

A47 North Tuddenham to Easton Dualling

Scheme Number: TR010038

Volume 6

6.3 Environmental Statement Appendices **Appendix 7.7 – Lighting Assessment**

APFP Regulation 5(2)(a)

Planning Act 2008

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

March 2021

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms and
Procedure) Regulations 2009**

The A47 North Tuddenham to Easton
Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT APPENDICES
Appendix 7.7 – Lighting Assessment

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LIGHTING IMPACT ASSESSMENT

PROJECT: A47 NORTH TUDDENHAM TO EASTON
DUALLING

PREPARED FOR: SWECO

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Designs for Lighting Ltd

17 City Business Centre, Hyde Street, Winchester, SO23 7TA

T: +44(0)1962 855080, E: info@dfi-uk.com www.dfi-uk.com

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1 Introduction

1.1 General

- 1.1.1 This report has been prepared on behalf of SWECO, by Designs for Lighting Ltd, a specialist exterior lighting consultancy with knowledge and experience in lighting impact assessments and mitigation. Designs for Lighting Ltd is currently represented within the Institution of Lighting Professionals (ILP) technical committee and British Standard committees for lighting, providing technical input into industry technical guidance documents.
- 1.1.2 The purpose of this report is to provide an analysis of the potential post construction light spill levels associated with the Proposed Development, to allow an assessment of the potential effects on sensitive receptors.
- 1.1.3 The Proposed Development consists of the dualling of a section of the A47 between North Tuddenham and Easton, including two grade separated junctions at Wood Lane junction and the Norwich Road junction: and associated side road alterations and walking, cycling and horse-riding connections along the length of the scheme (the 'Application Sites').
- 1.1.4 Lighting is to be provided for the Norwich Road junction and the Wood Lane junction.
- 1.1.5 This lighting assessment has been prepared in accordance with the lighting calculations **HE551489-GTY-HLG-000-CA-EO-30001 & HE551489-GTY-HLG-000-CA-EO-30007**.
- 1.1.6 The proposed site layout plan for the development, and associated Isolux contours, is presented in **Appendix 1**.
- 1.1.7 Identified potentially sensitive receptors are identified in **Appendix 2**.
- 1.1.8 The principal objective of the assessment is to identify the impact of obtrusive light associated with the Proposed Development on various sensitive receptors and assess the significance of any residual effects from artificial lighting associated with the operational phase of the Proposed Development.
- 1.1.9 The lighting impact assessment considers the maximum adverse scenario in relation to the artificial lighting associated with the Proposed Development to adequately assess the significance of the likely effects on the identified sensitive receptors.
- 1.1.10 The Application Sites are located between North Tuddenham and Easton, presented in **Figure 1**.



Figure 1 Application Site – Proposed junctions between North Tuddenham and Easton

2 Legislative and Policy Framework

2.1 National Policy and Legislation

Environmental Protection Act 1990 / Clean Neighbourhoods and Environment Act 2005

- 2.1.1 Since 2005, artificial light has been incorporated as a potential statutory nuisance. An amendment to section 79 of the Environmental Protection Act 1990, contained within the Clean Neighbourhoods and Environment Act 2005 states:

“Artificial light emitted from premises so as to be prejudicial to health and nuisance constitutes a ‘Statutory Nuisance’ and it shall be the duty of every local authority to cause its area to be inspected from time to time to detect any statutory nuisances which ought to be dealt with under section 80 and, where a complaint of a statutory nuisance is made to it by a person living within its area, to take such steps as are reasonably practicable to investigate the complaint”.

National Planning Policy Framework 2019

- 2.1.2 The National Planning Policy Framework (NPPF) sets out the government’s planning policies for England and how they are expected to be applied and provides a framework for local plans. With regard to light pollution, the NPPF was updated in November 2019 and states that the following elements are to be considered:

“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:

- a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life.*
- 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.”*

Planning Practice Guidance

- 2.1.3 Guidance for assessing the effects of proposed artificial lighting is outlined in the planning practice guidance (PPG). The guidance states:

“Does a new development proposal, or a major change to an existing one, materially alter light levels outside the development and/or have the potential to adversely affect the use or enjoyment of nearby buildings or open spaces?”

Does an existing lighting installation make the proposed location for a development unsuitable? For example, this might be because:

- the artificial light has a significant effect on the locality;*
- users of the Proposed Development (e.g. a hospital) may be particularly sensitive to light intrusion from the existing light source.*

Does a proposal have a significant impact on a protected site or species e.g. located on, or adjacent to, a designated European site or where there are designated European protected species that may be affected?

Is the development in or near a protected area of dark sky or an intrinsically dark landscape where it may be desirable to minimise new light sources?

Are forms of artificial light with a potentially high impact on wildlife (e.g. white or ultraviolet light) being proposed close to sensitive wildlife receptors or areas, including where the light shines on water?

Does the Proposed Development include smooth, reflective building materials, including large horizontal expanses of glass, particularly near water bodies (because it may change natural light, creating polarised light pollution that can affect wildlife behaviour)?”

2.2 Local Policy

2.2.1 The Proposed Development spans several local authorities, with the Western extents sitting within the Breckland District, and the scheme then moving into the Broadland District and South Norwich District to the East.

2.2.2 The relevant Local Authorities, and their corresponding planning policies, are as follows:

- **Breckland District Council.** Breckland Council Local Plan (Adopted Nov 2019).
- **Broadland District Council.** Joint Core Strategy for Broadland, Norwich and South Norfolk (Adopted March 2011, Amendments adopted Jan 2014). Development Management Policies Document (Adopted Oct 2015).
- **South Norwich District Council.** Joint Core Strategy for Broadland, Norwich and South Norfolk (Adopted March 2011, Amendments adopted Jan 2014). Development Management Policies Document (Adopted Oct 2015).

2.2.3 The identified planning documents outline relevant policies to light pollution associated with the Proposed Development. Whilst the Proposed Development sits on the Highways England network, local policies are considered within the scope of the lighting design and assessment.

2.2.4 Broadland District Council and South Norwich District Council share a Joint Core Strategy & Development Management Policies Document.

Joint Core Strategy for Broadland, Norwich and South Norfolk (Adopted March 2011, Amendments adopted Jan 2014)

2.2.5 The Core Strategy sets out the long-term vision and objectives for the whole of the area covered by Broadland District, Norwich City, and South Norfolk, including strategic policies for steering and shaping development.

2.2.6 The relevant policies of the Joint Core Strategy are:

Policy DM 3.13 Amenity, noise and quality of life

(1) *"Development should ensure a reasonable standard of amenity reflecting the character of the local area. In all cases particular regard will be paid to avoiding:*

- a. Overlooking and loss of private residential amenity space*
- b. Loss of daylight, overshadowing and overhearing impact*
- c. Introduction of incompatible neighbouring uses in terms of noise, odour, vibration, air, dusts, insects, artificial light pollution and other such nuisances.*

Planning permission will be refused where Proposed Development would lead to an excessive or unreasonable impact on existing neighbouring occupants and the amenity of the area or a poor level of amenity for new occupiers.

(3) *Development will not be permitted where the Proposed Development would generate noise or artificial light which would be significantly detrimental to the amenity of nearby residents or the occupants of other noise sensitive uses. Proportionate mitigating measures including limiting conditions will be used to reduce the potential noise or artificial light impact to an appropriate level whenever practical to do so”.*

South Norfolk local Plan Development Management Policies Document (Adopted Oct 2015)

2.2.7 Clauses 3.89 and 3.90 within the South Norfolk Local Plan Development Management Policies Document outline further detail on the implementation of lighting within the area:

Lighting

*“3.89 **Amenity** and environmental quality can be impacted in other ways including by poorly designed and managed lighting. This is a particular issue in rural parts where the relatively*

'dark skies' contribute greatly to character and amenity. References to useful guidance and advice are given in the Notes below.

3.90 The importance of tranquillity to wildlife should also be recognised. Increased noise and lighting in particular can have an adverse impact on certain bat and bird species."

Breckland Council Local Plan (Adopted Nov 2019)

2.2.8 The most relevant policy of the Local Plan is considered to be;

Policy COM 03 Protection of Amenity

"For all new development consideration will need to be given to general amenity impact issues, especially residential amenity. Development will not be permitted which causes unacceptable effects on the residential amenity of neighbouring occupants, or does not provide for adequate levels of amenity for future occupants. In assessing the impacts of development on the living conditions of occupants, regard will be had to the following amenity considerations:

- (1) The protection of adequate areas of usable and scheduled private amenity space for the occupiers of existing dwellings;*
- (2) The provision of adequate areas of usable and secluded private amenity space for the occupiers of proposed dwellings, in keeping with the character of the immediate surrounding areas;*
- (3) Overlooking of windows of habitable rooms and private amenity space;*
- (4) Overbearing impact/visual dominance;*
- (5) Overshadowing of private amenity space;*
- (6) Loss of daylight and/or sunlight to existing windows of habitable rooms;*
- (7) Odour, noise, vibration or other forms of nuisance such as artificial light pollution, insects and vermin; and*
- (8) Other forms of pollution (including contaminated land, dust, air pollution, for example the emission of particulates etc)."*

3 Guidance

3.1 Institution of Lighting Professional's Guidance Notes for the Reduction of Obtrusive Light, 2020

- 3.1.1 Guidance notes produced by the Institution of Lighting Professional (ILP) are among the most commonly referenced guidance notes for good practice within the lighting design industry.
- 3.1.2 Obtrusive light (or sometimes referred to as light pollution) refers to any light emitted in a direction in which it is not required or wanted and as such is detrimental to other users.
- 3.1.3 Consideration is given to light intrusion, direct upward light (sky glow) and glare within the context of varying environmental zones.
- 3.1.4 Light intrusion refers to the spilling of light beyond the boundary of the area to be lit. This includes the intrusion of light into bedroom windows.
- 3.1.5 Sky glow refers to the brightening of the sky above towns caused by direct or reflected upward light.
- 3.1.6 Glare refers to the uncomfortable brightness of a light source when viewed against a dark background. **Figure 2** illustrates the different types of obtrusive light.

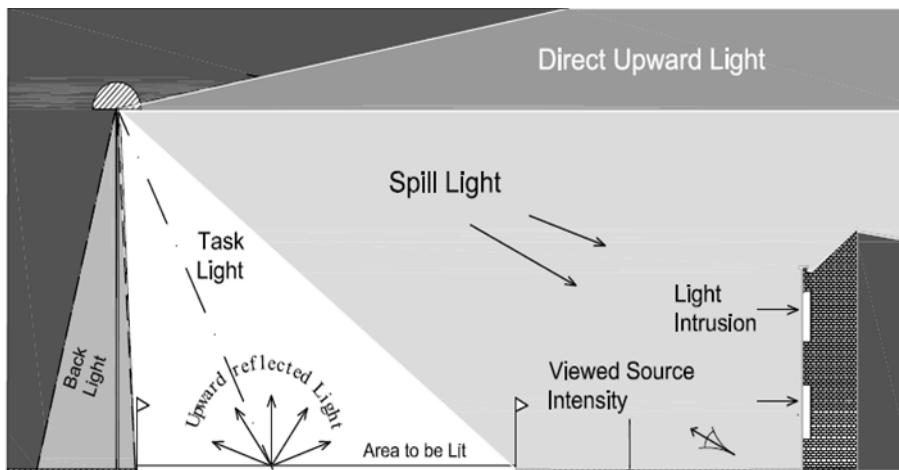


Figure 2 Obtrusive light diagram

3.2 Professional Lighting Guide PLG 04 “Guidance on Undertaking Environmental Lighting Impact Assessments” Institution of Lighting Professionals (ILP), 2013

- 3.2.1 PLG 04 is used to ensure that the lighting impact assessment is correctly carried out:

“...this document is designed to provide an explanation of, and guidance on, the process for producing a Lighting Assessment...to remove or minimise environmental problems”.

3.3 Institution of Lighting Professional's (ILP) GN08 – 18 – Bats and Artificial Lighting in the UK

- 3.3.1 Bats and Artificial Lighting in the UK (GN08/18,2018 The Institution of Lighting Professionals (ILP) and Bat Conservation Trust (BCT) prepared this document. It provides guidance for artificial exterior lighting in close proximity to light sensitive ecology. The following is stated within the document:

“Lighting in the vicinity of a bat roost causing disturbance and potential abandonment of the roost could constitute an offence both to a population and to individuals (Garland and Markham, 2007).

It is therefore important that the use of an area by bats is thoroughly assessed before artificial lighting is changed or added in the vicinity of a roost or where bats may commute or forage.”

“It is acknowledged that, especially for vertical calculation planes, very low levels of light (<0.5 lux) may occur even at considerable distances from the source if there is little intervening attenuation. It is therefore very difficult to demonstrate ‘complete darkness’ or a ‘complete absence of illumination’ on vertical planes where some form of lighting is proposed on site despite efforts to reduce them as far as possible and where horizontal plane illuminance levels are zero. Consequently, where ‘complete darkness’ on a feature or buffer is required, it may be appropriate to consider this to be where illuminance is below 0.2 lux on the horizontal plane and below 0.4 lux on the vertical plane. These figures are still lower than what may be expected on a moonlit night and are in line with research findings for the illuminance found at hedgerows used by lesser horseshoe bats, a species well known for its light averse behaviour (Stone, 2012).”

“Dark buffers, illuminance limits and zonation dark buffer zones can be used as a good way to separate habitats or features from lighting by forming a dark perimeter around them. Buffer zones rely on ensuring light levels (levels of illuminance measured in lux) within a certain distance of a feature do not exceed certain defined limits. The buffer zone can be further subdivided in- to zones of increasing illuminance limits radiating away from the feature” (see Figure 1).

Example of illuminance limit zonation

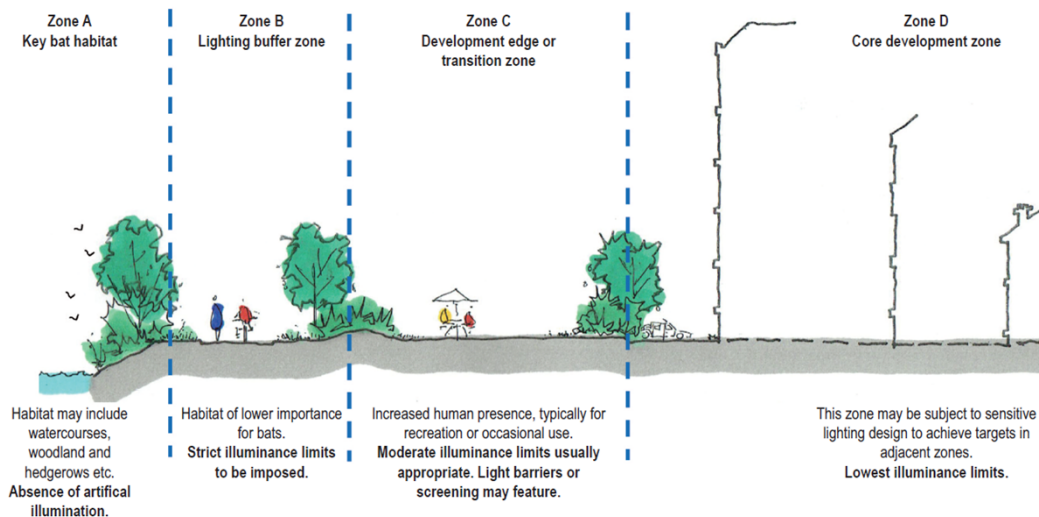


Figure 3 GN08/18 Guidelines for illumination buffer zones

3.4 British Standards

3.4.1 The most applicable British Standards for lighting that relate to the Proposed Development are:

- **BS 5489-1: 2020** – *Lighting of Roads and Public Amenity Areas (Code of practice)*. – This British Standard is applicable to the roads that help to facilitate movement of vehicular traffic about the Proposed Development.
- **BS EN 13201 Part 2: 2015** - *Road lighting. Performance requirements* is applicable to the selection of lighting classes across the roads throughout the Proposed Development.

3.5 Highways England Design Manual for Roads and Bridges

- 3.5.1 Lighting for the proposed development has been designed in accordance with the Highways England Design Manual for Roads and Bridges (DMRB).
- 3.5.2 Lighting levels have been selected in accordance with **TD 501** (formerly TD 34/07); which makes specific reference to BS 5489-1.
- 3.5.3 TD 501 contains the requirements for the design of new and replacement road lighting on motorways and all-purpose trunk roads; and specifically addresses the high-level approach for lighting requirements as well as the competencies of those involved.

4 Assessment Methodology and Significance Criteria

4.1 Methodology

- 4.1.1 The assessment has been carried out in accordance with the published guidance documents from the ILP They quantify the levels of direct upward light, light intrusion, viewed source intensity and glare regarded as acceptable for varying environmental zones.
- 4.1.2 The methodology employed for this assessment is appropriate to the location of the Application Site. It comprises a desk-top study of the legislative, policy and guidance context; consultation with the design team, as well as an assessment of the relevant environmental zone in which the application site is located; evaluation of the likely effects of the proposed lighting using appropriate assessment criteria (Outlined in **Tables 4 - 7**); indicative layout and associated light spill modelling.
- 4.1.3 The methodology takes guidance from the Institution of Lighting Professionals PLG 04 document “Guidance on Undertaking Environmental Lighting Impact Assessments”. This sets out good practice for conducting the assessment.
- 4.1.4 The desktop study involved research into relevant local and national legislation, policy and guidance relating to obtrusive light. It also involved consultation with relevant parties and studying of ordnance survey maps, plans and aerial photography views to identify likely receptor locations.
- 4.1.5 Research undertaken during the desktop study identified the potentially sensitive receptors, against which levels were modelled to determine possible levels of spill light.
- 4.1.6 The assessment has focussed on the proposed road lighting design of the Proposed Development.

4.2 Study Area

- 4.2.1 The desktop study includes a review of the potential receptors that could be affected by a change in artificial lighting in line with the criteria outlined in **Tables 4 - 7**. This includes nearby existing residential amenity, roadways, and any identified ecological receptors, within the vicinity of the Proposed Development.
- 4.2.2 Potentially sensitive receptors are identified in **Section 6**, and receptor positions are shown in **Appendix 2**.

4.3 Potential Effects from Artificial Light

- 4.3.1 The following potential effects can arise from inappropriately designed artificial lighting:
- Effects from light intrusion from exterior lighting on residents (through windows)**
- 4.3.2 Light intrusion (or light spill) is the term for the spilling of light beyond the boundary of the area being lit. The ILP Guidance Notes places a limit on the amount of vertical Illuminance which falls upon the centre of a dwelling window. The suggested maxima values quoted are relative to the amount of light measured as a baseline without the presence of the obtrusive light source.
- Effects from viewed source intensity on residents and sightseers**
- 4.3.3 **Table 4** within ILP GN01/20 (**Table 3** in this document) advises limits on luminaire intensity or viewed source intensity from flood lighting luminaires towards an observer. The greatest effects are usually encountered from poorly aimed floodlights or security lighting, or from lighting which is located too close to properties.
- Effects from upward light (or sky glow)**
- 4.3.4 Light emitted above the horizontal either directly from luminaires or indirectly as reflected light from surfaces such as the landscape or buildings, has the potential to cause sky glow. The ILP “Guidance Notes for the Reduction of Obtrusive Light” places limits on the percentage of direct upward light emitted from the luminaires in their installed attitude, which is dependent upon the environmental zone in which the site lies.

- 4.3.5 Indirect upward light is subject to surface reflectance properties. It is not easily quantifiable but is unlikely to be as significant as direct upward light from luminaires.

Effects from disability glare on transport users

- 4.3.6 The proposed lighting strategy includes requirements for lighting to be installed such that glare is minimised in accordance with the ILP guidance notes.

Effects from light on bats roosts and insects

- 4.3.7 Light falling on a roost access point will at least delay some species of bats from emerging and this shortens the amount of time available to them for foraging. As the main peak of nocturnal insect abundance occurs at and soon after dusk, a delay in emergence means this vital time for feeding is missed.
- 4.3.8 Insects and foraging in addition to causing disturbance to bats at the roost, artificial lighting can also affect the feeding behaviour of bats. There are two aspects to this - one is the attraction that light from certain types of lamps has to a range of insects; the other is the presence of lit conditions.

4.4 Classification of Environmental Zone

- 4.4.1 The ILP Guidance Notes Guide quantify the levels of Obtrusive light regarded as acceptable for varying environmental zones E0 to E4.
- 4.4.2 The Application Site is located within an area of low to medium level of district brightness, given the generally rural local environment. Therefore, the Environmental Zone is categorised as **E2** (Environmental Zone) in accordance with the ILP Guidance Notes.

Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark (SQM 20.5 +)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA Dark Sky Parks
E1	Natural	Intrinsically dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty 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 or suburban locations
E4	Urban	High district brightness	Town / City centres with high levels of night-time activity

Table 1 Environmental Zones

Notes:

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

4.5 Obtrusive Light Limitations

4.5.1 In the absence of suitable statutory guidance, the ILP “Guidance Notes for the Reduction of Obtrusive Light” GN01:2020 is typically used, in order to provide suitable assessment criteria against which to assess the likely effects of artificial lighting.

4.5.2 The relevant criteria of upward light, light intrusion and direct source intensity are discussed below, and **Table 2** provides the criterion for source intensity or glare, whilst **Table 2** sets limits for the criteria of upward light and light intrusion.

Table 4 (CIE 150 table 3 (amended)): Limits for the luminous intensity of bright luminaires⁴.

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

Notes:

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

Table 2 Source Intensity

Environmental Zones	Sky Glow ULR (Max %)	Light Intrusion (into Windows) E_v (lux)		Building Luminance Average, Pre-curfew
		Pre-Curfew	Post-Curfew	Average L (cd/m ²)
E0	0	0	0	< 0.1
E1	0	2	< 0.1 (1*)	< 0.1
E2	2.5	5	1	5
E3	5	10	2	10
E4	15	25	5	25

Table 3 Obtrusive light criteria relating to each Environmental Zones.

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

4.6 Significance Criteria

- 4.6.1 The significance of an effect from artificial lighting has been based upon the sensitivity of the receptor and the magnitude of change at that receptor due to the revised conditions.
- 4.6.2 The sensitivity of the receptor has been classified as High, Medium, or Low according to the descriptions provided in **Table 4**.
- 4.6.3 The magnitude of impact is determined as being High, Medium, Low or Negligible and descriptions for each are provided in **Table 6**.
- 4.6.4 The scale of effect is derived through a matrix (**Table 6**), matching the sensitivity of the receptor, with the magnitude of the impact.
- 4.6.5 The descriptions that have been adopted for each effect are summarised in **Table 7**, with effects identified as either beneficial or adverse.

Sensitivity	Description of Criteria
High	<p>The environment is fragile, and an impact is likely to leave it in an altered state from which recovery would be difficult or impossible.</p> <p>Human (Amenity) – receptors which are sensitive to a change in lighting such that the quality of life would be affected (i.e. lighting is designated a statutory nuisance)</p> <p>Human (Safety) - receptors where a change in the lighting has the potential to either dramatically improve or reduce safety (for pedestrians, drivers or workers).</p> <p>Ecological – where a change in the lighting affects the habitats, breeding or feeding of fauna (e.g. protected habitats or other special areas) or growth patterns of fauna / crops.</p>
Medium	<p>The environment has a degree of adaptability and resilience and is likely to accommodate the changes caused by an impact, although there may still be some residual modification as a result.</p> <p>Human (Amenity) – receptors which are sensitive to a change in lighting however not such that the quality of life would be affected.</p> <p>Human (Safety) - receptors where a change in the lighting has the potential to either improve or reduce safety (for pedestrians, drivers or workers).</p> <p>Ecological – where a change in the lighting affects the movement or feeding patterns of fauna but the receptor can adapt.</p>
Low	<p>The environment is adaptable and is resilient to change. Nearly all impacts can be absorbed within it without modifying the baseline conditions.</p> <p>Human (Amenity) – receptors which would not noticeably be aware of a change in lighting. (i.e. in areas of medium to high luminance)</p> <p>Human (Safety) - receptors where a change in the lighting has limited potential to affect safety (for pedestrians, drivers or workers).</p> <p>Ecological – area with limited wildlife.</p>
Negligible	Receptor has little or no night-time activity

Table 4 Criteria for Receptor Sensitivity

Magnitude of Impact	Description of Criteria
High	A large change compared to the natural variations in background levels. A clear breach of limits and standards may occur. For example, levels of obtrusive light in the form of sky glow, light intrusion or glare towards a receptor which exceeds the limits set within the ILP guidance for a higher environmental zone might classify as a high magnitude of change.
Medium	Change which is noticeable and may be a breach of limits and standards. In terms of the limits set in the ILP guidance this might equate to exceeding the limit but within the limits set for the next Environmental Zone.
Low	Change which, when compared to background levels, is only just noticeable.
Negligible	Change is not noticeable.

Table 5 Criteria for Magnitude of Impact

Magnitude of Impact	Sensitivity of Receptor			
	High	Medium	Low	Negligible
High	Major	Major	Moderate	Negligible
Medium	Major	Moderate	Minor to Moderate	Negligible
Low	Moderate	Minor to Moderate	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Table 6 Scale of Effect Matrix

Likely Effect	Description
Major beneficial	Substantial reduction in obtrusive light at sensitive receptors and/or users of the site such that large scale improvements to visual amenity, human safety or health is delivered. Significantly improves ecological habitats
Moderate beneficial	Moderate reduction in obtrusive light at sensitive receptors and/or users of the site such that noticeable improvements to visual amenity, human safety or health are delivered. Improves ecological habitats
Minor beneficial	Minor reduction in obtrusive light at sensitive receptors and/or users of the site such that perceptible improvements to visual amenity, human safety or health is delivered; perceptible improvement to ecological habitats.
Neutral/Not significant	No appreciable effect on sensitive receptors. Effects are reversible.
Minor adverse	Minor increase in obtrusive light at sensitive receptors and / or users of the site such as an increase in Glare, Light Intrusion to properties, increase in Sky Glow or effects on flora and fauna. Effects are reversible or temporary.
Moderate adverse	Moderate increase in obtrusive light at sensitive receptors and / or users of the site such as an increase in Glare, Light Intrusion to properties, increase in Sky Glow or effects on flora and fauna. Requires monitoring

	and local remedial work. For example, lighting which is visible and causes nuisance to a sensitive receptor outside the site.
Major adverse	Major increase in obtrusive light at sensitive receptors and / or users of the site such as an increase in Glare, Light Intrusion to properties, increase in Sky Glow or effects on flora and fauna. Requires extensive remedial works. For example, a floodlighting installation which directs light into the eyes of oncoming motorists causing disability glare and potential reduction in visual performance leading to an increased risk of collision.

Table 7 Likely Effects Description

- 4.6.6 The significance of any effect is determined through the application of **Table 7**. Significant effects are considered where the likely effect is of moderate or greater.

5 Limitations

5.1 Brief

- 5.1.1 The assessment of the overall effects on landscape and cultural heritage do not form part of the lighting assessment.
- 5.1.2 A limited assessment of the effects on bats and other species forms part of the lighting assessment, however final considerations of the total effects will be undertaken by a qualified ecologist.
- 5.1.3 At the time of writing, the location of construction compounds and haul routes have not been identified and therefore potential receptors associated with these areas do not form part of this assessment.

6 Baseline Conditions

6.1 Site Description and Context

- 6.1.1 The Proposed Development consists of the dualling of a section of the A47 between North Tuddenham and Easton, including two grade separated junctions at Wood Lane Junction and Norwich Road Junction; with associated side road alterations and walking, cycling, and horse-riding connections along the length of the scheme.
- 6.1.2 The existing Wood Lane Junction and approaches are unlit; with no existing artificial light sources overlooking the Junction.
- 6.1.3 The Norwich road Junction is lit, with lighting on the approach roads from all directions. Road lighting extends from the Junction along the A47, approx. 300m and 235m to the North West and East respectively. Lighting extends approximately 50m from the roundabout along Norwich Road.
- 6.1.4 As the application sites are located in a rural area, modelling has been undertaken to determine the potential levels of spill light from the proposed development onto nearby potentially sensitive receptors.
- 6.1.5 The proposed layouts of the Wood Lane Junction and Norwich Road Junction are shown in **Figure 4** and **Figure 5**:

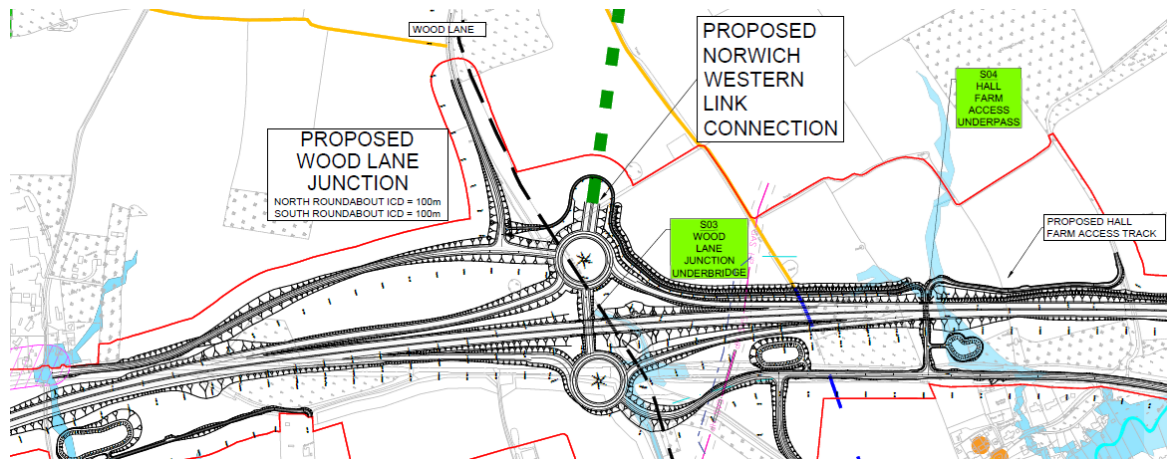


Figure 4 Wood Lane Junction Proposed Layout

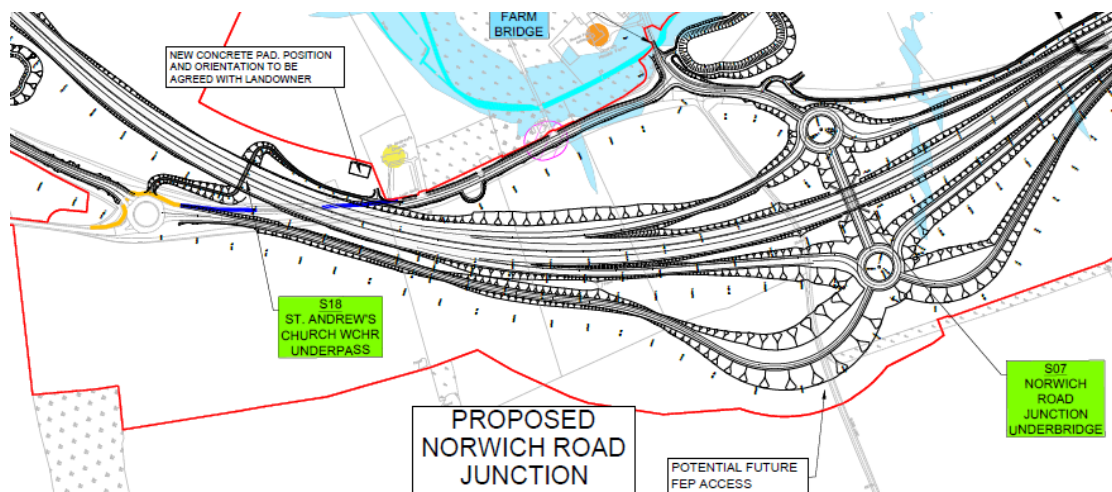


Figure 5 Norwich Road Junction Proposed Layout

6.2 Wood Lane Junction

- 6.2.1 The Wood Lane Junction is approximately 400 metres to the north west of Honingham, a settlement along the A47, and sits approximately 2 km south east of Hockering.
- 6.2.2 The junction is bordered in all directions by agricultural land & treelines. A residential property on Berrys Lane sits 300 metres to the south west over this agricultural land.

6.3 Norwich Road Junction

- 6.3.1 The Norwich Road Junction is located approximately 1.3 km to the east of Honingham, with the next closest settlement being Easton, which sits approximately 1.4 km to the east of the junction.
- 6.3.2 Residential properties and associated barns are located 120 metres to the north west of the junction, and 170 metres to the west; and the St Andrew Church, Honingham, is situated off the A47 approximately 370 metres to the west.
- 6.3.3 The sites are not covered by any statutory or non-statutory landscape designations at either a National or Local level, such as National Parks, AONB's, Special Landscape Areas, or Local Green Space designations.

6.4 Existing Lighting

- 6.4.1 As discussed in **Section 4** this section has been informed by a desk top survey.
- 6.4.2 Neither of the existing junctions has existing lighting in the immediate vicinity.

- 6.4.3 The surrounding villages are broadly dark, with no street lighting present in Honingham, Hockering, East Tuddenham or Colton. Street lighting is present in Easton, located approximately 1.4 km to the east of the Norwich road Junction; with lighting provided to main roads, some residential estates, and residential amenity lighting throughout. Main road lighting extends the length of the village, from the A47 Church Road Roundabout, approximately 1.25km eastwards.
- 6.4.4 The city of Norwich sits 10 km to the east of the Norwich Road Junction, contributing minimal levels of ambient light in the form of sky glow.

6.5 Sensitive Receptors

- 6.5.1 The application site was assessed to determine potentially sensitive receptors to the effects of obtrusive light, with consideration of ecological sensitivity, residential amenity, and human safety.
- 6.5.2 Receptors in the vicinity of the Wood Lane junction are primarily ecological, with planting and attenuation ponds identified in the immediate proximity. The northern boundary of the application site is considered more significant for the reduction of spill light than the other site boundaries, due to the broadly rural nature of the land to the north of the application site. Residential properties on Berrys Lane are also identified as potentially sensitive and sit approximately 300m south of the junction.
- 6.5.3 Receptors in the vicinity of the Norwich Road junction are also primarily ecological, with identified bat roosts in the proximity to the east, south west, and west, and an attenuation pond sits approximately 130m north of the junction. The only human amenity receptor in the immediate vicinity is St Andrews Church, Honingham, which sits approximately 525 metres west of the junction.
- 6.5.4 A map of potentially sensitive receptors is included in **Appendix 2**.
- 6.5.5 Potentially sensitive receptors are outlined in **Table 8**:

Receptor Designation	Receptor Type	Closest Junction	Description
1A	Human Amenity	Wood Lane	Berrys Lane residential property (300m S of Junction)
2A	Ecological		Ecology receptor – Planting, deciduous trees (Immediate SE)
3A	Ecological		Attenuation Pond (300m SE of Junction)
4A	Ecological		Attenuation Pond (650m SE of Junction)
5A	Ecological		Sensitive boundary (75m N of Junction)
1B	Ecological	Norwich Road	Bat Roost (170m E of Junction)
2B	Ecological		Attenuation Pond (130m N of Junction)
3B	Human Amenity		St Andrews Church, Honingham (525m W of Junction)
4B	Ecological		Bat Roost (120m SW of Junction)
5B	Ecological		Bat Roost (100m W of Junction)

Table 8 Likely Effects Description

7 Lighting Requirements

7.1 Artificial Lighting requirements

- 7.1.1 The Proposed Development requires British Standard compliant lighting for the safety and amenity of motorists on the approach to and using the Proposed Junctions, slip roads, and associated roundabouts.
- 7.1.2 To ensure consistency in the lighting design approach and compliance with Highways England & British Standards for lighting levels associated with the Proposed Development, in conjunction with lighting industry guidance for minimising obtrusive light and effects on ecology, external artificial lighting will be implemented in accordance with the layouts prepared

for the Proposed Development, as detailed in **HE551489-GTY-HLG-000-CA-EO-30001 & HE551489-GTY-HLG-000-CA-EO-30007** and presented in **Appendix 1**.

8 Potential Effects

8.1 Potential Effects from Operational Artificial Lighting (without mitigation)

- 8.1.1 As a result of the exterior lighting detailed above (i.e. without mitigation), there is a potential for obtrusive light due to poorly designed or installed lighting equipment if it is not implemented in accordance with the designs set out in **HE551489-GTY-HLG-000-CA-EO-30001 & HE551489-GTY-HLG-000-CA-EO-30007**.
- 8.1.2 Poorly designed lighting in a highways setting generally consists of the installation of poor-quality luminaires, the use of excessive tilt angles, inappropriate lighting distribution, or the over lighting of highways in areas of high environmental sensitivity.
- 8.1.3 Poorly designed lighting can contribute the following obtrusive light components:
- Light spill into windows: this is typical of wall mounted luminaires with high tilt angles;
 - Upward light causing sky glow: this is typical of up-lighting;
 - Glare: due to high light source intensity from floodlights; and
 - Light intrusion affecting ecology: caused by excessive height and tilt.
- 8.1.4 The potential effects from operational lighting without mitigation are likely to be permanent **Moderate Adverse**, based on the above components of obtrusive light, all of which could occur unless mitigation measures outlined in **Section 9** are implemented.

9 Scope of Mitigation

9.1 Mitigation by Design

- 9.1.1 Many of the potential effects of artificial lighting can be effectively mitigated by a suitable lighting strategy, good lighting design and choice of suitable lighting equipment and the lighting design being carried out by a suitably qualified and competent lighting professional in accordance with the relevant standards and guidance outlined in **Sections 2 & 3**.
- 9.1.2 The following paragraphs detail good lighting practices implemented in the design approach undertaken within: **HE551489-GTY-HLG-000-CA-EO-30001 & HE551489-GTY-HLG-000-CA-EO-30007**, which will be required to support the safe and secure operation of the Proposed Development within the completed development (operational) stage.
- 9.1.3 The highway lighting of the Proposed Development will:
- Be installed according to the designs presented in **HE551489-GTY-HLG-000-CA-EO-30001 & HE551489-GTY-HLG-000-CA-EO-30007**.
 - Use high quality luminaires throughout the design to ensure that light is focussed downwards onto the ground or other surfaces in the horizontal plane, minimising the potential for direct upward light, glare, light spill and light intrusion. Luminaires of this type would be designed to ensure that they are optically efficient, thus reducing the amount of light spilled onto the vertical plane, thereby reducing the potential for obtrusive light.
 - Ensure that luminaires are positioned such that light is along the road; and is only applied where needed for the safety of road users.
 - Use luminaires with good optical control and an option for installing shields. This would be an effective method of shielding the source intensity and reducing both horizontal and vertical spill light. If during the design of the lighting installation it is decided that luminaires

are to be installed with shields, then photometry with the effects of shields would be considered to ensure that the calculated lighting levels are as accurate as possible.

- Emit a warm white colour temperature light (3000K) to reduce the potential for adverse effects on potential ecological receptors.
- Ensure that the peak beam angle of all lights directed towards any potential observer is not to be more than 70 degrees when the luminaire is installed with a tilt angle of 0 degrees.
- Ensure that where luminaires are identified to produce light spill onto sensitive ecological receptors in excess of 0.2 lux, fixtures are fitted with rear shields to limit spill light.

10 Residual Effects Assessment

10.1 Operational Phase

- 10.1.1 The effects associated with the Proposed Development would be minimised by the application of the mitigation measures outlined above, in combination with the application of the lighting design set out in **Appendix 1**.
- 10.1.2 Whilst the lighting levels present within the boundaries of the Application Sites will increase, it is unlikely that potential human receptors with views of the Application Site would be subjected to an increase in obtrusive light, due to the distance between the Application Sites and potential receptors, mitigation measures, and compliance with lighting standards. Implementation of the proposed lighting design will also minimise light spill, ensuring that lighting is focussed only towards areas where it is required.
- 10.1.3 Although lighting is required for the Proposed Development, it is unlikely to be obtrusive through limiting the luminaire tilt angles and height. The visibility of lighting alone is not considered an obtrusive light component, and the effect on landscaping is to be considered in the EIA. The levels of lighting proposed within the lighting strategies are neither excessive nor are they uncommon for the particular environmental zone in which the Application Site is situated (**E2**). The residential receptors identified have been considered as having low sensitivity to changes in lighting due to their perspective of the Proposed Development and the distance between any proposed lighting and potentially sensitive residential receptors.
- 10.1.4 Views of the Wood Lane Junction will be partially obscured by earthworks as shown in **Appendix 1**, with the proposed lighting columns being set among significant banking. Proposed planting will further limit the already low light levels leaving the Application Site.
- 10.1.5 Views of the Norwich Road Junction will be significantly obscured by the position of the lighting columns relative to banking. Proposed planting at this junction will also be a significant limiting factor to the spread of spill light.
- 10.1.6 The majority of the proposed lighting associated with the Application Site will be set within significant banking, with topological barriers limiting potential spill light. Whilst the Isolux contours presented in **Appendix 1** present a negligible risk of light spill onto adjacent receptors, the levels presented assume an absolute adverse scenario of a flat landscape, whereas the banking present throughout will further reduce the potential for spill light.
- 10.1.7 The magnitude of change with regard to artificial lighting associated with the Proposed Development falling onto the identified receptor positions is considered 'negligible' in line with **Table 6**. This is because the proposed lighting is highly unlikely to breach the relevant **E2** environmental zone limits outlined in **Table 4**, or breach standards and guidance.
- 10.1.8 The artificial exterior lighting within proximity to potential ecological receptors is unlikely to give rise to significant effects, given the lighting design developed for the Proposed Development, which has been informed by appropriate guidance on sensitive ecological receptors (GN08/18). Luminaire mounting height and tilt have been limited, and effective lighting controls have been implemented within the design, which will both reduce the potential for obtrusive light. An indicative lighting layout is provided in **Appendix 1**, which demonstrates that the light levels at ground height onto the identified receptor positions will be minimised to less than 0.20 lux, as set out in GN08/18.

10.1.9 Due to the adjacent motorway bisecting the sites at a higher elevation compared to the lighting, along with foliage and vegetation between the motorway and lighting, it is unlikely that lighting associated with the Proposed Development would give rise to significant effects on road users or pedestrians.

10.1.10 Residual effects associated with the artificial external lighting for the Proposed Development are outlined in **Table 9**.

Environmental Effect	Receptor Type	Sensitivity of Receptor	Impact Magnitude	Nature of Impact (Permanent / Temporary)	Residual Effects
Light Spill, Direct Source Luminance	Human Amenity – Receptor 1A	Medium	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Ecological – Receptor 2A	Medium	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Ecological – Receptor 3A	Low	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Ecological – Receptor 4A	Low	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Ecological – Receptor 5A	Medium	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Ecological – Receptor 1B	Medium	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Ecological – Receptor 2B	Low	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Human Amenity – Receptor 3B	Low	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Ecological – Receptor 4B	Medium	Negligible	Permanent	Negligible (Adverse)
Light Spill, Direct Source Luminance	Ecological – Receptor 5B	Medium	Negligible	Permanent	Negligible (Adverse)

Table 9 Likely Effects Description

10.1.11 Following the implementation of mitigation measures as outlined in **Section 8**, and the implementation of the lighting layout proposed in **Appendix 1** the residual effects are assessed to be **Negligible Adverse** because although the general level of light upon the Application Site would increase, it is not likely to be obtrusive in nature. Furthermore, the lighting would be implemented in line with relevant British Standards and guidance.

11 Cumulative Effects Assessment

11.1 Intra-Project Effects

11.1.1 Due to the limited lighting requirements for the operation of the Proposed Development, including a design intended to limit the use of light only to areas where illumination is required for the safety of road users, there are unlikely to be Intra-Project effects of significance related to lighting.

11.2 Inter-Project Effects

- 11.2.1 Nearby completed developments have been considered in relation to the Proposed Development, in order to determine the potential for likely significant cumulative effects of lighting resulting from the Proposed Development.
- 11.2.2 There are no significant nearby developments to the Wood Lane Junction to be considered for Inter-Project Effects.
- 11.2.3 The Inter-Project Effects of the following development has been considered in relation to the Norwich Road Junction:
- Longwater Business Park - William Frost Way, Norwich, NR5 0JS**
- 11.2.4 The Longwater Business Park is situated 3.20 klm east of the Application Site and is a completed development. There is substantial lighting associated with car parks & businesses in the area, with lorry loading areas at *CEMEX Norwich* and *The Range* sitting closest to the application site. Lighting in these areas is typically lit in accordance with **BS EN 12464-2:2014 Table 5.1 – General requirements for areas and for cleaning at outdoor work places**, with lighting levels between 10 lux and 20 lux, and up to 50 lux for Vehicle turning, loading, and unloading points.
- 11.2.5 The ambient lighting associated with this type of development is likely to be consistent with areas of medium to high district brightness and would likely sit within an E3/E4 Environmental Zone.
- 11.2.6 The distance between the Application Sites and this development indicates that lighting between the site would not be significant enough to cause light spill towards identified receptor positions. The modelling undertaken in **Appendix 1** indicate that light levels towards Longwater Business Park are orders of magnitude below the levels required to constitute unacceptable levels of spill light, even when additional lighting from Longwater is considered.

11.3 Operational Phase Cumulative Effects

- 11.3.1 Information relating to baseline lighting levels for the adjacent projects indicates that the lighting associated with these developments presents the potential for spill light and glare based on the chosen light sources.
- 11.3.2 Measures have been implemented within the lighting layout provided in **Appendix 1** throughout the Proposed Development, to ensure that lighting provided is the minimal necessary to ensure site operational safety and security. The design presented in **HE551489-GTY-HLG-000-CA-EO-30001 & HE551489-GTY-HLG-000-CA-EO-30007** ensures that professional grade luminaires will be used throughout the site to ensure upward light is reduced to align with the relevant Environmental Zone Criteria.
- 11.3.3 Due to the good design practice that will be applied throughout the Proposed Development, the potential for light spill, glare and sky glow have been assessed as Negligible in significance. Therefore, significant cumulative effects from lighting in combination with the identified cumulative schemes is unlikely.

12 Conclusions

12.1 Introduction

- 12.1.1 This report considers the effects resulting from artificial lighting associated with the Proposed Development on the Application Site and its surroundings. It assesses the potential effects from obtrusive light associated with the proposed road lighting design. The principal objective is to assess the significance of likely residual effects.

12.2 Baseline Conditions

- 12.2.1 The Application Site is within a rural environment which is assessed to be an **E2** environmental zone due to the natural landscape buffering the Application Site.

- 12.2.2 A desktop study was undertaken to assess the baseline conditions on nearby potentially sensitive receptor positions, which were assessed to be of low ambient luminance, typical of an **E2 Environmental Zone**.

12.3 Potential Significant Effects

- 12.3.1 The requirement for artificial lighting to support the Proposed Development means that there could be some potential effects caused by some parts of the required lighting including light spill, direct source luminance or glare (onto receptor views) and sky glow or upward light. Without mitigation, the potential effects are likely to be **Moderate Adverse**, as poor-quality light sources could be installed, and lighting levels are non-compliant with British Standards or guidance documents. To avoid this, mitigation measures are implemented.

12.4 Mitigation and Enhancement

- 12.4.1 The mitigation measures deployed through the lighting layout presented in **Appendix 1** along with the mitigation measures outlined in **Section 8** would ensure that artificial lighting is not obtrusive.

12.5 Residual Effects

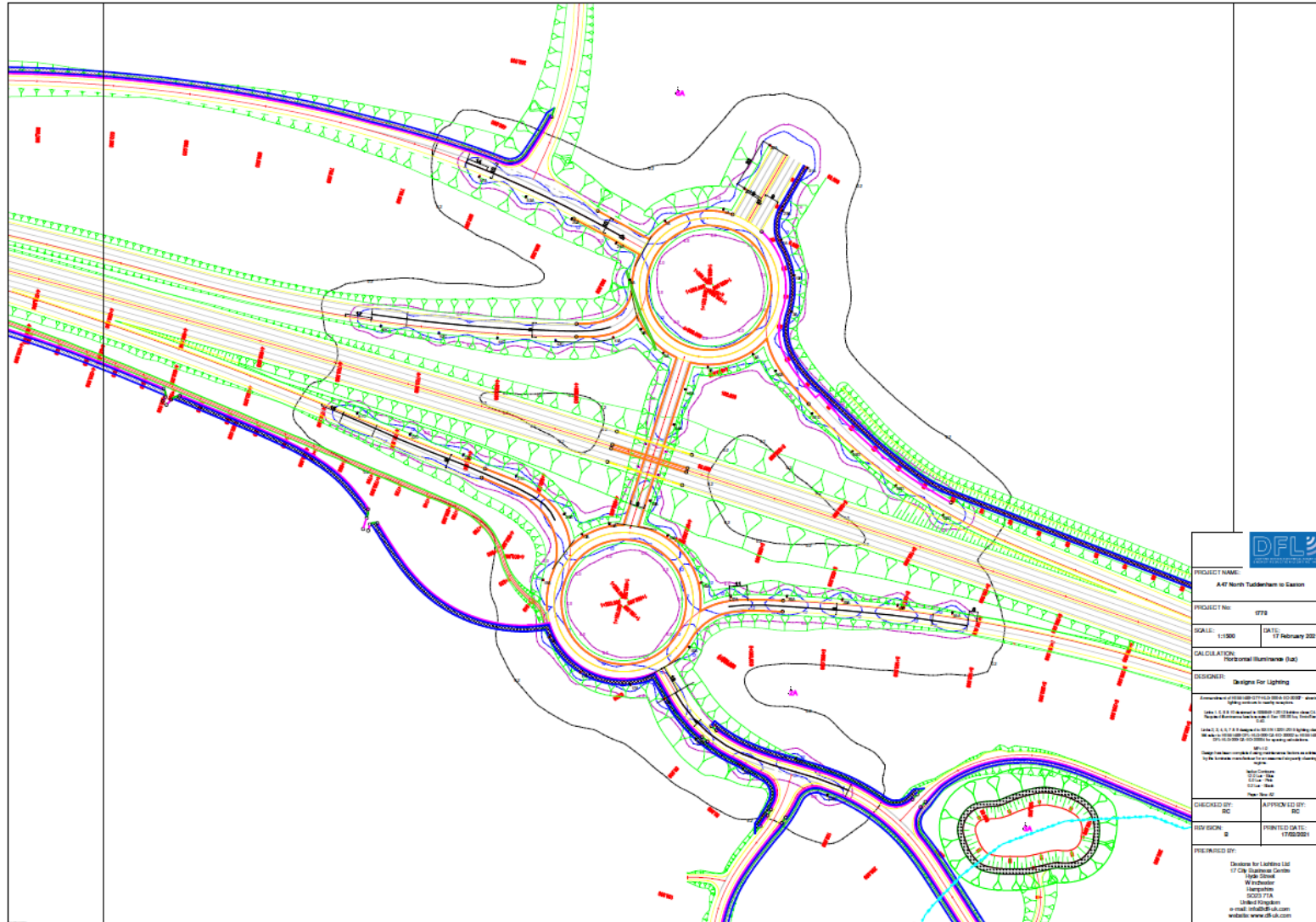
- 12.5.1 Due to the lighting strategy and the mitigation measures outlined in **Section 8**, the residual effects of the operational phase are assessed to be **Negligible Adverse**. This is due to the low potential for obtrusive light to affect human and ecological receptors, through the through implementation of the lighting layout.
- 12.5.2 Potential human sensitive receptors located outside the boundaries of the Application Site are unlikely to be subjected to obtrusive light from the Proposed Development, due to the design of the proposed lighting for the Application Site, and the distance between the Application Site and potentially sensitive receptors.
- 12.5.3 In combination, the design implementation seeks to ensure that light is only focussed where it is needed, and the layout of the site will provide shielding to sensitive receptors from the effects of obtrusive light. This will help reduce the potential for the levels of glare and light spill to be greater than those permitted within **Table 4**.
- 12.5.4 Lighting levels following the application of the mitigation measures outlined in **Section 8** are not expected to exceed limitations on light pollution set out within the Joint Core Strategy for Broadland, Norwich and South Norfolk or the Breckland Council Local Plan, as reasonable steps have been taken to minimise light pollution wherever possible.
- 12.5.5 Further to this, lighting levels following the application of the mitigation measures outlined in **Section 8** and the implementation of the lighting layout presented in **Appendix 1** are expected to comply with necessary guidance presented in ILP GN01:2020, PLG04, and GN08-18; meeting the tests identified for this installation.
- 12.5.6 In conclusion, lighting levels associated with the Proposed Development will be sympathetic to the surroundings and consist of the lowest possible lighting levels whilst meeting relevant British Standards. As such, there are unlikely to be significant effects from artificial lighting installed as part of the Proposed Development.

12.6 Cumulative Effects

- 12.6.1 Significant cumulative effects from the operational lighting associated with the identified cumulative developments are unlikely, due to the principles within the lighting design, that seek to reduce the potential for obtrusive light through glare, light spill and upward light caused by the Proposed Development.

Appendix 1- Light Spill Modelling

See Separate files: 1778-DFL-LD-001 & 1778-DFL-LD-002.



Appendix 2- Receptor Positions

Wood Lane Junction:



Norwich Road Junction:

