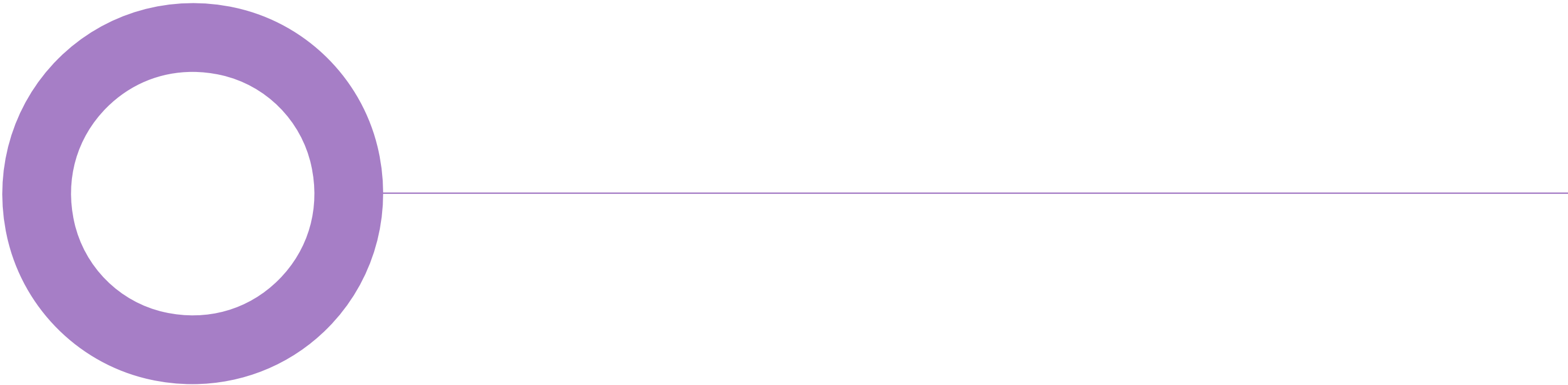


6.4 Lighting Parameter Plan (Hoare Lea)

Manor Farm - Parcel A.
Colnbrook, Slough.
Quod.

LIGHTING DESIGN
LIGHTING PARAMETER PLAN.
NOVEMBER 2024

REVISION P2



Audit sheet.

Rev	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
P0	24-08-26	First Draft for Review	KG	SK	RM
P1	24-10-25	Draft for DAS Input	KG	SK	RM
P2	24-11-19	Final Issue	KG	DK	RM

This document has been prepared for Quod from our Appointment only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

Introduction.

This document covers the proposed lighting approach for the external areas of the development at Manor Farm.

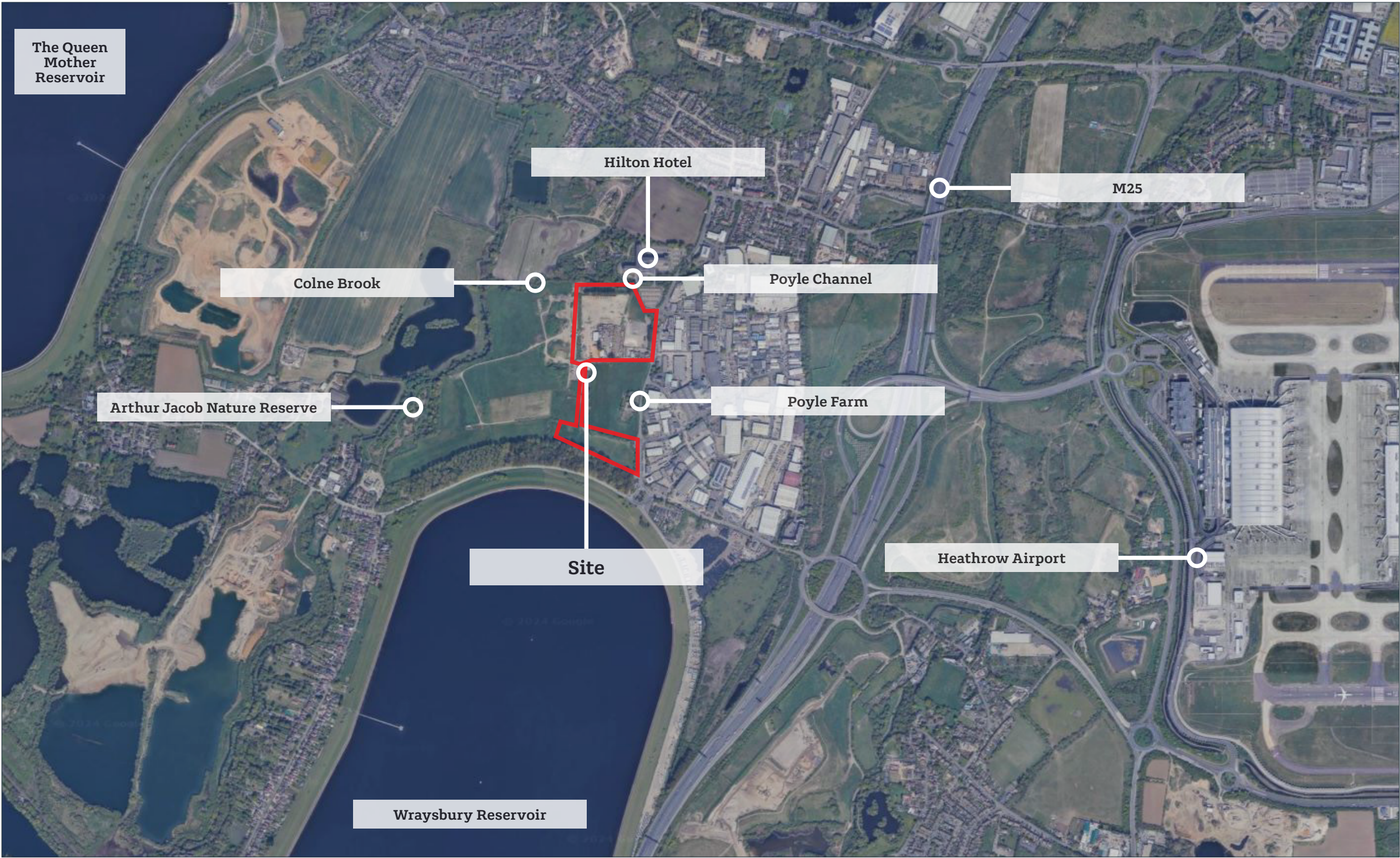
We have undertaken specialist lighting design analysis and produced scheme proposals taking the local context, Client needs, aviation requirements, and ecology concerns into consideration. While external lighting design can often be seen as purely functional, for the purpose of getting people in and out of a site after daylight hours, it should also enhance and create an atmosphere that is unique and appealing in the night time environment.

Lighting treatments to the site should both allow for safe navigation, whether by car, bicycle, or foot, but also promote safety and security of the site's physical assets and personnel.

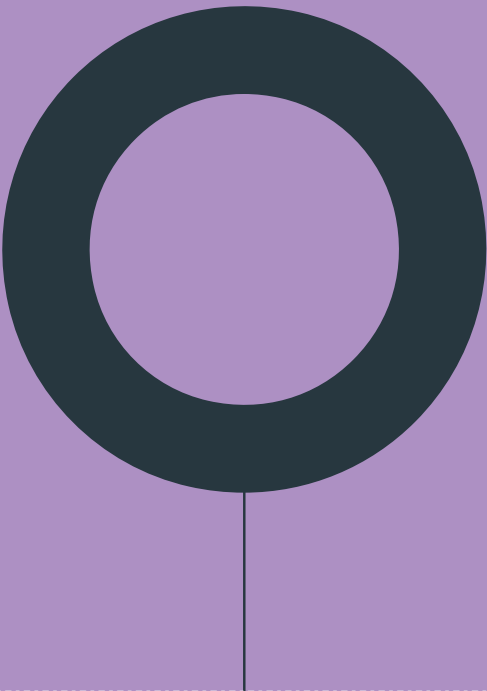
The lighting will be positioned and dimmed to levels that are sympathetic to the ecology, neighbouring buildings and users of the site, whilst respecting Client standards for this type of development.



Site Geography.



Design Guidance.



Design Considerations - Guidelines and Criteria.

External Lighting.

There are several documents outlining the best practice and guidance on providing sufficient and appropriate lighting for vehicular thoroughfares, pedestrians passage and visual interest.

These are:

- BS EN 12464-2:2014: Lighting of Work places - Outdoor work places
- BS 5489-1:2020: Design of road lighting
- BS EN 13201-2:2015: Road lighting - Performance requirements
- CIE 136:2000: Guide to the lighting of urban areas

And, as appropriate:

- CIBSE Lighting Guide 6: The Exterior Environment 2016
- CIBSE Lighting the Environment: A guide to good urban design

Light Pollution.

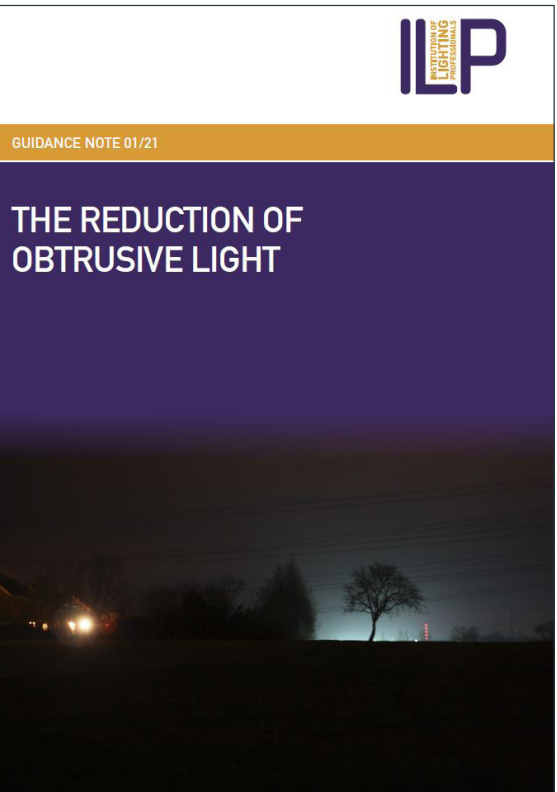
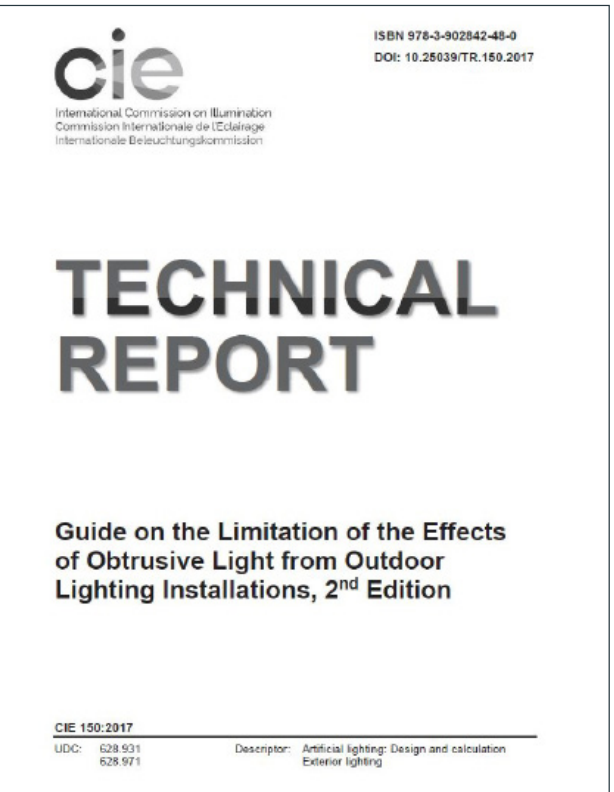
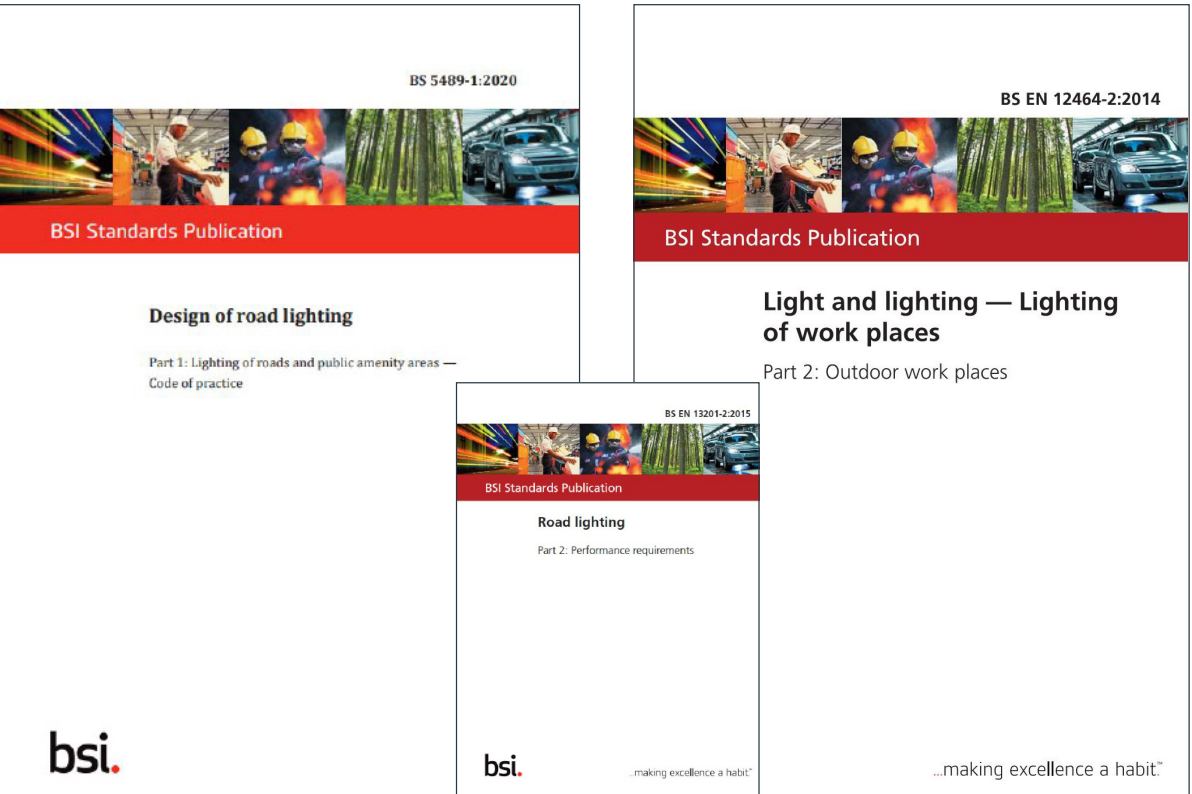
Similarly, there is an array of documents that outline best practice and guidance on reducing the visual and environmental impact of external lighting in relation to light pollution.

These are:

- CIE Technical Report - CIE 150: 2017
- ILP Guidance Notes for the Reduction of Obtrusive Light 2021 (GN01/21)
- Bat Conservation Trust (BCT)
- Institution of Lighting Professionals (ILP) Guidance Note 08/2023 “Bats and artificial lighting in the UK” ILP, Rugby

The implementation of these standards is vital because of “The Clean Neighbourhoods and Environmental Act, 2005” which makes light a statutory nuisance.

It should be noted that, based on the current ecological conditions of the site and the proposed changes to the site, any lighting proposed to the site shall be considerate of any wildlife or potential new wildlife by ensuring that where possible light is directed into the site and any luminaires that are in close proximity to wildlife have good optical control and/or back spill shielding to minimize the impact on these areas.



Lighting Design Considerations.

Safety and Orientation.

The amount of lighting required for obstacle avoidance and visual orientation is minimal. For example, emergency lighting standards suggest a value of between 0.5 and 1 lux for a person, in a high stress situation, to safely negotiate a safe passage. Often these low levels of illumination are provided by existing light spill and moonlight alone.

In reality, the purpose of urban realm pedestrian lighting is not one of obstacle avoidance, but of human subjectivity. Research has shown that the ability to read a persons facial features in external realm environments is a key function in reducing “fear of crime”.

Appropriately illuminated pedestrian areas can reduce feelings of discomfort or alienation, which is known to encourage footfall – this in turn can increase natural and community surveillance and further deter criminal acts.

A pleasing and visually interesting exterior environment can be further enhanced by creating spaces and zones of interaction which encourage utilisation of spaces in the evening.

Light Pollution.

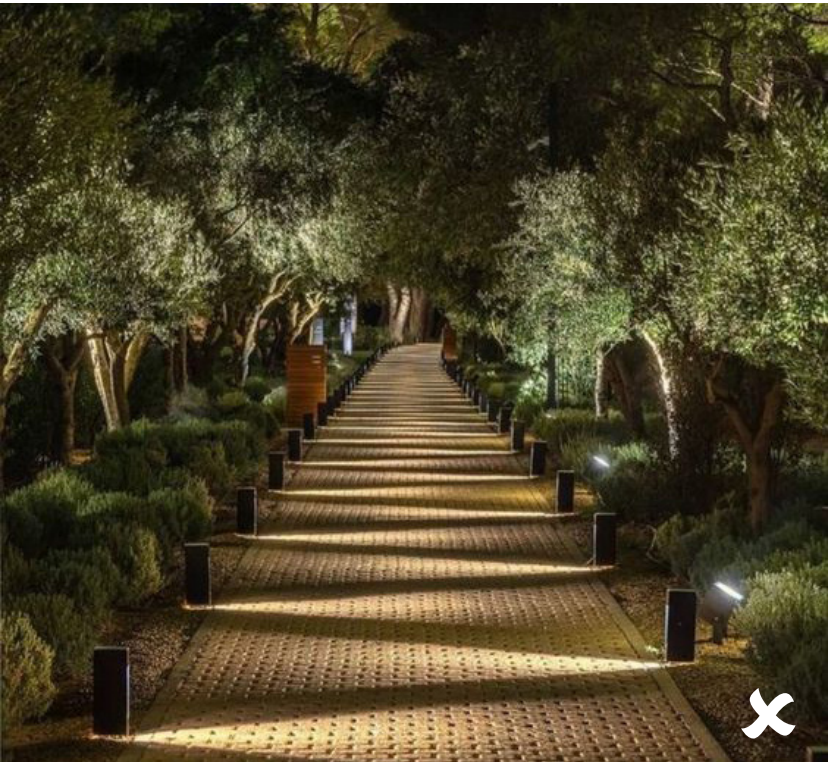
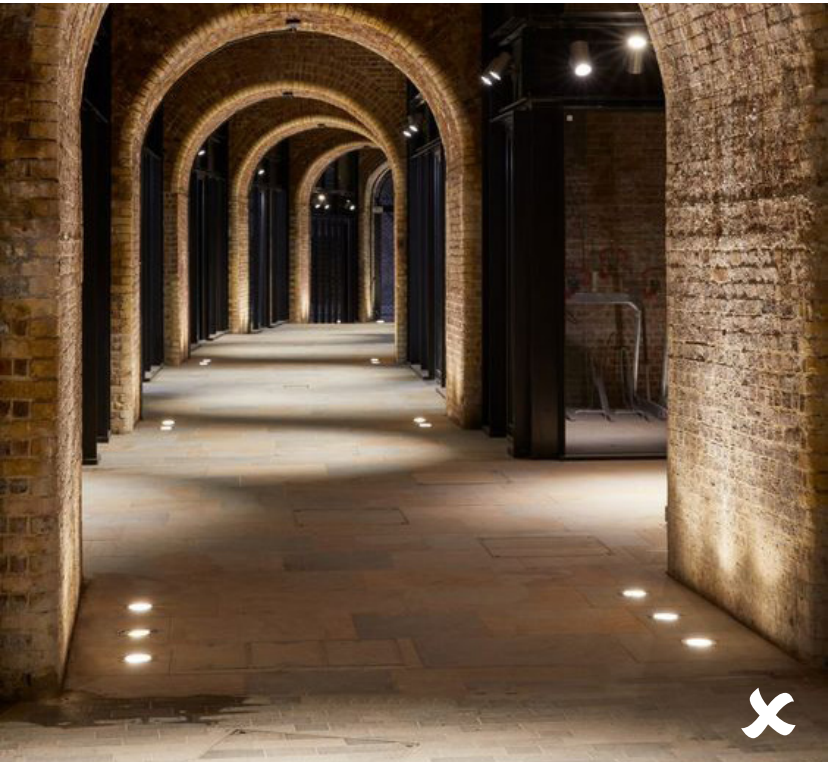
Light pollution this overarching topic can be broken down into three key parts:

Light intrusion (or nuisance): Lighting emitted into the boundary of residential properties typically assessed at bedroom or habitable windows.

Sky Glow: Where lighting shines directly upwards or is reflected upwards it can create “sky glow” which is typically seen above towns and cities. It washes out views of the dark night sky, taking away an important natural resource.

Glare (luminous source intensity): this can occur when a person sees light directly from the fixture (or light source) and contrast ratios are high. There is legislation as part of the ‘Clean Neighbourhoods and Environment Act 2005’ which covers lighting as a nuisance, although there are exclusions, it does start to highlight the importance of well-designed external lighting as an integral part of the modern urban landscape. The Institution of Lighting Professionals (ILP) Guidance note GN01/21 “The reduction of obtrusive light” assists with quantifiable metrics for the above topics.

Whilst the legislation above only deals with potential human impacts, other legislation is in place to protect the natural environment. As such where appropriate consideration needs to be paid to sensitive ecological features, such as hedgerows, treelines and waterways, the advice of an ecologist can provide guidance on suitable light levels.

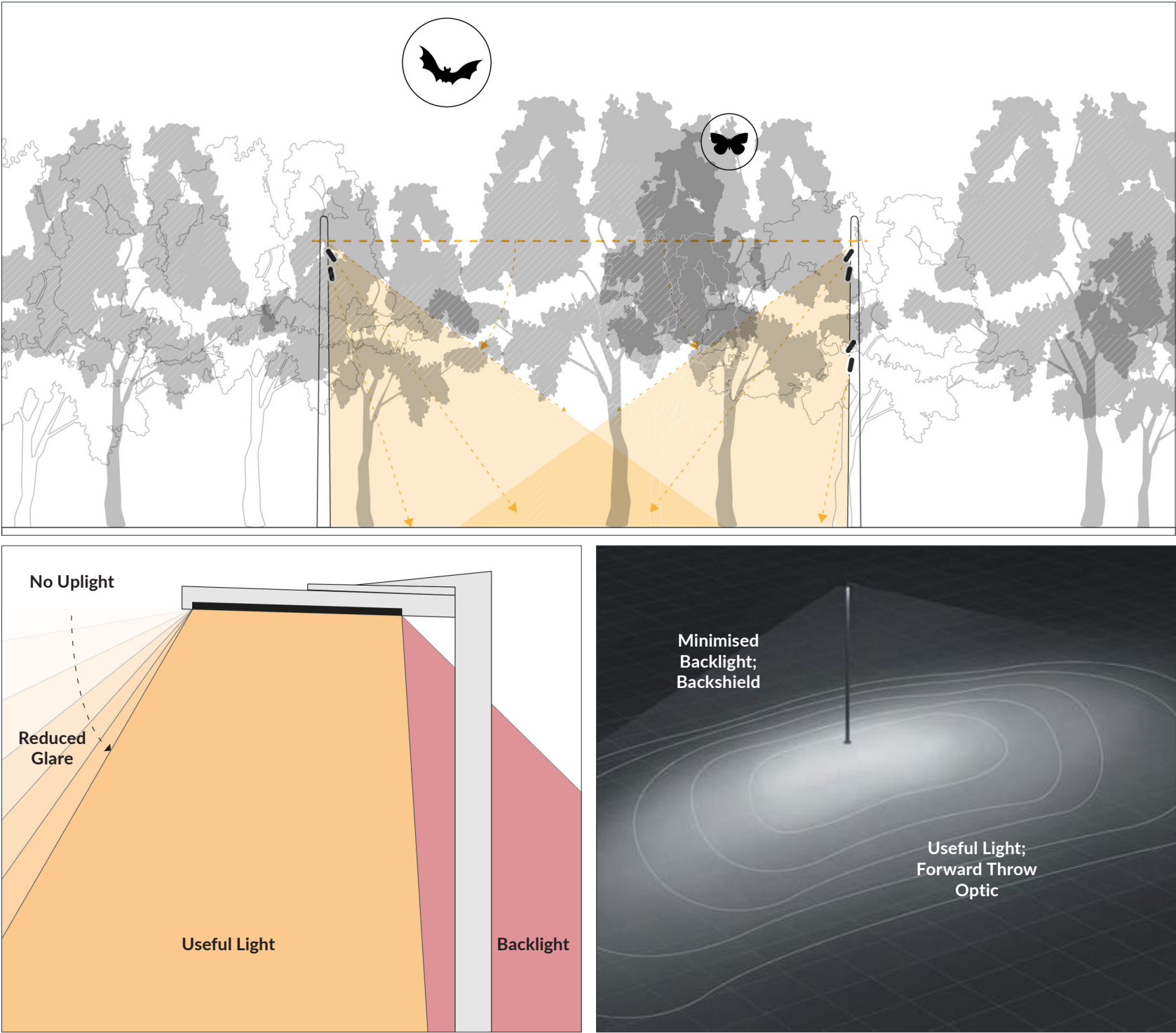


Lighting Design Considerations.

Ecology

Further to the guidelines and good practice, the site has its own specific ecology concerns which were discussed with the specialist consultant. Key items of note are as follows:

- A balance must be struck between the security needs of the site and the ecology and biodiversity that must be maintained. During the final specification stage, vertical illumination measurements should be taken at the site boundary, protected tree line, and within the developed hardscape; this will need to be compared to the threshold for facial recognition required by CCTV equipment.
- The existing northern protected tree line has the greatest opportunity for various species to thrive. Light spill onto the tree line is to be kept to an absolute minimum to not disturb existing migration or foraging patterns.
- The lighting strategy shall allow for the brightest areas to be dimmed when not in use, particularly at the northwestern refuelling station and loading bay. Internal glare shield accessories will be also be specified to minimise any light spill onto the perimeter tree line.



Lighting Design Considerations.

Control and Colour.

The use of controls and colour is important in creating an external environment that is sympathetic both to the occupants of the site and also the surrounding neighbours.

Leaving the luminaires on at full output, without any control or dimming, throughout the duration of the evening is not only a waste of energy but also insensitive to the inhabitants. All path and roadway luminaires will be dimmable to allow the light output to be correctly tuned to the needs of the development, and adjusted to create a balanced lighting scheme.

Safety and orientation lighting should remain on through the course of the evening to enable good active and passive surveillance of the site. Task-specific lighting, such as to the loading bay and refuelling station, should be dimmed down after curfew hours and when not in use.

As this site will be accessed 24/7, luminaires should be chosen with a warmer, more 'amber' colour of light to be the least disruptive to human circadian rhythm. However, different species of plants and animals are variably responsive to different spectral bands of light, and an in-depth conversation with the ecologist should be undertaken to choose a colour range that is the least impact on the resident species.



Environmental zone.

While the Environmental zone for the project has yet to be determined from the baseline study, some guidance can be found in the ILP Guidance Note on the Reduction of Obtrusive Light.

From our Baseline study of the existing site, we can confirm that the site falls into the E4 category, surrounded by E2 and E3 zones. Therefore the following parameters should be adhered to, trying to minimise the impact the project to adhere to the parameters of an E3 zone:

Table 4.1 - Environmental Zones			
Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places.
E1	Natural	Dark (SQM 20 to 20.5+)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~ 15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations.
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations.
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity.

Table 4.2 - (CIE 150 table 2): Maximum values of vertical illuminance on properties.						
Light technical parameter	Application conditions	Environmental zone				
		E0	E1	E2	E3	E4
Illuminance in the vertical plane (Ev)	Pre-curfew	n/a	2 lux	5 lux	10 lux	25 lux
	Post-curfew	n/a	<0.1 lux*	1 lux	2 lux	5 lux
Note:* If the installation is for public (road) lighting then this may be up to 1 lux.						

Table 4.4 - (CIE 150 table 5): Maximum values of upward light ratio (ULR) of luminaires.					
Light technical parameter	Environmental zone				
	E0	E1	E2	E3	E4
Upward light ratio (ULR)/%	0	0	2.5	5	15
Note: This does not take into account the effect of light reflected upwards from ground that also contributes to sky glow. This is the traditional method to limit sky glow and is suitable to compare different single luminaires.					

Table 4.5- (CIE 150 table 6): Maximum values of upward flux ratio of installation (of four or more luminaires).						
Light technical parameter	Type of installation	Environmental zone				
		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	16	15
Notes: Table 4.5 allows the effect of both direct and reflected upward components of a whole installation to be taken into account.						
Clauses 6.4.2 and 6.4.3 of CIE 150:2017 describe the calculation methods for both ULR and UFR.						

Lighting Criteria - British Standards.

It is important that the lighting applications provide both an aesthetic quality and also the appropriate levels of illumination required for the environmental context.

The adjacent tables, extracted from BS5489-1:2020 and BS 13201-2:2015 give a guide to the target levels of illumination.

It is important to remember however that these are a guide and appropriate interpretation of the space and how these requirements align with its intended use should be taken into account.

The lighting requirements within the scope area fall into the following categories:

Primary vehicular movement
(site entrance)

7.5 lux average, 1 lux minimum

Secondary mixed movement
(internal roads + main pathways)

5 lux average, 0.6 lux minimum

Pedestrian movement
(secondary internal pathways)

3 lux average, 0.4 lux minimum

Additional requirements noted for facial recognition using CCTV surveillance.

Zebra Crossings/ Areas of Conflict

- 10 lux, 0.4 u0 minimum (conflict)

- 25 lux, 0.4 u0 minimum (crossing)

Where vehicles and pedestrians share the same space, areas of conflict can occur. As a P3 and CE5 class are equivalent (7.5lx 0.4 u0), we would recommend increasing the light level to a 10lx 0.4 U0 as one step increase in perceived brightness. This increased level would apply to the area just outside the loading dock ramphe parking bays and loading zones will be illuminated to required light levels as described on the next page.

Designated pedestrian crossings will be lit to ILP recommended levels; i.e. 3.5 times that of the designed average horizontal illuminance of the standard road lighting.

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 ≤ 30 mph	Speed limit v ≤ 30 mph
Busy ^{B)}	P5	P4	P3
Normal ^{C)}	P5	P5	P4
Quiet ^{D)}	P6	P5	P4

Table extracted from 'BS 5489-1:2020'

Note: Table A.5 assumes no parked vehicles; see risk assessment in A.3.3.2.

Table 3 - P lighting classes

Class	Horizontal illuminance		Additional requirement if facial recognition is necessary	
	E^a [minimum maintained]	E_{min} [maintained]	$E_{v,min}$ [maintained]	$E_{se,min}$ [maintained]
	lx	lx	lx	lx
P1	15.0	3.0	5.0	5.0
P2	10.0	2.0	3.0	2.0
P3	7.5	1.5	2.5	1.5
P4	5.0	1.0	1.5	1.0
P5	3.0	0.6	1.0	0.6
P6	2.0	0.4	0.6	0.2
P7	Performance not determined	Performance not determined		

To provide for uniformity, the actual value of maintained average illuminance shall not exceed 1,5 times the minimum E value indicated for the class.

Table extracted from 'BS 13201-2:2015'

Lighting Criteria - British Standards.

The adjacent tables, extracted from BS5489-1:2020 and BS12464-2:2014 give a guide to the target levels of illumination.

It is important to remember however that these are a guide and appropriate interpretation of the space and how these requirements align with its intended use should be taken into account.

The lighting requirements within the scope area fall into the following categories:

- Open Air Car Parking

- 10 lux average, 0.25 uniformity

The open air car parking spaces around the building perimeter will be illuminated as per the medium traffic zone requirements, with the car park lighting 'on' during evening hours while the buildings are in standard operating hours. The lighting will be dimmed to 50% (5lx) and activated by motion sensor only after curfew hours.
- Vehicle Loading and Unloading

- 20 lux, 0.25 uniformity

Note that the 20lx will only be implemented when the loading zone is in use by a delivery vehicle, and the area will otherwise be illuminated to standard pedestrian and road lighting levels of the adjacent area.
- Refueling Area

- 100 lux, 0.4 uniformity

Note that the 100lx will only be implemented when therefueling zone is in use, and the area will otherwise be illuminated to 25lx to clearly demarcate the area without causing unnecessary light pollution onto the northwestern boundary.

Table 4 - Maintained lighting levels for outdoor car parks

Type of area and useage	E	U _o
Light traffic, e.g. parking areas of shops, terraced and apartment houses; cycle parks	5	0.25
Medium traffic, e.g. parking areas of department stores, office buildings, plants, sports and multipurpose building complexes	10	0.25
Heavy traffic, e.g. parking areas of major shopping centres, major sports and multipurpose sports and building complexes	20	0.25

Table extracted from 'BS 5489-1:2020'

Table 5.7 - Industrial Sites and Storage Areas

Ref.no.	Type of area, task or activity	E _m lx	U _o -	R _{GL} -	R _a -	Specific requirements
5.7.1	Short-term handling of large units and raw materials, loading and unloading of solid bulk goods	20	0,25	55	20	
5.7.2	Continuous handling of large units and raw materials, loading and unloading of freight, lighting and descending locations for cranes, open loading platforms	50	0,40	50	20	
5.7.3	Reading of addresses, covered loading platforms, use of tools, orindary reinforcement and casting tasks in concrete plants	100	0,50	45	20	
5.7.4	Demanding electrical, machine, and piping installations, inspection	200	0,50	45	60	Use local lighting

Table extracted from 'BS 12464-2:2014'

Table 5.10 - Oil and other chemical industries

Ref.no.	Type of area, task or activity	E _m lx	U _o -	R _{GL} -	R _a -	Specific requirements
5.10.1	Handling of servicing tools, utilization of manually regulated valves, starting and stopping motors, lighting of burners	20	0.25	55	20	
5.10.2	Filling and emptying of container trucks and wagons with risk free substances, inspection of leakage, piping and packing	50	0.4	50	20	
5.10.3	Filling and emptying of container trucks and wagons with dangerous substances, replacements of pump packing, gen-eral service work, reading of instruments	100	0.4	45	40	
5.10.4	Fuel loading and unloading sites	100	0.4	45	20	
5.10.5	Repair of machines and electric devices	200	0.5	45	60	Use local lighting

Table extracted from 'BS 12464-2:2014'

Lighting Criteria - Client Requirements.

The Client has their own set of Lighting requirements, which was given to us by the Security Consultant for consideration. The Client brief recommends maintaining significantly higher light levels than is required by British Standards, and also recommends a minimum light level across the whole development. The tables at right compare the two, and make recommendations for what should be adhered to.

There is stipulation within the Client guidance that prescribed light levels should be considered in the context of energy savings and environmental context, and our recommendations reflect this in the table.

Note that the Western site boundary of the site sits nearby an E2 'dark' zone, which should be treated delicately with less than 0.5lx spill outside of boundary. Therefore, for example, the Client requirement for 10lx at the perimeter fence is insensitive to the ecology and environment and unnecessary for the function of the CCTV equipment. In discussions with the Security team, the minimum light level requirements at eye height (cylindrical illuminance) for camera recognition is 0.5lx.

We would encourage the lower light levels be adhered to in order to maintain a sensitive approach to the site's location and ecological sensitivity.

Emergency lighting will be in alignment with British Standards, covering final exits and routes, but does not form part of this report.

Area / Space	Illuminance Target Average (Lux)			Note
	Client Directive	BS / ILP Guidance	HLL	
Sitewide Security Lighting	1lx minimum	N/A	-	Security Lighting should focus on ther vertical, rather than horizontal plane, to esnure good facial illumination.
Exterior Walkways	30lx	3lx (P5) or 2lx (P6)	5lx / 3lx	*In the current plan, there is only one walkway that crosses into the secure boundary. This should be illuminated to a P4 class at most to be in keeping with the perimeter road.
Loading Docks	50lx (in use) 30lx (not in use)	20lx	20lx (in use) 10lx (not in use)	20lx is stipulated in part 5.7.1 of BSEN 12464-2: 50 is unnecessary for the frequency and type of loading required onsite.
Vehicular Entry Points	30lx	-	30lx	As there is no specific light level requirement for guard hosues within the standard, a 30lx average at the main site access and the guard house are appropriate for security purposes.
Car Parking	20lx	10lx	10lx	10lx is stipulated in part 5.9.2 of BESN 12464-2: 20lx would only be appropriate for a much larger complex with more consistent traffic.
Perimeter Fence	10lx	-	5lx max	In order to maintain a dark boundary around the site, we would recommend that light levels taper off at the fance to not disturb wildlife.

Design Considerations - Illumination Criteria.

Lighting requirements.

Taking into account the comparison on the previous page, the adjacent colour key outlines the proposed lighting levels to the site. Some adjustments have been made and are for the consideration of the Planner and Client to deviate from the standard guidance to have a sympathetic and considerate lighting scheme.

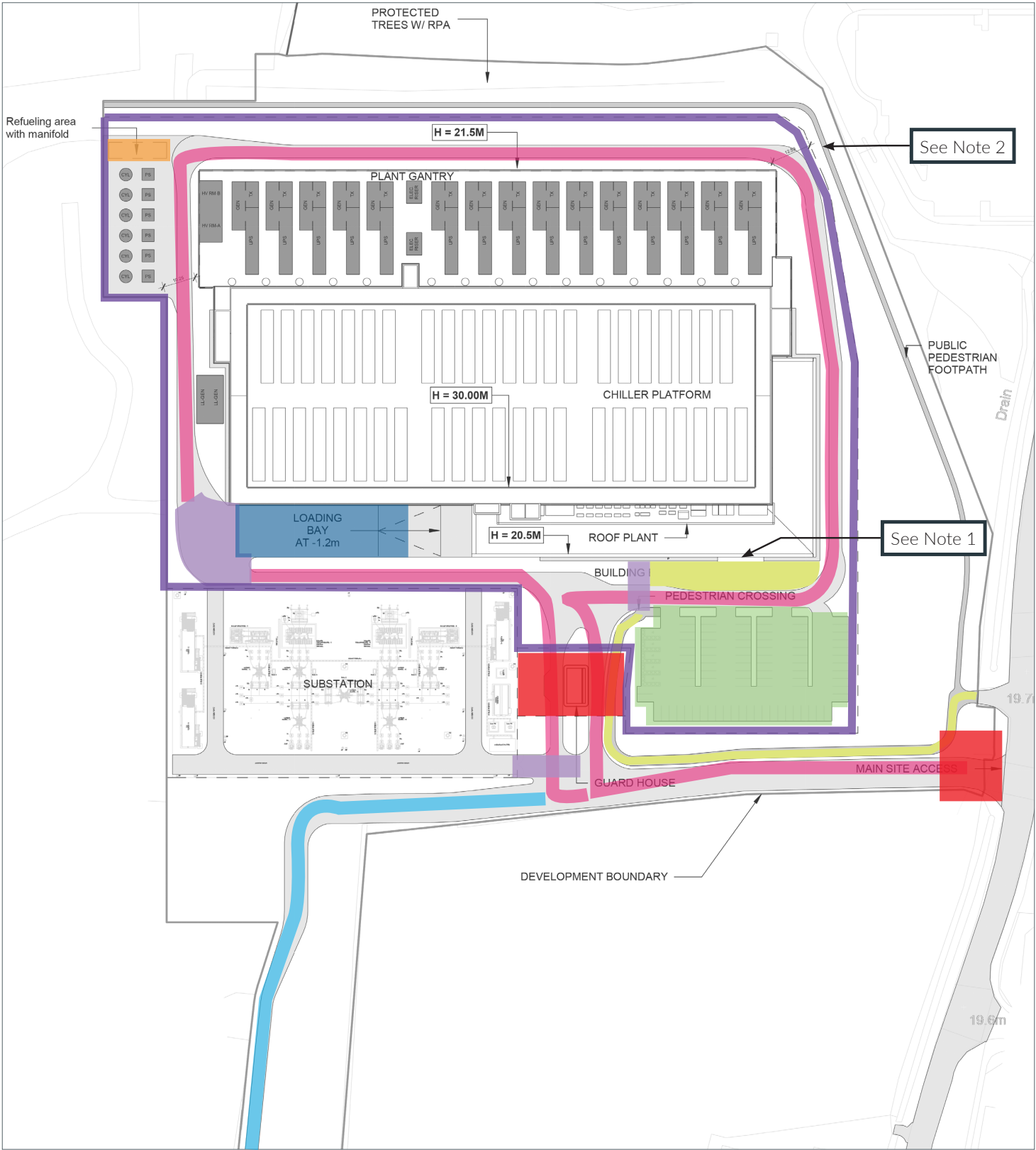
The lighting (lux) levels are considered to ensure a gradual increase or decrease in illuminance with no abrupt changes, while also considering ecologically sensitive areas. This will create a comfortable environment that will allow the users' eyes time to adapt safely and a secure perimeter to be maintained.

Key

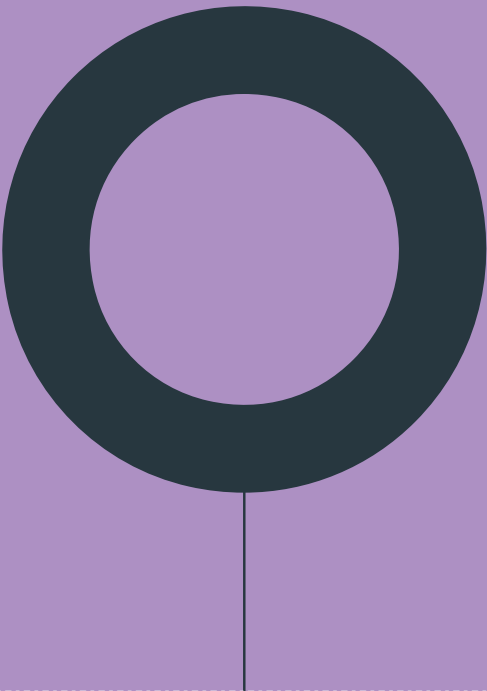
- Primary Road: 7.5lx min horizontal, 2.5lx avg vertical for CCTV
- Secondary Road: 5lx min horizontal, 1.5lx avg vertical for CCTV
- Pedestrian Walkways: 3lx min horizontal, 1lx avg vertical for CCTV
- Open Air Car Parking: 10lx avg, 0.25 u0 avg (dim to 5lx when not in use)
- Vehicle Loading: 20lx avg, 0.25 u0 avg (dim to 10lx when not in use)
- Zebra Crossing: 10lx, 0.4 u0 avg (increase on P3 class)
Area of Conflict: 25lx, 0.4 u0 avg (3.5x P3 class)
- Perimeter Fence: 5lx maximum on vertical
- Vehicular Entry Points: 30lx at thresholds
- Refuelling Station: 100lx 0.4 u0 (dim to 25lx when not in use)

Note 1: The building entrance threshold should be lit to a higher (10lx min) light level to ensure good contrast levels between indoor and outdoor lighting environments. Final light levels to be determined with internal lighting design spec and security requirements.

Note 2: The public footpath is not to be illuminated, as it is not within the protected boundary, and any illumination so close to the boundary line will have a negative impact on the local ecology.



Lighting Concept.



Lighting Concept - Luminaire Locations.

This report does not detail unique lighting positions, but instead offers guidance for future design development to ensure that the development's requirements are met. The primary focus for the scheme is to ensure a safe working environment, and adequate task and vertical illumination across the development.

Task:

Lighting levels on the horizontal plane shall be appropriate to the passage of people and goods throughout the site, while taking the sensitive ecological context of the site's surround into consideration. Roads and pavement shall be illuminated to levels deemed suitable for the Environmental Zone, travel speed, and users. The loading bay, car parking, and refuelling station will also be illuminated to the appropriate light levels when in use, and then dim down to a lower level when not in use.

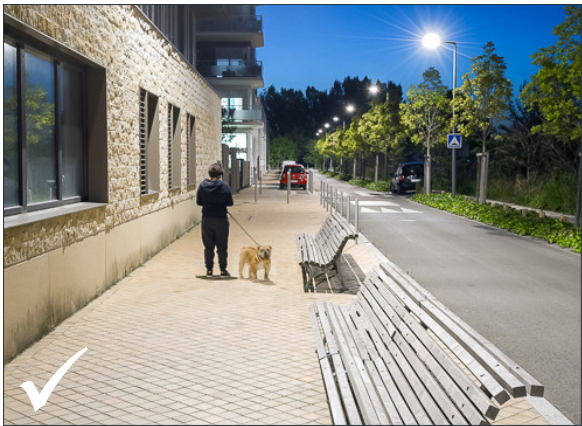
We have not prescribed a site-wide minimum horizontal light level at the floor plane as mentioned in the client brief, but rather recommend maintaining good cylindrical illumination across the site.

Vertical illumination:

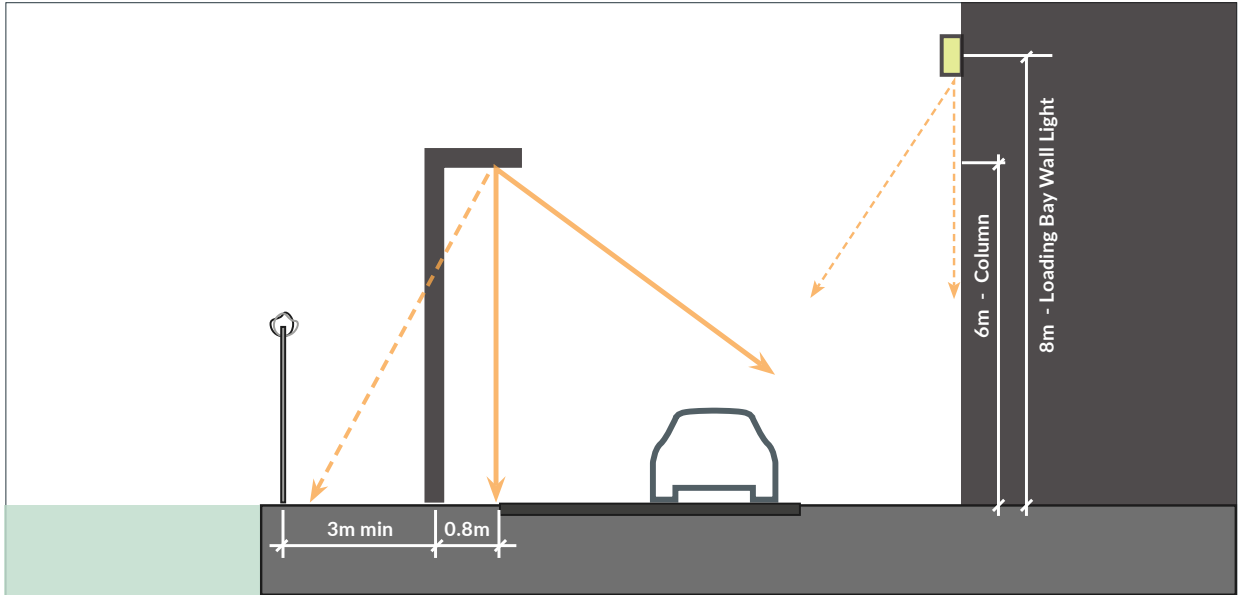
Uniform lighting at eye-height is key for surveillance, both by security staff and for CCTV cameras. Security relies on both active and passive surveillance, both of which can be supported by good lighting practice. A well-illuminated site with clear way-finding and routes of passage work to alleviate the emotional aspect of site safety. Being able to recognise faces plays into this as well, and thus recommend that final luminaire locations are determined with this consistency in approach in mind.



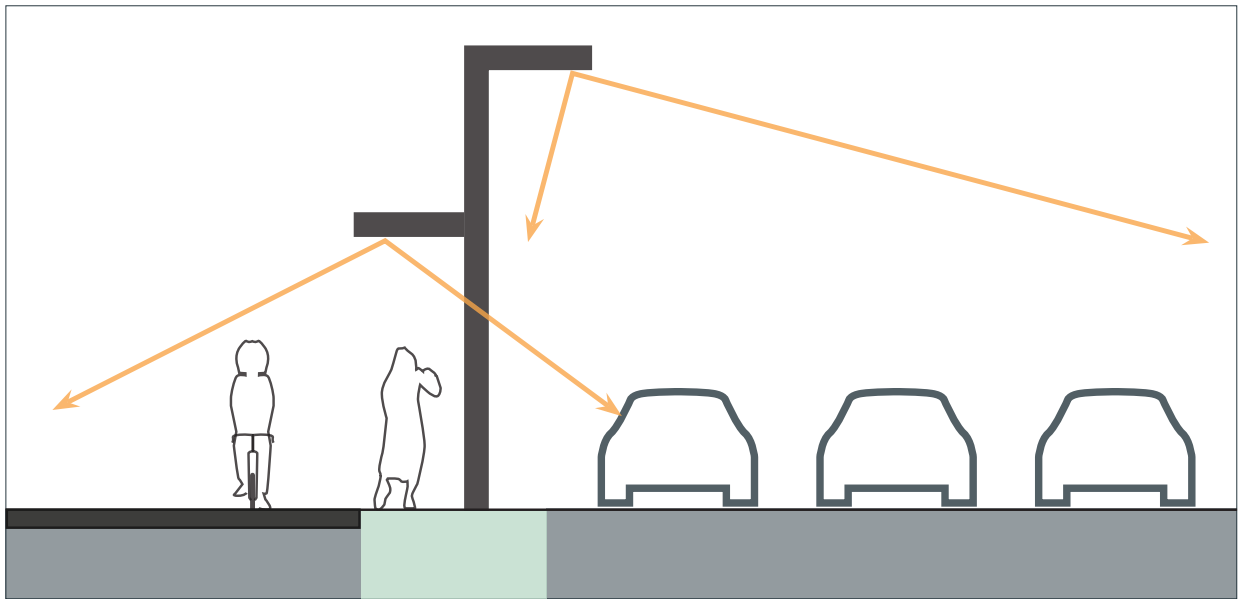
An example of adequate horizontal illumination (at street level) but without regard to uniformity or vertical illumination (at eye level).



An example of good horizontal and vertical illumination, using sources at the correct height in relation to architecture and landscape.



Above is an indicative section of the Western site, showing the relationship between site fixtures and luminaires. All lighting columns should be 3m from the perimeter fence, as stipulated by the Security Consultant, and also maintain the standard 800mm distance from column base to kerb edge as per BS 5498-1:2013. Column heights should be sensitive to the building massing and kept low (6m or less) to mitigate light spill outside the boundary.



We have identified one pedestrian crossing zone to bring staff to the building entry on the South facade. The lighting will be arranged to ensure that the pedestrian crossing is lit to a higher level than the perimeter road, allowing for users to quickly and easily identify the appropriate crossing location. An increased level of lighting to this area also helps to maintain consistent facial illumination levels for recognition and surveillance.

Luminaire Concept - Fitting Criteria.

Fitting choices across the site will be chosen on the basis of their durability and their directionality.

Technical characteristics

Fittings must be 3000K max (2700-2200K preferred), CRI 80 minimum (CRI 90+ preferred), 3 SDCM (2 preferred).

Fittings must be suitably IP rated, and IK rated as deemed appropriate by the Client and Security consultant.

Luminaires must have negligible (preferably zero) upward light spill to ensure that the parameters set out for light pollution in this Environmental zone are adhered to.

Embodied Carbon Criteria – Manufacturing

Manufacturer should provide Environmental Product Declaration (EPD) including Life Cycle Assessment (LCA), Product Environment Profile (PEP), Cradle to Cradle Assessment, TM65 Assessment, or similar to allow a realistic assessment of Global Warming Potential through life cycle be carried out. Results to be provided in KG/CO2e throughout the embodied carbon stages excluding stage B – operational carbon. Stage D optional dependant on methodology.

Other criteria should be taken into consideration, such as:

- Manufacturing plant should use renewable energy.
- Product delivery should utilise electric or hybrid vehicles and vehicles with ultra-low emissions.
- Manufacturer should be aware of all components within luminaire - Including those within LED chip and Driver. This includes the origins of all components.
- Product and delivery packaging should be recycled or recyclable.
- Preferably delivery packaging should be re-proposed / reclaimed from site for re-use.

Design for Repair / Refurbishment / Disassembly

In relation to The Ecodesign for Energy-Related Products and Energy Information (Lighting Products) Regulations 2021), products should be designed for refurbish / repair.

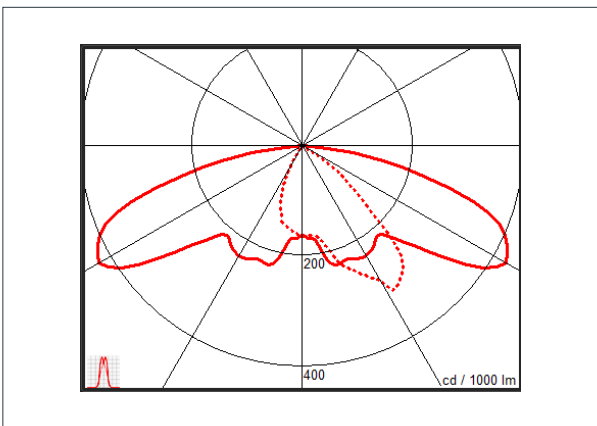
- Spare parts should be available for lifetime of luminaire.
- Preferably there should be a method of logging identifying parts for ease of replacement.
- Preferably manufacturer should offer free replacement parts to encourage repair.
- Manufacturer should offer a simple return methodology at end of life to encourage return as opposed to on site binning.
- LED drivers should be simply replaced on site - as opposed to returned to factory.
- Product should be designed for flexibility. Optics, LED engine and accessories can be replaced to allow for future flexibility.



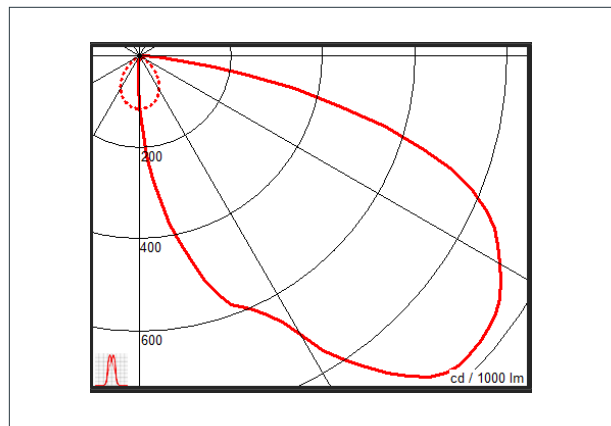
Column
Fitting reference, BEGA pole top luminaire.



Wall Light
Fitting reference, BEGA wall luminaire.



Photometric distribution reference, asymmetric flat beam.
For use at perimeter road.



Photometric distribution reference, asymmetric.
For use at loading bay, car park, gate house, and site entry.



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