

LIGHTING AGAINST CRIME



Copyright © 2025 ILP

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means: electronic, electrostatic, magnetic tape, mechanical, photocopying, recording or otherwise, without permission in writing from the Institution of Lighting Professionals.

Institution of Lighting Professionals
Regent House
Regent Place
Rugby
Warwickshire
CV21 2PN

Tel: (01788) 576492

Email: info@ilp.org.uk

Website: www.ilp.org.uk

Registered Charity Number 268547

Lighting Against Crime

Revised June 2025

Preface

When the first iteration of this Lighting Against Crime guide was published in 2011, I was entirely reliant on the expertise and kindness of John Brewis of the Institution of Lighting Engineers; as for this iteration, it is to Graham Festenstein that my thanks are owed for his knowledge, generosity and commitment to the project. In addition, I can't begin to adequately thank everyone else in the UK's professional lighting family who, over the years, have entertained with patience my repeated requests to explain lighting technicalities using only everyday terminology that I could understand.

This issue of using 'everyday terminology' to explain what is a complex and technical subject, goes to the heart of the thinking that was behind the first guide and remains behind this one; these guides are not intended for those who are already knowledgeable about the application and science of lighting and who are therefore familiar with the language that defines conversations around the subject; rather, it is to support those of us who might not know much about lighting, but must understand how best to use it, in order to deter crime and the fear of crime and to thereby reassure the public. Our intention is to provide basic information about lighting that will help us all to do our work more successfully.

Peter Kane

Police Crime Prevention Initiatives 2025

Contents

Preface	3
Introduction	7
What is lighting for security?	8
Scope	8
What is a Lighting Design?	9
Placemaking	9
Visual Considerations	11
Light, Shadow & Contrast	12
Illuminance & Uniformity	12
Contrast	13
Vertical Illuminance	14
Quality of Light	15
Colour Temperature	15
Colour Rendering Index (CRI)	16
Legibility, Orientation & Way-finding	17
Comfort, Safety & Security, Crime and Fear of Crime	18
The Perception of Crime	18
Inclusive Design	19
Risk Assessments	19
Crime Prevention Through Environmental Design	20
Lighting Techniques for Mitigation Against the Risk of Crime	21
Light & the Environment	25
Designer Competence	26

Lighting Standards, Guidelines, References and Publications	27
Glossary of Technical Terms / Definitions	28
Reading an Illuminance Plot	30
Vision	31
Adaptation	31
Glare	32
Appendix 1.	33
Appendix 2. ROLAN	34
Acknowledgments	35

Introduction

Everyone likes to feel safe, and indeed has the right to feel safe and most of us want to be able to see that we are safe during the hours of darkness; it is vital therefore that those responsible for the design, specification and delivery of our built environment implement the most appropriate lighting conditions for where we live, work and spend our leisure time.

This guide can be used by anyone involved with exterior lighting but it is particularly intended for those who must possess at least a basic knowledge of the subject and technical terminology in order to deliver successful developments and outdoor spaces for people to use at night.

Targeted lighting improvements when properly conceived and under the right circumstances have been shown to reduce both crime and the fear of crime. If design partners can discuss lighting values using mutually understood terminology, they will find it easier to agree on how to provide a higher quality nighttime environment.

Whilst reading the guide is no substitute for the expertise, advice and guidance of a qualified lighting engineer or designer, it will help with the sensible appraisal of an existing lighting system, or a proposed one.

Designing safe and comfortable public spaces that will reduce criminal opportunity and make the public less vulnerable is not the preserve of any one discipline but instead concerns all those with a responsibility to design, shape and specify the public realm. This guide intends to define some terminology and establish some common ground for those who discuss lighting in their work, and emphasises how the considered application of lighting can contribute to our safety and security.

Secured by Design and The Institution of Lighting Professionals have collaborated in the creation of this guide to assist all those involved in the design process to understand the importance of good lighting and its life enhancing role.

The Institution of Lighting Professionals unites the skills of engineering, creativity, design and technology, in order to deliver quality lighting for the built environment, achieving greater public benefit from lighting and establishing high standards for good practice.

Secured by Design is a UK wide police initiative which encourages those responsible for the built environment to employ police preferred design principles, hardware specifications and other crime prevention measures that serve to reduce crime and the fear of crime for the public, and contribute to the creation of safer and more sustainable environments.

What is lighting for security?

It is a basic right and desire for all human beings to feel safe, but only good lighting conditions and design will enable us to see that this is the case at night. It is also widely recognised that dark areas and poor lighting conditions can sometimes generate a fear of crime where there is actually no crime being committed.

Lighting facilitates nighttime observation for all and can enhance surveillance over extended distances. An often quoted example of this is the security guard who might be able to hear a locked door being attacked at night by a burglar from 30 metres away but, when good lighting is in place, can actually see the attack from over a 100 metres away.

Lighting of public space combines a number of elements and objectives, security is an important one and a successful lighting design will tackle all elements of lighting holistically to provide a well planned and coordinated result.

A good lighting design will take into account how a space will be used, by whom and when. In this way the designer will be able to understand the potential for crime and how the risk of crime may be perceived. Understanding how a site is used and how it will transition between day time and nighttime use is essential planning for nighttime security.

Good coordinated lighting of open spaces, footpaths, walkways, front doors, landscape features, shops and amenities can all contribute to an increased perception of safety, whilst actively reducing the opportunities for crime.

In some circumstances, it could be that a decision not to light an area might be thought beneficial; a children's playground will not normally be required for use late at night and leaving aside environmental, sustainability and ecological issues, lighting such a place could well attract just the kind of anti-social gatherings best avoided, as they may generate littering, disturbance, crime and the fear of crime.

Scope

Public space is diverse in nature encompassing both hard and soft landscaping in urban squares, parks and gardens. This document relates primarily to exterior public spaces associated with housing - related community and commercial facilities, pedestrian and cycle paths, vehicular routes and shared spaces.

In developments of this nature there may be conflicting requirements that need to be considered; the balance between security and environmental concerns for example, challenges of multiple ownership, potential conflict with adjacent sites or residents concerns. The guidance within this document cannot fully address these matters, but does provide overarching advice as to the design criteria that will enable a designer to identify a strategy to tackle these issues.

In this document, we define safety as the risk of physical injury such as tripping, slipping or being struck by a vehicle, whereas by the term security we mean measures used to protect people from criminal activity, anti-social behaviour and the fear of crime. However, safety

and security are often synonymous and there can often be little to choose between the tactics required to achieve both.

Lighting of public space often includes other practical or creative elements such as lighting for landscapes, facade lighting, lighting for way-finding or signage or a balance of these to create a specific ambience. This guidance describes how a sensitive amalgam of lighting for safety and security, and lighting for other creative reasons can result in a highly successful lit environment. Importantly, if we treat lighting for security as an entirely separate aspect of an overall design we are sometimes compelled to 'bolt it on' afterwards which can prove to be counterproductive to the overall effect of the lighting regime and the management of security problems. In most cases, when the lighting scheme is well conceived and includes safety and security considerations from the outset, there is no need to include dedicated security lighting or to add it at a later date.

In summary, these guidelines aim to encourage best practice in lighting design by establishing the following principle: ***Successful lighting regimes employ the right light in the right place at the right time.***

What is a Lighting Design?

The lighting design will normally include layout drawings and a schedule of equipment. Depending on the complexity of the scheme it may also include detailed drawings showing how lights integrate with architectural or landscape detail, and information regarding control schedules and schematic drawings. In all but the simplest schemes the lighting designer will generally have undertaken calculations to inform the design which will identify figures for illuminance and uniformity which are presented on a plan or layout drawing in the form of an isolux plot. (See page 29)

The design will have been produced taking into account the criteria described within the following pages and encompass the practical requirements of the scheme, the mood and visual appearance of the site after dark. A good lighting design will be well integrated with the architectural and landscape design of the site, to ensure the wider aspirations of the project are still met during the hours of darkness.

Placemaking

People in the UK spend a significant amount of time outside during the hours of darkness, especially during the long winter afternoons and evenings whilst commuting, shopping, dog walking, playing sports etc. The lighting of our public spaces is obviously important to us in finding our way around and promoting positive feelings of well being and confidence when using public spaces.

Good lighting creates a positive atmosphere which in turn contributes to the creation of places with their own identity - areas with efficient, usable routes and connections combined with outdoor spaces for residents and visitors to enjoy. Light plays a major role in creating

sustainable communities with really usable public spaces and viable nighttime economies.

Thoughtfully designed lighting will encourage the use of public space by responsible citizens which will, in turn, serve to promote reassuring feelings of safety and security among those who may have otherwise been fearful of venturing out at night.

Making public spaces legible, comfortable and possessed of a well-defined character and mood, focuses on community needs and activities and plays a major role in placemaking. Whilst the identity of a space is predominantly defined by its daytime use and character, this identification can be continued into the evening; if appropriate there are also opportunities to use lighting to alter the impression of an area, and thereby reflect how its use might change as night approaches.

A number of standards and guidelines are published that relate to lighting design for exterior public spaces (See appendices). Whilst not all of these are mandatory requirements they do guide best practice, and should be used accordingly. **The application of professional judgment on behalf of the lighting designer is required to interpret how best the standards and guidelines should be applied for each project.** The mere application of lighting standards to a design alone can result in over lit bright spaces that do not feel comfortable, and may consequently do little to enhance the perception of safety.



The different elements that go together to create a sense of place.

Visual Considerations

The nature of vision is complex and the way our visual system works at night is an important consideration for lighting designers. In particular, colour vision in low light, the hazardous impact of glare and the adaptation process - whereby the eye adjusts to changes in light level from bright to dimly lit environments and back, are all very important considerations.

Glare is especially problematic, the most extreme example of glare is when a driver is dazzled by the headlights of an oncoming car and is rendered unable to see the road ahead. Glare is present in public spaces through poor design, inappropriately selected or located luminaires, or the application of lighting standards without appropriate consideration for the people that will eventually use the spaces. Glare can make a space uncomfortable to be in, detracts from any positive atmosphere that the design of spaces can create and might ultimately deter people from using the space at all. Examples of glare could be poorly designed bollard lights along a footpath, which whilst lighting the ground perfectly to meet the standard, dazzle pedestrians rather than illuminating the way for them; or road lighting adjacent to a public space that only considered the road lighting and not the impact it may have elsewhere. Glare is more than annoying and blinding, it impacts the process of vision, disrupts the light/dark balance and alters the human perception of whether a space is safe to use.

Glare is controlled by the specification of suitable luminaires that are not too bright, shield the light source from direct view, are angled appropriately and are mounted at a suitable height with consideration for the geometry of the space.

More detail on vision and definitions can be found in the appendices of this document.

Glare from over bright and uncontrolled lights are disorientating and distracting. Glare can also mask the view of a potential attacker beyond.



Light, Shadow & Contrast

Without darkness and shadow an illuminated space becomes characterless. Contrast between light and shadow is fundamental to a quality lighting design as it defines the way we perceive three dimensional objects. It can be used to inject drama or a sense of serenity whilst at the same time being crucial to managing safety by emphasising physical hazards, such as traffic or surface changes in grade or level.

The use of shadow and contrast within a space aids legibility creating more comfortable places that positively enhance the perception of safety for those that occupy it.

Illuminance & Uniformity

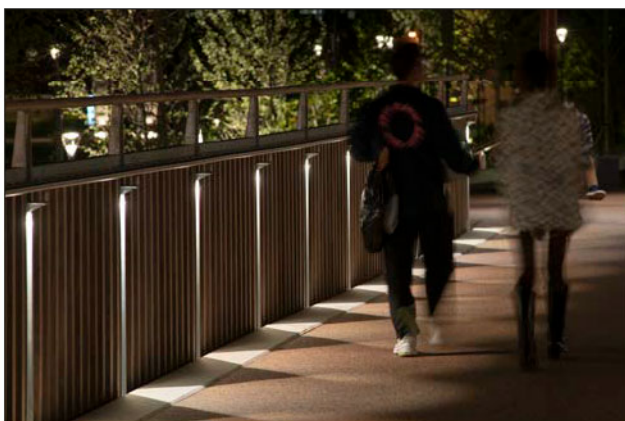
Illuminance is the measure of how much light is landing on a horizontal or vertical surface and is measured in lux. In terms of lighting standards for the Public Realm "**horizontal illuminance**" is generally used to identify how much light is required in a particular situation.

The term "**vertical illuminance**" is also sometimes quoted. By example, it can be helpful in determining how well a face, or a persons demeanour can be identified, making it a useful measure in situations where safety is especially important.

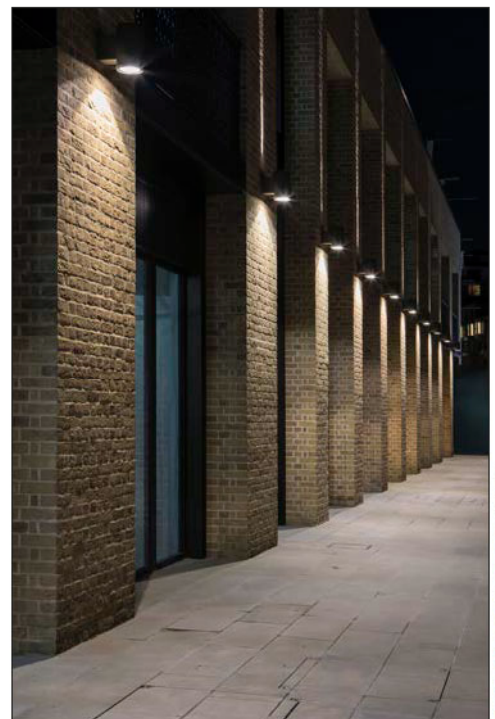
Uniformity is the term used to describe how evenly light is distributed and is generally expressed as a ratio between the average and the minimum illuminance.

Higher uniformity (e.g. 0.4) means the light levels across a surface will be consistent. As previously noted this is especially useful where hazards have been identified such as spaces with combined use by pedestrians and cyclists or vehicles. Lower uniformity (e.g. 0.25 or lower) allows for more contrast, as in pools of light below a lamp post.

In general terms for the public realm, high levels of uniformity are useful for defined routes and connections through or across a space, or where practical tasks need to be undertaken.



Green Heart University of Birmingham, Speirs Major
Light Architecture Photographer James Newton



Chelsea Barracks London, Nulty

Vertical illuminance helps define the space and higher uniformity helps clearly define 'safe' routes allowing for contrast elsewhere.

Contrast

Contrast between light and dark is essential to provide interest, texture, and drama. Light and shadow together are both important to show form and modify mood.

If poorly applied, contrast can be dangerous making it difficult to see hazards such as changes in ground level, and can contribute to a chaotic and confused ambiance. Dark areas especially around the periphery of an illuminated scene can feel uncomfortable and make users of a space feel vulnerable.

Application of contrast needs special consideration with respect to the visually impaired or those suffering with cognitive issues which includes many older people. Contrast can help define changes in level but can create confusion if applied inappropriately or in the wrong place, making a visual impairment more pronounced or causing fear and confusion. The correct balance between contrast and uniformity is essential to create a high quality and inclusive public realm that combines safety and comfort.



Elephant Park London, Speirs Major Light Architecture Photographer James Newton

Accent lighting provides contrast making the space more attractive and welcoming whilst routes are clearly defined and potential ambush points remain lit.

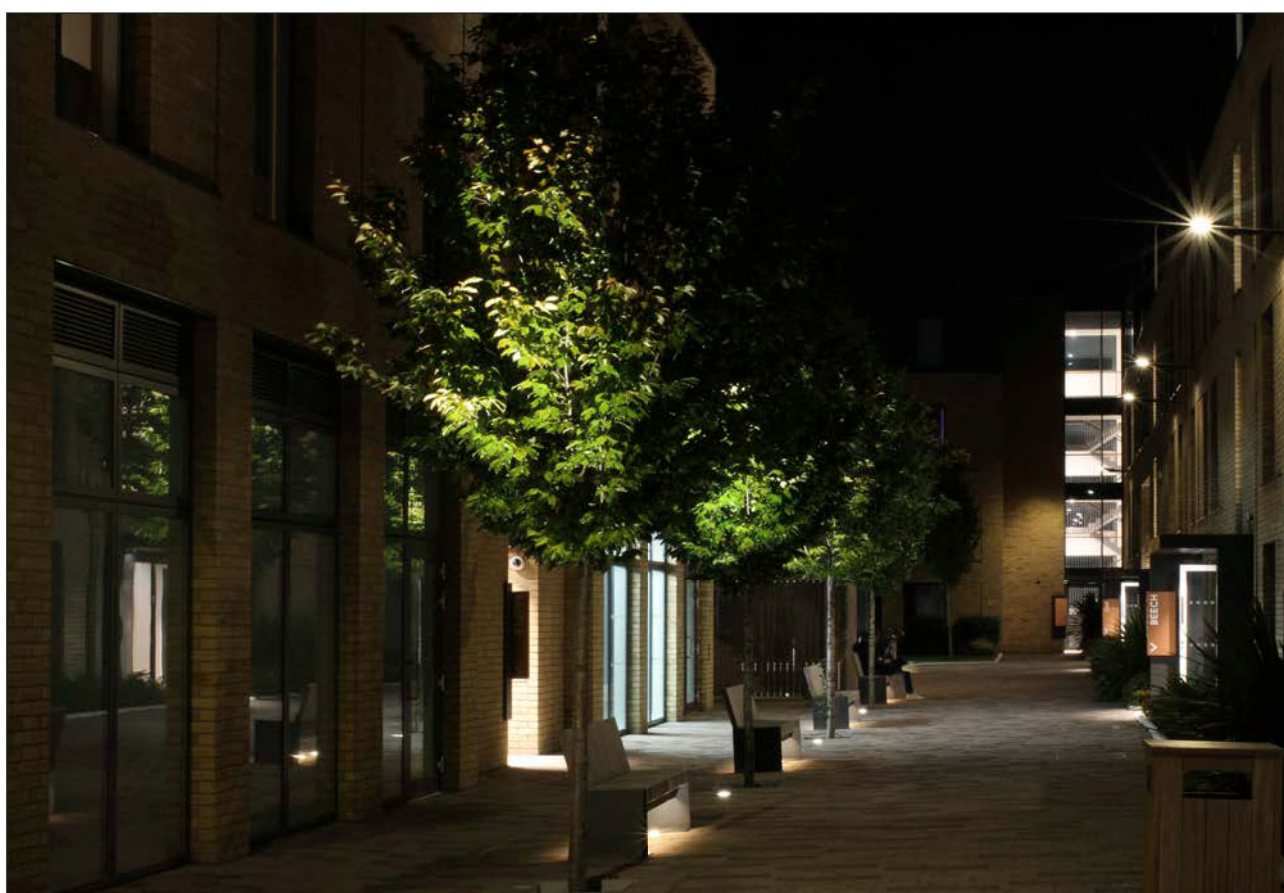
Vertical Illuminance

As previously described, vertical illuminance is important for the lighting and recognition of faces and expression and is an essential aspect of a good balanced design.

Lighting to vertical surfaces, through architectural feature or accent lighting, controlled light spill onto building facades, or illumination of landscape features such as trees or larger shrubs is very important to help define the boundaries and the scale of a space at night and making for more easily recognisable, comfortable and legible areas.

Bright uniform light on the horizontal plane alone whilst practical for sports pitches or warehouse yards, does not necessarily create an appropriate ambiance and it has been argued that too high a uniformity can contribute to a perception of vulnerability.

Properly balanced lighting that provides a legible space with a comfortable ambiance improves the perception of safety. Vertical illuminance provides people with addition information about their surroundings, this can help them feel more at ease and think of the surrounding space as being more brightly lit than if illuminated without. This provides an opportunity to reduce light levels and avoid over-lighting, which can be beneficial to the quality and environmental sustainability of a place.



Hox Park Runnymede, Graham Festenstein Lighting Design

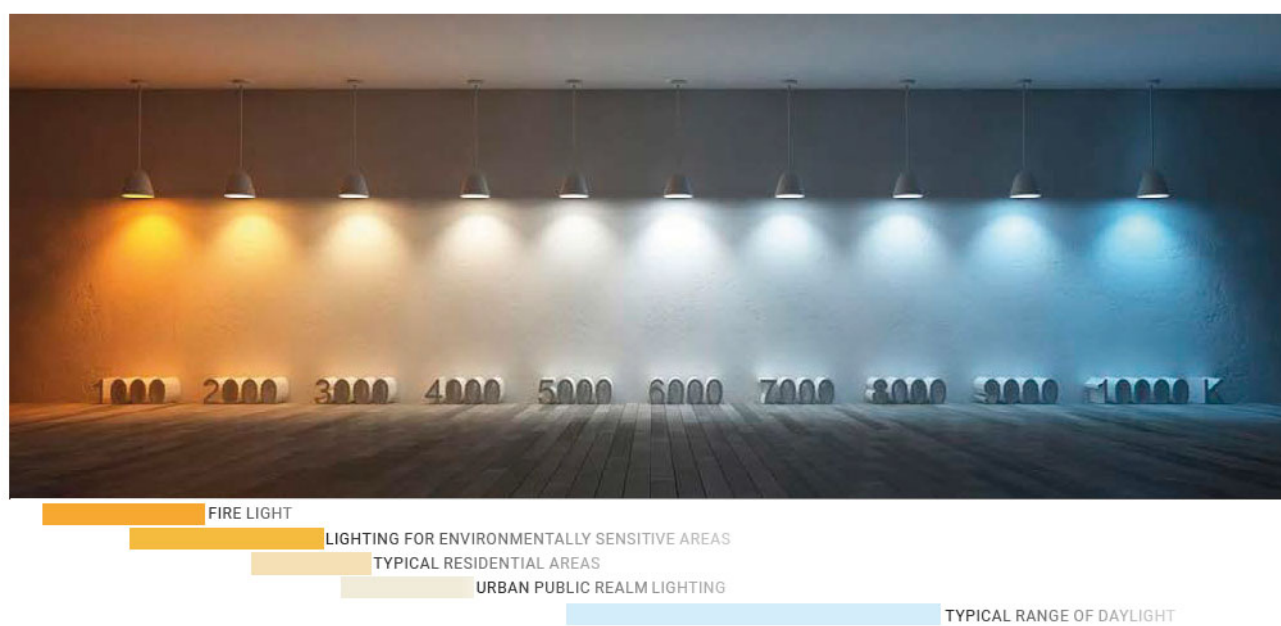
Vertical illuminance can be provided by controlled light spill onto facades, lighting from within the building, or from lighting to trees and planting.

Quality of Light

The quality of light is to a certain degree subjective and intangible. There are however some methods and terminology we can use to describe the quality of light that are in themselves quantifiable.

Colour Temperature

Colour temperature (CT or CCT) describes the perceived warmth of white light measured in degrees kelvin (K). The range of colour temperatures is shown in the figure below.



As well as defining the colour of white light, the colour temperature of a light source will impact how colours illuminated by it are perceived. Cooler temperatures (e.g. 4000K) enhance blues and cooler colours, whilst reds, oranges and other warmer shades stand out under warmer white light (e.g. 2700K).

Warmer colour temperatures are generally appropriate in residential spaces as they create a more comfortable and intimate ambiance. In historic environments where building materials are mostly warmer colours such as red or yellow brick, a warm CCT of 3000K or lower will enhance the appearance of the built environment. This also applies to a certain degree to new developments using warmer coloured building materials.

Lighting with a warmer CCT is beneficial to the environment as it has a less detrimental effect on the biology of animals and plants (see section below on environmental lighting).

Colour Rendering Index (CRI)

The higher the CRI the more accurately colours are rendered. Orange/yellow sodium lights (HPS) generally have a CRI of around 25 whereas a higher rendering white LED can be in excess of 95 CRI. For exterior lighting a CRI of 80 is generally considered suitable and in most cases this figure should be considered as the minimum acceptable.

The TM-30 standard may also be quoted within design specifications, this is similar to CRI but is a more complicated system, mostly applicable to higher end equipment and applications.



Warm colour temperature 2700K.



Cooler colour temperature 4000K.

Legibility, Orientation & Way-finding

In urban design, spaces that are easy to understand and navigate are described as legible. At night lighting is essential to ensure that a space remains legible, not only will this make it easier to get around, but as legible space feels comfortable the perception of safety will also be increased. Poor lighting can have a detrimental impact on the legibility of a space making it feel less comfortable, less safe and in a worst case actually increase the potential for criminal activity by making navigation and orientation more difficult.

Legible space at night is likely to include clearly visible destinations - such as gates or building entrances, a defined periphery or edges that show where the space begins and ends, and clearly identifiable routes and connections through or around the space.

Typical elements to a lighting design might include:

- Lighting of landmarks and destinations, for example building facades - lighting to vertical surfaces (vertical illuminance) helps to define the edges of a space and its scale. Lighting to the features of prominent buildings aids orientation and way-finding. Lighting to building entrances or emanating from an illuminated lobby can also provide helpful vertical illuminance and highlight a destination.
- Illuminated landscape features such as illuminated street furniture, trees or planting, or public art all contribute to the ambiance of a high-quality nighttime environment and can aid wayfinding at decision points at junctions between different paths or routes.
- Clearly defined routes between building entrances, site entrances, public spaces such as squares or parks. Lighting helps define these connections, highlight destinations, and aid way-finding between them. Ensuring adequate lighting to signage will also contribute to legibility.
- Lighting that enhances the character and identity of an area or space to help establish a sense of place.
- Lighting of dark corners or locations where someone may hide to ensure good visibility of spaces that otherwise may feel threatening or create risk of ambush.

The approach to lighting design is key to creating legible, successful, and functioning places at night.



Elephant Park London, Speirs Major Light Architecture
Photographer James Newton

Comfort, Safety & Security, Crime and Fear of Crime

The Perception of Crime

When considering the nighttime environment, the perception of crime is often significantly greater than the incidence of crime and this can have a detrimental effect on the appreciation and use of public space at night.

It may seem counter intuitive, but over lighting with bright uniform light can have the effect of making people feel vulnerable and even threatened, whereas a more nuanced and subtle approach to lighting specifications can bring a sense of calm and reassurance to a location.

The use of 'vandal resistant' luminaires requires careful consideration as they can have a detrimental effect on the lighting of public space if used inappropriately. The robust appearance of vandal resistant luminaires and street furniture can create negative perceptions of an area and might even encourage attempts to vandalise the fittings and furniture.

Vandal resistant installations can sometimes be unattractive, indiscreet and utilitarian, reducing the appearance and performance of a given area. For these reasons vandal resistant luminaires should be carefully integrated into a design and in most cases only used if circumstances dictate them necessary.

Where poorly lit environments increase the fear of crime in an area this may lead to a reduced public footfall and therefore the consequential reduction in responsible guardianship for public spaces. This dynamic can of itself give more opportunity for crime and anti-social behaviour. Poor lighting in public spaces can be especially problematic for those who feel vulnerable and may not go out in the hours of darkness if they feel unsafe, with the consequence of lost opportunities for social interaction, independence and exercise. This could include some elderly people, those with a visual or mental health impairment, those with mobility issues and women and girls (See under inclusive design).

When a place is perceived as unsafe the impact on residents is only ever negative, and reputational damage to an area itself can become a factor in attracting crime and anti social behaviour.



Magna Carta Park Runnymede, Graham Festerstein Lighting Design

Inclusive Design

Poor or inadequate lighting impacts some members of the community more than others, both in terms of perceived crime and the very real risk of becoming victims of crime.

Research indicates that a higher proportion of women and girls than men report feeling unsafe when using public space at night and is particularly noticeable when comparing the responses regarding the use of parks or other open spaces at night: 82% of women reported feeling very or fairly unsafe compared to 42% of men. *Office for National Statistics Perceptions of personal safety and experiences of harassment, Great Britain 2021.*

Points to consider are:

- Good practice creates legible, attractive and comfortable spaces which encourage use; greater footfall increases visibility and greater number of users increases the likelihood of public intervention in the event of harassment.
- Clearly defined routes and destinations create increased permeability and visible escape routes.
- Avoid creating dark secluded areas that may be potential ambush points or feel threatening.
- Good illumination for help or emergency call points.
- Consider lighting peripheral routes as the edges of the space may feel safer.
- Consider the impact that foliage and tree growth will have on lighting and future maintenance regimes.

As discussed in the previous pages, lighting design must consider other potentially vulnerable groups; the elderly, those with visual impairments, mobility, learning or mental health issues. Creating legible space with clear routes and destinations with increased footfall and permeability can reduce the perception of vulnerability, bring greater visibility for all and therefore reduce the likelihood of antisocial behaviour.

The positioning of equipment such as lighting columns and feeder pillars should also be considered with respect to reduction of safety hazards by minimising street clutter.

The identification and consideration of all potentially vulnerable groups should form a fundamental part of the risk assessment process.

Risk Assessments

All lighting designers or lighting engineers should undertake a risk assessment as part of the design process, this may be a formal written document for larger, more complex schemes, or an informal approach could be taken for smaller scale projects.

The risk assessment should identify all potential hazards to safety and security for the site or location, as well as all potential users of the area, including; residents, staff, general

public, customers, contractors and then propose how these should be addressed to ensure the risk is maintained at an acceptable level.

Risk assessments should be specific to each project and consider the nature of the scheme, the layout of the site and any architectural or landscape elements of the design relevant to exterior public space. Whilst the inclusion of generic risks is acceptable, a purely generic risk assessment document is not. Risk assessments must be site and project specific to be of practical use.

Risk Assessments should consider the following;

- Who uses the space?
- When do they use the space?
- What activities take place and do these change dependent on the time of day or month of the year?
- Are there specific hazards such as dark areas restricted escape routes, trip hazards?
- Are the routes into and through the space clearly defined?
- Are there special requirements for emergency access or evacuation?
- Are there requirements for CCTV?

Whilst there is no specific method or format for the risk assessment it is recommended that hazards are identified and risks assessed on the basis of potential severity, against frequency of likelihood. Significant risks should be addressed in the design.

Crime Prevention Through Environmental Design

The application of the principles outlined overleaf should ensure that any design is in line with the principles of Crime Prevention Through Environmental Design (CPTED).



100 Liverpool Street London, Speirs Major Light Architecture Photographer James Newton

Lighting Techniques for Mitigation Against the Risk of Crime

Consideration of the following should highlight the key points that contribute to the safety and security of exterior spaces, and the mitigation against the risk of crime.

Contrast, Uniformity and Illuminance Levels

Light levels between adjacent areas of a site should allow for a gentle transition between light and dark areas, avoiding a strong contrast or difference in perceived illuminance.

High levels of uniformity in line with the appropriate design standard should be maintained along roads and pathways, including primary routes across or around the periphery of open spaces. Uniformity across the wider areas can then be relaxed to allow for some contrast and visual interest.

Illuminance levels should meet the appropriate design standards for the application with care taken to avoid unnecessary high illuminance levels above the required minimum.

Where multiple building owners, operators or designers are working together on the same development or site, a cohesive lighting strategy should be developed with the various stakeholders to ensure that over-lighting or over-illumination is avoided, and lighting across the whole site is balanced and coordinated. Collaboration and clear, open dialogue can ensure that additional or unnecessary lighting is not installed by other parties.

As part of the risk assessment high risk areas such as dark corners, cut throughs, dense undergrowth or blind corners should have been identified. The illuminance levels and uniformity in these locations should be given special consideration, with additional lighting provided where necessary to mitigate against these risks.

In a multi-functional space such as a square, courtyard or gardens incorporating access to houses or flats, pedestrian routes and vehicular access with parking, the selection of light levels and uniformity will vary across the site creating a hierarchy of spaces. For example higher uniformity and illuminance will be required for primary pedestrian routes across the spaces occupied by both pedestrians and vehicles. Peripheral areas and routes are likely to require lower uniformity, however paths and connections will still maintain sufficient uniformity and illuminance levels to ensure a safe and comfortable journey. Open and peripheral spaces may not be directly lit at all; providing adequate light from adjacent areas ensures anyone occupying the space is visible. This hierarchy of light levels and uniformity helps provide contrast and legibility making the space comfortable and easy to read.

Routes, Paths, Destinations

Clear routes should be defined providing an easily navigable path to all destinations, entrances and exits. Other routes may be illuminated, but a defined safe route should be available which can easily be identified as an escape route if necessary.

Building entrances, exits, call points, toilets, bin or cycle stores, or other facilities or amenities should be clearly defined, visible, and connected to a safe network of routes.

Colour Temperature and Colour Rendering

In most applications a colour temperature of 3000K or lower (warm white) should be used for lighting in exterior public spaces. In certain circumstances cooler colour temperatures may be acceptable for aesthetic reasons, but in general this should be avoided in residential areas to maintain ambiance and environmental best practice.

Glare, Light Spill and Obtrusive Light

All luminaires should be designed to restrict a direct view of the light source either through the optical design, by means of shielding integrated within the design of the fitting, or by means of an external cowl or louvre.

The lighting design should ensure that lights are orientated to avoid glare caused by a direct view into the light source. Luminaires should be capable of locking firmly in position once set, to ensure that they are not accidentally misdirected in the future.

Decorative lights such as lanterns, festoons or any other luminaire, where the design of the light requires a view of the light source e.g. a glowing lamp or filament must be fitted with optics, a baffle or be of limited brightness so as to avoid excessive glare. In an ideal situation, a lighting control system will be used to allow fine tuning of light levels.

Lighting to areas, pathways, roads, or car parks, including floodlights used for security, should be implemented using luminaires that restrict or have NO upward light, only projecting light downwards where it is required.

There is a potential risk that instead of illuminating suspicious activity or anti-social behaviour, glare from the luminaire will instead obscure the vision of an onlooker.

Light spill into areas where it is not required should be avoided. This type of obtrusive light can cause nuisance to residents or users of a space and can also detrimentally impact the visual quality of a public space. Spill light is also controlled by the correct choice of luminaire optical design, or through the use of internal or external louvres.

Lighting Verticals

Lighting to architecture, landscape features, planting, trees or street furniture, can all add to the various layers of light. Borrowed light from decorative lights, wall mounted lights of building entrances or paths, are all beneficial in helping create legible space.

Careful considered design, combining the various lit elements can help define the limits of the space and scale, and raise the quality of the lit environment by adding contrast and interest. The lighting of vertical surfaces aids legibility and hence the perception of comfort and safety.

Lighting to Building Entrances or Facilities

Gates, building entrances, bin stores, cycle parks, service areas or other facilities can present potential risks to security. Where necessary or relevant additional lighting should be provided in these locations. In addition, this lighting will allow for practical use, aid wayfinding and orientation.

Emergency lighting is likely to be required externally at the final exit or emergency exits of buildings. Ideally these should be architecturally appropriate and if maintained (staying on all of the time), designed with consideration for the exterior public realm lighting.

Safety Hazards

Lighting to changes in grade, steps or other potential trip hazards will require special consideration. Particular attention should be given to the needs of those with visual or mobility impairment to ensure appropriate contrast or uniformity is provided to minimise any risk.

Positioning of equipment within the public realm should minimise street clutter to help reduce safety risks to pedestrians and cyclists. Consideration should be given to wheelchair users, mobility scooters and pushchairs.

Vehicular Lighting and Lighting Hierarchy

Road lighting for vehicular routes and car parks must comply with the appropriate standard, however it is important in residential applications that pedestrian lighting remains the primary visual consideration within the lit hierarchy of spaces.

Sports and Play Areas

Where provided sports facilities and play areas will require good uniformity and illuminance levels. The design will be informed by several factors including frequency, time and type of use. The lighting design in these areas should comply with the relevant recognised guidance. The use of lighting controls should be considered so that the installation can be dimmed or switched off when not in use.

CCTV

Most CCTV systems operate well under low light levels. A lighting designer should demonstrate coordination with the design of surveillance and other security systems to provide adequate light levels where necessary. This will also help to ensure that lighting does not interfere with or cause glare that impairs camera performance.

The CRI of light sources is important in locations where CCTV is used. The minimum 80 CRI should be used, and in critical locations a higher CRI of 90 should be considered.

Lighting Controls and Motion Detectors

By dimming or switching off lighting at times of low footfall e.g. after midnight, significant benefits can be achieved with respect to reduction in energy use, environmental impact and increased longevity of the light source.

Any proposals for time control, dimming or part night switch off should be subject to a risk assessment to ensure risks to security or users are not inadvertently introduced.

Lighting critical to safety, security, wayfinding and orientation should not be turned off, where appropriate may be dimmed, providing the facility exists to increase light levels when movement is detected.

Whilst dedicated security lighting under control of motion sensors can be of benefit in some circumstances, care should be taken to ensure they are used appropriately.

Additional light can sometimes aid criminal activity, especially if it is obvious that the lighting is an automated response to movement in a remote location.

If automated security floodlights are used then they should be correctly aimed and positioned, and comply with the requirements to control glare.

Depending on the scale and complexity of the lighting installation a lighting control or central management system is recommended. This allows for the adjustment of lighting levels / switch on or off of individual lighting circuits based on time of day or ambient light levels. On larger schemes this can be used to manage public events or facilitate a response by emergency services, by allowing manual control of lighting systems by security staff.

Appearance and Visual Design Of Luminaires

It is important that the choice of luminaire is in keeping with the architectural design language or local visual style of the site and its location. This will ensure that the lighting installation integrates with the landscape and architectural design, contributing to the quality of the public realm and not becoming an imposition.

Apart from decorative lighting or illuminated public art which are intended to be seen, the light fittings should ideally be concealed or discreet with only the lit effect visible. This will also help to deter vandalism.

Luminaires and equipment should be appropriate to the location and mounting height. Where necessary, the design of equipment should be robust, constructed of appropriate materials and with a suitable IK rating. The ease of maintenance and availability of spares for equipment that may be subject to vandalism should be considered. The use of vandal resistant equipment should be avoided where possible.

Luminaires should be manufactured to BS EN 60598-1:Luminaires. General requirements and tests

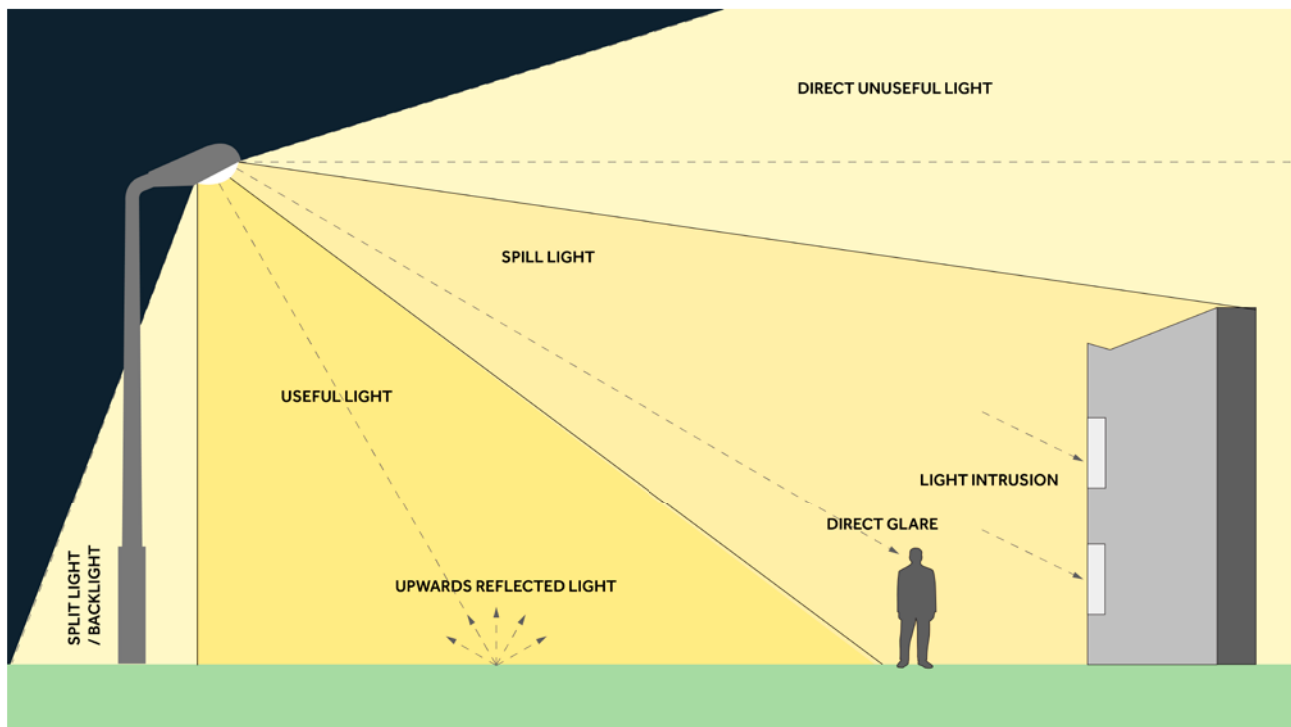
Light & the Environment

Inappropriate or overuse of light, *and use of the wrong type of light* can have a serious negative impact on both animals and plants, affecting biological processes and impacting ecosystems and biodiversity. All lighting design should employ best practice such as application of the ten principles outlined in the ROLAN declaration (Appendix 2).

In order to protect the environment, lighting design should be based upon nocturnal placemaking along with the application of best practice to control obtrusive light; glare, light spill and upward light into the sky (light pollution). (For reference please see ILP document GN01 – The Reduction of Obtrusive Light).

Lighting design should consider a hierarchy of light. If lighting is not required it should not be employed, further emphasising the need for a pragmatic and holistic approach. The principle of a 'mitigation hierarchy' is implicit in the application of the National Planning Policy Framework regarding 'significant harm to biodiversity resulting from development'. Further information on how this impacts lighting is available in the ILP Guidance Note GN08 Bats and Artificial Lighting at Night.

The application of best practice in environmental lighting design is entirely compatible with the approaches outlined within this document with respect to the lighting of public spaces, and need not conflict with the design of high-quality nighttime environments.



Designer Competence

The designers of the lighting installation should be able to demonstrate competence to undertake the work. The designer, engineer or consultant should be able to provide evidence, demonstrating a track record of experience of similar work of a scale relevant to the project.

The design process should include formal checking of the design, design calculations and compliance with the principles and requirements outlined in this document by a competent person with relevant experience. Ideally the competent person will be a professional member of a relevant professional body which could include The Institution of Lighting Professionals (ILP), The Society of Light and Lighting (SLL) or the International Association of Lighting Designers (IALD), however membership or registration alone, without relevant experience, does not demonstrate competence.

A Chartered Lighting Engineer working in highways may not have experience with lighting for public realm or housing, and conversely a lighting designer with much experience with housing may not be suitably qualified to undertake the lighting of roads that transverse the site.

A competent lighting designer will work in collaboration with other disciplines within the design team to address safety and security issues. This could include specialist security consultants, the police service, urban designers, architects and specialists in social and gender issues, or any other specialists as required.

Lighting Standards, Guidelines, References and Publications

Important Note: The lighting standards including the British Standards are not mandatory and deviation from the requirements is a matter of judgment by a competent person. Where any significant deviation is made that could potentially impact safety it would be considered best practice that these are identified within the risk assessment, or elsewhere within the submission as appropriate, highlighting the reason for deviation and detailing any mitigating factors.

Compliance with standards alone should not be evidence of a suitable design.

British Standards Institute

BS 5489-1 Design of Road Lighting Part 1: Lighting of roads and public amenity areas – Code of practice

BS EN 13201 Road Lighting Part 2: Performance requirements

BS EN 60598-1: Luminaires. General requirements and tests

Institution of Lighting Professionals

GN01 – Guidance Notes for the Reduction of Obtrusive Light

PLG03 – Lighting for Subsidiary Roads

PLG23 – Lighting for Cycling Infrastructure

Lighting Landscapes – A Guide to Implementing Successful Lighting Within the Public Realm

GN08 – Guidance Notes on Bats and Artificial Lighting at Night

Society of Light and Lighting

LG6 The Exterior Environment

LG9 Lighting for Communal Residential Buildings

LG21 Protecting the Nighttime Environment

International Commission on Illumination

Documents relevant to larger urban projects

CIE 234 - Guide To The Lighting of Urban Areas

CIE 136 - Guide to Urban Lighting Master planning

Glossary of Technical Terms / Definitions

Adaptation: See vision below

ALAN: Artificial Light at Night

CDM: Construction Design and Management Regulations. Health and safety regulations relating to construction projects

Colour Rendering: The measure of how accurately colours appear under a given light source

Colour Temperature: CT or CCT measured in Kelvin (K) The measure of the 'colour' or warmth of white light

Glare: See vision, page 31.

Glare Class: Predominantly relating to street lighting the glare class measures performance of a luminaire with respect to glare. There are six categories G1 – G6 with G6 signifying the minimum level of glare. Most street lighting installations will use luminaires with a glare rating of G2 / G3 in an urban high brightness area ranging to G6 in a rural environmentally sensitive location.

IK rating: The IK rating of a luminaire identifies how resistant the fitting is to impact and is useful to assess robustness against vandalism. IK ratings range from 1 to 10 with 10 being the highest impact resistance (20 Joules or the equivalent of 5kg weight dropped from a height of 400mm). Note: Not to be confused with the IP rating which refers to the ability of the luminaire to resist ingress of water or dust.

Illuminance: The measure of light landing on a horizontal or vertical surface measured in Lux. (Lumen / square meter or lm / m²) Used for the calculation of light levels in public space and in areas where pedestrian and vehicular traffic share the space, (conflict areas). The lighting standards identify average illuminance figures based on criteria such as environmental zone and footfall which are reflected in the lighting class that a lighting designer will identify as part of the design process.

Isolux or Illuminance Plots: These are the drawings produced by lighting calculation software to identify how light will be distributed across a space. They are used in the design process to ensure lighting will comply with the lighting class or standard identified.

Legible Space: Space in which it is easy to identify all the elements that make up the space, route, or connection. For example, paths or routes, buildings, entrances or other destinations, planting, street furniture and other amenities or facilities. Legible space will include contrasting areas and lighting that coordinates with architecture, landscape and scale, to provide character and ambiance that will give the space its identity.

Lighting Class: Lighting classes are a set of criteria laid out in the British Standards that describes the design parameters for a lighting scheme based on the nature of the place to be lit. Typically they define the illuminance, uniformity levels and other data that are required to carry out lighting calculations and may appear within the technical drawings or specification documents prepared for a project. There are three types of lighting class; P Classes that refer to pedestrian routes and spaces, and subsidiary roads. M Classes that refer

to vehicular routes and C Class which are described as conflict areas where pedestrian and vehicular traffic may share a space or other locations where pedestrians may be considered to be of higher risk. In simple terms the lighting class is selected on the basis of footfall, volume of traffic and traffic speed. Not all schemes will be allocated a lighting class.

Lumen: In simple terms this figure represents the amount of light emitted by a luminaire.

Luminaire: A light fitting or fixture sometimes also referred to as a lantern or lamp.

Luminance: (measured in candela per square metre or Cd / m^2) The measure of light reflected from a surface, mainly used with respect to road lighting calculations. Note: candela is similar to lumen with respect to representing the amount of light emitted by a light source.

Lux: See Illuminance

Obtrusive Light: Any light that is uncontrolled and impacts people or the environment in a negative way. This includes light spill into spaces that should remain dark, into the interior of buildings, or onto adjacent properties. It also relates to glare or excessively bright light sources. Uncontrolled light spill upwards causes light pollution and skyglow.

Optical or Photometric Performance: The way the light is distributed when emitted from a luminaire. A road lighting luminaire will give an elliptical distribution along a road, a symmetrical fitting will produce light equally in all directions and an asymmetric light mostly in one direction. Each luminaire will have a photometric distribution that can be used when calculating illuminance plots.

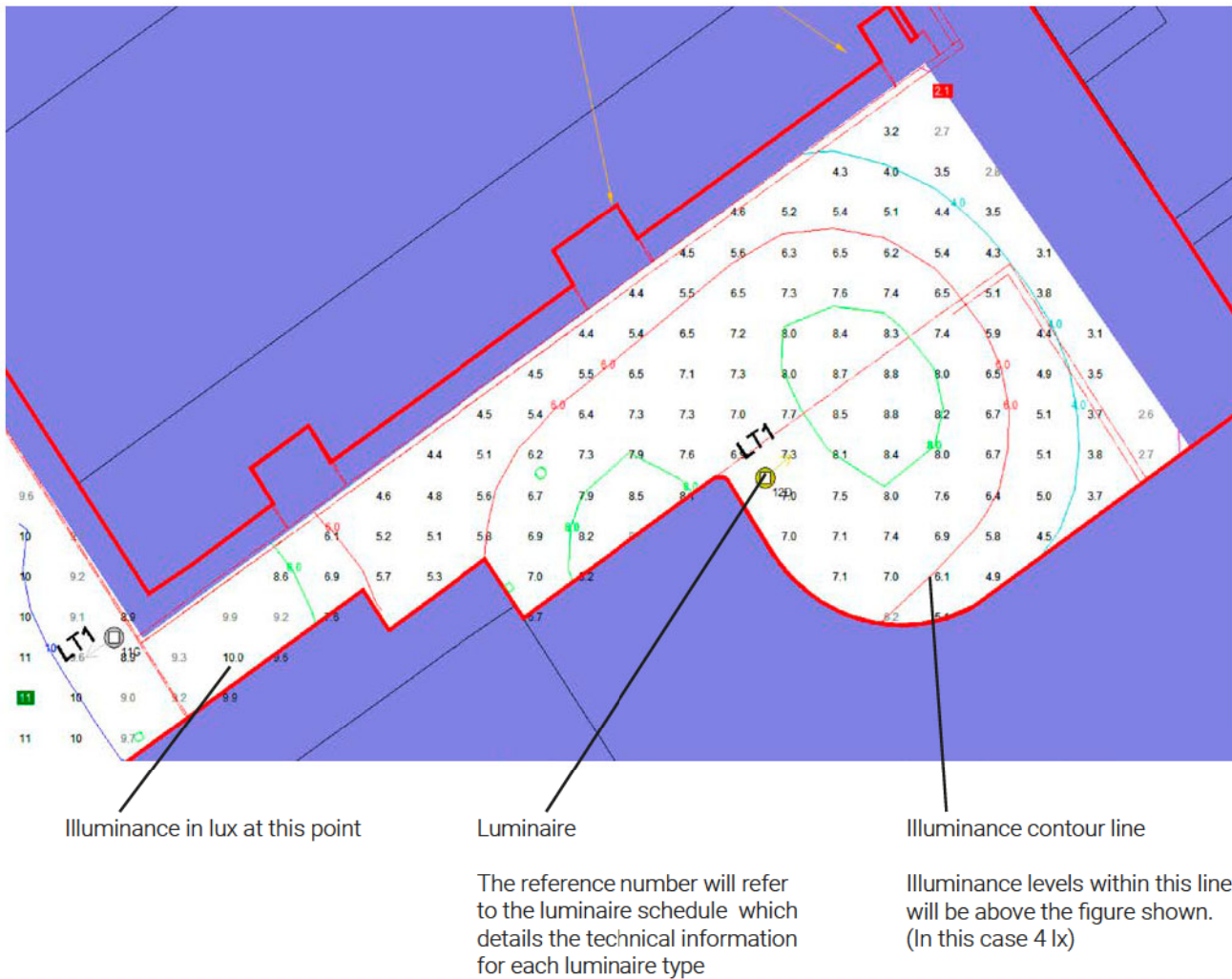
Placemaking: Is an urban design principle that describes the process of creating quality places that people want to live, work, play and learn in. It prioritises people and infrastructure, promoting social interaction and cultural exchange.

Public space: Any space within the development where residents or visitors gather or use to move around the site. This includes spaces open to the general public, semi-private space predominantly for residents but where access is not restricted and private space restricted to residents only.

ROLAN: Responsible Outdoor Lighting at Night.

Uniformity: U_o . The measure of how even and consistent lighting is. In terms of public realm uniformity it is a ratio of the minimum illuminance compared to the average illuminance within a space. Typical high uniformity will be around 0.4 or higher, for general spaces 0.25 would be typical. In low-risk areas, parks or public gardens uniformity will be lower, or may not be specified at all.

Reading an Illuminance Plot



Eav	Average illuminance (lx)	=	6.74
Emin	Minimum illuminance	=	2.12
Emax	Maximum illuminance	=	10.85
Emin / Eav	Uniformity Uo	=	0.31

Vision

In essence, the human eye consists of a lens to focus light onto the retina at the back of the eye, the iris then regulates the amount of light entering the eye and receptors (rods and cones) send visual information to the brain where it is processed.

The rods and cones process colour information in *specific* ways and respond differently to *variations in* light levels. These responses are described using three types of vision:

Photopic Vision: Applicable in high light levels; daylight, most interior lighting and bright external lighting. Photopic vision is high resolution and colours are perceived clearly.

Scotopic Vision: Applicable in very dark situations such as a dimly moonlit night. Scotopic vision is low resolution and colours are perceived only as shades of grey.

Mesopic Vision: In between photopic and scotopic is mesopic vision that functions at intermediate levels, for example at twilight or dusk. Most exterior lighting applications fit into the mesopic category shifting to photopic where brighter illumination is used. As light levels decrease and vision shifts from photopic to mesopic, colour vision and resolution both begin to deteriorate.

This is an important factor when determining design criteria for light levels and colour rendering performance of light sources. As people age visual performance decreases. Older people generally require higher levels of illumination to maintain the same level of visual performance function.

Adaptation

The human eye is capable of vision across a huge scale of different intensities of light (luminance). It can do this by the process of adaption which adjusts the sensitivity of the vision system to changes in light intensity.

This process is partly regulated by the pupil controlling the amount of light entering the eye, but also by chemical changes within the eye itself and neural processes within the brain. Whilst adaption occurs relatively quickly for small changes in luminance, large changes can take several minutes.

It is important to consider adaption when looking at transitions between brightly illuminated spaces and dimly lit ones, for example leaving a brightly lit street and entering a low-level park or garden, or leaving a brightly lit interior onto a dim street. In extreme circumstances this can be disorientating and can impact orientation or the ability to see hazards efficiently.

Glare

Glare can be caused by either peripheral or a direct view of a bright light source. There are two primary categories of glare that impact the public realm:

Discomfort Glare: Glare that causes annoyance or discomfort but does not impact on visual performance. Discomfort glare in a public space can have a detrimental impact on the perception, character, and enjoyment of the space.

Disability Glare: Affects visual performance and can cause visual confusion. Disability glare can interfere with the contrast of an illuminated scene, interfere with the adaptation process or if caused by light scatter within the eye, can produce a veil across the field of vision. Even minimal glare from light sources can make a space appear darker than it is, be distracting or contribute to visual confusion.

Glare of any form can be especially problematic for people with visual impairment, masking trip hazards or making mild impairments significantly worse. Due to the deterioration of vision with age, older people are also more susceptible to the effects of glare.

Appendix 1.

Lighting Design Submission Checklist

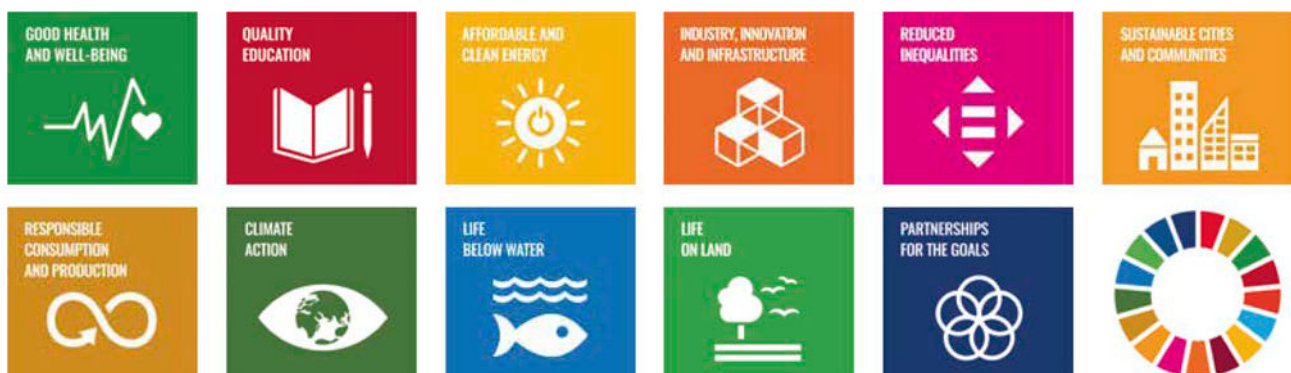
	Evidence to be provide by designers	Assessment / Requirements
Risk assessments	Larger or complex schemes - Formal risk assessment using an established format identifying all specific hazards, mitigation and residual risks. Smaller or simple schemes - A written statement identifying primary risks and mitigating actions.	Do the proposals identify all of the potential hazards that the lighting design should address? Are the mitigating actions adequate to address the risks? Are any remaining residual risks acceptable?
Competence	A written statement identifying relevant practice experience. Designers or supervisors accreditations or qualifications.	Is the experience relevant to the specific nature of the project? Do qualifications and accreditation support the requirements of the project?
High risk areas	The submitted design information should support the risk assessments and address any mitigation against risk they propose.	Are all high risk areas or locations identified suitably addressed within the final design proposals?
Consultation and compliance with other disciplines or planning authority requirements	The submitted design information should, where appropriate, evidence coordination with relevant requirements of other consultants, contractors or the planning authority with respect to safety or security. For example lighting requirements for CCTV installations. A written statement identifying any deviations from requirements identified including justifications or evidence as to why these have not been implemented.	Does the design take into account the design considerations required to coordinate the scheme fully? Note – It is not always appropriate that requirements are met, but in these circumstances the designer should provide statements and or evidence as to why this is considered unnecessary.
Placemaking and way-finding	Where appropriate the scheme should apply the principles outlined in the guidance with respect to creating legible and comfortable space.	Does the scheme address the perception of safety within nighttime public space creating comfortable and legible space that is easily navigated.
Standards and Guidance	The submission should identify the standards and guidance applied in the preparation of the design.	Are the standards applied appropriate and relevant?

Appendix 2. ROLAN

ROLAN Manifesto for lighting professionals

The Responsible Outdoor Lighting At Night (ROLAN) Manifesto sets out ten core principles for external illumination and a plan of action to implement positive change in the lighting community to lead to a more sustainable, healthier, and safer future for all.

1. Everyone should have the right to access darkness and quality lighting, and light needs to be used and distributed fairly without discrimination.
2. Start your design with darkness and only add light if it supports nocturnal placemaking and protects a view of the stars.
3. In all projects, strive to maximise the benefits of outdoor light at night by creating legible, safe spaces and journeys, simultaneously limiting each project's environmental and financial costs.
4. Apply the Five Principles of Responsible Outdoor Lighting in all lighting projects:
 - All light should have a clear purpose.
 - Light should be directed only to where it is needed.
 - Light should be no brighter than necessary.
 - Light should be dimmed down or turned off when not required.
 - Use warmer colour lights where possible.
5. Collaborate with researchers from different disciplines and specialties, such as astronomers, ecologists, biologists, lawyers, etc., so they can provide expertise on unfamiliar topics.
6. Educate your clients about the importance of ROLAN.
7. Ensure the community you work with is an active stakeholder and participant in all lighting projects. Enquire about their needs and wishes at night, and provide them with access to information to make informed decisions.
8. Embrace technology by asking for support from the lighting industry to ensure that nighttime biodiversity is sustained, and energy consumption is reduced. Engage with the lighting design industry to deliver an appropriate lighting solution.
9. A circular economy should be integrated into the brief, design, specification, and manufacturing process of your project, as well as its installation.
10. After project completion, visit the site at night with community stakeholders, to verify that your lighting design was fully implemented and meets ROLAN principles.



Because the UN Sustainable Development Goals (above) do not explicitly refer to external illumination and its multiple impacts, the Founding Partners of the ROLAN movement, are keen to address this in support of the SDG Goals. By following the principles outlined in the ROLAN manifesto, governments, businesses, and individuals support the implementation of the following SDG.

The principal authors of the ROLAN Manifesto are Dr Karolina M. Zielinska-Dabkowska - the ILLUME research group/the Gdansk University of Technology; and Ruskin Hartley - the International Dark-Sky Association, with contributions and support from further Founding Partners: the Society of Light and Lighting (SLL), the International Association of Lighting Designers (IALD), the Illuminating Engineering Society (IES), the Institution of Lighting Professionals (ILP) and the Lighting Industry Association (LIA).

If your organisation would like to support ROLAN movement, please contact: k.zielinska-dabkowska@pg.edu.pl

Acknowledgments

Graham Festenstein CEng FILP FSLL (lead author) and Peter Kane Police CPI

The contributions of the following are gratefully noted:

Ellie Coombs MSLL - Nulty

Phil Rose IALD - Speirs Major Light Architecture

With additional contributions from

Melissa Byers - Michael Grubb Studio

Colin Davis, Architect – Studio Partington

Terry Felstead FILP DMS

Aftab Khan I Eng FILP MIET - Amey

Richard Partington, Architect – Studio Partington

James Poore FSLL FRSA AMRIBA AMILP – Regional Director Aecom

Dr Don Slater – LSE Configuring Light / Staging The Social Research Group

Reviewed on behalf of the Institution of Lighting Professionals by:

Emily Bolt BEng (hons) CEng MILP MIET – VP Technical

EUR ING Guy Harding BSc CEng FILP FSLL – Technical Manager ILP

