Bryniau Clwyd a Dyffryn Dyfrdwy
Clwydian Range and Dee Valley

Awyr Dywyll
Dark Skies

Planning for Dark Night Skies

Supplementary Planning Guidance for lighting in the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty

Draft for consultation

April 2021

Planning for dark night skies

Supplementary Planning Guidance for lighting in the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty

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Mae'r ddogfen hefyd ar gael yn Gymraeg / This document is also available in Welsh

This draft version of the Guide will be subject to full public and stakeholder consultation. We will consider all representations made during this process in the formation of the final version ready for adoption by the respective Councils.

Glossary

Ambient light		The light that is already present before the introduction of any additional lighting.
Building Luminance		Light reflected from the surface of a building, often used to create a sese of place or highlight architectural features.
Candela	cd	A measure of luminous intensity, the intensity of light in each direction.
Colour temperature		Measured in Kelvins, the standard method for measuring the colour of light emitted from a lamp. It correlates to the effects of heating a piece of steel. Steel will glow a different colour depending on the temperature applied. It varies from a warm red, through yellow to amber then white and finally a cool blueish white.
Dark Sky Discovery Sites	DSDS	Local places that allow good access to observe the dark sky.
Glare		The uncomfortable brightness of a light source when viewed against a contrasting darker background.
Intrusive light		Light spilling beyond the intended task area.
Isolux		A line of equal illumination (it is like an Isobar, which is a line of equal barometric pressure found on a weather map, or to an Isotherm, which is a line of equal temperature found in nature or science).
Kelvin Scale	K	A measure of temperature, especially extreme temperatures. This includes the temperature of a light bulb filament.
Lumens	Lm	A measure of luminous flux, the total amount of light emitted in all directions by a light source.
Luminaire		A complete electric light unit.
Luminaires – asymmetric		Direct light in a certain path (e.g. Along a road or over a sports pitch) so they only light the task areas.
Luminaires – symmetrical		Direct light in a symmetrical pattern around the unit and are useful for lighting large areas to a high level of uniformity – such as decorative installations.
Luminous		Giving off light.
Lux	Lm/ m^2	A measure of illuminance, the total amount of light that falls on a surface; the higher the Lux value, the brighter a subject appears.
Maintained average illumination	EAv	The average level of light needed on a surface required to do a specific task.
Obtrusive Light		Unwanted light.
Radiance		The glowing light shining from something.
Sky Glow		The general diffuse sheen that is visible in the direction of large cities, airports, and industrial complexes.
Sky Quality Measurement	SQM	A measure of the luminance of the night sky, quantifying the skyglow in units of “magnitudes per square arc-second”. The larger the number, the darker the sky. A reading of 21.00 would indicate a very dark site, while a reading of 16.00 would indicate a light polluted sky.
Spectrum		The different wavelengths of energy produced by a light source (a ‘rainbow’ of colours form white light).

Executive Summary

There is a desire to let people experience the wonder of the night sky above the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty (AONB)

The night sky is amazing to see, it is awesome. One way of delivering this is through the formal recognition of the area as a 'Dark Sky Community'. To win this status we must reduce light pollution. 'Planning for dark night skies' is Supplementary Planning Guidance for lighting in the AONB. The document presents:

- The purpose, scope, and status of the guidance;
- The policy context;
- An introduction to the AONB and Dark Sky Community designations;
- A definition of light pollution and its effects;
- The means of controlling light pollution;
- Lighting design principles;
- A method of assessing the need for lighting; and
- Lighting design advice.

Following adoption by the respective Local Planning Authorities, 'Planning for dark night skies' becomes a material planning consideration when those authorities are making planning decisions within the AONB and its setting.

Artificial light has done much to enhance peoples' use of the night-time environment but it can cause light pollution. Light pollution is the unnecessary brightening of the night sky and this leads to problems. It affects our health and well-being, our safety, and our heritage. It endangers wildlife that needs the dark, and the environment though the over-use of energy and the generation of carbon. Light pollution arises from a lack of thought or attention in the design of development schemes and installation of lighting equipment.

Reducing light pollution delivers many benefits. All living things, including people, adjust their behaviour according to natural light. The cycle of night and day controls Nature's rhythms but in different ways for different things. It is a part of our nature to sleep at night, a dark night sky improves our mental state. We are often safer in natural light conditions, even at night, as impenetrable shadows accompany intense light, and we see less. And under natural conditions, we see our night-sky heritage. Nature benefits. Some wildlife needs the dark to survive, and we save the planet by using less energy and cutting our carbon footprint. We also strengthen our local economy by attracting more visitors; star-gazing is a growth tourism activity.

To control light pollution, all exterior light sources should be 'fully shielded'. That is, a screened light source with its light directed in such a way that there is no emission above the horizontal plane. Never install unshielded bulkhead lights; they waste light in all directions, shining only a small fraction of light to where it is needed. There may be permission for unshielded fittings with small light sources (less than 500 Lm) in special circumstances, but proper upward light control will always be the recommended approach. If the angle of a lighting unit is adjustable, direct it downwards. There should be no light escaping above the horizontal plane. Only light what needs lighting and not neighbouring property.

Switching controls can reduce energy costs and restrict light issues to those times when lighting is necessary (use light sensors, motion sensors, timers or dimmers). Whilst lighting systems typically generate a 'white' light, this includes a range of different tones from a dim orange glow to a blinding blue white. The Kelvin scale (K) measures this range of 'colour temperature'. Lower kelvin lights are cost and energy efficient, safer, better for human health and the natural environment, and contribute less to skyglow. For these reasons, lighting systems affecting the AONB should emit a colour temperature of no more than 3000K.

When designing a lighting scheme, it is important that the design process considers how a proposal will interact with the night-time environment, the likely night-time use, and how site layout planning and design minimises the need for exterior lighting.

Illumination should be appropriate to the surroundings and character of the whole area, not just the site.

Some lighting installations will require planning permission. 'Planning for dark night skies' will help in the selection of the best lighting and in the assessment of such proposals. If the lighting scheme requires planning permission then there must be a lighting plan and assessment. This will likely need the services of a qualified lighting design engineer. The lighting plan must show:

- Where the site is
- The need for the lighting
- The standards to be used

Caer Drewyn Hillfort, Corwen

- The position of all proposed lighting
- The installation details of all proposed lighting (angle, tilt, height)
- The technical specifications of the lighting
- A modelled illuminance plot of the proposal, detailing spill and average illuminance against lighting guidelines.
- Elevation plans showing lines of illumination from lights on walls
- The baseline conditions, including details of any existing lighting or any nearby lighting
- If the proposed lighting exceeds the limits described in 'Planning for dark night skies'

There is detailed design advice in 'Planning for dark night skies', this includes advice by development type. But many installations need no permission. We hope that everyone will see the benefits of retaining our dark night sky and choose to follow the **Good Lighting Code**:

Think before you light; the right amount of light, where needed, when needed.

Before installing any external light fitting, answer these questions:

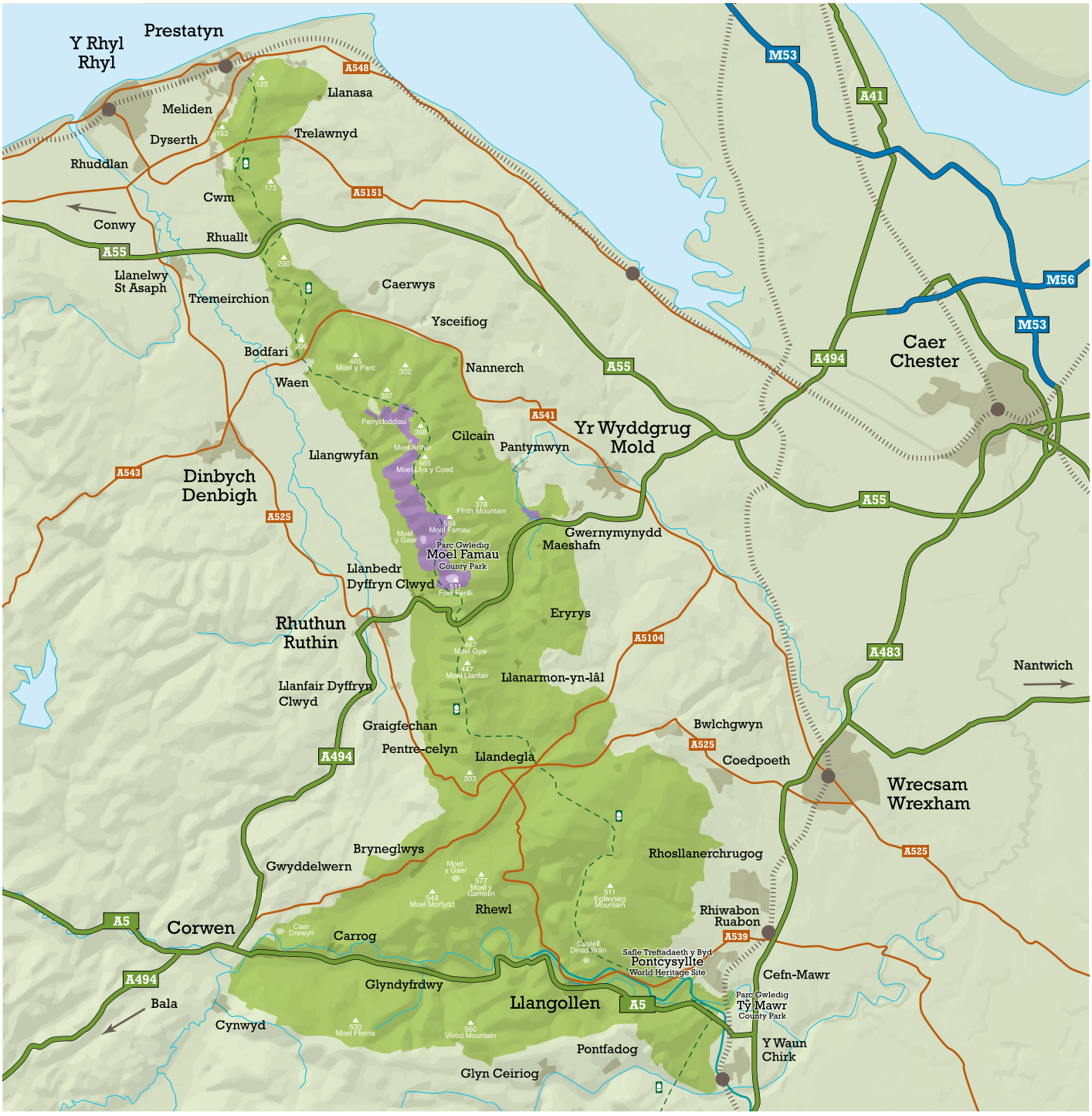
- Do you really need additional lighting?

If yes –

- What is it you must illuminate?
- When must you illuminate it (can you use a time switch or motion sensor)?
- What is the dimmest light source you can use (is this below the level set out in the guidance)?
- What is the colour temperature of the light source (it should throw a soft white glow and be less than 3000 Kelvin)?
- How will you make sure that you do not illuminate anything else (orientation, shielding, tilt of the light)?
- How will you avoid any light spilling into the night-sky (angle fitting downward to a non-reflective surface)?

Clwydian Range and Dee Valley AONB

Figure 1



Clwydian Range and Dee Valley AONB

1. Introduction

"No sight is more provocative of awe than is the night sky"

Llewelyn Powys

Purpose and scope of this Supplementary Planning Guidance

1.1. The Clwydian Range and Dee Valley Area of Outstanding Natural Beauty (AONB) covers part of the counties of Denbighshire, Flintshire and Wrexham. Each county has a principal council that is the local planning authority. These local planning authorities each have a Development Plan that is their policy base for planning decisions. The intention of 'Planning for dark night skies' (the Guidance) is to provide Supplementary Planning Guidance (SPG) in amplification of those Development Plan policies that seek to conserve and enhance the AONB and deliver distinctive and natural places.

1.2. This Guidance is for individuals proposing new development and for decision makers involved in the management of the AONB. It sets out guidance to lighting design for the protection of the dark night sky of the Clwydian Range and Dee Valley AONB. The Guidance enables developers and planners to design, submit and assess lighting schemes that are appropriate to the landscape, whether planning permission is a requirement or not.

1.3. There is no specific statement on what proposals may need planning permission as reliable advice is available elsewhere. Before considering any new development, it would be advisable to seek professional assistance from a planning agent or architect, to ascertain whether there is a need for planning permission or any other consents, such as works affecting public rights of way or highways. If there is a requirement for planning permission, prospective applicants may wish to obtain further advice from their local planning authority by submitting a pre-application request for advice before embarking on a formal planning application. Further information is available from individual authorities. The contact details for planning departments and the AONB are set out in **Appendix 1**, together with a map showing the respective local authority areas within the AONB.

The Area of Outstanding Natural Beauty

1.4. The Countryside and Rights of Way Act 2000 states that the primary purpose of an AONB designation is to conserve and enhance its natural beauty. Planning authorities have a statutory duty to have regard to the AONB's purpose. This duty applies in relation to all activities affecting the AONB, whether those activities lie within, or in the setting of, the designated area. The planning authorities should also have regard to the identified special qualities of the AONB. The AONB "must be afforded the highest status of protection from inappropriate development", which is identical to the protection afforded to National Parks. National planning policies in Wales underpin the statutory designation of the AONB (Planning Policy Wales Edition 10, December 2018). Chapter 6 addresses AONBs. AONBs should be drivers of the sustainable use and management of natural resources in their areas. Planning authorities should have regard to their identified special qualities.

1.5. The initial designation of the Clwydian Range as an AONB was in 1985. In 2011, the Welsh Government extended the area to include the Dee Valley (Figure 1). Within the Dee Valley, there also lies a part of the Pontcysyllte Aqueduct & Canal World Heritage Site (inscribed in 2009). A Joint Committee of the counties of Denbighshire, Flintshire and Wrexham oversees the management of the AONB. That committee produces a statutory AONB Management Plan on behalf of the three councils. This plan sets out the local authority's policies for the AONB and the means of achieving them. It also defines the special qualities of the area, one of which is tranquillity. In the plan, tranquillity is associated with an atmosphere of calm and stillness; peace and quiet; and with dark night skies.

Policy context

1.6. The Guidance takes account of the most recent changes to the legislative and strategic planning context that have arisen at both national and local level. This includes the current version of Planning Policy Wales and supporting Technical Advice Notes (TANs) produced by the Welsh Government. It also builds on the AONB Management Plan (2014) but this plan is currently under review; the review will strengthen Dark Night Sky policies and objectives.

NATIONAL POLICY

1.7. The Environment (Wales) Act 2016[1] introduces the Sustainable Management of Natural Resources (SNMR) and sets out a framework to achieve this as part of decision-making. The objective of the SMNR is to maintain and enhance the resilience of ecosystems and the benefits that they provide. The Environment Act also sets a legal target of reducing greenhouse gas emissions by at least 80% by 2050.

1.8. Planning Policy Wales (Edition 10, December 2018)[2] refers to light pollution in Chapter 6. It recognises the need to balance the adverse impacts of lighting on the environment, amenity and wildlife with the need to provide security and enable night-time recreational and sporting events to take place with the need to:

- protect the natural and historic environment including wildlife and features of the natural environment such as tranquillity;
- retain dark skies where appropriate;
- prevent glare and respect the amenity of neighbouring land uses; and
- reduce the carbon emissions associated with lighting.

It notes that dark sky reserves can contribute positively to an area in economic and environmental terms. The advice to planning authorities is to adopt policies for lighting, including the control of light pollution, in their development plans.

LOCAL POLICY

1.9. Development Plans set out the proposals of the local planning authority for future development and use of land in their area and which areas need to be protected for their environmental qualities. After adoption, the plan forms the basis of planning decisions that the local planning authority makes.

Bryn Alyn

1.10. The Institute of Lighting Professionals (ILP) recommends that Local Planning Authorities specify environmental zones for exterior lighting control within their Development Plans. It presents guidance for reducing obtrusive light (ILP 2020 Guidance Note 01). This guidance is set out in Section 5.

1.11. In addition, the AONB Management Plan provides a framework to inform and guide anyone who undertakes activities within the area.

Status of the Guidance

1.12. Following adoption by the respective Local Planning Authorities, 'Planning for dark night skies' becomes a material planning consideration when those authorities are making planning decisions within the AONB and its setting. It is Supplementary Planning Guidance to amplify the following Development Plan Policies:

Denbighshire LDP 2006-2021 (adopted 2013)

- Policy VOE2: Area of Outstanding Natural Beauty and Area of Outstanding Beauty
- Policy VOE3: Pontcysyllte Aqueduct and Canal World Heritage Site
- Policy RD1: Sustainable development and good design

Denbighshire Local Development Plan 2018 – 2033 Draft Preferred Strategy May 2019 (not yet adopted)

- Draft Key Policy: Placemaking
- Draft Key Policy: Natural & Built Environment

Flintshire UDP 2000-2015 (adopted 2011)

- Policy L2: Area of Outstanding Natural Beauty
- Policy D2: Design
- Policy D4: Outdoor Lighting
- Policy EWP13: Nuisance

Flintshire LDP 2015-2030: Deposit Plan September 2019 (not yet adopted)

- Strategic Policy STR10: Tourism, Culture, and Leisure
- Strategic Policy STR13: Natural and Built Environment, Green Networks and Infrastructure
- Strategic Policy STR14: Climate Change and Environmental Protection
- Policy PC2: General Requirements for Development
- Policy PC3: Design
- Policy EN5: Area of Outstanding Natural Beauty
- Policy EN18: Pollution and Nuisance

Wrexham UDP 1996 – 2011 (adopted 2005)

- Policy EC5: Special Landscape Areas
- Policy CLF4: Playing Fields, Children's Play Areas and Open Space

1. https://www.legislation.gov.uk/anaw/2016/3/contents/enacted
2. https://gov.wales/sites/default/files/publications/2019-02/planning-policy-wales-edition-10.pdf

Note paragraph 5.7: Area of Outstanding Natural Beauty

Wrexham LDP 2013-2028 Deposit Plan April 2018 (not yet adopted)
- Policy SP15: Natural Environment
- Policy DM1: Development Management Considerations
- Policy NE4: Area of Outstanding Natural Beauty

The text of these polices is set out in **Appendix 2**. Further information on planning policies and procedures of individual authorities are available on their websites.

Clwydian Range and Dee Valley AONB Management Plan (confirmed 2014[3])

1.13. The AONB Management Plan defines **'Tranquillity'** as one of the area's special qualities. It states:

"tranquillity is associated with an atmosphere of calm and stillness; peace and quiet; and with dark night skies"

Objective LQCO4 seeks to conserve this quality: *"Protect the tranquillity of the AONB and take steps where possible to reduce noise and light pollution".*

To view the AONB Management Plan go to: http://www.clwydianrangeanddeevalleyaonb.org.uk/plans-and-strategies

1.14. Designers, developers, landowners and relevant organisations **must have regard to 'Planning for dark night skies'** when preparing their plans, proposals or strategies. Local authority planning officers will also assess development proposals against the principles outlined in this document together with other material planning considerations. Lighting is only one consideration in the assessment of planning applications. Applicants will need to demonstrate compliance with other policies in the LDPs and with national guidance and other material considerations when applying for planning permission.

1.15. The Councils will continue to monitor the effectiveness of the Guidance through LDP monitoring and planning application feedback questionnaires. The AONB Joint Committee sets out its monitoring indicators in **Appendix 3**.

Dark Sky Community designation

1.16. The Councils are seeking the formal recognition of the Clwydian Range and Dee Valley AONB as a 'Dark Sky Community' from the International Dark Sky Association (IDA). That Association defines a Dark Sky Community as:

"a town, city, municipality or other similar political entity that has shown exceptional dedication to the preservation of the night sky through the implementation and enforcement of quality lighting policies, dark sky education and citizen support of the ideal of dark skies."

Achieving this designation brings recognition of the efforts made by the community to protect the night sky and the nocturnal environment dependent on it.

1.17. This recognition requires:

- a suite of minimum standards for permanent lighting installations in the AONB;
- community commitment to dark skies and quality lighting;
- demonstrated success in light pollution control; and
- a sky brightness measurement programme to monitor light pollution in the area.
- **1.18.** This SPG covers the following matters:
- Overview of the importance of conserving the dark night sky;
- Lighting terminology and light pollution impacts;
- What to consider in a lighting assessment;
- Replacement of existing lighting installations; and
- Best practice for all lighting, domestic and non-domestic.

1.19. Reducing light pollution delivers many benefits. All living things, including people, adjust their behaviour according to natural light. The cycle of night and day controls Nature's rhythms but in different ways for different things. It is a part of our nature to sleep at night, a dark night sky improves our mental state. We are often safer in natural light conditions, even at night, as impenetrable shadows accompany intense light, and we see less. And under natural conditions, we see our night-sky heritage. Nature benefits. Some wildlife needs the dark to survive, and we save the planet by using less energy and cutting our carbon footprint. We also strengthen our local economy by attracting more visitors; star-gazing is a growth tourism activity.

1.20. The Guidance does not seek to eliminate or ban lighting within Clwydian Range and Dee Valley AONB. The Councils recognise that there is a duty of care for developments to include lighting to meet health and safety requirements and other legitimate needs. However, maintaining the dark sky environment relies on good lighting design that is appropriate to the rural setting and that does not cause light pollution. Degrading the dark sky environment will damage the special qualities of the AONB. Also, the Councils will seek to prevent statutory nuisances where lighting forms part of a planning permission and may seek to regulate light as part of planning conditions and obligations.

1.21. All lighting installations in the AONB should apply best practice to reduce light pollution and impacts on the dark sky. To minimize the harmful effects of light pollution, follow the **Good Lighting Code**:

'Think before you light; the right amount of light, where needed, when needed.'

3. The AONB Management Plan is currently under review. It is the intention that the review (among other things) will strengthen policies and objectives relating to Dark Sky Community Status.

Castell Dinas Brân

2. Dark Sky and light pollution

"There are two kinds of light – the glow that illuminates, and the glare that obscures"

James Thurber 1894–1961 Lanterns and Lances

What is light pollution?

2.1. All living things adjust their behaviour according to natural light. The invention of artificial light has done much to safeguard and enhance our night-time environment but, if not properly controlled, obtrusive light (known as light pollution) can present serious physiological and ecological problems. Light pollution arises from a lack of thought or attention in the design of development schemes and installation of lighting equipment.

2.2. There are three general types of light pollution:

- **Sky glow** – This is the glow that is visible around urban areas resulting from the scattering of artificial light. Sky glow is light from reflected surfaces and badly directed light sources illuminating air molecules and other particles. A major effect of sky glow at night is to reduce contrast in the sky. This is the most pervasive form of light pollution and can affect areas many miles from the original light source. Light directed at the near horizontal is the most damaging as it travels furthest and lowest through the atmosphere; pointing lights downward avoids this.
- **Glare** – the uncomfortable brightness of a light source when viewed against a contrasting darker background. Glare forms a veil of luminance from poorly controlled and directed lighting that reduces contrast and visibility. To road users, glare can be highly dangerous. Lights in the rural, darker area of the AONB will be relatively higher in glare than in urban areas causing impacts on night time landscape tranquillity.
- **Nuisance / intrusion** – the spilling of light beyond the area or property being lit. Light nuisance can include intrusion into windows of neighbouring properties, but it can also cause issues to habitats and areas of high biodiversity interest.

Sky glow

Glare

Nuisance/intrusion

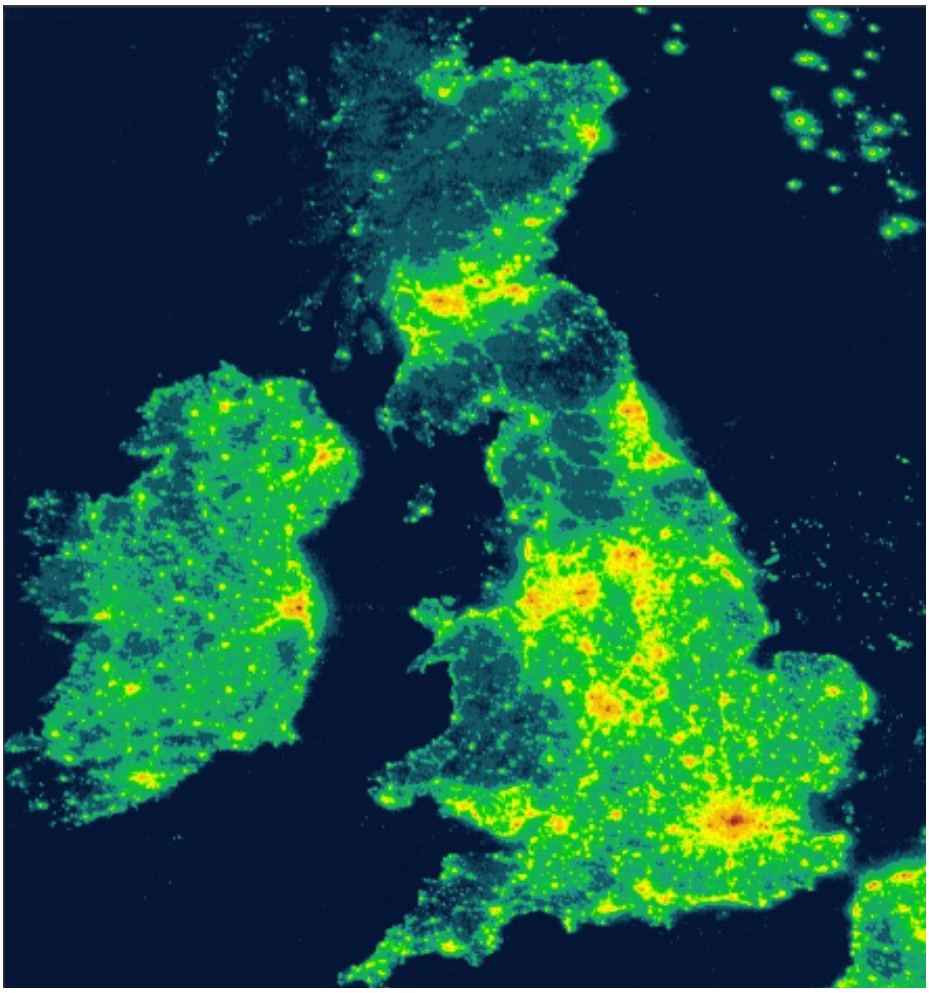
Effects of light pollution

2.3. Light pollution in the UK has increased significantly in recent years (up 24% between 1993 and 2000). Over 90% of UK population now live under a highly polluted sky. As light pollution increases, the opportunities to enjoy the night sky and its stars are declining.

2.4. Excessive or inappropriate lighting can harm our health and well-being; and harm the natural environment. For example:

- **Health** – Light pollution impacts on human sleep patterns with links to obesity, depression, diabetes, and cancer.
- **Tranquillity** – Obtrusive lighting can reduce the perception of tranquillity. This reduces the feeling of general well-being and self-reported levels of health.
- **Nature** – Plants and animals depend on Earth's daily cycle of light and dark rhythm to govern life-sustaining behaviours such as reproduction, nourishment, sleep and protection from predators. Artificial light at night has negative and deadly effects on many creatures.
- **Climate** – Reducing light levels will save energy and reduce carbon emissions.
- **Economy** – Dark Sky status can support a tourist economy where the quality of the skies is an important part of the tourism offer. Reducing light levels can also save money.
- **Crime and safety** – There is no proven link between lighting levels and crime rates. Crime is a societal problem, not a lighting problem.

Figure 2: Image of light pollution in the UK



2.5. Light pollution has been demonstrated to disrupt human Circadian rhythm ('body clocks'), with consequences including loss of attention, increased stress and fatigue. Recent studies have linked particularly blue-rich lighting with the supressing of melatonin production – the hormone that regulates the human sleep-wake cycle.

2.6. Tranquillity is not a characteristic of the environment itself but rather a 'state of mind'; a perception by the observer. It is the quality of calm experienced in places with mainly natural features and activities, free from disturbance from manufactured ones, such as obtrusive lighting and structures. General wellbeing and self-reported overall health are both significantly higher for people who frequently experience tranquil spaces. A recent study found that the well-being value of parks and green spaces is £34.2 billion per year in the UK and it saves the NHS around £111 million per year, primarily due to the reduced number of GP visits. It also found that general wellbeing and self-reported overall health are both significantly higher for those who frequently use parks and green spaces.[4]

2.7. Artificial light can be very disruptive to body clocks of many animal species; but it can also act as a barrier to migration, animal movement and

4. Fields in Trust (2018) Revaluing Parks and Green Spaces. Measuring their economic and wellbeing value to individuals www.fieldsintrust.org/Upload/file/research/Revaluing-Parks-and-Green-Spaces-Report.pdf

ecosystem integrity. Artificial light can alter a species' phenology. For example, lighting affecting the wetland breeding habitat of frogs and toads can disrupt their nocturnal croaking – an important part of their breeding activity – with consequences for reproduction success and population size. Movement by vegetation or wildlife can trigger poorly positioned lights.

2.8. Poor design and/or installation will allow light spill into adjacent areas or the sky where there is no need or use; this is a waste of energy and a loss of efficiency. Whilst new LED systems are reliable and cheap to power, only their effective design and installation will allow their peak operation and efficiency.

2.9. Dark skies are becoming an important aspect for tourism, through landscapes offering unblemished views of the night sky. After its designation as a Dark Sky Park, the tourism authority in Northumberland reported many of the hotels in and close to it witnessed increases in business with visitors especially from urban areas, wishing to see and experience the wonders of the night sky; 2017 figures estimated that dark skies tourism in Northumberland was worth over £25m to the county, supporting around 450 jobs.

2.10. People cite the reduction of outdoor lighting as being responsible for increased crime, anti-social behaviour, and reduced road safety. However, whilst outdoor lighting at night is often meant to enhance safety and security, its overuse and/or poor management can in fact have the opposite effect, impacting adversely upon visibility. Thus, glare from bright, unshielded lights reduces safety by constricting pupils, so impacting on the ability to see and making it more difficult to adjust to low-light conditions. Bright lights can create contrasting dark spots for intruders to hide within, unseen from the outside. Lights can help criminals see what they are doing, and help them to see an escape route in what would otherwise be unfamiliar surroundings. Lighting can mean that intruders do not need to use a torch that would otherwise advertise their presence. A recent study[5] in 62 English and Welsh local authorities found that streetlights do not prevent accidents or crime, but do cost a lot of money. Domestic security lighting can have the opposite effect to that desired.

"Where there is much light the shade is deepest" Johann Wolfgang Von Goethe, Goetz Von Berlichingen

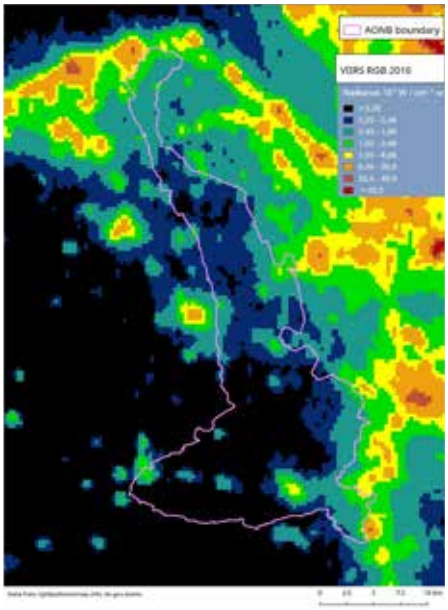
2.11. Tackling light pollution can reduce or avoid the above effects; in addition, sympathetic and energy-efficient lighting can satisfy community needs at lower cost and reduce carbon emissions.

Light pollution in the Clwydian Range and Dee Valley

2.12. The assessment of the quality of the night skies in the AONB uses two complementary studies. There is a desktop examination of light pollution using existing satellite and other data (**Figure 3**). To support the desktop analysis, there is a network of 49 survey points across the AONB. Selection of these points was through a grid system to provide a good representation across the area (listed in **Appendix 4**).

2.13. The dark night sky quality at the majority of the AONB locations monitored is of a very good standard. There are areas of higher light pollution that correspond to the more populated areas with the more rural locations showing better dark sky quality. There is a high incidence of light pollution in the centre of Llangollen, and from holiday parks. Highways lighting is also noticeable. The light spillage from the towns of Mold and Wrexham, as well as Deeside, Chester and Merseyside, affects the quality of the night sky on the eastern edges of the AONB. There are similar impacts in the north from the coastal towns. These have a significant effect upon tranquillity, particularly at night, spilling light into the sky to the north and east of the AONB.

Figure 3: Radiance observed from space 2016



(Source: VIIRS 2019 Satellite imagery. www.Lightpollutionmap.info)

5. Steinbach R, Perkins C, Tompson L, et al The effect of reduced street lighting on road casualties and crime in England and Wales: controlled interrupted time series analysis J Epidemiol Community Health 2015; 69:1118-1124.)

3. Control of light pollution

There are several characteristics of light that describe and assess lighting installations.

3.1. The following metrics describe light quantities and limits (see Figure 4) and include:

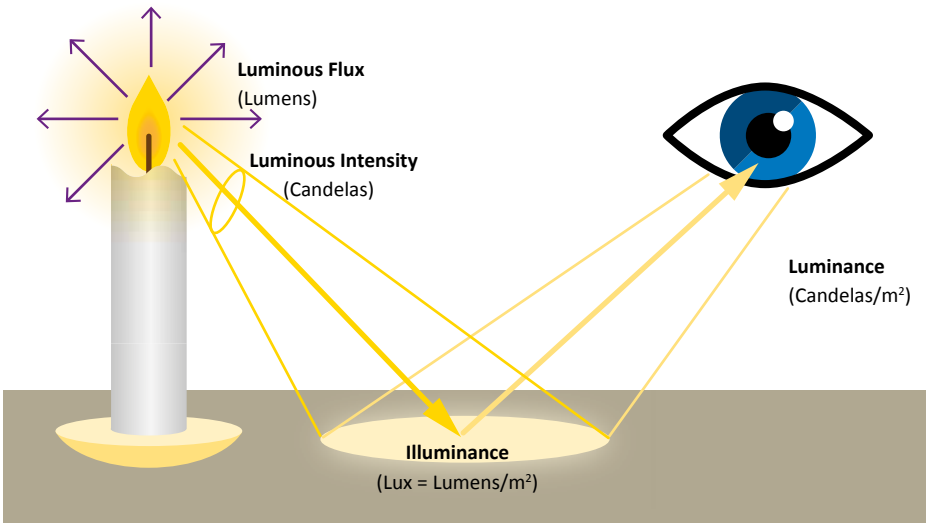
- **Lumens** (Lm) – a measure of luminous flux, the total amount of light emitted in all directions by a light source.
- **Candela** (cd) – a measure of luminous intensity, the intensity of light in each direction.
- **Lux** (Lm/m²) – a measure of illuminance, the total amount of light that falls on a surface; the higher the Lux value, the brighter a subject appears.

3.2. In the Clwydian Range and Dee Valley AONB, any exterior light source of 500Lm (or greater) output will be 'fully shielded'. That is - a screened light source with its light directed in such a way that there is no emission above the horizontal plane passing through its lowest light-emitting part. There may be permission for unshielded fittings with small light sources (less than 500 Lm) in special circumstances, but proper upward light control will always be the recommended approach.

3.1. The following metrics describe light quantities and limits (see Figure 4) and include:

- **Lumens** (Lm) – a measure of luminous flux, the total amount of light emitted in all directions by a light source.
- **Candela** (cd) – a measure of luminous intensity, the intensity of light in each direction.
- **Lux** (Lm/m²) – a measure of illuminance, the total amount of light that falls on a surface; the higher the Lux value, the brighter a subject appears.

Figure 4: Metrics of light



3.3. Outside lights that have the bulb tucked out of sight into the lamp casing, but have a glass bowl beneath, are NOT fully shielded; the light is refracted upwards from the curvature of the glass. Never install unshielded bulkhead lights, of any output; they waste light in all directions, shining only a small fraction of light to where it is needed.

3.4. If the angle of a lighting unit is adjustable, direct it downwards. There should be no light escaping above the horizontal plane. Only light what needs lighting and no neighbouring property.

3.5. Switching controls can reduce energy costs and restrict light issues to those times when lighting is necessary. Integrate switching controls into lighting projects, incorporating at least one of the following:

- Passive Infra-red (PIR) switching with integrated daylight sensing. These systems activate lights for a set time by detecting the presence of a person/ animal after dark. (Note: check that light units with an integrated PIR sensor allow the light to be angled downwards, and the PIR sensor to angled independently in the direction it needs to work.

A separate light unit and PIR sensor may be better.)

- Timer controls to switch off lights until needed.
- Where low-level lighting is necessary use dimmer controls.

Figure 5: Kelvin colour temperature chart

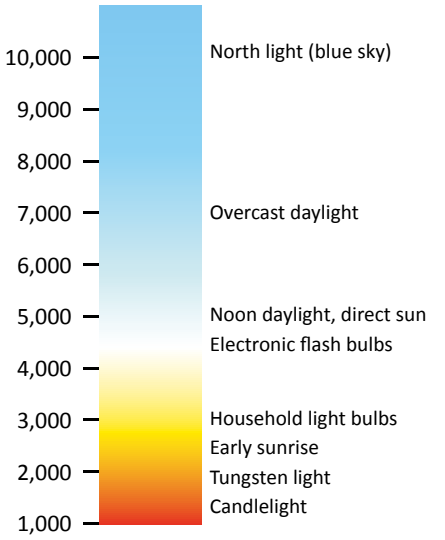


Table 1: Characteristics and purpose of light bulbs

Kelvin (K)	Description	Use
< 2000K	a dim glow of light like that of candlelight	Intimate lighting
2000K-3000K	a soft white glow, often yellow in appearance	Outdoor spaces
3100K-4500K	a bright amount of white light	Normal task lighting
4600K-6500K	a bright amount of blue-white light, like that of day-light	Detailed task lighting
6500K +	a bright bluish hue of light	Blinding lights

3.6. Modern LED technology provides for reliable and energy efficient lighting systems. Whilst lighting systems typically generate a 'white' light, this includes a range of different tones that manufacturers describe using phrases such as 'warm white' or 'cool white'. The Kelvin scale (K) measures this range of 'colour temperature' (see Figure 5 and Table 1).

3.7. High kelvin lighting includes more light in the blue part of the range. This can create a harsh glare, making it difficult to see clearly at night; it may also suppress melatonin production, leading to disrupted sleep and other health risks. High kelvin external lighting can also affect nocturnal wildlife and their habitats, particularly bats.

Lower kelvin lights are cost and energy efficient, safer, better for human health and the natural environment, and contribute less to skyglow.

3.8. For these reasons, lighting systems affecting the Clwydian Range and Dee Valley AONB should emit a colour temperature of no more than 3000K.

Bryn Alyn

4. Lighting Design Principles

Illumination should be appropriate to the surroundings and character of the whole area, not just the site.

4.1. It is important that the design process considers how a proposal will interact with the night-time environment, the likely night-time use, and how site layout planning and design minimises the need for exterior lighting. For example: areas of a development that need higher levels of task lighting such as storage yards, car parks, loading bays, yards outside of farm buildings etc., should be in less visually sensitive intrinsically dark locations, to avoid light being visible beyond the site. Locating these uses behind buildings or within internal courtyards for example might help. The location of lighting to avoid impact is therefore a factor that could influence the layout of buildings and external spaces. Understanding where the public viewpoints of the site are will help in making these decisions. Developers should refer to, and apply, other published professional guidance on the reduction of obtrusive light within projects (see references for links to guidance, especially the Institution of Lighting Professionals publications).

4.2. Table 2 identifies some general lighting principles for any lighting projects affecting the AONB.

Table 2: Clwydian Range and Dee Valley general lighting principles

New lighting should not degrade the night sky quality or night-time tranquillity of the AONB • Direct light to the place of need, not in a direction that disturbs neighbours or wildlife • Angle lights downward, no unnecessary light above or near the horizontal • Lamps of 500 lumens or less are enough for most domestic purposes • Installation of lamps above 500 lumens should always be in dark night sky friendly fixtures that prevent upward light • Switch lights off when not needed, use proximity sensors and timed circuits • Light to the appropriate illuminance, do not needlessly over-light • Avoid bright white and cooler temperature LED's of over 3000 Kelvin • Install fixtures at the lowest possible height to achieve lighting levels • Extinguish or dim external lighting after 2300 hours (curfew time)
Within buildings: • Use and shut curtains and blinds at night • Limit the size of picture windows, or add louvers to reduce the extent of night time illumination, where these are visible from beyond the site • In new builds and replacement buildings, recess and shield internal lighting within ceilings or walls in rooms with picture windows
Note: Lighting design should comply with the obtrusive light limitations set out in Table 5

5. Lighting assessment and design

Some lighting installations will require planning permission. This guide will help in the selection of the best lighting and in the assessment of such proposals.

5.1. Many installations need no permission. We hope that everyone will see the benefits of retaining our dark night sky and choose to follow the lighting design principles (Table 2) and design advice set out in paragraphs 5.4 to 5.3[6].

Lighting assessment

5.2. For those developments where the Planning Authority requires a lighting plan, the design and assessment should aim to address the key points in Table 3. If the lighting scheme requires planning permission then there must be a lighting assessment. This will likely need the services of a qualified lighting design engineer. Pre-application discussions are useful in helping applicants and agents identify what issues to cover and the information needed to support any application for planning permission. This can help minimise delays in processing the application.

5.3. The lighting plan must show:

- Where the site is
- The need for the lighting
- The standards to be used
- The position of all proposed lighting
- The installation details of all proposed lighting (angle, tilt, height)
- Technical specifications of the lighting including isolux , power, lumen output, colour temperature
- A modelled illuminance plot of the proposal, detailing spill and average illuminance against lighting guidelines
- Elevation plans showing lines of illumination from lights on walls
- Baseline conditions, including details of any existing lighting, or any nearby lighting that is providing useful levels of ambient lighting
- If the proposed lighting exceeds the limits described in this document

The following table summarises the questions for a lighting plan to address. There is a paragraph reference to supporting information.

Jubilee Tower, Moel Famau Country Park

6 An Isolux is a line of equal illumination. It is like an Isobar, which is a line of equal barometric pressure found on a weather map, or to an Isotherm, which is a line of equal temperature found in nature or science.

Table 3: Key aspects of a lighting assessment

Whether submitting, designing or assessing applications, the key questions to address are those shown in **bold.**

Aspects		Description	Paragraph
Need			
1	Statement of client needs and parties' comments	**Is the lighting needed?**	5.4
Baseline conditions			
2	Existing lighting environment of the site	• What is the current lighting on site? • How is it used and what for? • Is the current lighting dark sky compliant? • Is there potential for improvement?	5.5 5.6
3	Survey of surrounding night environment	What is the surrounding lighting environment? Is the locality: • Completely dark? (no lighting) • Intrinsically dark? (light sources are rare) (continued)	
3	(continued)	• Intrinsically dark with scattered light sources? (light sources are present but at scattered intervals) • Intrinsically dark with light clusters? (lighting within nucleated rural settlement, farms and rural enterprises, along roads, lighting of sports fields in open countryside)	
4	Identification of critical viewpoints	• Are there 'Dark Sky Discovery Sites' nearby? • Are there any 'Sky Quality Measurement' monitoring points nearby? • Are there any important habitat/wildlife sites nearby? • Is the site visible from any viewpoints, public routes or sites?	5.4 5.7 5.8
5	Determination of the obtrusive light limitations for lighting installations	• What is the maximum acceptable level of Sky Glow? • How much light can spill into a room? • What is the maximum acceptable intensity of each light source? • What is the maximum level of light intended to create a sense of place or to emphasise architectural structures acceptable on a building (building luminance)? **What limitations to Obtrusive Light apply?**	5.12 5.13
Design			
6	Lighting Design Objectives	• What are the general lighting objectives? • What are standards or policies of reference? • Is it an expected design for the task?	
7	Task Illuminance	• What guidance/standards were used to reference lux levels? • What levels of illuminance are to be used and why? **Does the illuminance exceed the Dark Environment limits?**	5.12 5.14

Aspects		Description	Paragraph
Design			
8	Calculated Predictions	A lighting design should include: • A site layout plan showing illuminance and uniformity levels across the site. • Where the intention is to illuminate buildings, elevation drawings showing illuminance and uniformity levels across the site. • A comparison between the maintained averages (EAv) calculation for task lighting areas and the guidance standards. **Are the predicted averages consistent with guidance standards?**	5.14
9	Obtrusive Light Calculation	A design should show: • How it meets the criteria as set out by the ILP protected or natural zones when installed (not as bought) **Do any luminaires exceed any of the ILP natural dark zone limits?**	5.4 5.12
10	Comparison with Baseline Values	• What is the assessment of the expected cumulative impact? **Does the design negatively affect the dark sky environment?**	5.6 5.17
11	Luminaire Schedule	• Luminaire light distribution type • Lamp type and Wattage • Mounting Height • Orientation • Tilt • Lumens • Colour Temperature (CCT) • Spectrum **Does the colour temperature exceed 3000Kelvin?** **Does the tilt when installed exceed ILP guidance?**	5.18 5.19 5.20
12	Mitigation	Are other controls in use to bring design into compliance? Such as: • Curfews • Proximity sensors • Shielding • Baffles and louvres • Infra-red CCTV • Surfaces **Is it possible to make adjustments to prevent harm under astronomically dark conditions?**	5.6 5.21-5.26

Castell Dinas Brân

Design advice

LIGHTING NEED

5.4. From the outset it is important to justify the need for lighting – only consider that which is essential for the task. The Guidance recognises that there is a duty of care for lighting to meet health and safety requirements and other such legitimate needs. However, there is not a need for all lighting. Some is solely for decoration and this may not be appropriate in the AONB. Examples include architectural or 'mood' lighting, illuminated signage or access pathways. There must be proof that lighting proposed as a duty of care is essential - and not justified on a general perception that there is always a need for lighting.

EXISTING LIGHT LEVELS

5.5. Consider existing lighting levels when proposing new installations that illuminate areas. If existing street lighting, safety or security lighting already provides direct lighting on to a task area, then a lighting design must allow for this. Do not add new lighting if existing conditions already provide enough lighting.

OVERALL FOOTPRINT

5.6. Reduce the overall footprint of a lighting design by offsetting against existing lighting that has been poorly installed. The installation of older systems is less likely to be in line with dark sky standards, making an adjustment to comply with the standards is good. This may not need a complete replacement, but an adjustment to a fitting or installation of sensors. Reducing the light pollution of the existing stock may help in lowering the cumulative impact of the proposed lighting, which may present a design more favourably.

DARK SKY DISCOVERY SITES

5.7. Dark Sky Discovery Sites (DSDS) are local places that allow good access to observe the dark sky. DSDS are part of a growing UK network of sites and it is probable that the number in Clwydian Range and Dee Valley AONB will increase soon.

- Llangwyfan
- Moel Arthur
- Bwlch Penbarras
- Horseshoe Falls

SKY QUALITY MEASUREMENT MONITORING POINTS

5.8. The Sky Quality Measurement (SQM) Monitoring Points are easily accessible sites (often roadside). This is where we take SQM measurements as a way of monitoring the dark sky in the AONB. As key observation and meeting points, these need to be free of any direct sources of light pollution. Any lighting installations proposed close to these sites should aim to avoid any illumination towards or within them.

The current SQM points are set out in Appendix 4 but these may change over time. Contact the AONB Team for an UpToDate list, see Appendix 1 for contact details.

5.9. SQM is a measure of the luminance of the night sky, quantifying the skyglow in units of "magnitudes per square arc-second". The larger the number, the darker the sky. A reading of 21.00 would indicate a very dark site, while a reading of 16.00 would indicate a light polluted sky.

BIODIVERSITY

5.10. Lighting plans should weigh up the impacts on biodiversity. The impact of artificial light on wildlife is a growing area of research. Evidence shows that light can be very disruptive to many different species, not just from a disruption to their circadian body clocks, but also as a barrier to migration, movement and ecosystem integrity. Artificial light causes negative phenology adaptions in many species and disrupts the movement of species in an otherwise dark habitat. Whilst any lighting will have some impact on all species and habitats, there are some particular considerations:

BATS:
All bat species are susceptible to impacts from artificial light. There is legal protection for all bat species and it is illegal to kill, capture or disturb bats; obstruct access to bat roost; or to damage/destroy roosts. Lighting in the vicinity of a bat roost could be a disturbance. This includes large scale feature glazing, there is a concern that internal lighting spilling through these windows impacts on bat roosting and foraging. Development proposals should:

- Survey area for bat species/activity
- Not directly illuminate bat roosts
- Avoid illuminating foraging areas and routes
- Review and apply the detailed guidance published by The Institute of Lighting Professionals and the Bat Conservation Trust

BIRDS:
Exposure to artificial light can reduce sleep in birds, disrupting long-term Circadian Rhythm that determine the onset of breeding. Birds are also likely to be influenced by changes in insect behaviour due to artificial lights. Lighting proposals should avoid the direct illumination of important areas for nesting birds.

INVERTEBRATES:
Artificial light can disrupt feeding, breeding and movement that may reduce and fragment invertebrate populations. This disruption can significantly reduce plant pollination rates in lit areas. Lighting design should:

- Avoid illuminating water or reflective surfaces
- Avoid the direct illumination of ecologically sensitive areas
- Use lighting of no more than 3000K
- Review and apply the detailed guidance published by Institute of Lighting Professionals and the Invertebrate Conservation Trust

WILDLIFE SITES:

Artificial lighting may disturb all important wildlife sites.

Wildlife sites include areas of internationally importance (e.g. Special Areas of Conservation), national interest (e.g. Sites of Special Scientific Interest) and local interest (e.g. County Wildlife Sites or Sites of Importance for Nature Conservation).

As the AONB includes a very high concentration of wildlife sites, lighting proposals should note the presence of any nearby sites and avoid their illumination.

Note: artificial light should not fall across existing or proposed bat or bird roosting boxes.

OBTRUSIVE LIGHT

5.11. Obtrusive Light, whether it keeps you awake through a bedroom window or impedes your view of the night sky, is a form of pollution and can be substantially reduced without detriment to the lighting task. The Institute of Lighting Professionals (ILP) presents guidance for reducing obtrusive light (ILP 2020 Guidance Note 01:20). It proposes five environmental zones for exterior lighting control within Development Plans (**Table 4**).

5.12. All development within the Clwydian Range and Dee Valley AONB with external lighting should ensure an **E1 dark lighting environment**. The aim is to reach an average SQM of 20 across the AONB with night-sky viewpoints being 20.5+. These levels will also apply to developments outside of the AONB where their lighting proposals may impact on the sky quality of the AONB. These are recommended limits for the control of the main sources of light pollution – sky glow, glare and light spill. Data from three annual surveys (2017, 2019 and 2020[7]) suggests that the average SQM for the AONB is 20 (**Figure 6** & **Appendix 4**).

5.13. Table 5 sets out the limitations for exterior lighting in the AONB, as seen by a general observer.

MAXIMUM LUX – MAINTAINED AVERAGE ILLUMINATION

5.14. Lux is a measure of light on a surface and it can describe the level of light needed on a surface required to do a specific task. Tasks that need high levels of lighting (e.g. sports) will require greater lux levels than other areas where lower light levels are acceptable (e.g. pedestrian pathways). For nondomestic lighting, the calculation of lux is generally an average (the maintained illuminance (EAv) across a surface) as levels will vary significantly over a large task area. It is important to design a lighting scheme with the correct levels of light.

5.15. Obtaining the right level of lux can be a complex task and is likely to require a lighting engineer to model the design and calculate the average for the task area. A range of design aspects affect the lux level, such as: lamp height and direction; number of lamps; lumen output; and source intensity. Poor design and installation of task lighting may lead to areas being either over or under lit. This can impair its use as well as impact on dark skies. Table 6 provides example lux levels, showing that non-domestic needs require substantially more lighting, which will have a greater impact in darker areas. Compilation of these levels is by the South Downs National Park (2018) and sourced from several guidance documents. In designing a lighting plan, denote the average level of lux (EAv) needed according to standard guidance that recommends levels of lighting for different tasks.

5.16. There are some useful guidance documents in the references. Where there is no specific guidance for a task, reference the most appropriate and similar activity. In some cases, the level of required lux will be so great that the inherent surface illuminance will pose a significant threat to the dark skies landscape - no matter how well the design meets all other criteria. Designs requiring an illuminance greater than 10 lux in most situations in the AONB will produce this threat.

KEY VIEWPOINTS

5.17. There are many key daytime viewpoints across and outside the AONB that serve both the daytime and night. Proposals should consider the impact on these viewpoints, particularly regarding the disruption of the continuity of the dark landscape. Large-scale develop ments are more likely to be outside the AONB. There is a need to consider their impact on dark skies and key viewpoints within the AONB.

''The sea-bird wheeling round it,
with the din of wings and winds and solitary cries,
Blinded and maddened by the light within,
Dashes himself against the glare, and dies''.

Extract from *The Lighthouse* by Henry Wadsworth Longfellow 1849

Table 4: Environmental zones for exterior lighting

Zone		Lighting environment	Example
E0	Protected	Dark (SQM 20⍰5+)	IDA dark sky place
E1	Natural	Dark (SQM 20-20⍰5)	AONB
E2	Rural	Low district brightness (SQM ~15-20)	A village
E3	Suburban	Medium district brightness	Well inhabited settlements
E4	Urban	High district brightness	Town centres with high levels of night-time activity

After Institute of Lighting Professionals guidance notes for reducing obtrusive light 2020

Table 5: Obtrusive light limitations for exterior lighting installations

Zone	Sky Glow ULR [Max%]	Light Intrusion (into windows) E_{Av} [lux]		Luminaire Intensity *I* [candelas]		Building Luminance Pre-curfew
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Average *L* [cd/m²]
E0	0	0	0	0	0	0
E1	0	2	0 (1*)	2500	0	0

KEY

ULR =	Upward Light Ratio of the installation is the maximum permitted percentage of luminaire flux that goes directly into the sky. Some lighting schemes will require the deliberate and careful use of upward light, e.g. ground recessed luminaires, ground mounted floodlights, festive lighting, to which these limits cannot apply. However, care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and light controlling attachments.
E_{Av} =	Vertical Illuminance in Lux – measured flat on the glazing at the centre of the window. (* is ONLY for public road lighting installations)
I =	Light Intensity in Candelas (cd)
L =	Luminance in Candelas per square metre (cd/m2)
Curfew =	the time after which stricter requirements (for the control of obtrusive light) will apply.

For further clarification, refer to the Construction Information Service Guide on the limitation of the effects of obtrusive light from outdoor lighting installations 2017

Figure 6: Illustration of SQM readings in 2017 and 2019

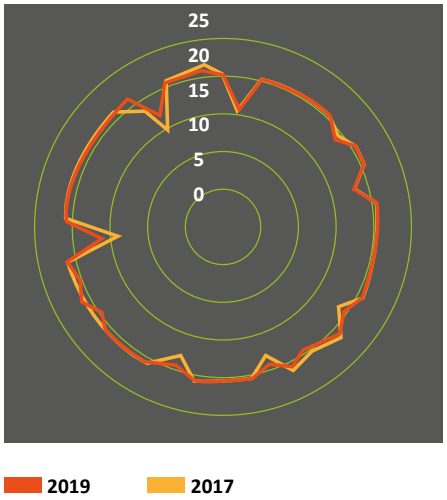
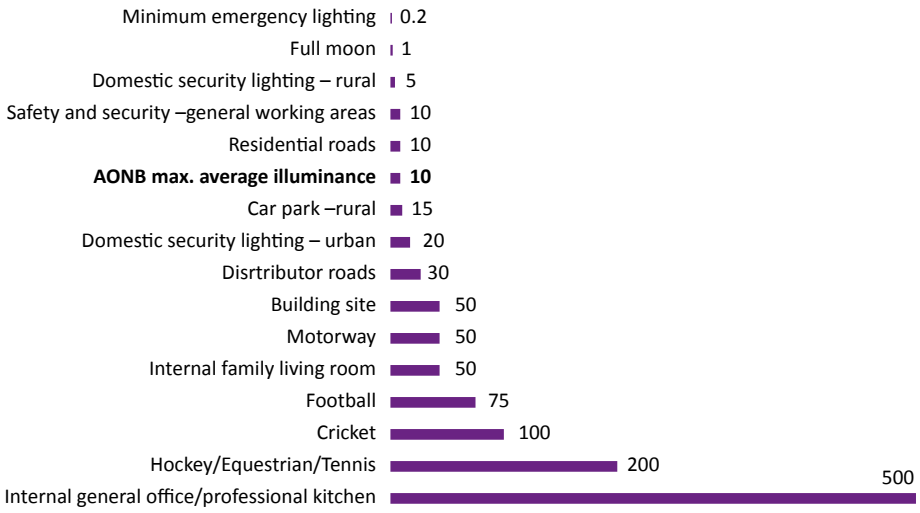


Table 6: Recommended average lux illumination levels



7. Note: during 2020 a full survey was not possible because of the Covid-19 outbreak.

Looking over Llangollen, Dee Valley

Luminaires – Physical Characteristics

SYMMETRICAL AND ASYMMETRICAL LUMINAIRES

5.18. Luminaires fall into two categories:

- Symmetrical luminaires direct light in a symmetrical pattern around the unit and are useful for lighting large areas to a high level of uniformity – such as decorative installations. The design of the enclosure and the choice of materials are critical in ensuring that the unit dos not cause undue levels of obtrusive light. Styles that complement the aesthetic or historic character of the area are better than bulky and 'functional' lighting. However, their design should inhibit all upward light (e.g. there are LED versions of traditional 'carriage style' units that house the lamp under the lid).
- Asymmetric luminaires direct light in a certain path (e.g. along a road or over a sports pitch). Such units allow a design to minimise light spill in unwanted areas and provide high illuminance to specific wanted areas. Many standard security light units have an asymmetric design, so direct the light to the task areas only.

FULL CUT-OFF

5.19. Luminaires can have a variety of glass features that alter the path of light. Their classification is according to the amount of light that shines above the horizontal. They are:

- Non Cut-off: No limitation
- Semi Cut-off: 5% above the horizontal
- Cut-off: 2.5% light above the horizontal
- Full Cut-off: No light above the horizontal – zero upward light.

The recommendation for use throughout the AONB is for full cut-off fixtures, where the glass is flat to the horizontal. This must be the case where the light exceeds 500 lumens. (See **Appendix 5** for examples of Dark Sky Friendly Lighting units).

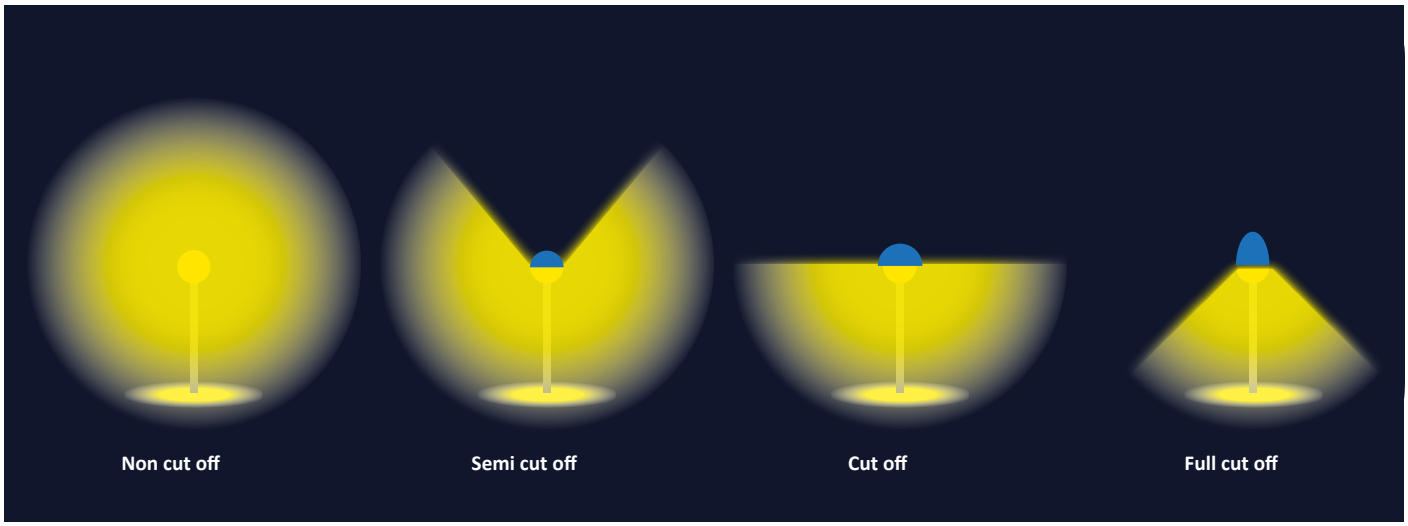
INSTALLATION HEIGHT

5.20. To achieve the same illuminance, light sources further away from the intended subject will require brighter lights with a greater intensity than those closer to the surface. Installations should be as close to ground level as practicably possible. For example, light footpaths with lower powered, low-level bollards or wall lights rather than overhead lighting.

SURFACES

5.21. Choices in surface type can impact on upon the visibility of the installation and the amount of sky-glow (the light from reflected surfaces illuminating air molecules and other particles). Avoid the illumination of whiter or mirrored surfaces, including water. Darker colours, such as dark greens or asphalt greys and blacks will reduce reflectivity.

5.22. Note: Technological advances may present new alternatives to lighting. If 'glow in the dark' strips and pathways or luminous discs result in the removal of luminaires, they may be suitable. Any new technologies will still have to comply with the lighting specifications that minimise light pollution.



Pontcysyllte Aqueduct

Mitigation Measures

PROXIMITY AND TIMED CIRCUITS

5.23. Proximity PIR (Passive Infra-Red) sensors fitted to external lighting will minimise the time that a unit is on and so reduce light pollution. Use timed circuits to turn off lights after a certain time; timed circuits should be set to a maximum of 5 minutes after activation.

SHIELDING

5.24. Cowls, baffles or louvres fixed to a light source (or reflection) will act as a physical barrier to an observer. LED lighting systems tend to limit the need for this type of mitigation.

SECURITY LIGHTING VS CCTV

5.25. There is little evidence to suggest that security lighting will directly deter criminals, and a poorly designed system may make things easier for intruders. Developers could consider the installation of night vision CCTV or wireless camera systems to avoid the need for security lighting.

STREET LIGHTING

5.26. There is no statutory requirement on local authorities to provide public lighting. Street lighting is not always necessary. Where there is to be a street lighting scheme, use the Dark Skies Community Appendix to the North Wales Lighting Design Guide and Specification to determine design parameters, as this will satisfy IDA requirements. Where possible (especially for minor or private estate residential roads), use low level bollards rather than tall, brighter columns. This will limit the total lumen output, possible glare scattering and reduce the surrounding impact.

CURFEW

5.27. To prevent waste and excessive areas of light pollution, consider curfews as significant lighting controls. In areas where some lighting is appropriate, a programme of dimming lights can operate at periods where there is minimal use of the location. In the Clwydian Range and Dee Valley AONB, the general 'exterior light curfew' should be 2300 hours. However, where development may affect a night sky viewpoint, then the curfew should be earlier. All lighting schemes should include a curfew. The expectation is that new lighting development within the AONB will extinguish or reduce the quantity of lighting to benefit dark skies.

The best light to protect dark skies is a light that is not on!

INTERNAL LIGHTING - GLAZING

5.28. The spill of light through windows can create significant amounts of light pollution. Internal illuminance demands can greatly exceed most types of domestic rural lighting, so the impact on dark skies can be significant. In general, internal glazing will cause light to spill horizontally (and in the case of sky lights,

directly upward), which are the most damaging paths of light. Internal spill will have a similar impact to external lighting, particularly in interrupting and disrupting the continuity of the dark landscape. Where local habitat is good for bats, there are some concerns about the impacts of the internal lighting spilling through large feature windows or glazed walls.

5.29. Keep glazing should to a minimum. Wherever possible, glazing should:

- not exceed 25% of the floor area (using Elemental Method Energy Efficiency as reference (building regulations);
- avoid large single areas (>50% glazing on a single elevation is becoming 'large') of glazing such as floor to eaves glazing/cart shed openings or single elevations; and
- not be on roofs without sufficient mitigation.

5.30. There are several technologies available to reduce the light pollution through glass:

- Inward facing glazing where nearby buildings or courtyards offer shielding.
- Low Transmittance 'tinted' Glass can reduce light transmission by up to 66%.
- Smart Glass uses an electrical current through the material to change its transparency.
- Electronically timed blinds/shutters/ blackout blinds can cut out light spill, particularly where glazing design exceeds recommendations.

5.31. Where floor to eaves glazing cannot be avoided, eaves should over-hang the glazing sufficiently to block all upward spillage of light.

TEMPORARY FLOODLIGHTING

5.32. Temporary installations of a duration of less than 28 days may not require planning permission. If temporary lighting is in use, it is important to follow the recommendations for lighting in this document. Portable floodlight systems are extremely bright to cater for a range of purposes, but they are highly threatening to dark skies. Due to its design and general use, temporary lighting can create significant light pollution. Take care to ensure that the power and installation of the equipment is appropriate for the task and is not obtrusive to neighbours.

Note:

- Where temporary lighting is likely to be in use beyond 28 days or with consistent regularity over some years, then seek planning permission.
- Do not use temporary and portable floodlighting in dark areas.
- Do not use temporary and portable floodlighting for community facilities and sports fields. Agree a permanent design.

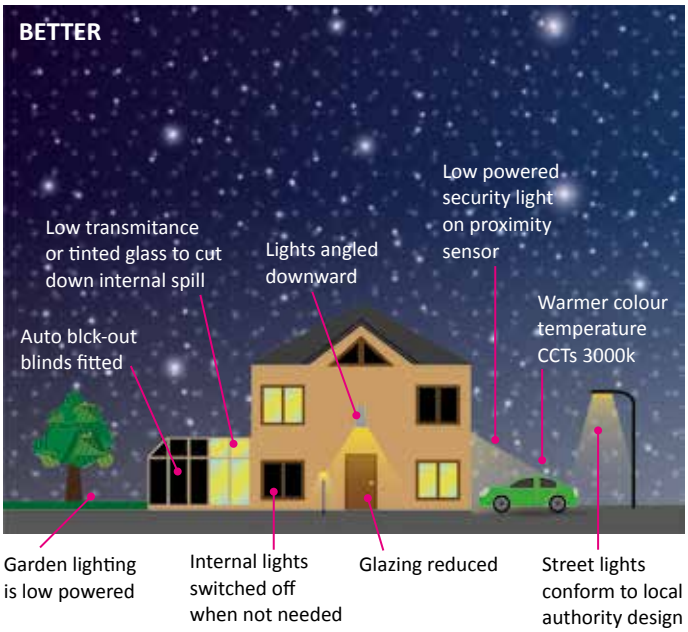
Planetarium

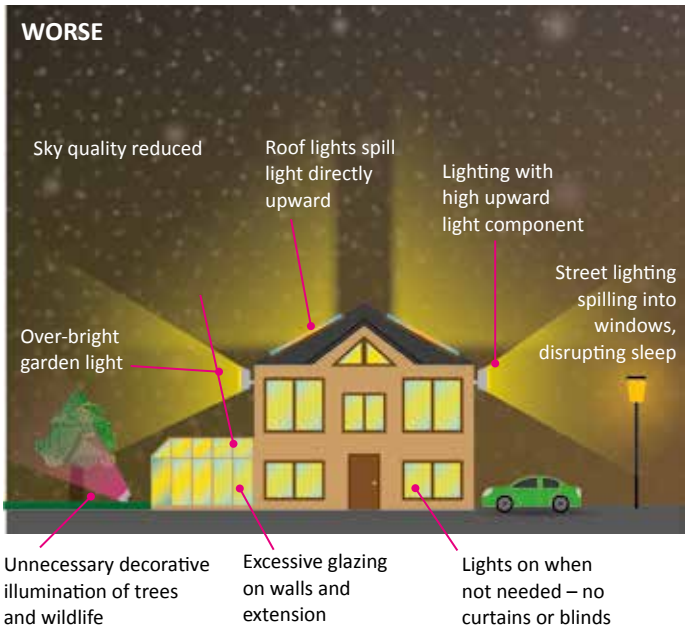
Advice by type of development

DOMESTIC

Key points: ✔ Use lights less than 1000 lumen ✔ Shield lights above 500 lumens ✔ Use proximity sensors or timers ✔Angle lights downwards ✔ Use curtains and blinds

5.33. These principles apply to single dwellings and estates

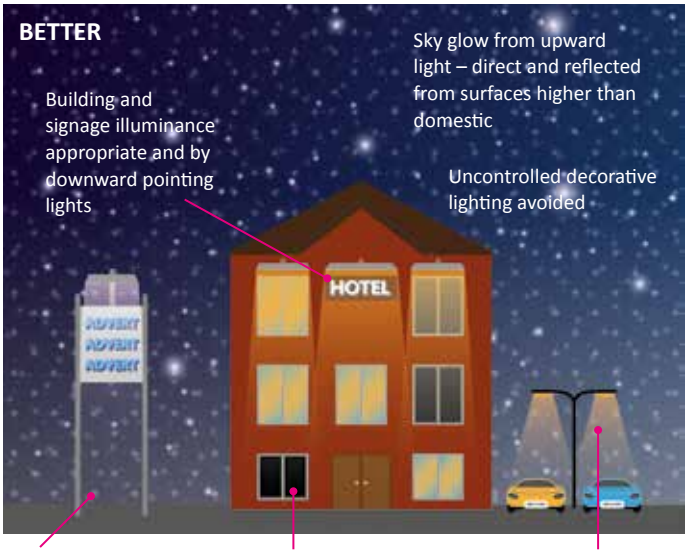


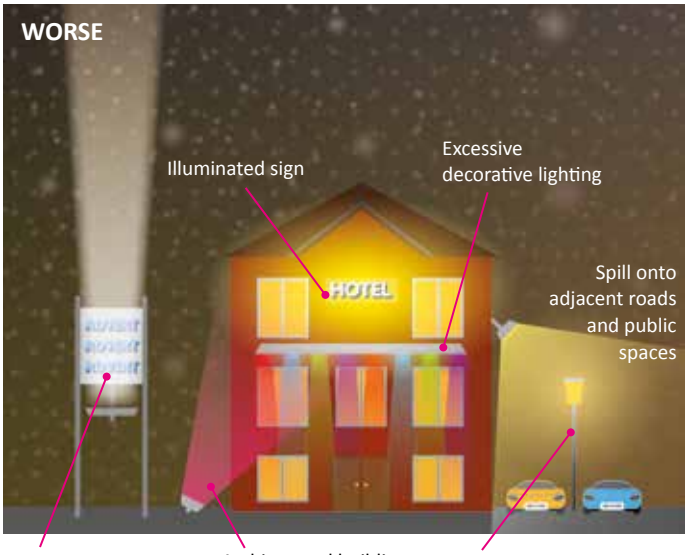


COMMERCIAL

Key points: ✔ Shield lights above 500 lumens ✔ Use proximity sensors or timers ✔ Angle lights downwards ✔ Turn off at close of business ✔ Avoid uncontrolled decorative lighting

5.34. These principles apply to smaller retail/commercial properties and public houses

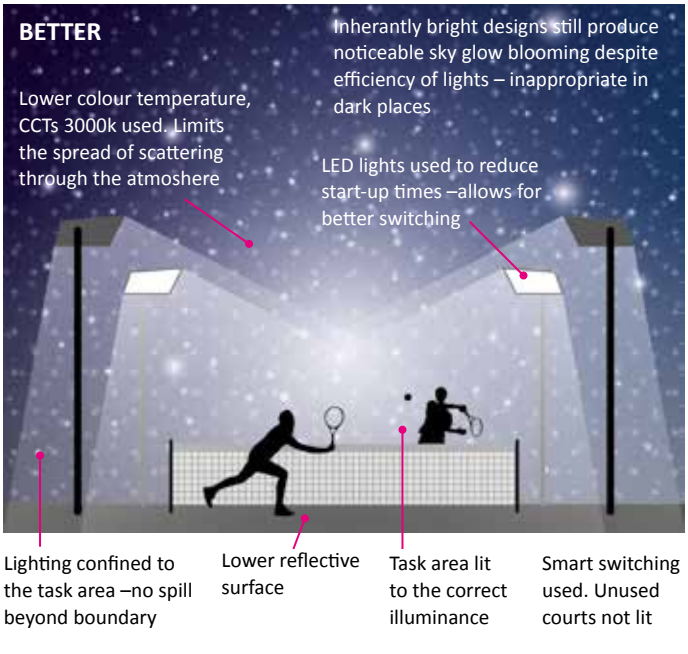


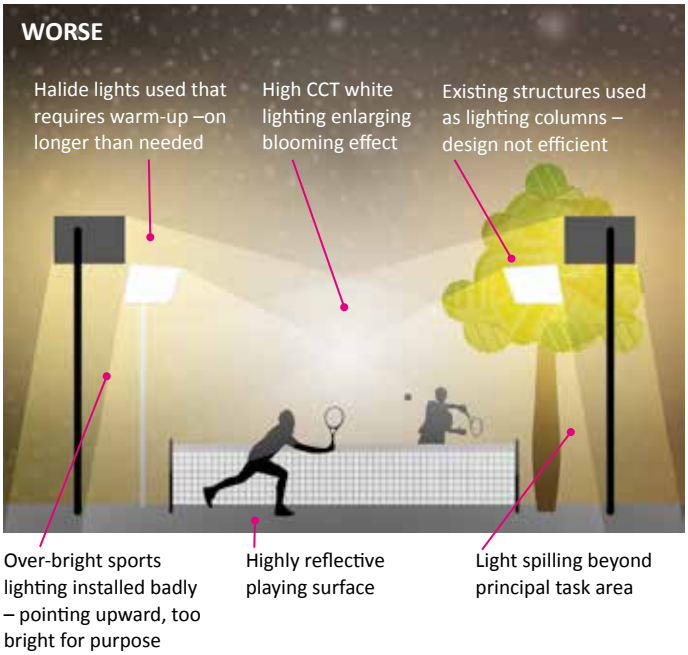


SPORT

Key points: ✔ Design scheme in accordance with standards ✔ Limit hours of use ✔ Situate closer to urban locations ✔ Use low reflective surfaces ✔ Use shielding

5.35. Lighting designs will be different between sports, but the principles apply throughout.

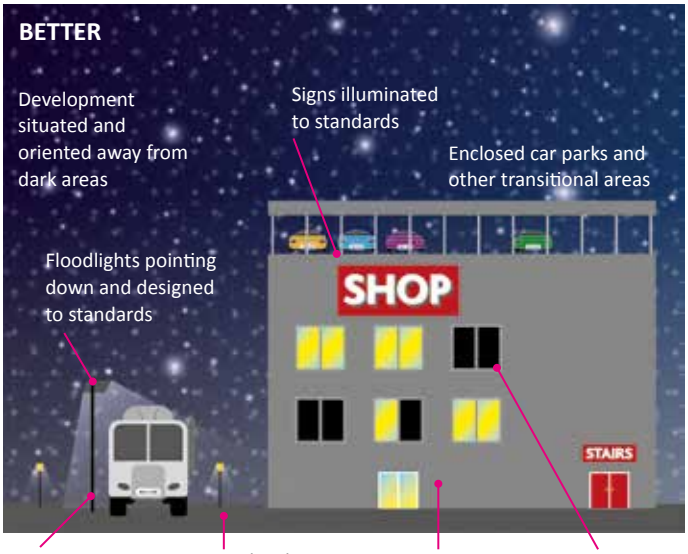


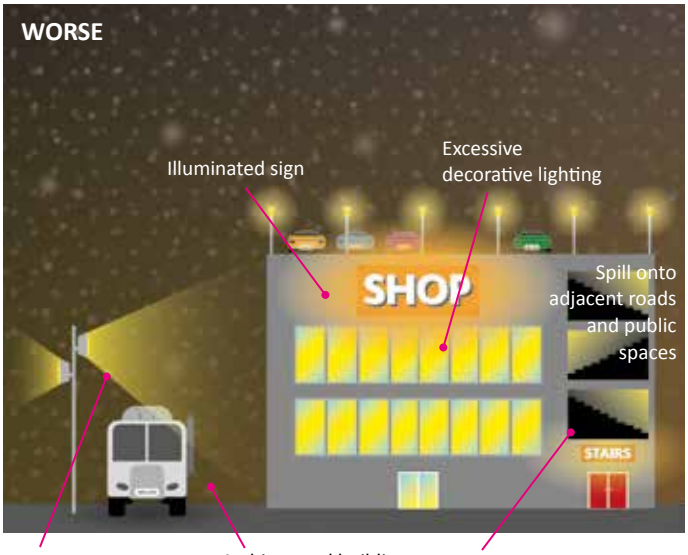


INDUSTRIAL

Key points: ✔ Design scheme in accordance with standards ✔ Turn off when not needed✔ Angle lights downwards ? Situate further away from rural locations ✔ Avoid tall lighting columns in open areas

5.36. This applies to larger developments including offices, warehouses and retail centres





Summary assessment and design check list

5.37. We hope that everyone will see the benefits of retaining our dark night sky and choose to follow the **Good Lighting Code**: ***think before you light; the right amount of light, where needed, when needed***. 'Planning for dark night skies' presents a comprehensive guide to the design and installation of light fittings in the AONB. We set out this simple checklist to help you understand the steps we would like you take before you change any lighting on your building or site.

5.38. Before installing any external light fitting, ask yourself these questions:

- What is the current lighting affecting the site?
- How is it used and what for?
- Is the current lighting causing sky-glow or glare?
- Can you improve it (see the guidance for new lighting)?
- What is the surrounding lighting environment (is it completely dark or nearly so)?
- Are there any dark sky viewing points nearby?
- Are there any important wildlife sites nearby?
- Is your site visible from public viewing points?

5.39. Having considered these questions, do you really need more lighting? If yes: new lighting should not degrade the night sky quality or night-time tranquillity of the AONB. You must carefully address these questions:

- What is it you must illuminate?
- When must you illuminate it (can you use a time switch or motion sensor)?
- What is the dimmest light source you can use (try to use lamps of 500 lumens or less)?
- What is the colour temperature of the light source (it should throw a soft white glow and be less than 3000 Kelvin)?
- How will you direct light to the place of need, not in a direction that disturbs neighbours or wildlife (orientation, shielding, tilt of the light)?
- How will you avoid any light spilling into the night-sky (angle fitting down-ward to a non-reflective surface)?
- Can you extinguish or dim external lighting after 2300 hours (curfew time)?
- Will the lighting scheme require planning permission (many do not but if in doubt, ask)?
- If it does require planning permission, will the Local Planning Authority require a formal lighting plan (if it does, you may need the help of a qualified lighting design engineer)?

5.40. Within buildings -

- Do use and shut curtains and blinds at night.
- Limit the size of picture windows, or add louvers to reduce the extent of night time illumination, where these are visible from beyond the site.
- In new builds and replacement buildings, recess and shield internal lighting within ceilings or walls in rooms with picture windows.

Perseids meteor shower

References

Illumination should be appropriate to the surroundings and character of the whole area, not just the site.

International Dark Sky Community Program Guidelines (2018) International Dark-Sky Association.
https://www.darksky.org/our-work/conservation/idsp/communities/

British Standards Institute. https://shop.bsigroup.com/

- BS5489-1: 2013 Code of practice for the design of road lighting – Part 1: Lighting of roads and public amenity areas
- BS EN 12193: 2018 Light and lighting - Sports lighting

Construction Information Service (CIE 2017): *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations, 2nd edition* CIE 150:2017 ISBN: 978-3-902842-48-0
https://www.techstreet.com/cie/standards/cie-150-2017?product_id=1997388

Institute of Lighting Professionals - https://www.theilp.org.uk/resources/free-resources/

- Institute of Lighting Professionals (ILP, 2020) *Guidance Note for the Reduction of Obtrusive Light GN01*
- Institute of Lighting Professionals and the Bat Conservation Trust (ILP, 2018) *Guidance Note for Bats and artificial lighting in the UKGN08*
- C Bruce-White and M Shardlow (2011) *A Review of the Impact of Artificial Light on Invertebrates*, The Invertebrate Conservation Trust

International Dark Sky Community Program Guidelines (2018) International Dark-Sky Association.
https://www.darksky.org/our-work/conservation/idsp/communities/

Northumberland National Park Authority (2017). Good Practice Guide for Outside Lighting.
https://www.northumberlandnationalpark.org.uk/wp-content/uploads/2017/05/NNP-outside-lighting-guide.pdf

South Downs National Park Authority (2018). Dark Skies Technical Advice Note.
https://www.southdowns.gov.uk/wp-content/uploads/2018/04/TLL-10-SDNPA-Dark-Skies-Technical-Advice-Note-2018.pdf

Appendix 1

Map and contact details for Local Planning Authorities and the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty

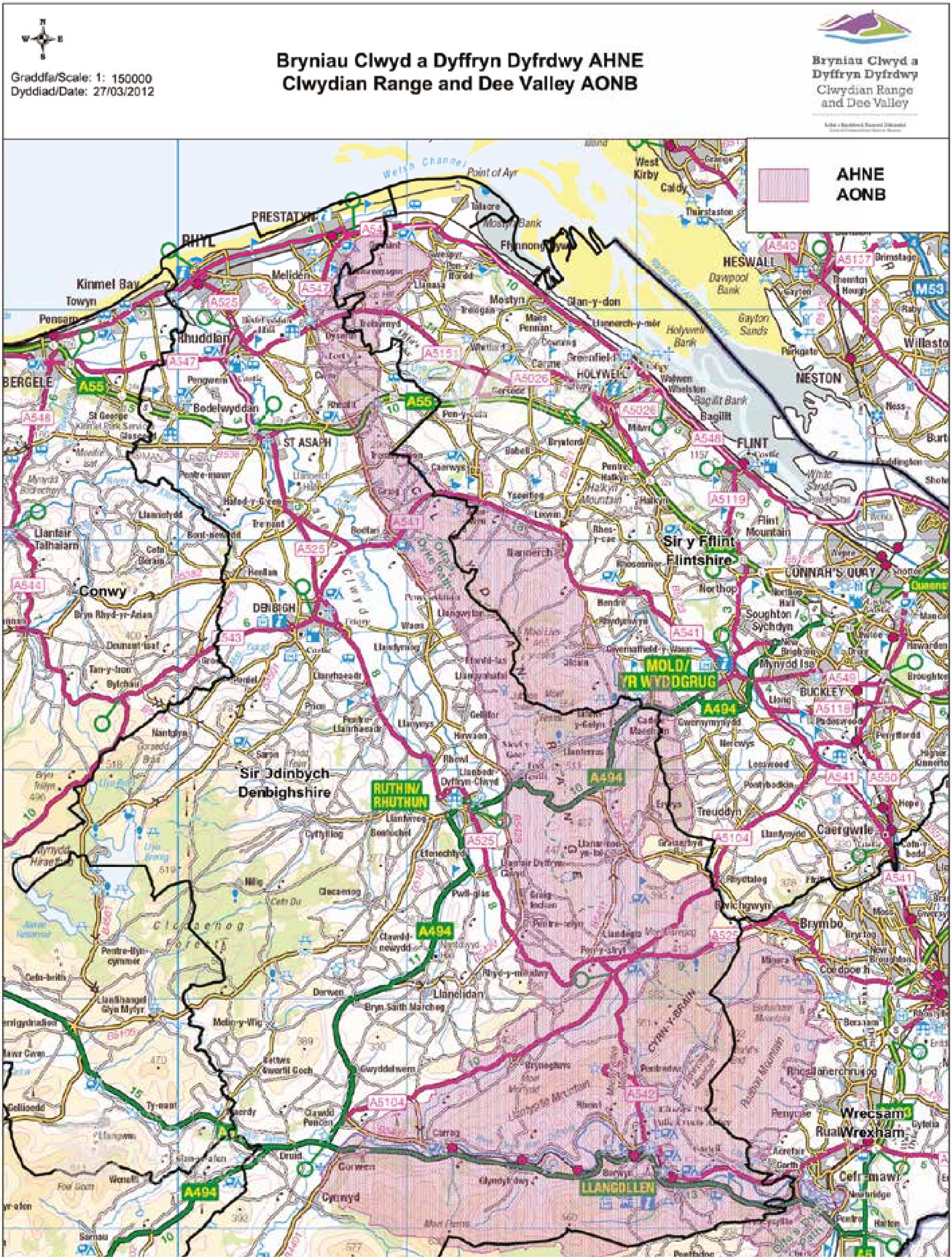
Denbighshire County Council
Development Management
P.O. Box 62
Ruthin
LL15 9AZ
Email: planning@denbighshire.gov.uk
Tel: 01824 706727
Website: https://www.denbighshire.gov.uk/en/resident/planning-and-building-regulations/planning/planning.aspx

Flintshire County Council
County Hall
Mold
Flintshire
CH7 6NF
Email: planningdc@flintshire.gov.uk
Tel: 01352 703234
Website: http://www.flintshire.gov.uk/en/Resident/Planning/Home.aspx

Wrexham County Borough Council
Environment and Planning
16 Lord Street
Wrexham
LL11 1LG
Email: planning@wrexham.gov.uk
Tel: 01978 298994
Website: http://www.wrexham.gov.uk/planning

Clwydian Range and Dee Valley AONB
Loggerheads Country Park NR. Mold
Denbighshire CH7 5LH
Email: clwydianrangeaonb@denbighshire.gov.uk
Tel: 01824 712757
Website: http://www.clwydianrangeanddeevalleyaonb.org.uk/plans-and-strategies/

Figure 7: Map of administrative boundaries



Appendix 2

Relevant policies of the local planning authorities

Extracts from Denbighshire Local Development Plan 2006 – 2021

Policy VOE 2: Area of Outstanding Natural Beauty and Area of Outstanding Beauty

In determining development proposals within or affecting the Area of Outstanding Natural Beauty (AONB) and Area of Outstanding Beauty (AOB), development that would cause unacceptable harm to the character and appearance of the landscape and the reasons for designation will not be permitted.

Policy VOE 3: Pontcysyllte Aqueduct and Canal World Heritage Site

Development which would harm the attributes which justified the designation of the Pontcysyllte Aqueduct and Canal as a World Heritage Site and the site's Outstanding Universal Value will not be permitted. The following are considered to be key material considerations:

i. The authenticity and integrity of the attributes that contribute to the Outstanding Universal Value of the World Heritage Site including views, and features of cultural, artistic, historical, social and natural environmental importance.

ii. The setting of the World Heritage Site and attributes important to the Outstanding Universal Value of the site present within the Buffer Zone. Where there is a demonstrable need for essential non-residential visitor attraction facilities for the World Heritage Site which cannot be provided within the settlement limit, their location outside settlement limits will be permitted where there is no adverse impact on the Outstanding Universal Value of the site present within the Buffer Zone.

Where there is a demonstrable need for essential non-residential visitor attraction facilities for the World Heritage Site which cannot be provided within the settlement limit, their location outside settlement limits will be permitted where there is no adverse impact on the Outstanding Universal Value.

Policy RD1: Sustainable development and good design

Development proposals will be supported within development boundaries provided that all the following criteria are met:

i. Respects the site and surroundings in terms of the siting, layout, scale, form, character, design, materials, aspect, micro-climate and intensity of use of land/buildings and spaces around and between buildings; and

ii. Makes most efficient use of land by achieving densities of a minimum of 35 dwellings per hectare for residential development (unless there are local circumstances that dictate a lower density).

iii. Protects and where possible enhances the local natural and historic environment; and

iv. Does not unacceptably affect prominent public views into, out of, or across any settlement or area of open countryside; and

v. Incorporates existing landscape or other features, takes account of site contours and changes in levels and prominent skylines; and

vi. Does not unacceptably affect the amenity of local residents, other land and property users or characteristics of the locality by virtue of increased activity, disturbance, noise, dust, fumes, litter, drainage, light pollution etc., and provides satisfactory amenity standards itself; and

vii. Provides safe and convenient access for disabled people, pedestrians, cyclists, vehicles and emergency vehicles together with adequate parking, services and manoeuvring space. Proposals should also consider impacts on the wider Rights of Way network surrounding the site; and

viii. Does not have an unacceptable effect on the local highway network as a result of congestion, danger and nuisance arising from traffic generated and incorporates traffic management/calming measures where necessary and appropriate. A transport assessment and travel plan will be required where appropriate; and

ix. Has regard to the adequacy of existing public facilities and services; and

x. Does not prejudice land or buildings safeguarded for other uses, or impair the development and use of adjoining land; and

xi. Satisfies physical or natural environmental considerations relating to land stability, drainage and liability to flooding, water supply and water abstraction from natural watercourse; and

xii. Takes account of personal and community safety and security in the design and layout of development and public/private spaces and has regard to implications for crime and disorder; and

xiii. Incorporates suitable landscaping measures, including where appropriate hard and soft landscaping treatment, the creation and/or protection of green and blue corridors, mature landscaping, and arrangements for subsequent maintenance. Landscaping should create a visually pleasant, sustainable and biodiversity rich environment that protects and enhances existing landscape features and also creates new features and areas of open space that reflect local character and sense of place; and

xiv. Has regard to the generation, treatment and disposal of waste.

Extracts from Denbighshire Local Development Plan 2018 – 2033 Draft Preferred Strategy May 2019

Draft Key Policy: Placemaking

All proposals must support the delivery of economic, social, environmental and cultural well-being, and demonstrate the following:

- Resource efficiency
- Promotion of health and well-being
- Maintenance and enhancement of the natural environment
- Equality of access
- Access to services and facilities
- Support and enhancement of the Welsh language
- Resilience to the impacts of climate change
- Promote decarbonisation and renewable energy technology
- High quality design that respects local character and distinctiveness.

Draft Key Policy: Natural & Built Environment

Denbighshire's natural and built environment will be protected from development that adversely affects their protected characteristics, features or their setting.

All proposals must contribute towards the preservation and, where possible, the enhancement of the natural and built environment.

Extract from Flintshire Unitary Development Plan 2000 - 2015

Policy L2: Area of Outstanding Natural Beauty

Development within or affecting the Area of Outstanding Natural Beauty (AONB) will be permitted only where:

a. it maintains and where appropriate enhances the natural beauty, wildlife and cultural heritage and preserves the natural tranquillity of the AONB; and

b. it will be designed to a high standard using traditional materials and planting.

Major developments within the AONB will be the subject of rigorous examination and will not be permitted unless there is an overriding need in terms of proven national interest and there are no alternative sites.

Policy D2: Design

Development will be permitted only where:
a. the proposed building and structures are of a good standard of design, form, scale and materials; and
b. it protects the character and amenity of the locality and adds to the quality and distinctiveness of the local area.

Policy D4: Outdoor Lighting

Development will be permitted only where any associated lighting is restricted to the minimum which is necessary to:
a. ensure public safety and security;
b. facilitate enjoyment of the physical and visual fabric of the development and its surroundings; and
c. prevent light pollution by the creation of excessive glare.

Policy EWP13: Nuisance

Development which is sensitive to noise, vibration, odour, dust or light pollution and which is proposed near to existing sources of nuisance, such as railways, roads, airfields or industrial activities, will be permitted only if the developer is able to demonstrate that sufficient measures will be taken to mitigate any potential adverse effects.

Proposals which are likely to cause an increase in noise, vibration, odour, dust or light pollution will be permitted only if the developer has demonstrated that there will be no detrimental impact on users outside the boundary of the site, who may be sensitive to such nuisance.

Flintshire LDP 2015-2030: Deposit Plan September 2019 (not yet adopted)

Strategic Policy STR 10: Tourism, Culture, and Leisure

The intrinsic attractiveness of Flintshire's natural and built

environment makes the County an attractive destination for sustainable tourism development. Development that capitalizes on these assets and creates a year round broad appeal will be supported.

Particular emphasis will be placed on:

i. Supporting new and extended tourism development which is appropriate to its location and enhances the existing offer within Flintshire;

ii. Support development that promotes accessibility to Flintshire's landscape, cultural and historic assets, including the Clwydian Range AONB, coastline, rights of way, cycling and active travel networks;

iii. Promote and enhance the maintenance and diversification of a sustainable rural economy;

iv. Conserving and enhancing Flintshire's natural, built and cultural heritage;

v. Enabling a range and choice of tourism accommodation to meet a variety of needs from short visit to long stay.

Strategic Policy STR 13: Natural and Built Environment, Green Networks and Infrastructure

Environmental networks can, and do, have a variety of roles in protecting and enhancing biodiversity, defining the landscape setting of places, defining the transition from urban to countryside, and facilitating well-being through amenity, recreation and active leisure. The key is to balance these sometimes conflicting roles, achieving a sustainable balance.

Development will identify, respect, protect, enhance and connect Flintshire's environmental assets, to create a multifunctional network of natural and historic resources.

To achieve this all development will:

i. Protect open countryside and the undeveloped coastline

ii. Protect the open character and appearance of green wedges

iii. Protect and enhance the quality and diversity of Flintshire's natural, built, and historic environmental networks;

iv. Promote opportunities to enhance biodiversity;

v. Maintain, enhance, and contribute to green infrastructure;

vi. Create and protect green spaces and open space / play environments that encourage and support good health, well-being, and equality;

vii. Contribute to local distinctiveness having regard to the quality of Flintshire's landscape, biodiversity, and heritage assets including the Dee Estuary and Clwydian Range AONB;

viii. Not adversely affect the conservation status of Flintshire's natural, built and historic environments;

ix. Make financial contributions where appropriate, to facilitate and maintain the favourable conservation status of key environmental assets;

x. Support measures to minimise the consequences of climate change

xi. Protecting playing fields and open space from development: and

xii. Ensuring adequate new open space and playing fields are provided as part of new housing development.

Strategic Policy STR 14: Climate Change and Environmental Protection

The Council will seek to mitigate the effects of climate change and ensure appropriate environmental protection in the County through:

i. Ensuring new development is sustainably located and designed so as to reduce the need for travel by private car;

ii. Supporting the use and development of appropriate or suitable brownfield land;

iii. Adopting a sustainable approach to water resource management including supply, surface water run-off and waste water treatment;

iv. Directing development away from flood risk areas, assessing the implications of development in areas at risk of flooding and ensuring that new development does not increase the risk of flooding elsewhere;

v. Encouraging energy efficient development, environmentally acceptable renewable and zero / low carbon energy generation and combined heat and power and communal / district heating networks;

vi. Ensuring that new development has regard to the protection of the environment in terms of air, noise and light pollution, unstable and contaminated land and former landfill sites;

vii. Design of development to be adaptable and resilient to future effects of climate change.

Policy PC2: General Requirements for Development

All development should, where appropriate:

a. harmonise with or enhance the character, local distinctiveness and appearance of the site, existing building(s) and surrounding landscape/townscape;

b. not have a significant adverse impact on the safety and living conditions of nearby residents, other users of nearby

land/property, or the community in general, through increased activity, disturbance, noise, dust, vibration, hazard, or the adverse effects of pollution;

c. take account of personal and community safety and security in its design and layout;

d. maximise sustainable travel choice by having safe and convenient access by foot, cycle, public transport and vehicles;

e. not have an unacceptable effect on the highway network or highway safety as a result of problems arising from traffic generation, inadequate and poorly located parking spaces, servicing and manoeuvring;

f. not result in or be susceptible to problems related to foul and surface water drainage, land stability, contamination, flooding, or pollution of light, air and water, either on or off site.

Policy PC3: Design

All new development should, where appropriate:

a. be of a high quality, distinctive and inclusive design which respects and enhances the site and its surroundings in terms of its siting, layout, scale, height, design, density, use of materials and landscaping, and creates a sense of place;

b. retain existing landscape and nature conservation features and incorporate opportunities to enhance biodiversity and ecological connectivity;

c. ensure that new materials are appropriate, durable and sympathetic to the character and context of the site;

d. protect and enhance the townscape, architectural, historic and cultural built environment;

e. incorporate suitable provision of space about dwellings, amenity space, landscaping and planting;

f. create attractive, accessible and safe and healthy places with natural surveillance, visibility and sensitive lighting;

g. incorporate Sustainable Urban Drainage Schemes to bring about multiple benefits as an integral part of the development.

Policy EN5: Area of Outstanding Natural Beauty

Within the Clwydian Range and Dee Valley AONB, development will only be permitted where it conserves or enhances the natural beauty of the designated area and its setting. In assessing the likely impact of development proposals on the natural beauty of the AONB, cumulative impact will also be taken into consideration.

Development must:

a. not have an adverse impact on the special character and qualities of the AONB; and

b. contribute to the social, economic and cultural well-being of the local community; and be of a scale, form, density and use that is compatible with the character of the AONB and local area; and

c. be of an appropriately high standard of design and use appropriate materials that are compatible with the character of the AONB.

Policy EN18: Pollution and Nuisance

New development which is sensitive to the effects of existing noise, vibration, odour, dust, light or other pollution or nuisance, will be permitted only if it can be demonstrated that appropriate measures can be taken to mitigate any potential adverse effects.

New development which would create an increased risk of noise, vibration, odour, dust, light or other pollution or hazard will only be permitted if:

a. it would not unacceptably harm general amenity or living conditions; and

b. it would not impose significant restrictions on the use or development of surrounding land.

If new external lighting is proposed, particularly in or near to the AONB, this should be considered as part of an overall landscaping scheme and kept to a minimum to avoid light pollution.

Extract from Wrexham Unitary Development Plan 1996 - 2011

Policy EC5: Special Landscape Areas

Within Special Landscape Areas, priority will be given to the conservation and enhancement of the landscape. Development, other than for agriculture, small-scale farm-based and other rural enterprises, and essential operational development by utility service providers, will be strictly controlled. Development will be required to conform to a high standard of design and landscaping, and special attention will be paid to minimising its visual impact both from nearby and distant viewpoints.

Policy CLF4: Playing Fields, Children's Play Areas and Open Space

The redevelopment of sports grounds, playing fields, children's play areas and informal open spaces and allotment gardens for uses other than sport and recreation will not be permitted unless:-

a) redevelopment of only a small part of the site would allow the retention and enhancement of that existing facility; or

b) the long term requirement for the facility has ceased and it would not lead to, or increase an existing shortfall of that facility in the immediate locality; or

c) the loss can be replaced with an equivalent or greater provision in the immediate locality. Alternative sites should be within settlement limits or, in exceptional circumstances, adjacent to settlement limits provided that associated buildings, lighting, and parking facilities are not intrusive in the landscape and user accessibility is not reduced.

Note paragraph 5.7: Area of Outstanding Natural Beauty

'During the plan period the existing Clwydian Range Area of Outstanding Natural Beauty may be extended to include sections of Ruabon Mountain, and the Berwyn Mountain Range, which includes much of the Ceiriog Valley, may be designated as an Area of Outstanding Natural Beauty. The Council supports such a proposal. Such designation would recognise the national importance of that landscape and the need to protect, manage, and enhance it. Landscape conservation would be the primary consideration and development which detracts from the character and appearance of the landscape would be resisted. Any development permitted must be of the highest standard of design, and use materials appropriate to the locality'.

Wrexham LDP 2013-2028 Deposit Plan April 2018 (not yet adopted)

Strategic Policy SP15: Natural Environment

Development will only be supported where it protects, conserves and enhances the natural environment including:

- Internationally protected Special Areas of Conservation, Special Protection Areas, and Ramsar Sites,
- Nationally protected Sites of Special Scientific Interest and National Nature Reserves;
- Protected Species and their habitat;
- The Clwydian Range and Dee Valley Area of Outstanding Natural Beauty including recognising the importance it has in contributing to the Outstanding Universal Value and setting of the Pontcysyllte Aqueduct and Canal World Heritage Site;
- Local Wildlife Sites including the strategic ecological network on Wrexham Industrial Estate and Regionally Important Geological Sites;
- Local Nature Reserves;
- Special Landscape Areas recognised for their outstanding local landscape character;
- natural landscape features such as trees, hedges and woodland and the green networks between them which contribute to the quality and diversity of the natural environment and play an important role in mitigating the impact of climate change;
- The quality of natural services including water, air and soils
- Developing and maintaining Green Infrastructure links; and
- Habitats and species of principal importance to Wales.

Policy DM1: Development Management Considerations

Developments proposals, where relevant, must:

a) Accord with or enhance the character, local distinctiveness and appearance of the site, existing building(s) and surrounding landscape/ townscape in terms of its siting, layout, scale, height, design, density, use of materials and landscaping;

b) Not have an unacceptable effect on the amenity of the occupiers of nearby properties/land by virtue of noise, disturbance and overlooking; and provides a satisfactory standard of amenity for the occupiers/users of the development itself;

c) Safeguard the environment from the adverse effects of pollution of water, land, light or air, or land instability, arising from development;

d) Take account of personal and community safety and security in its design and layout

e) Be safely and conveniently accessible for all potential users/occupiers of the development on foot, bicycle, by public transport and by car;

f) Not give rise to parking or highway safety problems on site or in the locality;

g) Maximise sustainable travel choices first and then provides for car related needs;

h) Contribute to low carbon communities through energy efficiency, be designed to minimise the use of non-renewable energy, water and the production of waste both during construction and when in use;

i) Not increase the risk of flooding but makes adequate provision for sustainably dealing with foul and surface water drainage and not result in an unacceptable impact upon the water environment;

j) Consider the needs of a diverse population including those with protected characteristics such as age or disability;

k) On sites which have previously been developed, new development proposals should make use of existing suitable building materials wherever possible for appropriate uses in order to re-use recyclable materials and reduce the amount of imported materials; and

l) Ensure that any risks arising from past coal mining, as indicated on the proposals map, can be adequately managed.

Policy NE4: Area of Outstanding Natural Beauty

Within the Area of Outstanding Natural Beauty (AONB), development will only be supported where it conserves or enhances the natural beauty of the area and its setting. In assessing the likely impact of development proposals on the natural beauty of the AONB, cumulative impact will also be taken into consideration.

Development must:

i. Not have an adverse impact on the special qualities of the AONB or the resources and ecosystem services on which the local economy and well-being of the area depends;

ii. Contribute to the social, economic and cultural well-being of the local community;

iii. Be of a scale, form, design, density and intensity of use that is compatible with the character of the AONB; and

iv. Be designed to an appropriately high standard in order to integrate with the existing landscape and where feasible enhance the landscape quality Development proposals that are outside, but closely interlinked with the AONB must not have an adverse impact on the natural beauty of the AONB.

Appendix 3

Monitoring indicators

Monitoring is essential to establish what is happening now, what may happen in the future and then compare these trends against existing policies and targets to determine what needs to be done. Monitoring helps to address questions like:

- are our policies achieving their objectives?
- have the policies had unintended consequences?
- are the assumptions and objectives behind policies still relevant?
- are we achieving our targets?

The Clwydian Range and Dee Valley Area of Outstanding Natural Beauty (AONB) Joint Committee will use the following indicators to monitor progress in achieving and maintaining 'Dark Sky Community' status:

- The average SQM across the whole AONB (target to be 20 magnitudes per square arc-second).
- The SQM at each designated night-sky viewpoint (target to be 20.5+ magnitudes per square arc-second).
- The number of survey point SQM readings of 16 or less magnitudes per square arc-second in any AONB-wide survey (target to be a maximum of 2).
- The number of planning permissions with dark-sky friendly approved lighting schemes or conditions.

The respective Local Councils may choose to adopt their own monitoring indicators.

Appendix 4

SQM survey sites and data

Table 7: SQM survey sites and data

Averaged survey readings[8] by magnitude per square arc sec[9]							
Survey Point location		**2017**	**Survey Point location**		**Grid Reference**	**2019**	**2020**
1	Gronant	19.67	1	Gronant	0882 8334	20.2	0
2	Gwespyr	19.59	2	Llanasa	1059 8145	15.72	0
3	Llanasa	19.93	3	Gwaenysgor	0771 8083	20.32	0
4	Gwaenysgor	20.29	4	Gop Hill	0920 8021	20.47	0
5	Gop Hill	20.18	5	Bron Heulog	0869 7870	20.49	0
6	Bron Heulog Hill	20.32	6	Marian Ffrith	0773 7811	20.46	0
7	Marian Ffrith	20.25	7	Cwm	0711 7719	20.38	0
8	Cwm	20.22	8	Rhuallt	0744 7511	19.24	0
9	Rhuallt	20.24	9	Glan Llyn	0955 7631	20.64	0
10	Glan Y Llyn	20.37	10	Bryn Gwyn	0886 7508	20.60	0
11	Bryngwyn Mawr	20.51	11	Tremeirchion	0826 7307	18.34	0
12	Moel Meanefa	20.57	12	Bodfari	0909 7031	20.72	0
13	Tremeirchion	20.41	13	Afonwen	1219 7180	20.67	0
14	Bodfari	20.58	14	Nannerch	1672 6923	20.59	0
15	Afonwen	20.45	15	Bryn Golau	1569 6962	20.67	0
16	Nannerch	20.32	16	Coed Llangwyfan	1389 6686	20.81	0
17	Bryn Golau	20.87	17	Llangwyfan	1229 6587	20.71	0
18	Coed Llangwyfan	20.46	18	Hendrerwyd	1220 6340	19.65	19.56
19	Llangwyfan	20.42	19	Moel Famau	1373 6336	21.25	20.86
20	Llandyrnog	19.01	20	Gellifor	1250 6280	20.24	20.82
21	Hendrerwydd	18.50	21	Llanbedr	1426 5966	20.17	20.12
22	Moel Famau Country Park	20.63	22	Bwlch Ucha	16645825	20.95	20.83
23	Gellifor	20.50	23	Llanferres	1887 6053	19.15	19.91
24	Llanbedr Dyffryn Clwyd	18.73	24	Loggerheads	1971 6253	20.39	20.34

25	Bwlch Uchaf	20.61	25	Cilcain	1773 6519	20.39	20.43
26	Llanferres	17.48	26	Llangynhafal Track	1455 6414	20.82	20.28
27	Loggerheads	20.41	27	Penbarras	1618 6057	20.76	20.59
28	Cilcain	19.87	28	Llanarmon Church	1906 5618	19.22	20.46
29	Eryrys	20.10	29	Llandegla	1977 5181	20.23	0
30	Llanarmon yn Iâl	19.82	30	Pentrecelyn	1502 5347	20.76	20.9
31	Llandegla	20.49	31	Graigfechan	1458 5524	20.84	20.89
32	Pentre Celyn	20.08	32	Ty Mawr -	1629 4841	20.88	20.98
33	Graigfechan	20.12	33	Bryneglwys	1498 4759	20.45	20.86
34	Tŷ Mawr	20.18	34	Carrog	1051 4387	21.16	21.52
35	Bryneglwys	19.68	35	Corwen	0830 4410	20.86	21.26
36	Carrog	20.14	36	Glyndyfrdwy	1246 4310	21.24	21.19
37	Corwen	17.28	37	Llangollen	2152 4215	15.77	12.09
38	Glandyfwrdwy	19.68	38	Llantysilio Car Park	1971 4331	20.87	20.19
39	Llangollen	13.76	39	Eglwyseg	2160 4610	20.63	20.81
40	Eglwyseg	20.03	40	Cyrn y Brain	2348 4951	20.59	20.63
41	Gwter Siani	19.98	41	Gwter Siani	2526 5013	20.54	20.44
42	New Brighton	19.77	42	New Bright	2715 5115	20.31	19.77
43	Horseshoe Pass	20.85	43	Horseshoe Pass	1922 4721	20.76	20.83
44	Tai'rant	19.67	44	Berwyn Bends	1847 4332	21.05	20.65
45	Garth	19.62	45	Garth	2481 4311	20.48	20.84
46	Pontcysyllte	16.97	46	Froncysyllte	2717 4123	16.27	16.74
47	Froncysyllte	16.96	47	Pontcysyllte	2680 4208	20.55	20.98
			48	Tai Nant	2697 4641	20.68	20.58
			49	Eryrys	1998 5817	21.08	20.94
	Average SQM	**20**				**20**	**20**

Appendix 5

Examples of Dark Sky Friendly Lighting

GOOD LIGHT FITTINGS

Choose compact LED downlights or fully shielded pendant style fixtures, preferably with sensors to switch off when not needed.

BAD LIGHT FITTINGS

Unshielded or poorly shielded floodlights that cannot be tilted sufficiently to shine below the horizontal. Avoid common 'Bulkhead' style fittings that scatter light in all directions. The Institution of Lighting Professionals (ILP) website is a useful source of information and advice on lighting and reducing obtrusive light.

LIGHTING SUPPLIERS

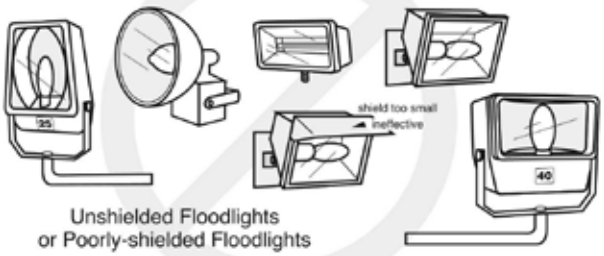
The list below is some of the wholesalers, distributors and retailers that currently supply dark sky friendly light fittings. The list is not exhaustive.

- B & Q
- City Electrical Factors (CEF) Ltd
- Collingwood Lighting Ltd
- Edmundson Electrical Ltd
- Firstlight Ltd
- Homebase
- Integral-LED Ltd
- Luceco Ltd
- Nordlux Lighting
- Philips Lighting plc
- Screwfix
- Searchlight Ltd
- Tamlite Lighting Ltd
- Thorn Lighting Ltd
- Toolstation
- Whitecroft Lighting Ltd
- YESSS Electrical Ltd

Examples of Acceptable & Unacceptable Lighting Fixtures

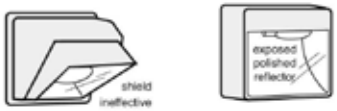
Unacceptable/Not Compliant

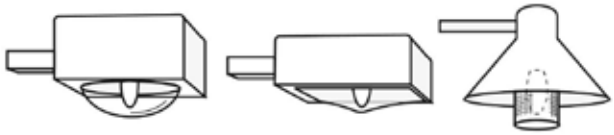
Fixtures that produce glare and light trespass



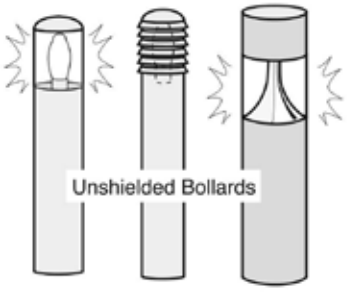
Unshielded Floodlights
or Poorly-shielded Floodlights

Unshielded Wallpacks
& Unshielded or
Poorly-shielded Wall
Mount Fixtures



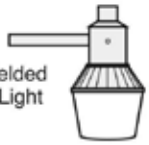


Drop-Lens & Sag-Lens Fixtures
w/ exposed bulb / refractor lens

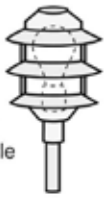


Unshielded Bollards

Unshielded Streetlight



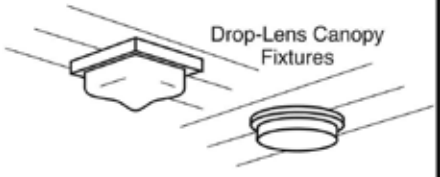
Unshielded
Barn Light



Louvered
'Marine' style
Fixtures

Unshielded
'Period' Style
Fixtures

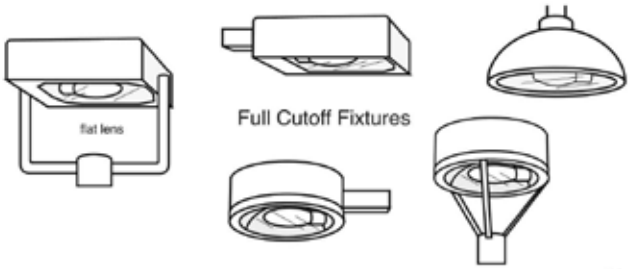
Unshielded
PAR
Floodlights



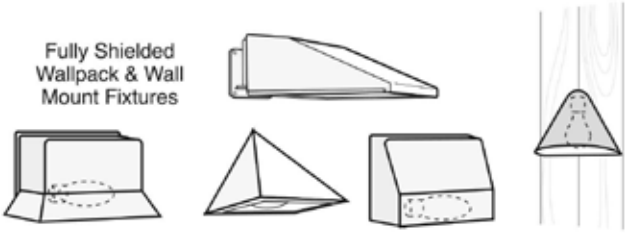
Drop-Lens Canopy
Fixtures

Acceptable/Compliant

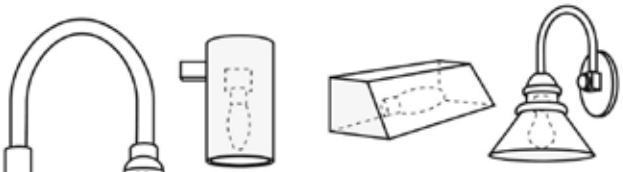
Fixtures that shield the light source to minimize glare and light trespass and to facilitate better vision at night



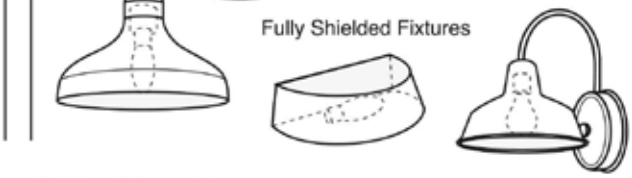
Full Cutoff Fixtures



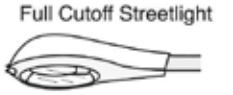
Fully Shielded
Wallpack & Wall
Mount Fixtures



Fully Shielded Fixtures



Full Cutoff Streetlight



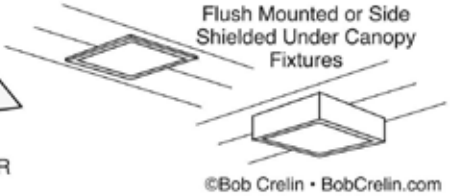
Fully Shielded
Barn Light

Fully Shielded
Walkway
Bollards

Fully Shielded
Decorative
Fixtures

Fully Shielded
'Period' Style
Fixtures

Shielded /
Properly-aimed PAR
Floodlights



Flush Mounted or Side
Shielded Under Canopy
Fixtures

Bryniau Clwyd a Dyffryn Dyfrdwy
Clwydian Range and Dee Valley

Awyr Dywyll
Dark Skies

AONB Main Office:
Loggerheads Country Park
Ruthin Road
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LL20 8NU
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Email: clwydianrangeaonb@denbighshire.gov.uk