Land south of Newark Road, Sutton-in-Ashfield, Ref. SKA3e

Lighting Strategy and Mitigation Report for the Proposed Development

Revision A - 22nd September 2017

dpa lighting consultants

"RIGHT LIGHT, RIGHT PLACE, RIGHT TIME"™

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INTRODUCTION

dpa lighting consultants were commissioned by Hallam Land Management Limited to undertake an assessment of any potential impacts towards the Sherwood Observatory resulting from the lighting of the proposed development site ref. SKA3e. The lighting assessment is to provide mitigation recommendations, if any adverse impact is identified.

This report identifies potential negative lighting impacts and provides appropriate mitigating measures that should be employed to reduce or remove any identified negative impacts.

The development site ref. SKA3e is identified on the adjacent plan in relation to the Sherwood Astronomical Observatory. We understand that the development site is to be residential in nature and will include the following elements:

- Streets, lanes, pedestrian and cycle links
- Landscaping and public open space
- Housing

Site in context

STANDARDS & GUIDANCE

The following documents have been referred to in the development of the lighting strategy for this development. It is expected that at time of detailed design, the latest issue of the documents below will be referred to, so as to ensure current regulations and best practice are met.

British and European Standards

BS 5489-1:2013 Code of Practice for the Design of Road Lighting, Part 1: Lighting of Roads and Public Amenity Areas.

BSEN 13201-2:2003 – Road Lighting - Part 2: Performance Requirements (where not superceded by BS 5489 above).

BSEN 12464-2:2014. Lighting of Workplaces – Part 2: Outdoor Work Places.

Government

Clean Neighbourhoods and Environment Act 2005, (Section 102).

DEFRA: Guidance on Sections 101 to 103 of the Clean Neighbourhoods and Environment Act 2005.

Wildlife & Countryside Act 1981.

Conservation (Natural Habitats etc.) Regulations 1994.

Department for Transport: Manual for Streets 2007.

Institution of Lighting Professionals (formally Institution of Lighting Engineers)

GN01:2011. Guidance Notes for the Reduction of Obtrusive Light.

PLG02:2013. The Application of Conflict Areas on the Highway.

PLG03:2012. Lighting for Subsidiary Roads.

PLG04:2013. Guidance on Undertaking Environmental Lighting Impact Assessments.

TR12:2007. Lighting of Pedestrian Crossings.

TR25:2002. Lighting for Traffic Calming Features.

Local Authority (Nottinghamshire)

6Cs Design Guide (http://resources.leicestershire.gov.uk/environment-and-planning/planning/the-6cs-design-guide).

Street Lighting - Series 1300.

CIE - International Commission on Illumination

CIE Publication 001-1980. Guidlines for minimising Urban Sky Glow near Astronomical Observatories.

CIE Publication 126-1997. Guidelines for minimizing skyglow.

The effects of improper lighting on professional astronomical observations. Dr. Ferdinando Patat, 2010.

Other

International Dark-Sky Association. http://www.darksky.org

Bat Conservations Trust. http://www.bats.org.uk/pages/bats_and_lighting.html

General Limitations and Constraints

Lighting within the proposed development should conform to the Institute of Lighting Professionals' Guidance on Reduction of Light Pollution. Table A adjacent summarises the recommended limitations for specific photometric criteria depending on the relevant environmental zone classification. As noted in the baseline lighting survey report, it is our opinion that lighting within the application site should comply with the limits associated with environmental zone E2 as a minimum due to the close proximity to the Sherwood Astronomical Observatory.

The topography of the site is such that direct views of lighting equipment should not be seen from the observatory location, thus in our opinion, the prime consideration in terms of limiting any negative impact due to lighting on the observatory is the minimisation of any direct upward light.

The more stringent values of E1 should be strived for within the east / southeast section of the development, close to the observatory.

Locations close to the border of the proposed development to the existing housing (e.g. Searby Road) can be considered E2, with the areas of the development to the south requiring E2 targets as well, where the development softens the transition into the countryside.

Identified Areas for Consideration Against Obtrusive Light

In addition to the above general site requirements, a number of specific areas have been identified where further restrictions on obtrusive light should be applied.

• Eastern boundary with agricultural land (of particular importance due to the presence of the observatory further east / southeast).

• Southern boundary with agricultural land (of particular importance due to the presence of the observatory further east / southeast).

• Boundaries with existing residential developments.

Table A. Environmental Zones & Obtrusive Light Limitations for Exterior Lighting Installations
As defined within the ILP Guidance on Reduction of Light Pollution Tables 1 & 2

Zone	Surrounding	Lighting Environment	Examples	Sky Glow ULR [Max %]	Light Intrusion (into Windows) E_v [lux]		Luminaire Intensity I [Candelas]		Building Luminance Pre-Curfew Average L [cd/m²]
					Pre - Curfew	Post-Curfew	Pre Curfew	Post Curfew	
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks	0	0	0	0	0	0
E1	Natural	Intrinsically Dark	National Parks, Areas of Outstanding Natural Beauty etc.	0	2	0 / 1*	2,500	0	0
E2	Rural	Low district brightness	Village or relatively dark outer suburban locations	2.5	5	1	7,500	500	5
E3	Suburban	Medium district brightness	Small town centres or suburban locations	5	10	2	10,000	1,000	10
E4	Urban	High district brightness	Town/city centres with high levels of nighttime activity	15	25	5	25,000	2,500	25

ULR = Upward Light Ratio of the Installation. The maximum permitted percentage of luminaire flux (lumens) that goes directly into the sky
E_v = Vertical illuminance in Lux, measured flat on the glazing at the centre of the window
I = Light Intensity in Candelas
L = Luminance in Candelas per Square Metre
Further explanatory notes can be found within the ILP Guidance on Reduction of Light Pollution.

LIGHTING ZONES

The primary source of external lighting from the development is expected to be that emitted from fixed lighting installations associated with roadways and pathways. Carefully considered lighting design and implementation within these areas will be a key factor in minimising any obtrusive light from the development.

The lighting strategy on the following pages of this report uses the following distinctions with regard to roadway lighting:

- Main Street
- Secondary Road
- Street/Lanes
- Pedestrian/Cycle Links
- Public Right of Way Routes

In addition to the above, there will also be a requirement for lighting to the following private spaces:

- Residential Lanes/Private Drives
- Private Courtyards, Parking
- Private Dwellings and Gardens

Site Plan

Roadway Lighting

- Street lighting is expected to be provided to the majority of roadways within the development.
- The determination of whether a street or area is to be illuminated, and if so, to which class and illumination level, will be based upon a risk assessment for the street. The risk assessment will consider the following:
  - Amount and speed of vehicle traffic
  - Segregation / interaction with pedestrians
  - Complexity of visual field and navigation
  - Hazards, such as parked cars or traffic calming
  - Relationship with surrounding illuminated areas
  - Crime risk and perception of safety
- Initial expectations for road lighting classes and treatments can be found within Table B (next page). Further development of the lighting requirements will be undertaken at future stages of the design process.
- It is expected that the majority of luminaires throughout the development will utilise LED technology.
- LED technology should allow for luminaires to have fully cut-off optics, meaning no direct upward light is emitted from the luminaire. This should be a requirement for all the equipment used when designing the lighting scheme for the proposed development.
- LED luminaires offer higher colour rendering than legacy sodium / mercury based light sources. As such, it is proposed that the development aims for the lower lighting level requirements of each class of road. However, as LED fixtures do deteriorate over time, a proper safety factor needs to be allowed for in calculations, to factor for the lumen depreciation of the fixtures. **dpa** would suggest this to be in the region of 0.60 (exterior area, average pollution, 3-year cleaning cycle).
- Column heights for street lighting are expected to be related to the height of the surrounding properties, ideally being no higher than the eaves of the predominant property type within the street. Mounting heights between 4 and 6 metres are expected within the majority of illuminated streets. Higher columns are expected on main streets, with the lower height columns being used in the lanes close to the south / east boundaries of the development. Pedestrian links will feature either very low columns, or low level lighting (i.e. illuminated bollards) where appropriate.
- The use of cool white (>3000K) colour temperature LEDs in street lighting (especially if not properly shielded) is the cause of major disruptions in astronomical observations in the following ways:

  a) The cool white LED blue dominant spectrum invades the darkest portion of the natural night sky spectrum (see Figure A).

  b) The wide spectrum light emitted by LED light sources contaminates astronomical observations on a wide spectral range. This was not an issue with legacy sodium and mercury based lighting systems as their spectral distribution was very limited and could be excluded with appropriate filtering etc.
- LED lamps have been associated with a very cool and 'harsh' quality of white light. This has historically been based on the higher efficacies achieved with LED and cooler colour temperatures. However, cool white (>3000K) colour temperature greatly affect astronomical observations as explained in the points above. As such, it is proposed that 3000K (or reasonably close) colour temperature light sources are utilised throughout the development. The increasing efficacy of modern LEDs and the reduction in variation between the cooler and warmer efficacies mean that warmer colour temperatures can now be fully considered from an efficiency standpoint.
- The colour temperature of the light source has a significant perception on the nature of a space at night. Equally the colour temperature and spectrum of light sources has been shown to have impacts on surrounding flora and fauna.
- The proposed warm white colour temperature (3000K) is contrary to established suggestions of the Bat Conservation Trusts' interim guidance issued following the 2014 European Symposium which require cool white colour temperatures >4200K.
- However, appropriate shielding of the fixtures used in conjunction with the provision of an appropriately deep buffer zone around the development that will be characterised by darkness (E0/E1 category), should mitigate the impact of the development on the local bat populations.

Lighting Control

- Luminaires to roadways will be provided with integral drivers, to be compatible with the local authority's street lighting system. The exact control regime for each street will be subject to detailed designs and risk assesments.

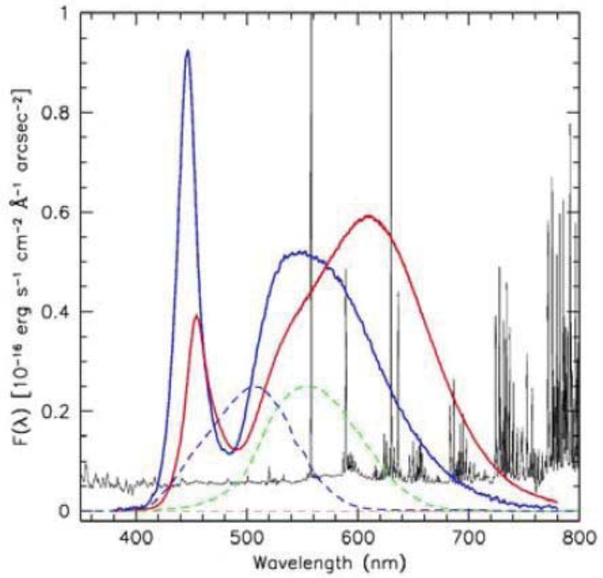


Figure A: The natural night sky in the region of 350-800 nm. The dashed curves trace the photopic (green) and scotopic (blue) passbands. The red and blue solid curves trace the V(L)-weighted relative flux spectra of a white-warm (CCT=3000K; red), and a blue-white (CCT>5000K; blue) LED.

It is obvious that cool white LEDs intrude into the lower wavelengths substantially more than warm white LEDs.

Lighting to Public Spaces

- At this stage of the application process, the exact nature of any public spaces within the application area has not been established. If lighting is required to these spaces beyond the hours of daylight, then it is recommended that they are lit with lighting installations which comply with the appropriate requirements of the E2 classifications of the ILP Guidance Notes as a minimum.

- Sports lighting would require control such that it is only illuminated when required for activities and would be subject to an appropriate curfew. It is expected that LED floodlights would be utilised to illuminate any pitches. Mounting heights and orientations would be determined based on the illumination levels required, which are in turn subject to the level of activity occurring. Careful aiming would reduce potentially obtrusive light from falling outside of the field in which the pitches are located. Mechanical glare reduction arrays (i.e. baffles, shields) would be applied to luminaires as applicable, to further reduce their impact. All luminaires should be full 'cut-off' types with no direct upward light emission.

Domestic Lighting

- Domestic lighting, notably garden amenity 'floodlights' are often cited in instances of obtrusive lighting. This is often from 'floodlights' mounted on to buildings and operated via PIRs (presence detection equipment) with incorrect sensitivity (resulting in false or incorrect triggers), incorrect orientation of the luminaire (such that it illuminates outside of the target area) or inappropriate output or photometric properties.

- This is particularly applicable to external lighting such as 'porch lighting' or amenity lighting around locations where lighting levels from street lighting are at a minimum or no dedicated street lighting has been provided. Consideration will, therefore, need to be given to any external lighting installed by the developer to ensure that it only illuminates the target/immediate area when triggered and is linked to PIR/Photocell circuits such that it is only illuminated when required.

- Lighting installations under home owner control, fall within the scope of The Clean Neighbourhoods and Environment Act 2005, (Section 102), however, inclusion of appropriate and environmentally sensitive external lighting at the time of the construction of dwellings, reduces the likelihood of poor quality owner supplied alternative installations post occupancy.

Table B. Target Illumination Levels and Strategy Notes

Road / Area Type	Users	Expected Vehicle Speed	Traffic Flow	Road Lighting Class based on E1 / E2 Environmental Zone	Expected Lighting Treatment
Adopted / Public Spaces					
Main Street	Vehicles Pedestrians (Segregated) Parked Vehicles, in dedicated spaces.	≤ 30 mph	Normal	S4 / S3	Illumination from LED streetlights mounted on 6 metre column heights.
Secondary Road	Vehicles Pedestrians (Segregated) Parked Vehicles, in dedicated spaces.	≤ 30 mph	Quiet	S5 / S4	Illumination from LED streetlights mounted on 4-5 metre column heights.
Streets / Lanes		≤ 30 mph	Quiet		
Pedestrian / Cycle Links	Bicycles Pedestrians	≤ 30 mph	Normal	S6 / S7	Illumination from LED streetlights. Column heights equivalent to surrounding lighting conditions.
District Centre	Vehicles Pedestrians Parked Vehicles, in dedicated spaces.	≤ 20 mph	Normal	Roads according to CE classes Parking 10 lux Average Open Arcades (if applicable) 50 lux min	Illumination from LED streetlights mounted on 4-6 metre column heights.
Private Spaces					
Residential Lanes / Private Drives	Vehicle Pedestrians	≤ 10 mph	Quiet	P6, Unclassified or Unlit.	Low level bollard lighting where illumination is required.
Private Courtyards	Vehicle Pedestrians	≤ 10 mph	Quiet		Local illumination at key entrance and exits to the space. Bollards, wall mounted bulkheads or ceiling mounted downlights expected.
Business Area	Vehicle Pedestrians	≤ 10 mph	Normal / Quiet	5 - 10 Lux average based on size of office complexes	Illumination from LED streetlights mounted on 4-6 metre column heights.
School		≤ 10 mph	Busy to Quiet	Variable. Refer to	Lighting is expected from a range of treatments from column mounted luminaires, bollards and wall or ceiling mounted fixtures.
Playing Fields (if applicable)	Recreation	N/A	N/A	Subject to level of activity	Column mounted floodlights at appropriate mounting heights for area being illuminated.
Community Use Buildings	Vehicle Pedestrians	≤ 10 mph	Quiet	5 lux average for car parks	Column mounted luminaires to any car park area, with wall mounted luminaires to perimeter of buildings, where required to illuminate access routes around buildings.

The values illustrated in the table above are based on the standards BS EN 13201-2:2003, Road lighting — Part 2: Performance requirements and BS 5489-1:2003 Code of practice for the design of road lighting — Part 1: Lighting of roads and public amenity areas

GENERIC LIGHTING TREATMENT - ROADWAYS

Table C. illustrates the target illuminance values for the types of roads within the development.

Please note that these are indicative and that the lighting to the individual areas within the development should be fine tuned, to take into account local conditions and always in the context of the surroundings.

This is especially the case for the section of the development that will be in closer proximity to the Sherwood Observatory site, along the east / southeast boundary of the development.

Table C. Target Light Levels in relation to Road Lighting Class.

The following are the lighting levels associated with the lighting classes determined previously.

Area	Lighting Class		
	Class	Average, Maintained Illuminance (Lux)	Minimum Illuminance (Lux)
Main Streets	S3	7.5	1.5
Secondary Road	S4	5	1
Streets	S5	3	0.6
Pedestrian / Cycle Link	S6	3	0.6

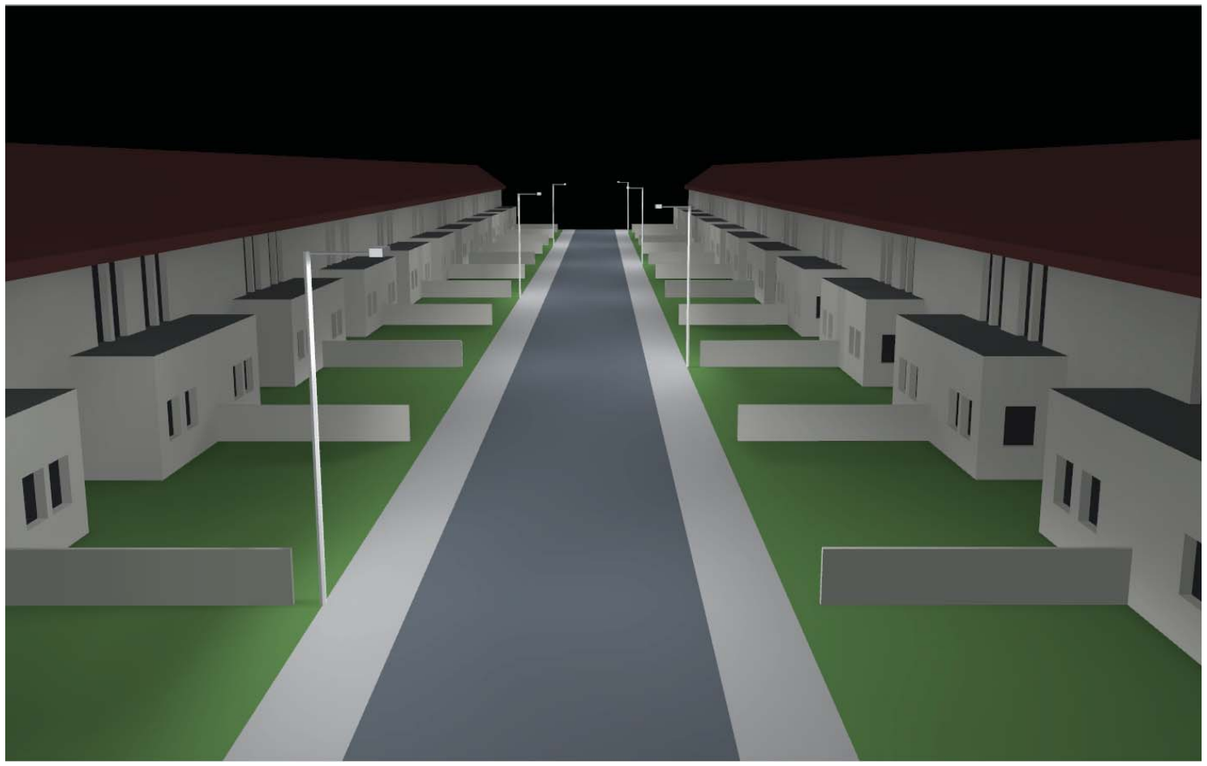
The values illustrated in the table above are based on the standards BS EN 13201-2:2003, Road lighting — Part 2: Performance requirements and BS 5489-1:2003 Code of practice for the design of road lighting — Part 1: Lighting of roads and public amenity areas

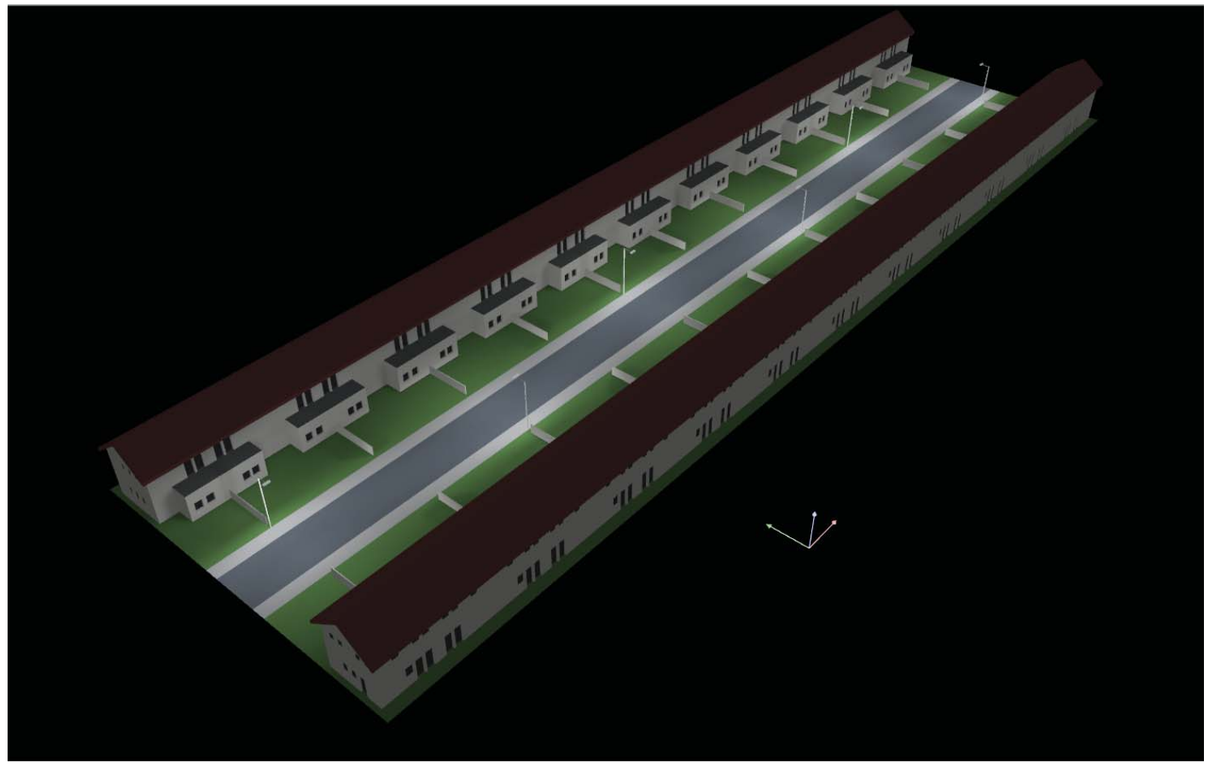
Indicative type of column mounted LED luminaire. Street lighting of this type demonstrates very good glare control and should be the target specification for the development.

Good example of LED street lighting. The lighting equipment utilised is targeted, relatively glare free and limits the amount of light that escapes behind the fixture.

Image showing excessive light spill from a column mounted luminaire – careful luminaire selection and positioning should be used to avoid light trespass such as this.

INDICATIVE LIGHTING LAYOUTS





The two images shown above illustrate a typical staggered arrangement on a Main Street.

The fixture used is the Factor Small family from Holophane, with asymmetric optics and circa 7,500 lumens light output.

Mounting height in this instance is 6 metres, with a 24 metre spacing (between light points, i.e. 48m between columns in the staggered arrangement).

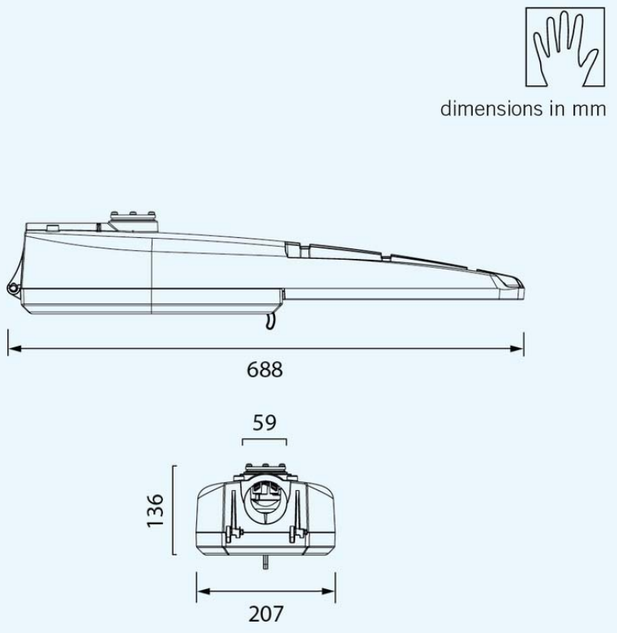
The arrangement above is based on a typical residential layout and would need to be adjusted to suit the final layout[s] of the main streets within the development site.

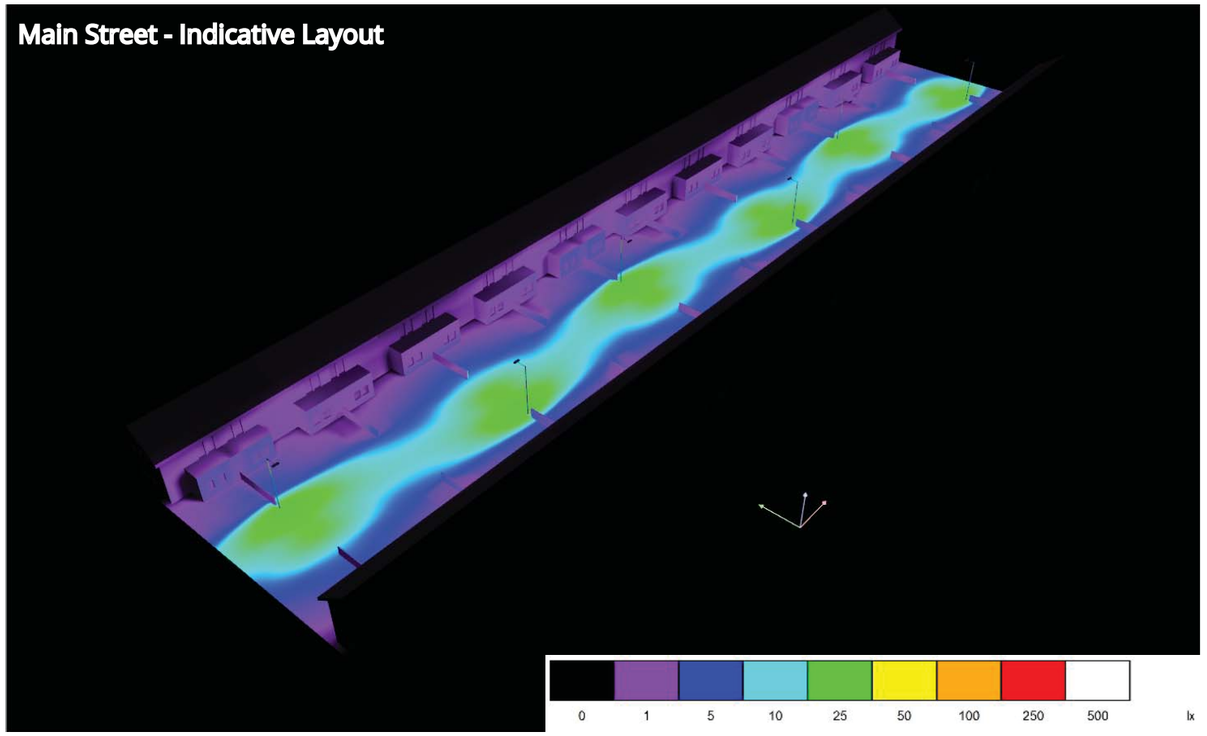
Factor Small post top mounted luminaire by Holophane.

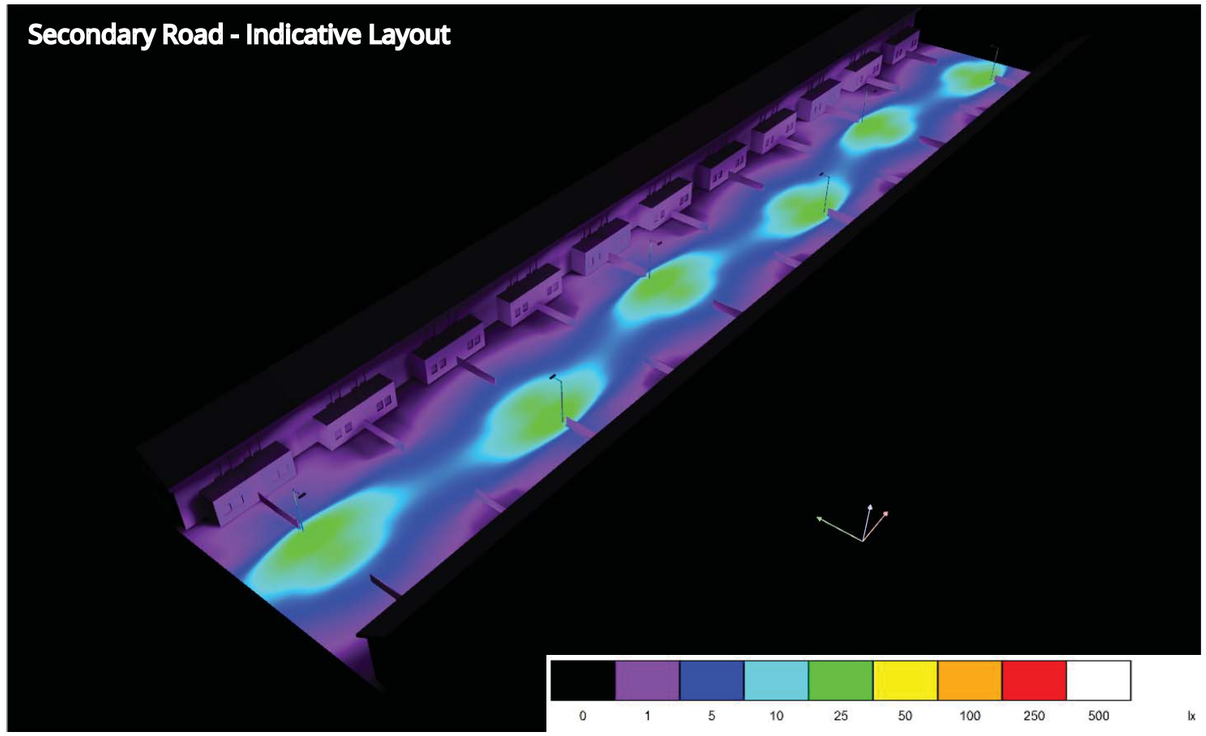
Indicative luminaire, providing a wide range of light outputs ranging from 2,000lm to 12,000lm with efficiencies of up to 136lpw (Lumens Per Watts).

IP65 rated, side entry fixture with tool-less access to gear tray.

The fixture demonstrates good glare control, 0% ULR (upwards lighting ratio) and is suitable for residential developments.







The three Dialux calculation extracts illustrate the lighting conditions for each of the roadway cases.

Main Streets

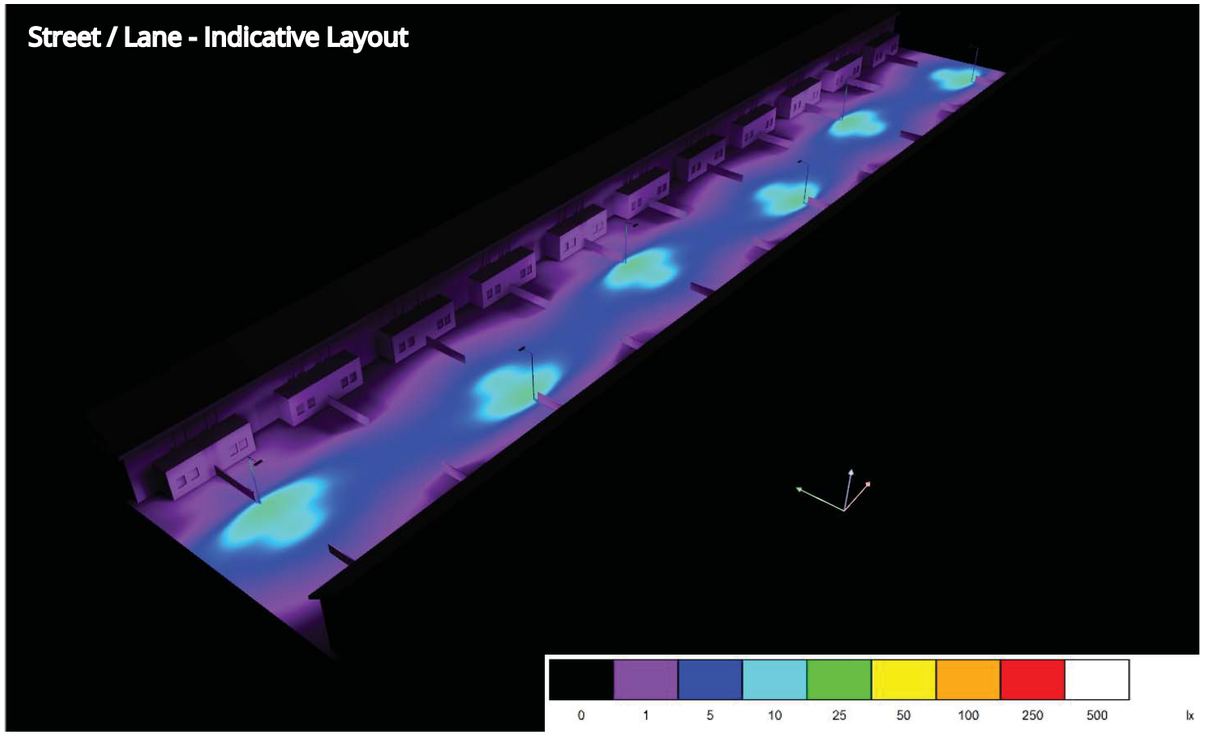
Luminaire used: Holophane FTS.LA074, 52W load, 7,500lm output.
Arrangement: 24 metre spacing (staggered arrangement), 6 metre tall columns.
Average Illuminance: 14 lux (ground level)
Uniformity: 0.53

Secondary Road

Luminaire used: Holophane FTS.LA054, 35W load, 4,500lm output.
Arrangement: 24 metre spacing (staggered arrangement), 5 metre tall columns.
Average Illuminance: 11 lux (ground level)
Uniformity: 0.45

Streets / Lanes

Luminaire used: Holophane FTS.LA054, 23W load, 2,800lm output.
Arrangement: 24 metre spacing (staggered arrangement), 5 metre tall columns.
Average Illuminance: 7 lux (ground level)
Uniformity: 0.45



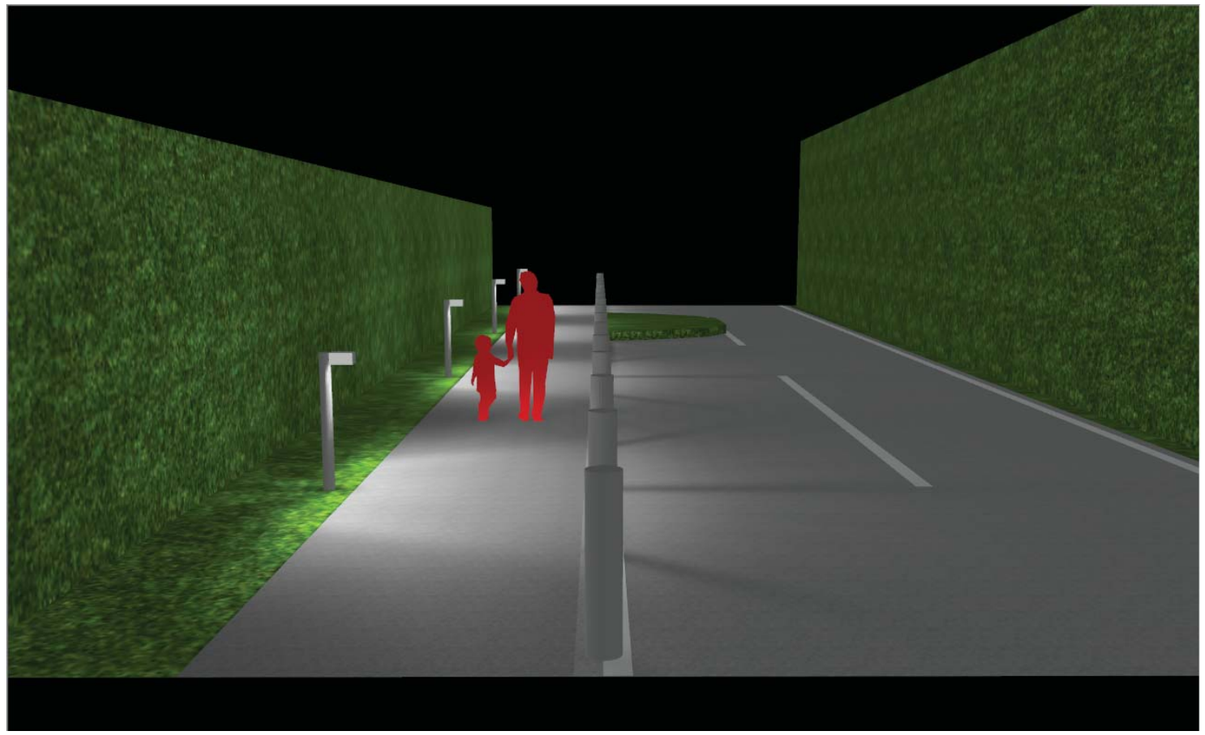
INDICATIVE LIGHTING LAYOUTS

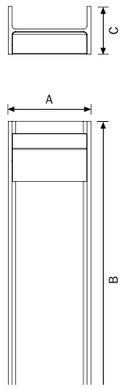
The Dialux calculation extracts shown on this page illustrate a typical lighting scenario for pedestrian / cycle links.
Instead of pole top fixtures, this utilises low level lighting in the form of bollards, spaced approximately 8 metres apart.

Luminaire used: DW Windsor LAG010, Lago LED Bollard 8W load, 225lm output.

Arrangement: 8 metre spacing.

Average Illuminance: 7 lux (ground level)
Uniformity: 0.2



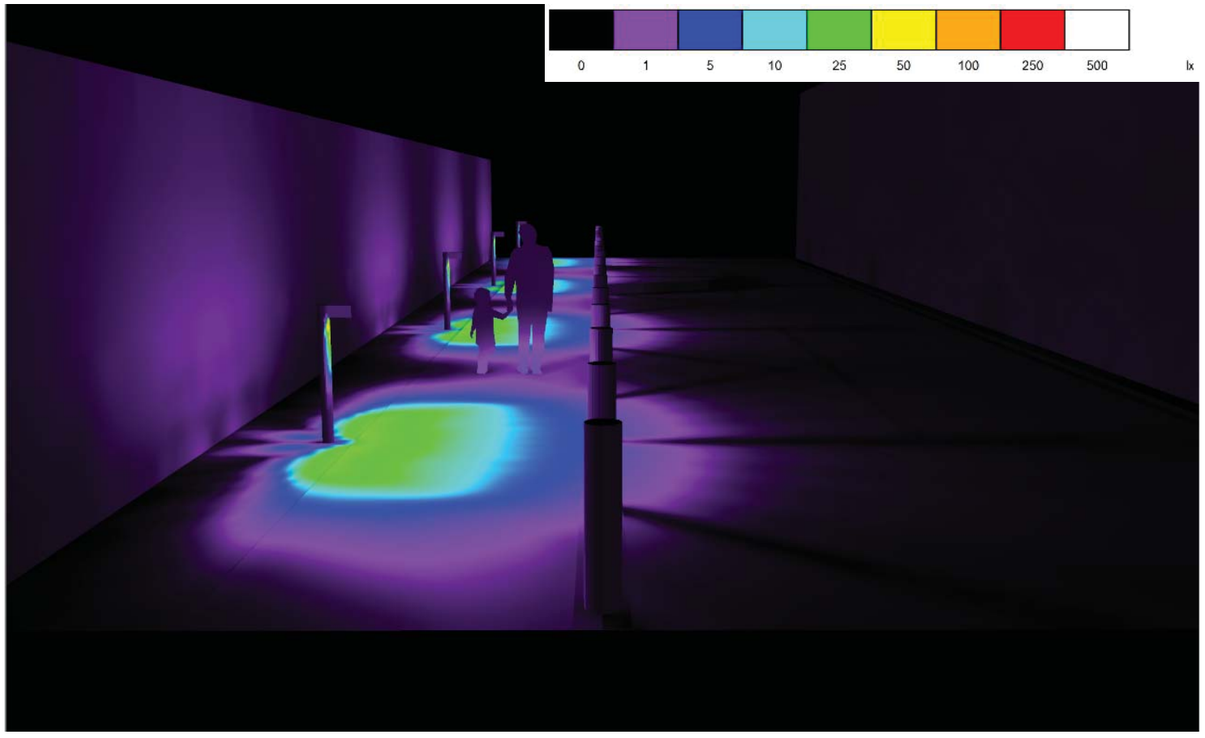


Dimensions mm			Weight kg
A	B	C	
260	1000	150	35
260	2200	150	75

Typical low glare bollard by DW Windsor.

Typical applications for pedestrian areas call for 10W load, 250lm output approximately.

The light source is very well shielded and is suitable for instances where low glare is required.



CONCLUSION

It is acknowledged that the introduction of a lit development onto previously unlit land cannot be undertaken without having an impact on the surrounding environment.
This report, however, outlines the following means by which any adverse impacts to the neighbouring Sherwood Observatory can be mitigated against.

Selective Lighting

Lighting to the development site should be limited to those areas which require illumination so as to provide safe access throughout the site. Illumination levels provided should correspond to the recognised standards so as to ensure illumination levels are appropriate for the context and so as to avoid excessive illumination levels.

Lighting Hierarchy

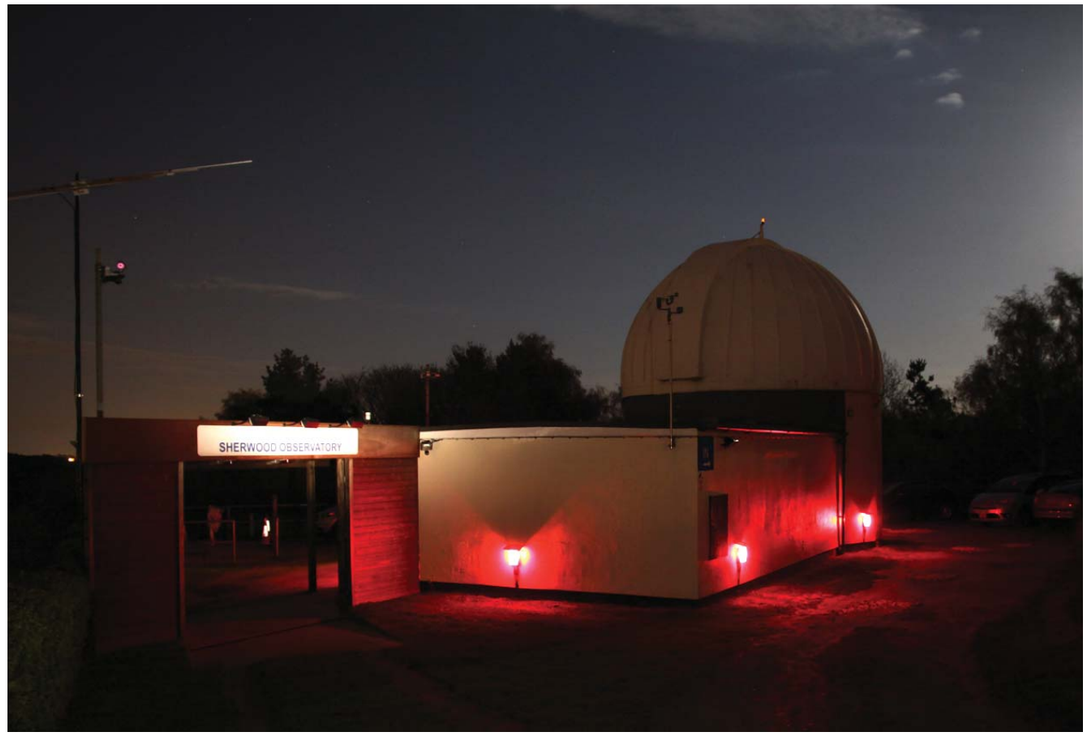
A hierarchy of lighting levels should be used within the development site that reflects recognised standards and guidelines for the relevant application. This report outlines typical lighting arrangements and luminaires which we feel are appropriate for various applications such as Main Streets, Secondary Streets, Lanes and Pathways etc.

Lighting Equipment

Luminaires used within the development should generally be of good quality with full cut-off optics wherever possible so as to limit direct upward light emission and thus ensure the total Upward Light Ratio of the installations within the development falls within the recommendations of the ILP Guidance Notes for the Reduction of Obtrusive light for zone E2 as a minimum. Furthermore, luminaires employed shall be carefully selected in terms of photometric properties so as to ensure appropriate illumination levels result with the minimisation of any spill light to areas outside the relevant task area.

3000K warm white colour temperature (or reasonably close to 3000K) LED light sources are preferable. Light sources with cooler colour temperatures above this value can affect the quality of astronomical observations by interfering with blue spectrum light, as such it is recommended that these should be avoided.

It is our opinion that if the outline lighting strategies and associated mitigating measures in this report are included by the developer as part of the detailed lighting design for the application site any negative impacts to the Sherwood Observatory will be reduced to an acceptable level.



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