3 show a comparison between the variation in colour temperature of natural daylight and those simulated by artificial light sources.

Figure 5—2 Variation in colour temperature of natural daylight

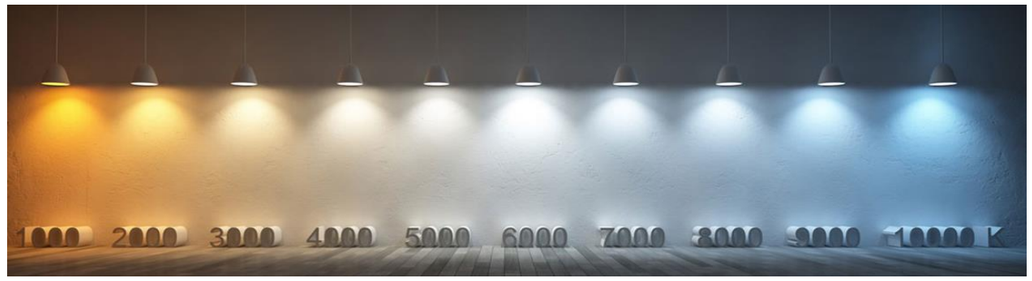


Figure 5—3 Variation in colour temperature of artificial light sources (LED).

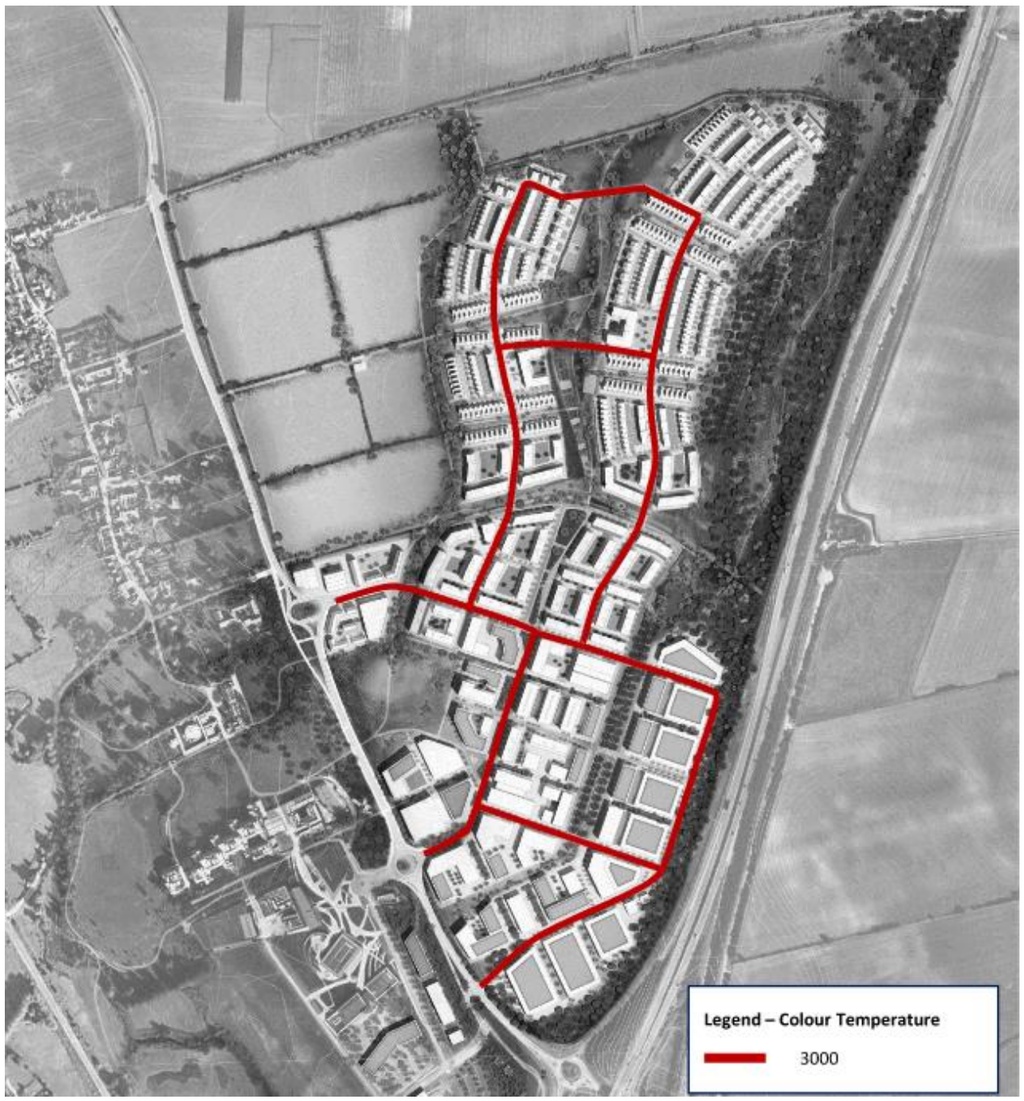


Figure 5—4 Site wide colour temperature strategy

Figure 5.5 illustrates the colour temperature of light source to be applied for the external lighting.

The use of variation in colour temperature are utilised to provide a differentiation between primary and secondary routes and share pedestrian and cycle route within green corridors or nearby sensitive receptors to ensure minimum impact from lighting onto these areas.

The main vehicular and pedestrian routes are illuminated to a neutral white (3000K).

Routes in close proximity to sensitive receptors being of a warmer colour (2700K). These routes are denoted with variations in operation with those highlighted in within the area of development (highlighted in orange) being operation during all hours of darkness.

Intensity

The intensity of light across the site must be appropriately considered from the brightest thoroughfares to the dimmest landscaped areas, both for the area in question, and in relation to adjacent areas.

Users' safety, security and comfort is of primary importance and a considered approach to the amount of light employed across the development will help improve all these measures. Varied levels of light intensity will act to increase the legibility of the area, improving peoples' orientation as they move through the site.

Mounting height and shielding

The mounting height of the lighting equipment will contribute to the perceived scale of spaces. Mounting luminaires too high on columns or buildings risks creating an environment that feels unwelcoming and scale-less for pedestrians and an increased proportion of spilled and uncontrolled light on the natural environment.

Therefore, shielding is required in certain lighting fixtures. It helps to minimise the amount of light that can spill onto the night sky and the surrounding natural environment

In principle luminaires across the site should:

- Have integrated shielding or integrated with additional external shielding
- Always point downwards
- Have forward-throwing light distribution with a reduced kickback

Integrated shielding

A full cut-off shielded light fixture has an integrated solid barrier at the top, located over the light source (lamp) such that it is covered. The solid housing should not have any translucent parts or diffused materials which will allow for lighting escaping towards the night sky. These luminaires allow light to be accurately cast downwards into the desired area without major levels of light spill. Spread lenses, snoots, internal/external louvres, honeycomb louvres and other glare mitigation and light control measures can be used in these luminaires to further limit the spread of light beyond a targeted area.

Integrated and external shielding

Areas within the Lighting Environmental Zone E2 where further mitigation measures to be adopted in order to fully shield the light from direct line of sight from the sensitive receptors shall adopt the following recommendations. Light source shielding can be achieved using physical landscape and architectural barriers (such as: dense shrubs, trees and dense low-level vegetation, bunds, berms, etc.) and integrated (or otherwise recessed) luminaires, solid or very dense screens, and

others, in combination with shielded fixtures where required to maintain light spill within the permissible levels noted within the GN01/21.

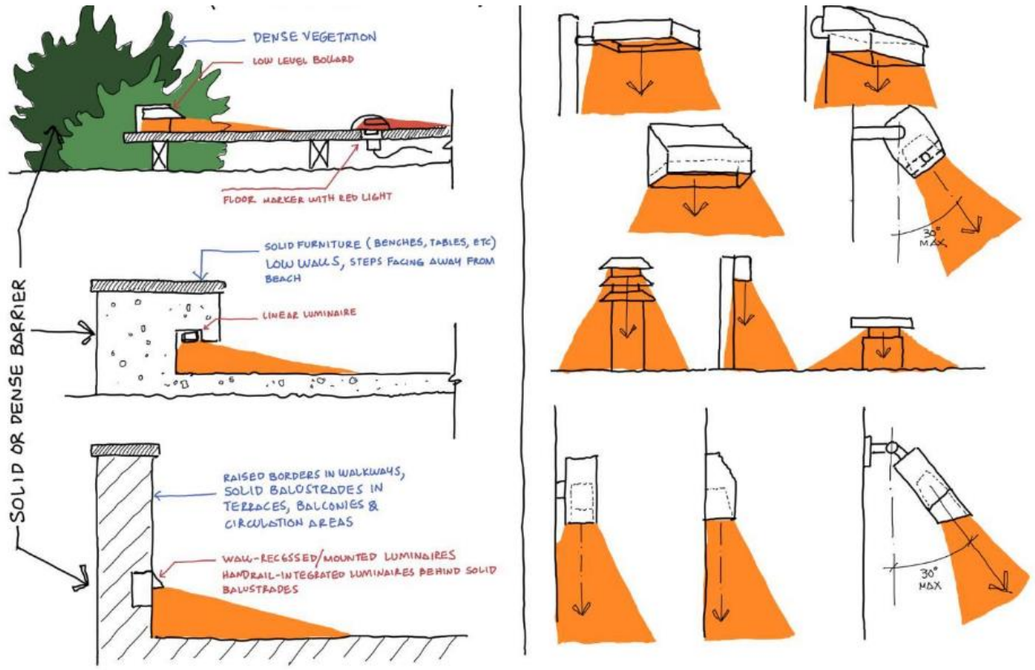


Figure 5—6 The above figure show examples of luminaires with integrated shielding and external shielding. The sketches on the right above show luminaires with only integrated shielding. Image Buro Happold

Roadways and circulation route lighting strategy

Figure 5-7 Site access routes

Figure 5.7 provides an indication of the general roadways and access route to be developed for the site. The lighting design for the roads, circulation, and open working external areas around and inside the site area shall seek to minimise the amount and intensity of light applied to fulfil the various functional and aesthetic objectives demanded by each application. This will not only help to save energy and reduce light pollution, but more importantly it will contribute with the creation of a unique, appropriate, and legible character for each route.

The following provide the design criteria for each of the roadways and circulation routes based on the requirement of the British Standards.

Table 5—2 Recommended mounting height summary chart

Proposed maximum height	Location
Max 6m	Utilised where for Primary Roadways
Max 4m	Utilised for Secondary Roadways
Max 1m	Pedestrian and cycle pathways within green corridors, woodlands and gardens.

Primary Roads and Secondary Roadways

Table 5—3 Table A.5 BS 5489 Classification of road lighting category.

Table A.5 — *Lighting classes for subsidiary roads*

Traffic flow	Lighting class		
	E1 to E4[A)]	E1 to E2[A)]	E3 to E4[A)]
	Pedestrian and cyclists only	Speed limit $v \leq 30$ mph	Speed limit $v \leq 30$ mph
Busy [B)]	P5	P4	P3
Normal [C)]	P5	P5	P4
Quiet [D)]	P6	P5	P4

The primary and secondary roads within the site are assessed to be within a lighting class of P5.

Table 5—4 Table 3 BS EN 13201, Classification of road lighting category.

Table 3 — P lighting classes

Class	Horizontal illuminance		Additional requirement if facial recognition is necessary	
	$\bar{E}$ [a] [minimum maintained] lx	E_{min} [maintained] lx	$E_{v,min}$ [maintained] lx	$E_{sc,min}$ [maintained] lx
P1	15,0	3,00	5,0	5,0
P2	10,0	2,00	3,0	2,0
P3	7,50	1,50	2,5	1,5
P4	5,00	1,00	1,5	1,0
P5	3,00	0,60	1,0	0,6
P6	2,00	0,40	0,6	0,2
P7	performance not determined	performance not determined		

[a] To provide for uniformity, the actual value of the maintained average illuminance shall not exceed 1,5 times the minimum $\bar{E}$ value indicated for the class.

The above table 5.4 denotes the lighting performance criteria for the secondary roads within the site to be within a P5 lighting classification. The primary roadways are assessed to be within a P5 lighting category.

Pedestrian and Cycle Routes

The pedestrian and shared cycle paths shall be illuminated to a lighting class of P5. Following a similar lighting criterion for P5 lighting class requirements, however with a variation of uniformity for the share pedestrian and cycle pathways located within the green corridors or within close proximity to sensitive receptors.

Table 5—5 Table A.5 BS 5489 Classification of road lighting category.

Table A.5 — *Lighting classes for subsidiary roads*

Traffic flow	Lighting class		
	E1 to E4[A)]	E1 to E2[A)]	E3 to E4[A)]
	Pedestrian and cyclists only	Speed limit $v \leq 30$ mph	Speed limit $v \leq 30$ mph
Busy [B)]	P5	P4	P3
Normal [C)]	P5	P5	P4
Quiet [D)]	P6	P5	P4

The lighting shall predominantly be addressed utilising low-level bollards.

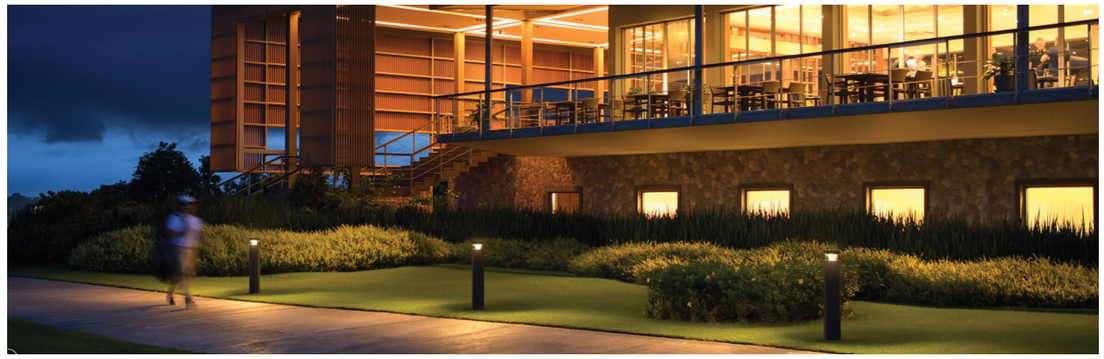


Figure 5—4 Image of low-level bollard lighting for pedestrian and cycle paths.

Figure 5—5 Road Lighting Category

Figure 5.5 illustrates the roadway class upon which the lighting criteria for each route is based.

Primary roads and secondary roads highlighted.

Figure 5—6 Road Lighting Category

Figure 5.6 illustrates the mounting hights of luminaires, with the main primary road to include 6m high columns, secondary roads 4m lighting columns, with some pedestrian and cycle paths utilising low level lighting bollards.

Car Parks

The lighting classification that applies to this zone has the requirements for external car parking area with a medium vehicular volume. Please see column 5.9.2 in Table 6—4 for illumination criteria.

The lighting of the car park facilities within the site shall operate on between operational hours and controls to include external photocells with 'dusk till dawn' operation together with an astronomical time clock and manual override. The lighting shall be programmable to have pre-determined operation timing to switch off the lighting outside operation hours as required.

The lighting for multi storey car parks shall adhere to the British Standards and the recommendation of the CIIBSE SLL Guides. The lighting shall also ensure compliance with maximum permissible limits on light spill. Direct visibility of luminaires at the perimeter of multi storey car parks shall be shielded to avoid visibility of any intense light sources from external viewing.

Table 5—7 Table 5.9 BS EN 12464-2:2014

Table 5.9 — Parking areas

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.9.1	Light traffic, e.g. parking areas of shops, terraced and apartment houses; cycle parks	5	0.25	55	20	
5.9.2	Medium traffic, e.g. parking areas of department stores, office buildings, plants, sports and multipurpose building complexes	10	0,25	50	20	
5.9.3	Heavy traffic, e.g. parking areas of major shopping centres, major sports and multipurpose building complexes	20	0,25	50	20	

The illumination of multi-storey car parks shall conform to the

Figure 5—6 Precedent image of luminaires/columns used for car parks

External areas immediate to buildings

The externa lighting to building shall follow the parameters set out within this report as to the permissible levels of light spill within the locality of the building boundaries, together with adopting to the standards and recommendation of the CIBSE SLL Guides and BS EN 12464-1, 2021Light and lighting, Lighting for Work Places, Part 1 Indoor working places.

The lighting for commercial properties other those required for operational use shall operate on between operational hours and controls to include external photocells with ‘dusk till dawn’ operation together with an astronomical time clock and manual override. The lighting shall be programmable to have pre-determined operation timing to switch off the lighting outside operation hours as required.

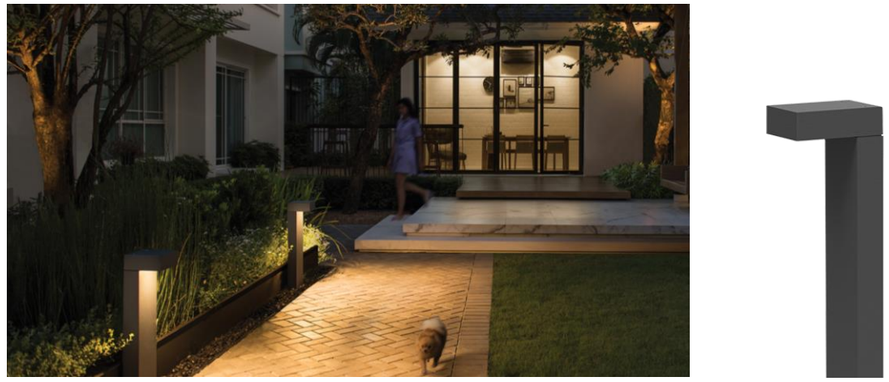
Public Realm

The area of public realm, communal external areas and gardens shall be illuminated in line with the recommendation of the CBISE SLL Guide LG6 and British Standards BS 5489 and BS EN 12464-2, 2014 Light and lighting, Lighting of work places, Part 2 Outdoor work places.

The illumination of these area shall portray the character of the development and create ambient lighting schemes, with low level lighting and lighting integrated within the external future to create a visually comfortable spaces and avoid intrusive high intensity light sources and high-level lighting columns.

Luminaire typologies

Public realm



Low level lighting bollards provide illumination of pathways and access routes avoid visibility of high level light sources and providing lighting local to the areas required.

Variation in light distribution to cater for different requirements and limit light spill onto areas of sensitive receptors.

Localised low-level lighting within public external space creates clam and visually comfortable spaces in keeping with the rural surroundings.

Integrated lighting with external furniture.

Indicative equipment for 4m and 6m Columns

Indicative equipment for 1m high bollards

Lighting Controls

Smart lighting control systems applied to the lighting equipment installed throughout the project can help to reduce energy consumption and operate the lighting schemes in a more efficient way. These systems can be linked to meteorological measurement devices, data collection and artificial intelligence development centres to create smart operation cycles that will keep non-essential lighting off working 24 hours to minimise energy consumption and reduce lighting levels of essential illumination equipment whilst maintaining safe levels of illuminance overnight.

Advanced lighting technology can limit the operating hours of lighting equipment to reduce running costs and limit environmental impact by setting scenes, curfew times, and dimming levels and times.

Astronomical timeclock

The astronomical timeclock or switch is an automatic time-switch control that controls lighting based on the time of day and astronomical events such as sunset and sunrise, accounting for geographic location and calendar date.

Timers with both astronomic and Daylight-Saving Time (DST) functionality automatically adjust to the seasonal day-to-night-time changes throughout the year. An electronic timer with astronomic functionality determines each day's sunrise and sunset times based on geographic location, while the automatic DST functionality resets the clock by one hour in the spring and fall.

Photocells

Photocells are devices that can be incorporated to luminaires or installed remotely and connected to a control system. Photocells can turn lighting on when the ambient light falls below a pre-set level, or automatically adjust the light output of luminaires depending on the amount of natural light available to a maintained illuminance level.

Motion sensors

These devices can be used as energy-saving sensors in exterior and interior areas, turning off lights in empty zones and turning them on when someone moves along the area. Many of these products have adjustable sensing areas, allowing for different coverage areas in specific locations. They can also be integrated into general control systems and can be used to override lighting scenes.

Programmable control systems

DALI (Digital Addressable Lighting Interface) control protocol

DALI stands for Digital Addressable Lighting Interface and is a manufacturer-independent standard for lighting control in external areas and buildings. It is specifically used in external areas and properties such as offices, shops, restaurants, and hotels, but can perfectly be used in industrial complexes.

It is a communication protocol for building lighting applications and is used for communication between lighting control devices, such as electronic ballasts, brightness sensors or motion detectors and lighting fixtures. It allows the creation and programming of lighting scenes and their triggering times.

The DALI systems can be programmable and connected via wired and wireless systems. They can also receive input from manual switches.

DALI 2 control protocol

DALI-2 is the updated and improved version of the DALI lighting protocol, which includes more features and more product types and has a strong focus on product interoperability.

Compared with the original DALI version 1 standard, DALI-2 includes clearer specifications for control gear features such as timing, fading, power-on and start-up, as well as new features such as extended fade times. DALI-2 is designed for backwards compatibility, so DALI-2 control gear can be used in older systems.

DALI-2 certification is already available for a broad selection of product types, including LED drivers, control devices (single-master and multi-master application controllers), Further product types – notably sensors of different types, as well as control gear for emergency lighting systems – will follow when technological developers have created the necessary test sequences.

These control mechanisms guarantee that the maximum levels of light can be defined and never be more than 10% of the maximum defined level for specific zones.

Conclusion

Existing Conditions

The proposed development is predominantly located on intensively farmed arable fields. The existing site area is unilluminated during the hours of darkness. The existing area is identified as, a Zone 2 – Rural, low district brightness Lighting Classification (ILP GN01:21). As the area is predominantly unilluminated during hours of darkness, the lighting requirements for the Proposed Development for operational, and health and safety during the hours of darkness would maintain the existing lighting classification from Zone 2. The sky glow rating for the existing areas will also remain unchanged.

Summary

The proposed development would change the character of the existing area within the area of development (within site boundary) which is currently unilluminated, this will cause a visual change, however with minimal impact on the existing ecology and surrounding areas.

Considerations for the preservation of the existing ecology are also addressed and identified within this report. Suitable measures are provided to ensure these areas together with the introduction to the area to the south of the development are to be preserved and enhanced to promote wildlife habitats.

The artificial lighting for the Development, would have a therefore impact on existing area of development within site boundary which that are currently unilluminated during the hours of darkness, due to the introduction of lighting within these areas for purposes and those of health and safety. However, the impact on surrounding areas and ecology would be minimal. The existing lighting environmental zone (zone 2) within the site boundary and surrounding areas would be unchanged and maintained as current. The upward sky glow from the site would be negotiable and not impact on the existing lighting conditions, there by maintaining the current Bortle Scale of Class 4 for sky glow as per existing conditions for the site and surrounding areas.

The Lighting Strategy states the requirements for compliance with the relevant regulations, recommendations, and adaptation of best practice, ensure that the artificial lighting for the Proposed Development would not constitute or be a cause of nuisance or detrimental effect on health and safety.

The guidelines noted for compliance with the ILP GN01:21, ensure that the lighting shall not exceed the permissible levels of light spill outside the boundary of the Proposed Development onto the surrounding areas and adjacent properties, together with the mitigation of any undue light spill onto the night sky.

Noah Jones

Buro Happold
17 Newman Street
London
W1T 1PD
UK

T: +44 20 7927 9700
Email: farhad.rahim@burohappold.com