Replacement Local Development Plan 2018-2033

Background Paper

# BP8: Planning for the Conservation and Enhancement of Dark Skies in Wales

**Deposit Plan**

**February 2025**

CONWY

**Mae’r ddogfen hon ar gael yn Gymraeg hefyd.**

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Llywodraeth Cymru
Welsh Government

Good Practice Guidance:

# Planning for the Conservation and Enhancement of Dark Skies in Wales

**This Good Practice Guidance has been developed collaboratively with a Dark Skies Working Group.**

**The Working Group is made up of the following:**

- Jill Bullen, Natural Resources Wales
- Peter Frost, Natural Resources Wales
- Dani Robertson, Eryri National Park Authority
- Gayle Lister, Pembrokeshire Coast National Park Authority
- Robin Sandham, Conwy County Borough Council
- Alun Owen, Ynys Mon National Landscape
- David Shiel, Clywdian Range and Dee Valley National Landscape
- Siobhan Wiltshire, Welsh Government

Cover image: ©Robert Colbourne

Photo on page 3: Dark Skies over Bannau Brycheiniog



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Mae'r ddogfen hon ar gael yn Gymraeg hefyd / This document is also available in Welsh
Rydym yn croesawu gohebiaeth a galwadau ffôn yn Gymraeg / We welcome correspondence and telephone calls in Welsh

# Foreword by Cabinet Secretary for Economy, Energy and Planning

Ahead of Wales' Dark Skies Week, I am delighted to publish this Good Practice Guidance document on Planning for Dark Skies.

Our connections to the night sky are ancient and Wales is incredibly fortunate to have the highest percentage of protected dark skies in the world. When star gazing, I am always struck by the awesomeness of the night sky and how it creates a tangible connection to generations past who observed and experienced the same sky.

Working together, we can address light pollution and promote the important role of dark skies in biodiversity, human health, energy conservation, heritage preservation, and astronomy.

Planning for dark skies is critical. Good design and appropriate lighting choices bring benefits for society and nature. This Good Practice Guidance provides a national approach to planning for dark skies, reflecting the absence of boundaries in the night sky and the wider opportunities presented by a consistent dark skies approach.

I am very grateful for the hard work of the Dark Skies Working Group which has collaboratively written this Good Practice Guidance, and their organisations (Natural Resources Wales, Eryri and Pembrokeshire National Park Authorities, Clwydian Range and Dee Valley and Ynys Môn National Landscapes, and Conwy Local Planning Authority) for generously giving the time and expertise of their officers to co-produce this excellent and much needed piece of planning guidance. The Well-Being of Future Generations Act specifies collaboration as one of the five ways of working and this guidance document is an exemplar of the benefits of following that approach. As a result, we have robust, practitioner-focused guidance that will deliver improved outcomes for the night sky in Wales.

My expectation is that this guidance will be used across Wales by all those involved in the planning system, with the aim of letting people experience the wonder of the natural night sky and allowing ecosystems to function naturally by avoiding and removing light pollution across the country. A dark sky approach does not mean the use of no lights, but using better, dark sky friendly lights. Whatever our role and however big or small our development, our responsibility to ourselves and our future generations is to contribute positively to the well-being of Wales – this includes planning for dark skies.

**Rebecca Evans**

Cabinet Secretary for Economy
Energy and Planning
Welsh Government

# Contents

Pont ar Elan, Elan Valley
© Sam Price

# Glossary

Stars over Pembrokeshire National Park
Stock image

| Term | Definition |
|---|---|
| Ambient Light | The natural light level that is already present before the introduction of any additional artifical lighting. |
| Arc tube | A tube, normally ceramic or quartz, enclosed by the outer glass envelope of a high-intensity discharge lamp (HID) that contains the arc stream. |
| Building Luminance | Light reflected from the surface of a building, often used to create a sense of place or highlight architectural features. |
| Calculation Plane | An even grid of points denoting the anticipated or modelled intensity (candelas) or illuminance (lux) at a given point. |
| Candela (cd) | A measure of luminous intensity, the intensity of light in each direction. |
| Central Management Systems (CMS) | A specially developed software and service package that can efficiently handle all tasks of data collection and facility management. It allows users to remotely monitor and control lighting and apply dimming and/or switching controls. |
| Colour Rendering Index (CRI) | A scale from 0 to 100 percent indicating how accurate a given light source is at rendering colour when compared to a reference light source. The higher the number, the better a light source is at revealing the actual colours present at a surface or object. |
| Colour temperature | Measure 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. |
| Contrast | The relationship between the luminance of an object and its background. The higher the contrast the more likely it is that an object can be seen. |
| Cowl | Physical light spill control accessory. |
| Dark Sky International | Non-profit organisation with the mission to restore the nighttime environment and protects communities from the harmful effects of light pollution through outreach, advocacy, and conservation. |
| DECCA approach | A framework for assessing the impact of development on biodiversity and ecosystems in Wales. |
| Diffuse | Term describing dispersed light distribution referring to the scattering of light. |
| Efficacy | A measure of light output against energy consumption measured in lumens per watt. |
| Glare | The uncomfortable brightness of a light source when viewed against a contrasting darker background. |
| Hood | Physical light spill control accessory. |
| Illuminance | Illuminance is the quality of light, or luminous flux, falling on a unit area of a surface. It is sometimes designated by the symbol E and the unit of measurement is the lux. |
| Intrusive light (nuisance) | Light spilling beyond the intended task area. |
| Isolux | A line of equal illumination (like an isobar on a weather map showing equal barometric pressure). |
| Kelvin Scale (K) | A measure of temperature, especially extreme temperatures. This includes the temperature of a light bulb filament. |

# Glossary continued

| Term | Definition |
|---|---|
| LANDMAP | An all-Wales GIS based landscape resource where landscape characteristics, qualities and influences on the landscape are recorded and evaluated into a nationally consistent dataset. |
| Lamp | Light source. |
| Light cone | The angle at which the beam falls off to 50% peak intensity. |
| Light pollution | The spillage of light into areas where it is not required. Also known as obtrusive light. |
| Light spill | The light that falls outside the light cone. |
| Light trespass (nuisance) | Light that impacts on a surface outside of the area designed to be lit by a lighting installation. The legal term is nuisance. |
| Louvres | Physical light spill control accessory. |
| Lumens | A measure (Lm) 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 (i.e. over a road) 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, for example, decorative installations. |
| Luminous | Giving off light. |
| Lux | A measure ($Lm/m^2$) 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 | The average level of light (EAv) needed on a surface required to do a specific task. |
| Maintenance factor | A correction applied to a lighting calculation to allow for the build up of dirt on a luminaire and the depreciation of the lumen output of a lamp over time. 1=100%, 0.9=90% etc. |
| Obtrusive light | Unwanted light. |
| Optic | The components of a luminaire such as reflectors, refractors and protectors which make up the directional light control section. |
| Passive Infrared Sensor (PIR) | Electronic sensor that measures infrared light radiating from objects on its field of view. Commonly used in automatic lighting applications. |

| Term | Definition |
|---|---|
| Priority Ecological Network (PEN) | PENs in the terrestrial environment are versions of the all-Wales habitat networks that show areas of connectivity between Protected Sites, and as such provide a framework to inform the location of action to build functional resilient ecological networks based on our most important places for biodiversity. |
| Photocell | A unit which senses light to control luminaires. |
| Radiance | The glowing light shining from something. |
| Reflector | A device used to reflect light in a given direction. |
| Refractor | A device used to redirect the light output from a lamp when the light passes through it. It is usually made from prismatic glass or plastic. |
| Resilient Ecological Networks (RENs) | Networks of habitat in good ecological condition and species diversity, and the landscape features which provide links from one habitat to another. Ecosystem resilience is the ability of an ecosystem to deal with disturbances, adapting to change or recovering from them. |
| Shield | Physical light spill control accessory. |
| Sky Glow | The general diffuse sheen that is visible in the direction of large cities, airports and industrial complexes. |
| Sky Quality Measurement | 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. |
| Sky Quality Meter (SQM) | Device used to measure sky quality using 'magnitudes per square arc-second'. |
| Spectrum | The different wavelengths of energy produced by a light source (i.e. a 'rainbow' of colours form white light). |
| Voltage | The difference in electrical potential between two points of an electrical circuit. |
| Watt | The unit (W) for measuring electrical power. |
| Upward Light Output Ratio (ULOR) | The proportion (%) of direct light transmitted from the luminaire above 90° in the vertical plane. |

# Acronyms used throughout the document

Llangollen, Dee Valley

| Term | Definition |
|---|---|
| ALAN | Artificial Light at Night. |
| AONB | Area of Outstanding Natural Beauty (now referred to as National Landscapes). |
| BCT | Bat Conservation Trust. |
| CCTV | Closed Circuit Television. |
| CFL | Compact Fluorescent Lamp. |
| COP | Conference of Parties. |
| DSI | Dark Sky International. |
| DECCA | Diversity, Extent, Condition, Connectivity and Adaptability (aspects of ecosystem resilience). |
| GIS | Geographic Information System. |
| GGG | Gwent Green Grid. |
| ILP | Institute of Lighting Professionals. |
| LDP | Local Development Plan. |
| LED | Light Emitting Diode. |
| LVIA | Landscape and Visual Impact Assessment. |
| NELM | Naked-eye Limiting Magnitude. |

| Term | Definition |
|---|---|
| NOAA | National Oceanic and Atmospheric Administration. |
| NRW | Natural Resources Wales. |
| PEDW | Planning and Environment Decisions Wales. |
| PEN | Priority Ecological Network. |
| PIR | Passive Infrared Sensor. |
| PPW | Planning Policy Wales. |
| REN | Resilient Ecological Network. |
| SPG | Supplementary Planning Guidance. |
| SSSI | Site of Special Scientific Interest. |
| SQM | Sky Quality Meter. |
| ULOR | Upward Light Output Ratio. |
| UV | Ultraviolet. |
| VIIRS | Visible Infrared Imaging Radiometer Suite. |
| VLT | Visible Light Transmission. |
| ZTV | Zone of Theoretical Visibility. |

# Executive summary

Castell Dinas Bran, Llangollen
© Gareth Môn — Clwydian Range
and Dee Valley National Landscape

Dark skies are an important natural resource for Wales, its people, and future generations. More than two-thirds of Wales has a dark sky, parts are internationally recognised as Dark Sky Reserves, Dark Sky Park, Dark Sky Sanctuary and as a Dark Sky Community. Yet there is much more to be done to get lighting at night right in communities where people live, and for nature.

Light pollution is caused by artificial light at night (ALAN) in areas where it is not wanted, is excessive or inappropriate to context. Although awareness of the opportunities of a night sky and of light pollution and its effects are becoming more apparent, light pollution remains a problem across much of Wales. Light pollution wastes money by costing to light where it is not needed.

The purpose of this guidance is to increase understanding of how to conserve and enhance dark skies in Wales through planning and design to make a tangible difference. The guidance does not mean no lights, but only where light is needed. Good lighting practice should be followed using the right light in the right place, at the right time.

This Welsh Government guidance supports national and local planning policies on dark skies and light pollution. It provides an opportunity to promote a national approach and should be followed by all those involved in the planning, design and determination of planning applications or lighting schemes.

The guidance is relevant to planners and developers, for proposals that require planning consent, as well to changes outside of planning for new or replacement lighting, street lighting or retrofits.

The recommendations, lighting design principles and advice set out in this guidance are applicable to the whole of Wales and will lead to more sensitively designed and appropriate lighting schemes that will deliver improved outcomes for the night sky and ecosystems.

### ☆ Summary of Good Practice Lighting Principles

- Don't light unless it's necessary.
- Light only where needs to be lit, avoiding over-lighting and clutter.
- Light should be no brighter than necessary.
- Use warm colour temperatures; 2,700K or lower.
- Use switch-off, dimming or PIR sensors.
- Use a lower mounting height where possible.
- Limit internal lighting spilling outside target area.
- Keep light away from wildlife.

Following the Good Practice Lighting Principles should result in improved outcomes for energy and carbon saving, attractive and safe spaces, lead to higher quality residential amenity, health and wellbeing, improved enjoyment of dark sky culture and heritage, and importantly protect biodiversity.

By working together, it is possible to address light pollution and promote the crucial role of dark skies for biodiversity, human health, energy conservation and more.

Promoting and encouraging dark sky lighting and reducing light pollution are the simplest, quickest, and most cost-effective way to make visible, positive change for local communities, supporting them to become prosperous, healthy places whilst making positive changes in the context of the climate, biodiversity, and cost of living crises and aligning with the Well Being of Future Generations Act.

# 1.0 Introduction

Starry sky over Port Eynon and Horton Bay on the Gower Peninsula
Stock image

## 1.1 Purpose, status and scope of this good practice guidance

Dark skies are an important natural resource for Wales, its people, and future generations. The purpose of this document is to set out the key design objectives and considerations for planning for dark skies. This document provides practical good practice guidance to support the implementation of national planning policy for lighting contained in Section 6.8 of Planning Policy Wales (PPW) 12 and Policy 9 (Resilient Ecological Networks and Green Infrastructure) of Future Wales.

The status of this document is Welsh Government Good Practice Guidance to assist all those involved in planning for dark skies. Welsh Ministers, Planning and Environment Decisions Wales (PEDW) and Local Authorities can use this guide in their respective roles reviewing, shaping, and determining planning applications. Developers can use the good practice early in the planning process to identify and address potential issues and design schemes appropriately. Stakeholders and consultees can draw from the design principles and use them to shape their interactions with the planning process, and those coming to the planning process for the first time can use this good practice guidance to better understand the key dark sky issues that development proposals should consider and identify wider useful sources of information.

Building on the established guidance contained in the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty (now referred to as a National Landscape) Supplementary Planning Guidance on Planning for the Dark Night Sky, this document extends and develops the design principles for the whole of Wales. 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. Even where planning permission is not required, those looking to install new lighting or replace existing lighting can play their part by following the guidance set out in this document.

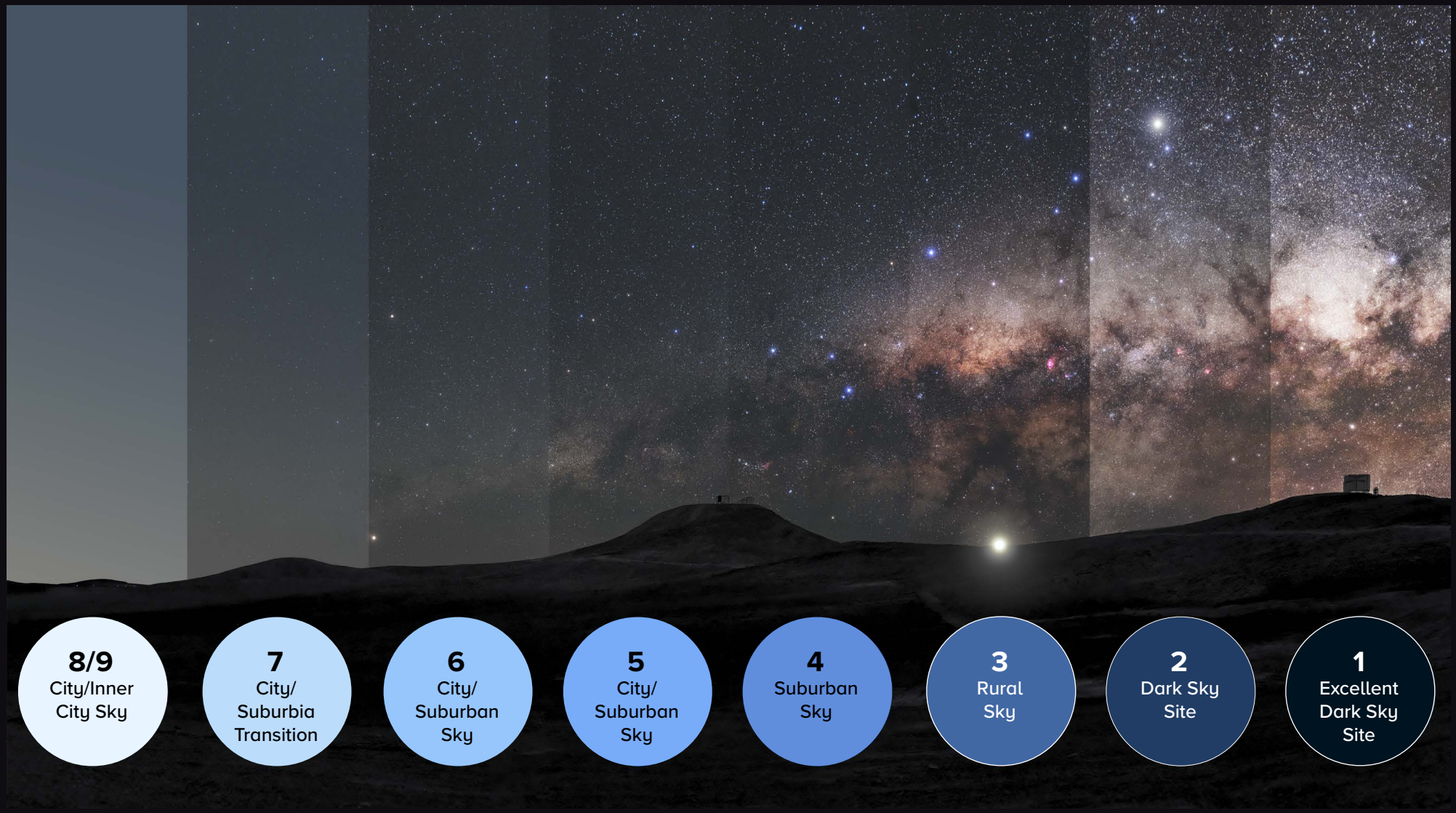
## 1.2 What is light pollution?

DarkSky International defines light pollution as ‘the human-made alteration of outdoor light levels from those occurring naturally’. Light pollution is artificial light that illuminates where it is not supposed to or is needed. It is lighting that is obtrusive, wasteful and harmful.

The Institution of Lighting Professionals advocates ‘good lighting practice is the provision of the right light, at the right time, in the right place, controlled by the right system’. Light pollution arises from a lack of thought or attention in the design of development schemes and installation of lighting equipment. Light can travel far from its intended source, with ALAN from cities being visible up to 90 miles away.

**Why does it matter?**

All living things adjust their behaviour according to natural light, artificial light can alter the natural patterns of light and dark. The invention of artificial light has done much to safeguard and enhance the nighttime environment but, if not properly controlled, obtrusive light pollution can have serious, adverse effects on ecosystems, landscapes and on people’s physical and mental health. Switching to energy efficient dark sky lighting, and switching off when it is not needed, has the potential to save energy, money and reduce carbon emissions in Wales.




Bortle Scale – European Southern Observatory

### Bortle scale and sky quality

The Bortle Scale has nine levels that relate to the brightness of the night sky at a specific location. Level one on the scale corresponds to excellent dark skies and levels seven to nine indicate very poor to bad night sky. As the Bortle number increases, the night sky visibility quality deteriorates.

## 1.3 Light pollution and obtrusive lighting types

There are three general types of light pollution:

**Sky glow –** This is the glow that is visible around urban and built-up areas resulting from the scattering of artificial light across the horizon giving a "halo effect". 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 areas of Wales will be relatively higher in glare than in urban areas causing impacts on nighttime landscape tranquillity. A common example would be low cost 'security' floodlights that are installed on commercial and domestic properties.

Glare may result directly from lighting, or indirectly off surfaces by reflecting light such as smooth wet roads, sizeable water bodies, rocky or roofed areas; indirect lighting can help to minimise reflected glare. Individual or multiple luminaires can cause light cluttering and harmful glaring.

### The four main forms of Glare are:

**Distracting glare** which represents an annoyance or distraction to the viewer and can lead to eye fatigue, or in mammals and invertebrates can cause exhaustion or death by collision with lit buildings.

**Discomforting glare** occurs in varying degrees of intensity resulting in visual discomfort, often shown by symptoms of eyestrain or fatigue. The response is people squinting, shielding their eyes or turning to another direction.

**Disabling glare** is more intense than discomforting glare and the high level of light produces a glare that can interfere with or block vision, reducing the sharpness of vision.

**Blinding glare** results from light reflecting off smooth, shiny surfaces such as metal, glass, or water. It can be strong enough to block vision to the extent that the viewer becomes visually compromised.

**Nuisance/light intrusion –** is the spilling of light beyond the area or property being lit into where it is not wanted or necessary. Light nuisance can include intrusion into windows of neighbouring properties, but it can also cause issues to habitats and for areas of high biodiversity interest.

Lights should be installed correctly to reduce the spill of light beyond that of the required task area. It is important to prevent light spill into areas that should not be lit, including priority wildlife habitats, hedgerows, ponds, lakes, rivers and wetlands, species rich grasslands, saltmarshes, estuaries, or roosting, breeding and foraging sites for sensitive species. It is also important to prevent light spill within landscapes where dark skies are an important landscape characteristic.

## 1.4 Security and crime

There is little evidence to suggest that security lighting will directly deter criminals, and a poorly designed system may make things easier for intruders. Bright lights can create contrasting dark spots which can be used for concealment. Badly installed lights can also be triggered by wildlife which reduces the effectiveness of the lights purpose. Developers and householders should consider the installation of night vision CCTV or wireless camera systems to avoid the need for security lighting.

Domestic floodlights are some of the most disruptive lights. Easily bought, fitted and at low cost, these off-the-shelf 'security' floodlights can be extremely powerful, and some types can emit brighter light than a streetlight. As these lights are also installed at a much lower height than streetlights, the illuminance of the task area will be considerably excessive and will often cause annoyance to neighbours, particularly if they are triggered by PIR sensors throughout the night. At a maximum, these lights should not exceed 1000 lumens and should be installed correctly, pointing down not sideways, should illuminate ground floor levels only and have good optical control.

### Good Practice Lighting Principles

Don't light unless it's necessary. Is the light really needed to fulfil a clear task or function?

Light only what needs to be lit. Avoid over lighting and lighting clutter, direct light downwards and use the correct beam distribution.

Light should be no brighter than necessary. Vision is harmed when intense light glares. Use lighting sensitively and ensure it is comfortable on the eye.

Use warm colour temperatures. 2,700 Kelvins or lower should be used.

Use switch-off, dimming or PIR sensors. Only have lights on when needed. This helps reduce carbon emissions and reduces costs.

Use a lower mounting height where possible. Mounting a light lower contains light more effectively.

Limit internal lighting spilling outside. Avoid extensive glazing, fit blinds, curtains, external shutters and/or use tinted or electrochromic glass.

Keep light away from wildlife. Nature needs darkness to function and be healthy.

Following the above principles should result in the right light being used in the right place and at the right time.

## 1.5 Good lighting outcomes

Following the Good Practice Lighting Principles should result in improved outcomes for:

### Energy and carbon saving

Artificial lighting is a precious resource which should not be wasted. The United Nations Environment Programme reported in 2013 that electricity for lighting accounts for 6% of the global $CO_2$ emissions and 20% of the electricty used worldwide. Poorly installed lighting can waste money and electricity, whilst having negative impacts on the night sky, biodiversity, health and wellbeing. It also undermines the net zero carbon targets for 2030 and 2050. The key objective is to install the minimum number of lights required to fulfil the task, choose lights with the lowest embodied energy and install timers and sensors to reduce operational use.

### Attractive and safe spaces

Sensitive lighting contributes positively to the public realm, place-making, creating inclusive spaces, working with character and enhancing perceived safety and security. Harsh glare and cluttered disorientating light sources can affect uniformity (lighting location and focus) and legibility (what can be seen at nighttime affecting sense of safety). Good lighting can increase nighttime usage of active travel routes.

### Higher quality residential amenity, health and wellbeing

Residential amenity, health and wellbeing are all material planning considerations and common law 'quiet enjoyment' of private property. Good lighting minimises disruption to sleep and prevents light spill causing nuisance. During the hours of darkness humans produce melatonin, which is an antioxidant, anti-inflammatory and reduces blood vessel permeability, anxiety and stress. Seeing the dark sky connects people to nature and maintains their circadian rhythm.

### Enjoyment of dark sky culture and heritage

Enjoying dark skies and astro tourism are increasing in popularity and are particularly valued for winter tourism. Eliminating skyglow is vital throughout Wales and where it may affect dark sky designations.

### Protecting biodiversity

The day and night cycle through the seasons is in the DNA of all living creatures and darkness is essential for nature to flourish. Planning decisions must provide a net benefit for biodiversity and secure ecosystem resilience; therefore, all lighting must be sensitive to the habitats and species potentially affected. Addressing existing poor lighting throughout Wales and eliminating skyglow and the illumination of natural habitats is a priority.

Nash Point Lighthouse
and Milky Way
© Ben Anscombe

# 2.0 Context

Penycloddiau, Clwydian Range and Dee Valley National Landscape

## 2.1 Dark skies in Wales

Dark Sky International define a dark sky place as somewhere with skies that are 'naturally dark at night and free of light pollution'. Dark skies refer not only to the natural night sky, but the quality of the nightscape. Where darkness still exists, it is paramount that it is protected. 98% of Western Europe is living under heavily light polluted skies. Where light pollution is identified, every attempt should be made to reduce its impacts.

Wales has some of the darkest skies left in mainland United Kingdom, and according to Dark Sky International, Wales has the highest percentage of protected dark skies of anywhere in the world. Wales is one of the top destinations in the world for stargazing and has three International Dark Sky Places (IDSPs) within its borders, including two of 18 'International Dark Sky Reserves' (the largest geographical category of IDSP) worldwide. Wales is a global pioneer in Dark Skies.

The dark night sky quality in Wales is of a good to very good standard away from the coastal urbanised areas across the north and south coasts. There are pockets of light pollution that correspond to the more populated areas with the more rural locations showing better dark sky quality. Highway lighting is noticeable along the main motorways and trunk roads. The light spillage from coastal areas affects the quality of the night sky along the coast and offshore wind turbine and harbour development which adds light interference in the seascape and marine environment.

Promoting and encouraging dark sky lighting and reducing light pollution are the simplest, quickest, and most cost-effective way to make visible, positive change for our communities, supporting them to become prosperous, healthy places whilst making positive changes in the context of the climate, biodiversity, and cost of living crises and aligning with the Well Being of Future Generations Act.

**To truly value dark skies in Wales and beyond, the Good Practice Guidance Recommends:**

Preserve and enhance the dark night sky especially in designated landscapes and conservation sites.

Raise awareness of the importance of a dark night sky and encourage a reduction in light pollution.

Engage with individuals and groups in the area, grow an outreach and education dark skies programme linked to astronomy, nature, the historic environment and human well-being.

Guide residents and visitors to the most appropriate locations and opportunities for appreciating the dark night sky.

Promote "eco" and astro-tourism.

Inspire other areas at a local level to appreciate and protect their dark skies, both formally and informally.

## 2.2 Dark Sky Designations

### Designations

DarkSky International formed in 1988 (formerly known as the International Dark-Sky Association) and has become the recognised global authority on combating light pollution. They control the programme of International Dark Sky Places. Each Dark Sky place must follow a rigorous application process and report annually on progress once designated. There are five different designations, these are set out and explained below. They are all places that possess an exceptional or distinguished quality of starry nights and nocturnal environment that is specifically protected for its scientific, natural, or educational value, its cultural heritage, and/or public enjoyment.

### International Dark Sky Sanctuary

The most remote (and often darkest) places in the world, whose conservation state is most fragile. They are often small and uninhabited areas. The typical geographic isolation of Dark Sky Sanctuaries significantly limits opportunities for public outreach, so a Sanctuary designation is specifically designed to increase awareness of these fragile sites and promote their long-term conservation.

### International Dark Sky Reserve

These are often National Parks where planning is more controlled. Reserves consist of a core area meeting minimum criteria for sky quality and natural darkness, and a peripheral area that supports dark sky preservation in the core. Reserves are formed through a partnership of multiple land managers who have recognized the value of the natural nighttime environment through regulations and long-term planning. There is a minimum land size of 270 square miles.

### International Dark Sky Park

Publicly or privately owned conservation areas that implement good outdoor lighting and provide dark sky programs. These are usually in National Landscapes (Areas of Outstanding Natural Beauty). There is no minimum or maximum land size.

### International Dark Sky Community

A Dark Sky Community is a town, city or other legally organised community that has shown exceptional dedication to the preservation of the night sky through the implementation and enforcement of a quality outdoor lighting ordinance, dark sky education, and citizen support of dark skies. Dark Sky Communities excel in their efforts to promote responsible lighting and dark sky stewardship, setting good examples for surrounding communities.

### International Urban Night Sky Place

An Urban Night Sky Place is a municipal park, open space, observing site, or other similar property near or surrounded by large urban environs, and whose planning and design actively promote an authentic nighttime experience amid significant artificial light. By virtue of their characteristics, these sites do not qualify for designation within any other International Dark Sky Places category. However, they are worthy of recognition for their efforts to educate the public on the benefits of proper outdoor lighting that ensures public safety while minimising potential harm to the natural nighttime environment.

### Dark Sky Discovery Sites

Dark Sky Discovery Sites are a UK nationwide network of publicly accessible places, where it is possible to view the night sky away from street lighting and other light pollution. There are over 30 Dark Sky Discovery Sites in Wales.

### Case Study Example

Eryri National Park was granted International Dark Sky Reserve status in 2015. Much of the Park's terrain (which covers around ten percent of the total land area of Wales) is rugged and mountainous and largely uninhabited. As a result of this, DarkSky International considers Eryri to be one of the darkest places remaining in southern Britain.

# Dark Sky Areas:

**Eryri**

Designation: International Dark Sky Reserve
Size: 823 Square Miles
Date designated: December 2015
Fact: UK's largest International Dark Sky Reserve

**Ynys Enlli**

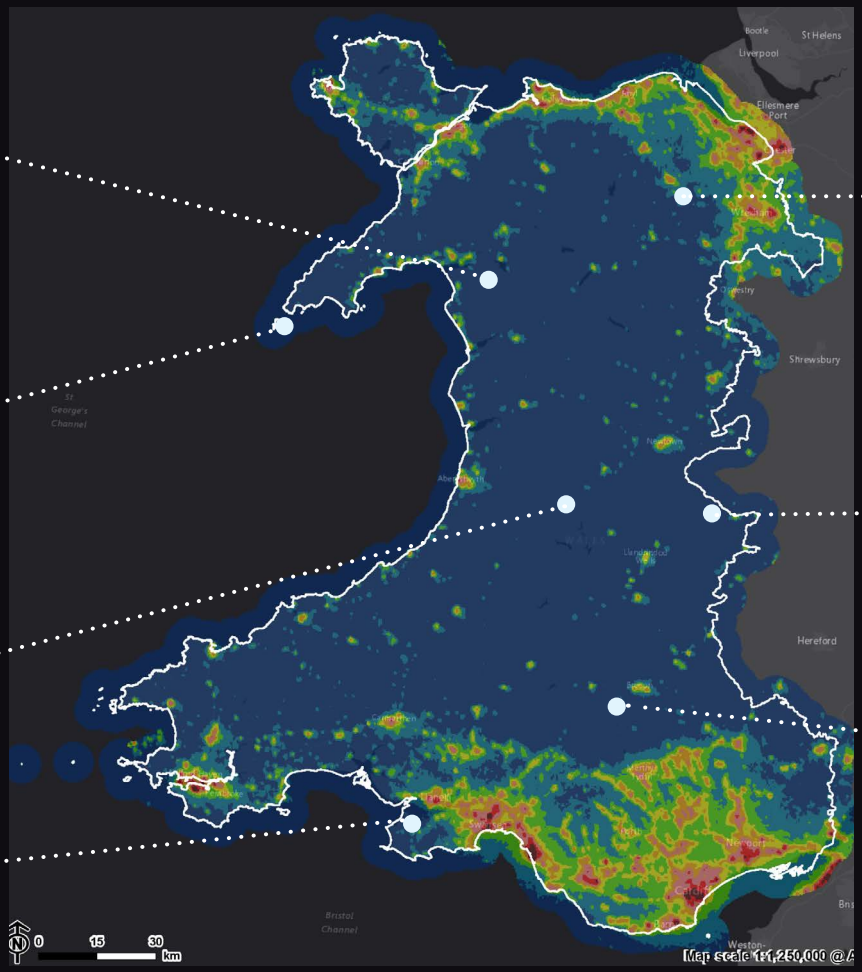
Designation: International Dark Sky Sanctuary
Size: 0.69 Square Miles
Date designated: February 2023
Fact: Europe's first and only International Dark Sky Sanctuary

**Elan Valley Park**

Designation: International Dark Sky Park
Size: 72 Square Miles
Date designated: July 2015

**Gower Dark Sky Community**

Designation: International Dark Sky Community
Date designated: 2025




**Clwydian Range and Dee Valley National Landscape**
(Area of Outstanding Natural Beauty)
Designation: International Dark Sky Community
Date designated: To be confirmed

**Presteigne and Norton**

Designation: International Dark Sky Community
Size: 16 Square Miles
Date designated: January 2024
Fact: Wales' first International Dark Sky Community

**Bannau Brycheiniog**

Designation: International Dark Sky Reserve
Size: 520 Square Miles
Date designated: January 2013
Fact: The first Welsh International Dark Sky Reserve

Cwm Idwal, Eryri International Dark Sky Reserve

## 2.3 National dark skies data

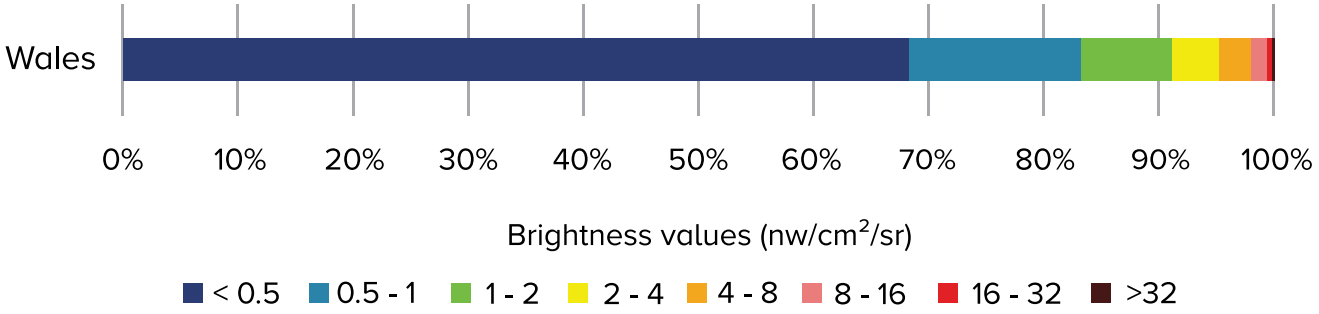
The assessment of the quality of the night sky in Wales relies on Natural Resources Wales (NRW) Tranquillity and Place – Dark Skies data. The national dataset for Wales is divided into eight colour bands. Lower brightness values relate to lower light pollution levels and darker skies (dark blues), higher brightness values relate to greater levels of light pollution (dark reds).

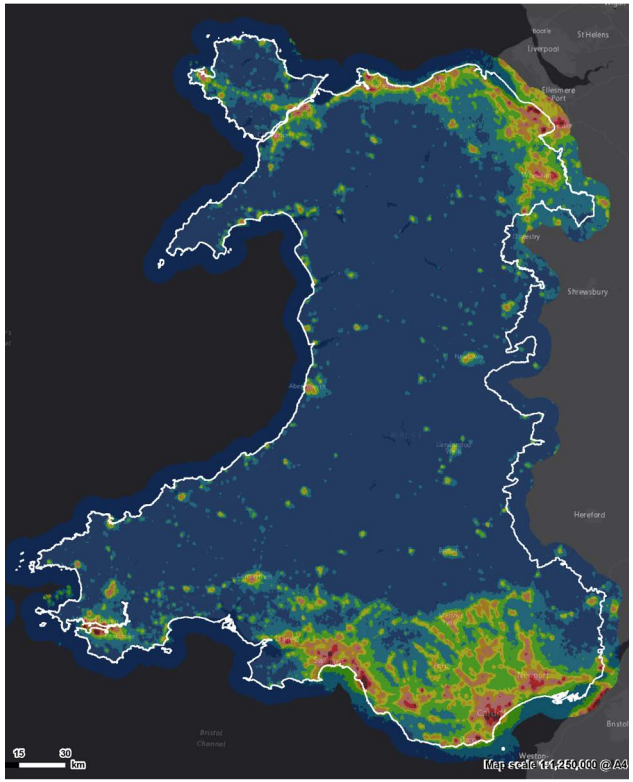
The following table and graph show the breakdown of land in Wales (as defined by Ordnance Survey) in relation to the eight colour bands, the data excludes the 5km buffer around the coast.

### The national map of Wales' dark skies and light pollution, classified into the eight colour bands

Percentage and area of Wales falling into each colour band

| | Brightness values (nw/cm$^2$/sr) | % of total area | Area (km$^2$) |
|---|---|---|---|
| Darkest | <0.5 | 68.1 | 14,458 |
| | 0.5 - 1 | 15.0 | 3,184 |
| | 1 - 2 | 7.9 | 1,667 |
| | 2 - 4 | 4.3 | 9.8 |
| | 4 - 8 | 2.7 | 574 |
| | 8 - 16 | 1.5 | 314 |
| | 16 - 32 | 0.4 | 95 |
| Brightest | > 32 | 0.1 | 28 |



# 3.0 Planning Process and Lighting

Milky Way over Tryfan, Eryri International Dark Sky Reserve
© Ian McDowall

This section is aimed at planners, developers, and practitioners to help assess existing conditions, produce lighting plans and address existing lighting pollution.

## 3.1 Lighting assessment and design

Some lighting installations will require planning permission. This guidance will help in the selection of the most appropriate lighting and in the assessment of such proposals. Whilst many lighting installations don't require planning consent the benefits of retaining the dark night sky and following the lighting design principles and design advice will lead to a more sensitively designed and appropriate lighting scheme.

For those developments where the planning authority require a lighting plan, the design and assessment should aim to address all the aspects of a lighting plan. The Planning Authority will make a judgement on whether a full lighting assessment and plan is required depending on the scale and nature of the development and its likely impact on the night sky. A full assessment and plan are likely to require the services of a qualified lighting design engineer.

Small scale developments with minimal lighting impact are unlikely to be required to prepare a full assessment and plan but should follow the basic principles of the lighting assessment and dark sky friendly design. Pre-application discussions are useful in helping applicants and agents identify the issues to cover and the information needed to support any application for planning permission. This can help minimise delays in processing the application.

## 3.2 The lighting plan

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 guidance.

**Plan Drawings**

A legible and scaled lighting plan with specifications is required to show the location of each external luminaire type and light source whether they form part of a new proposal or if they are existing and proposed to be retained. The aim is to convey the information as comprehensively and clearly as possible.

**Visual information**

Lighting can be communicated using visual information and can be an effective way to convey and understand new lighting, proposed changes to existing lighting or to share the comparative effects of retrofits.

Visual information relating to lighting may be used to support planning applications, nighttime assessments as part of a Landscape and Visual Impact Assessment where required, Listed Building Consent, grant applications and retrofit proposals.

Requirements should be agreed as early as possible to ensure the choice(s) of visual information are appropriate and will meet requirements, be proportionate, deliver the intended benefits and be affordable.

**Visual information can be used to convey the:**

- Existing lighting baseline.
- Type, scale, design and layout of proposed lighting.
- Likely effects on the surroundings or landscape.
- Likely effects where people may view and experience the lighting.

Visual information depicting a before and/or after may include:

- Maps and plans at an appropriate scale and level of detail
- Photographs and photomontages
- Visualisations as illustrations, photomontages or digital images
- Aerial imagery taken by a licensed drone
- A Zone of Theoretical Visibility (ZTV) digital map showing where a development and its effects may be visible

Supporting information may include, as appropriate:

- Technical details of photographs, location, date, time and distance from lighting
- Viewpoint locations, direction and angle of view
- Weather, moon phase and seasonal conditions which may affect visible lighting
- Text to explain the intent of the visual material

The Landscape Institute Technical Guidance Note on Visual Representation of Development Proposals, published in 2019, can be viewed on the Landscape Institute website. The guidance includes information on nighttime and low-light photography considerations and visualisation types.

Plas Newydd, Llangollen
©Kerem Asfuroglu

## 3.3 Understanding the baseline

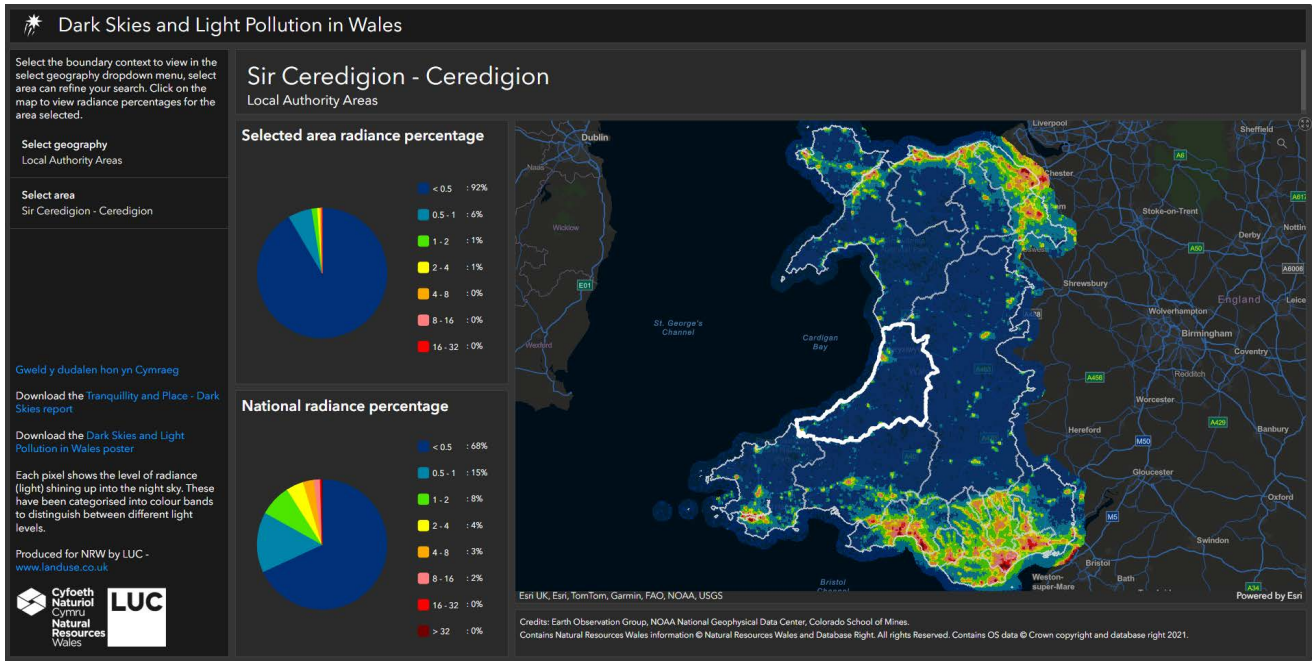
An assessment of the baseline quality of the night sky can be achieved through consulting satellite imagery derived data, and where possible complemented by a field based local sky quality assessment. Establishing an evidence baseline of dark skies and light pollution aids the understanding of the spatial extent and distribution of dark skies including:

- areas of light pollution and their likely source(s);
- areas where there is light spillage;
- areas where value is placed on dark skies, such as in relatively undeveloped and remote landscapes and seascapes; and
- the contribution dark skies make to other valued aspects, e.g. sense of tranquillity and solitude.

An assessment provides a baseline against which changing sky quality, or brightness associated with light pollution, can be monitored and the impact of any lighting related actions assessed. Evidence of a sky quality monitoring programme may be a requirement for dark sky related designations. The section on measuring dark skies provides further information on undertaking a sky quality assessment to complement and refine satellite derived data.

Baseline assessments can be used to identify where reducing light pollution could be particularly beneficial for communities and nature networks. Additional examples include Designated Landscapes' Plans, Green Infrastructure Assessments, Wellbeing Assessments and submitted evidence in new Dark Sky Reserve applications.

The NRW Tranquillity and Place – Dark Skies national dataset is intended to be used as baseline evidence to inform policy intent, practice and provision for wellbeing benefits.




The Dark Skies dataset is based upon satellite imagery taken at 01:30 in December 2019 by the United States National Oceanic and Atmospheric Administration (NOAA) Suomi National Polar-orbiting satellite with the Visible Infrared Imaging Radiometer Suite (VIIRS) capturing visible and infrared imagery, the imagery was processed in 2021.

The methodology for the dataset is explained in the Dark Skies evidence report. There is cross border consistency with England's Light Pollution and Dark Skies data.

The Tranquillity and Place – Dark Skies dataset is available from the DataMapWales website.

The Tranquillity and Place – Dark Skies dataset is also available on the Dark Skies and Light Pollution in Wales interactive web application created to present the results. Users can choose from several geographical contexts to display the Dark Skies data including by:

- Local Authority, Future Wales, National Parks, National Landscapes (AONBs), NRW Operational Areas, National Landscape Character Areas, and LANDMAP Visual & Sensory landscape areas.
- The Tranquillity and Place – Dark Skies StoryMap is a useful place to start for an introduction to some of the work relating to dark skies in Wales, the baseline dataset and further information.

Causeway over Llyn Llydaw, Eryri International Dark Sky Reserve
© Dani Robertson

## 3.4 Planning process

Whether submitting, designing or assessing planning applications, the key questions to address are shown below:

| Aspects | | Description | |
|---|---|---|---|
| **Need** | | | |
| 1 | Statement of client needs and parties' comments | Is the lighting needed? | |
| **Baseline conditions** | | | |
| 2 | Existing lighting environment of the site | – What is the current lighting on site?<br>– How is it used and what for? | – Is the current lighting dark sky compliant?<br>– Is there potential for improvement? |
| 3 | Survey of surrounding night environment | What is the surrounding lighting environment? Is the locality:<br>– Completely dark? (no lighting)<br>– Intrinsically dark? (light sources are rare)<br>– 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 locations and viewpoints | – Are there 'Dark Sky Discovery Sites' nearby?<br>– Are there any 'Sky Quality Measurement' monitoring points nearby? | – Are there any important species, habitats or wildlife sites nearby?<br>– Is the site visible from any viewpoints, public routes or sites? |
| 5 | Determination of the obtrusive light limitations for lighting installations | – What is the maximum acceptable level of Sky Glow?<br>– How much light can spill into a room?<br>– 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)?<br>– What limitations to Obtrusive Light apply? |

| Design | | | |
|---|---|---|---|
| 6 | Lighting Design Objectives | – What are the general lighting objectives?<br>– 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?<br>– What levels of illuminance are to be used and why? | – Does the illuminance exceed the lux illuminance limits? |
| 8 | Calculated Predictions | A lighting design should include:<br>– A site layout plan showing illuminance and uniformity levels across the site.<br>– Where the intention is to illuminate buildings, elevation drawings showing illuminance and uniformity levels across the site.<br>– A comparison between the maintained averages (EAv) calculation for task lighting areas and the guidance standards. | – Are the predicted averages consistent with guidance standards?<br>– A comparison between the maintained averages (EAv) calculation for task lighting areas and the guidance standards.<br>– Are the predicted averages consistent with guidance standards? |
| 9 | Obtrusive Light Calculation | A design should show:<br>– 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? |
| 10 | Comparison with Baseline Values | – What is the assessment of the expected cumulative impact? | – Does the design negatively affect the dark sky environment? |
| 11 | Luminaire Schedule | – Luminaire light distribution type<br>– Lamp type and Wattage<br>– Mounting Height<br>– Orientation<br>– Tilt | – Lumens<br>– Colour Temperature (CCT)<br>– Spectrum<br>– Does the colour temperature exceed 3000Kelvin?<br>– Does the tilt when installed exceed ILP guidance? |
| 12 | Mitigation | Are other controls in use to bring design into compliance? Such as:<br>– Curfews<br>– Proximity sensors<br>– Shielding<br>– Baffles and louvres | – Infra-red CCTV<br>– Surfaces<br>– Is it possible to make adjustments to prevent harm under astronomically dark conditions? |

*Source Planning for Dark Night Skies Supplementary Planning Guidance for lighting in the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty (2022).*

Bryn Alyn, Eryrys
© Gareth Môn — Clwydian Range
and Dee Valley National Landscape

## 3.5 Policy context for dark sky action

The Good Practice Guidance takes account of the legislative and strategic planning context at the national level. Planning Policy Wales (PPW) was fully revised in 2018 to reflect the Well Being of Future Generations (Wales) Act 2015 and to support the implementation of the Environment (Wales) Act 2016 through the planning system.

In February 2024, Edition 12 of PPW was released updating planning policy covering green infrastructure, net benefit for biodiversity, the protection afforded to Sites of Special Scientific Interest and trees and woodlands.

The updates to PPW 12 are driven by the need to fulfil the Global Biodiversity Framework obligations agreed at COP15, the Biodiversity Deep Dive recommendations developed in response to this and in continuing to fulfil the Environment (Wales) Act (2016) Section 6 duty to maintain and enhance biodiversity and the resilience of ecosystems in Wales. The updates reflect the national priority to address the nature emergency, where opportunities for biodiversity are an embedded objective of development. Planning for dark skies is part of this wider strategic approach.

The net benefit for biodiversity policy is defined in PPW as “the concept that development should leave biodiversity and the resilience of ecosystems in a significantly better state than before, through securing immediate and long-term, measurable and demonstrable benefit, primarily on or preferably immediately adjacent to the site”. It is a qualitative and primarily site-based approach applicable to all developments, embedded in wider placemaking principles and it is driven by the Section 6 Duty of the Environment (Wales) Act (2016).

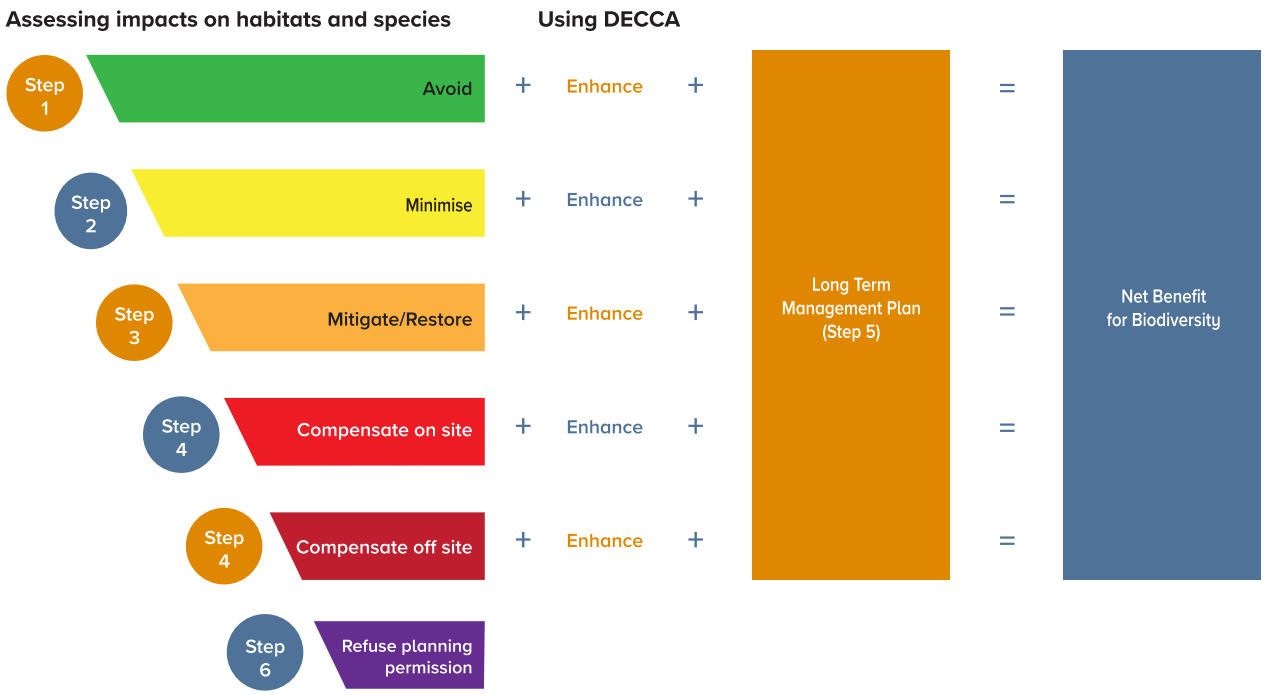
The onus is on the developer to demonstrate how their proposals will deliver a net benefit, including evidence of long-term site management and committed resources.

NRW have a support framework to help implement the net benefit for biodiversity policy. Going beyond an exclusive focus on habitats and species, the DECCA (diversity, extent, connectivity, condition, and adaptability) framework sets out the attributes of ecosystem resilience that the planning system must consider.

The DECCA framework guides the policy response as set out at paragraph 6.4.15 of PPW – the Step-Wise Approach.

The Step Wise Approach is a 6-step process for policy development and decision makers that sets out a logical and pragmatic progression through a series of policy considerations. Structured around the over-riding need to avoid harm to biodiversity and ecosystem resilience in the first place, the Step-Wise Approach details distinct steps in the mitigation hierarchy all with the aim of minimising harm to biodiversity and ecosystem resilience.

### Summary of the Step-Wise Approach



Biodiversity enhancement must be secured at each step of the policy.

PPW12 refers to light pollution in Chapter 6 (Section 6.8). 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 nighttime 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.

PPW notes that Dark Sky Reserves exist in various parts of Wales and recognises that Dark Sky Reserves can contribute positively to an area in economic and environmental terms and their characteristics should be considered when preparing development plan strategies and policies and when considering individual development proposals.

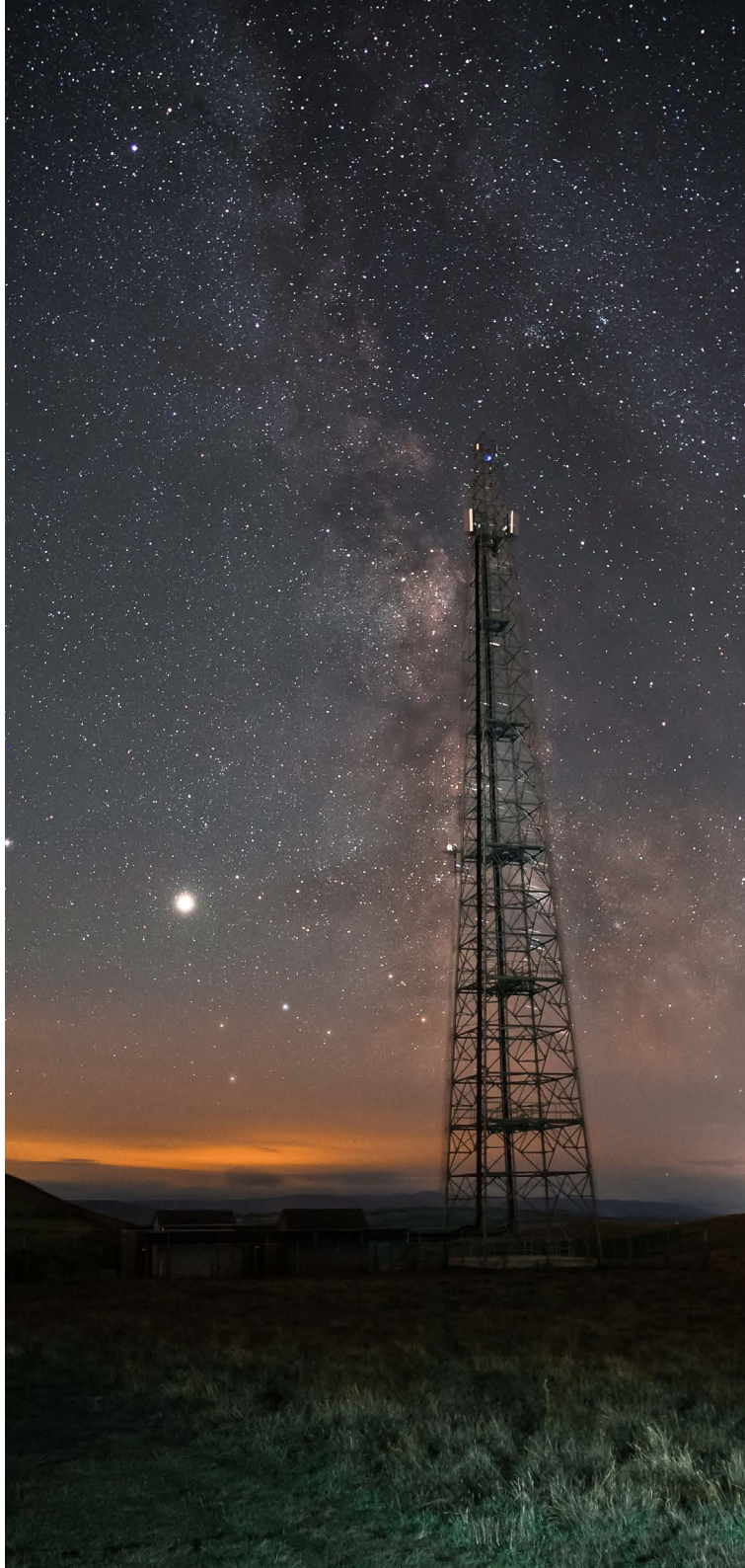
Future Wales contains three policies with particular importance in planning for dark skies.

**Policy 9** Resilient Ecological Networks and Green Infrastructure where the objective of avoiding light pollution is for ecological purposes;

**Policy 17** Renewable and Low Carbon Energy and Associated Infrastructure; and

**Policy 18** Renewable and Low Carbon Energy Developments of National Significance where the objective of avoiding light pollution is in relation to nighttime visual impacts.

The objectives of these policies in relation to the importance of retaining dark skies across Wales and the need to avoid light pollution should be considered when preparing development plan strategies and policies and when considering individual development proposals.



Transmitter Mast

## 3.6 LDP policies and model conditions

There is no 'one size fits all' approach and the exact wording of such policies will be for each Local Planning Authority to decide. However, the following are considered to be good examples of wording for lighting policies that can be used and/or adapted. Local Development Plans should contain policies that seek to balance the need for lighting for safety and security whilst limiting the impact of light pollution from artificial light on people, wildlife and dark skies/landscape, reducing carbon emissions and increasing energy efficiency.

### Development proposals

| Policy wording | Considerations |
|---|---|
| Development proposals involving external lighting will be permitted where supported by information on how light spillage has been minimised and demonstrates no unacceptable adverse effect on/risk to... | – Biodiversity, including protected species<br>– harm to health<br>– local amenity<br>– landscape character and quality<br>– built heritage<br>– visual amenity |
| Where lighting is necessary, proposals should include an appropriate lighting scheme to ensure:<br>a. lighting is necessary<br>b. proposed lighting is the minimum required<br>c. light spillage is minimised<br>d. prevention of glare/glow/spillage<br>e. respect for amenity of neighbouring land uses<br>f. visual character of built and natural environment is not unacceptably affected<br>g. potential impacts on biodiversity are considered | – rural/urban settings<br>– assessment of likely impact<br>– minimisation and/or mitigation measures<br>– balance between security/ prevention of crime and need for lighting<br>– individual and/or cumulative impacts |
| Improvement of environmental quality as a result of development is positively encouraged. | – replacement of obtrusive lighting with low level schemes<br>– carbon reduction |

### Sensitive species/habitats/landscape/dark skies

| Policy wording | Considerations |
|---|---|
| Proposals involving external lighting only permitted where lighting scheme demonstrates no:<br>a. unacceptable levels of light pollution<br>b. unacceptable adverse effect on visibility of night sky<br>c. unacceptable disturbance to protected species | – natural/historic landscape<br>– wildlife/features of natural environment such as tranquillity<br>– dark sky status (existing/proposed/aspirational)<br>– excessive lighting and light trespass<br>– impact of lighting apparatus on daytime views<br>– dark wildlife movement corridors for bats and light sensitive species<br>– consideration if development could proceed without lighting<br>– mitigation of potential cumulative impacts on night sky<br>– correlated colour temperature of lighting |

Carew Castle, Pembrokeshire Coast National Park

**Model conditions**

Conditions and planning obligations can enable development proposals to proceed where it would otherwise be necessary to refuse planning permission. Policy and guidance on applying conditions to applications is set out in Welsh Government Circular 016/2014: The Use of Planning Conditions for Development Management.

The intention of the model conditions outlined below is to act as a reference point for local planning authorities when drafting conditions to attach to a grant of planning permission. The list does not provide conditions for every possible development scenario but acts as a best practice guide to be used in conjunction Circular 016/2014. The conditions contained within the list should therefore not be applied without careful thought and must be proportionate to the development and its potential effects. Regard must always be had to the six tests, conditions should be: (i) necessary; (ii) relevant to planning; (iii) relevant to the development to be permitted; (iv) enforceable; (v) precise; and (vi) reasonable in all other respects.

**Model conditions for a scheme of lighting, and reasons, might be as follows:**

Major development/Development of National Significance:

**Condition A:** [The development shall not begin until/Prior to the installation of any external lighting on the site] a scheme for the external lighting of the development has been submitted to and approved in writing by the local planning authority. The scheme shall be informed by a site-wide lighting assessment and shall be designed to comply with the lighting standards [for Environmental Zone [E0 (Protected)/E1 (Natural)/E2 (Rural)]] set out in 'Guidance Note 1 for the Reduction of Obtrusive Light' (2021) and/or 'Guidance Note 8 'Bats and Artificial Lighting in the UK' (2023) from the Institute of Lighting Professionals. The external lighting shall thereafter be installed and retained in accordance with the approved details for the lifetime of the development.

**Reason:** In the interests of [e.g. visual amenity/ protected species] and to promote opportunities for the enjoyment of the [e.g. tranquility or other special quality] of the [National Park/Landscape], and in accordance with policies [] of the [] Local Development Plan and policies 9, 17 and 18 of Future Wales.

**Minor/householder development:**

**Condition B:** No external lighting shall be installed or operated on the [e.g. building hereby approved], including emergency or security lighting, until the written approval of the local planning authority has been obtained of the details thereof, including a light mitigation strategy which specifies measures to limit [upward] light spillage [onto foraging habitats for bats as identified in []]. The scheme shall be carried out in accordance with the approved details and retained for the lifetime of the development.

**OR:**

**Condition C:** All external lighting must be hooded and angled downwards to ensure no upward light spillage.

**Reason:** In the interests of e.g. protected species and to promote opportunities for the enjoyment of the [e.g. tranquility or other special quality] of the [National Park/Landscape] [in accordance with policies [x] of the [x] Local Development Plan].

The Manx Shearwater avoids predators by flying to its breeding burrow under cover of darkness

## 3.7 Biodiversity and resilient ecological networks

Artificial Light at Night (ALAN) has been shown to impact biodiversity in a wide variety of ways. Impacts include those on primary production, herbivory, animal behaviour, interspecific interactions such as competition and predation, and even soil characteristics, and therefore affects whole ecosystems across different environments.

The loss and fragmentation of habitats constitute two of the main threats to global biodiversity and studies have shown that ALAN reduces and blocks the movements of native species through barrier effects, thus generating habitat fragmentation and loss.

### Biodiversity and resilience of ecosystems duty (Section 6 Duty)

This sets out that Planning Authorities must seek to maintain and enhance biodiversity in the exercise of their functions. This means development should not cause any significant loss of habitats or populations of species (not including non-native invasive species), locally or nationally and must work alongside nature to provide a net benefit for biodiversity and improve, or enable the improvement, of the resilience of ecosystems. The stepwise approach outlined in the policy context section is the means of demonstrating the steps which have been taken towards securing a net benefit for biodiversity. In doing so, planning authorities must also take account of and promote the resilience of ecosystems, following the DECCA Framework.

### Resilient ecological networks

Resilient ecological networks are vital for nature recovery and are networks of habitat in good ecological condition linking protected sites and other biodiversity hotspots across the wider landscape, providing maximum benefit for biodiversity and wellbeing (Future Wales, Policy 9).

The protection and creation of networks of statutory and non-statutory sites, and of the landscape features which provide links from one habitat to another can make an important contribution to developing resilient ecological networks and securing a net benefit for biodiversity and in doing so improve the quality of the local place and its ability to adapt to climate change.

The definition of ecosystem resilience from the State of Natural Resources reports in 2016 (and 2020), is "*the capacity of ecosystems to deal with disturbances, either by resisting them, recovering from them, or adapting to them, whilst retaining their ability to deliver services and benefits now and in the future*" (disturbances are interpreted to mean pressures and demands on the ecosystem).

### Protection and management of designated Sites

Statutorily designated sites must be protected from damage and deterioration, with their important features conserved and enhanced by appropriate management. The contribution of the designated site to wider resilient ecological networks should be recognised and captured as part of a strategic approach to planning policy and decision making.

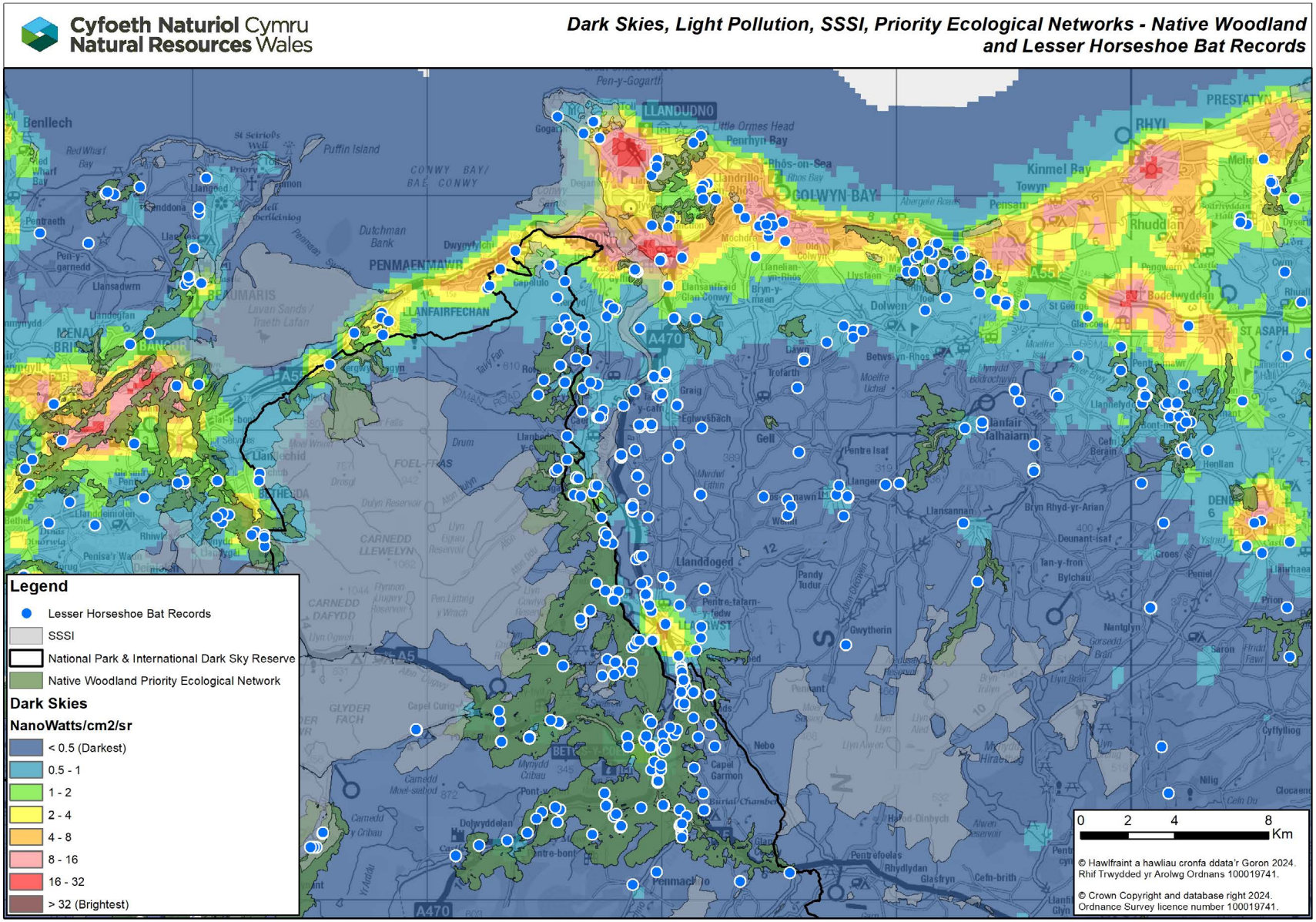
PPW 12 states that Planning Authorities should consider opportunities to restore networks of habitats to a healthy condition identified as a result of undertaking the Green Infrastructure Assessment and the identification of appropriate interventions to secure delivery against the attributes of resilience, namely; diversity, extent, connectivity, condition and adaptability. This includes identifying opportunities for restoration and nature recovery even if this is beyond its own administrative boundaries. Taking a spatial approach which, for example, identifies buffer zones around designated sites or stepping stones to improve connectivity between them will strengthen the ability of designated sites to fully perform their role at the heart of resilient ecological networks and to encourage nature recovery on a larger scale.

### Dark skies and nature networks

By connecting dark skies and light pollution mapping with protected sites and nature network mapping it is possible to identify areas that are and should remain dark, as well as those areas where reducing light and/or retrofitting with dark sky friendly lighting would be of benefit to the protected site and wider nature networks. Mapping can help us understand spatial patterns, connections, and where taking action could make positive differences.

Many large, often upland, Sites of Special Scientific Interest (SSSIs) are predominantly dark, but they are under threat of increasing light pollution, it is important to retain their dark environs.

The map (right), featuring North-West Wales and Eryri National Park, illustrates this by connecting SSSIs with dark skies and light pollution.
The addition of Priority Ecological Network mapping, in this case native woodlands, illustrates the importance of dark ecological networks too.
The further addition of Lesser Horseshoe Bat Records (which includes roosts) emphasises the value of dark ecological networks to nocturnally active ecosystems.


Cyfoeth Naturiol Cymru
Natural Resources Wales
Dark Skies, Light Pollution, SSSI, Priority Ecological Networks - Native Woodland and Lesser Horseshoe Bat Records
Legend
Lesser Horseshoe Bat Records
SSSI
National Park & International Dark Sky Reserve
Native Woodland Priority Ecological Network
Dark Skies
NanoWatts/cm2/sr
< 0.5 (Darkest)
0.5 - 1
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
> 32 (Brightest)
0 2 4 8 Km
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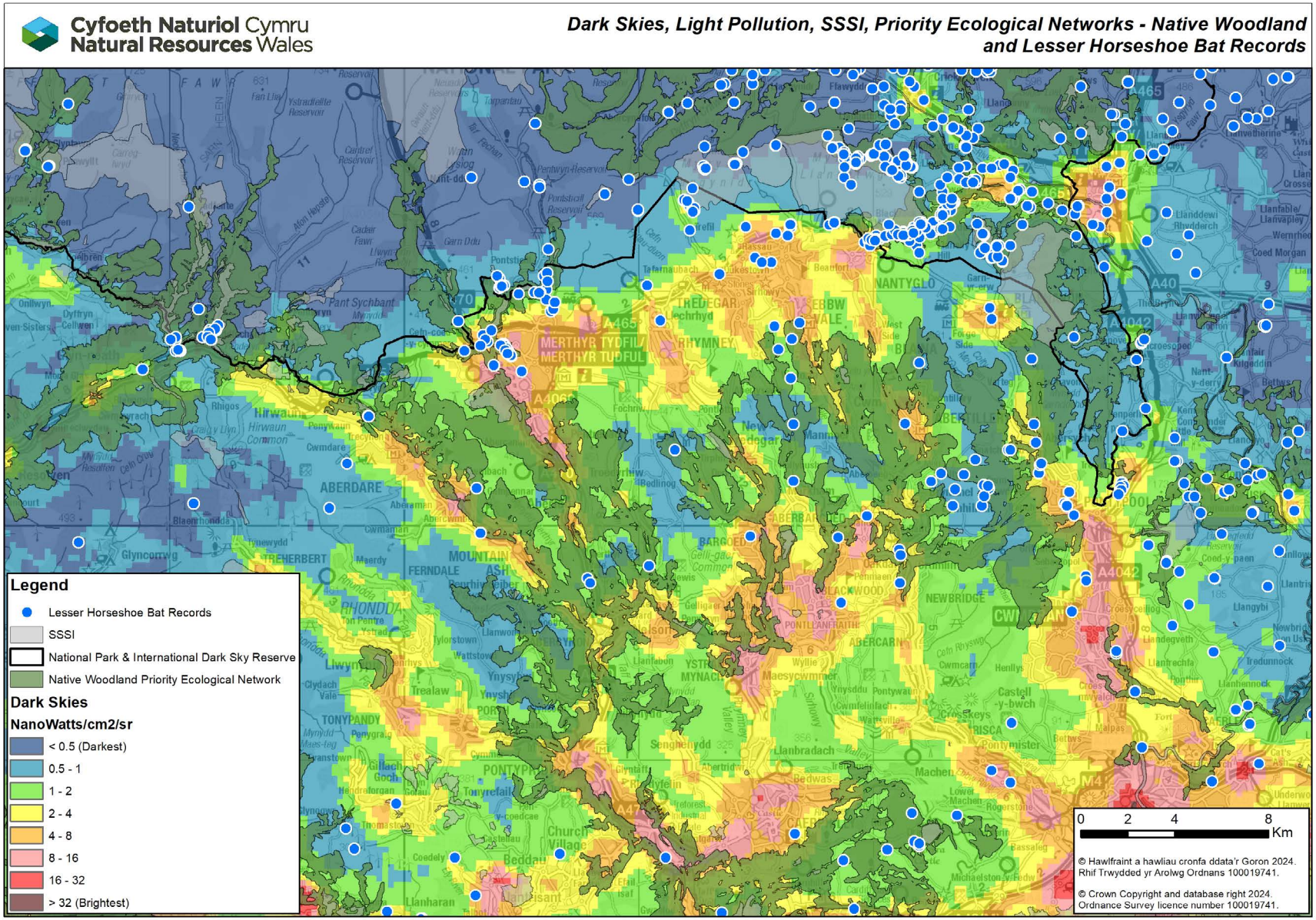



The most light-polluted areas often contain many small SSSIs, because they are in the most developed areas their habitats are the most fragmented, as evident in the South Wales and Bannau Brycheiniog National Park example.

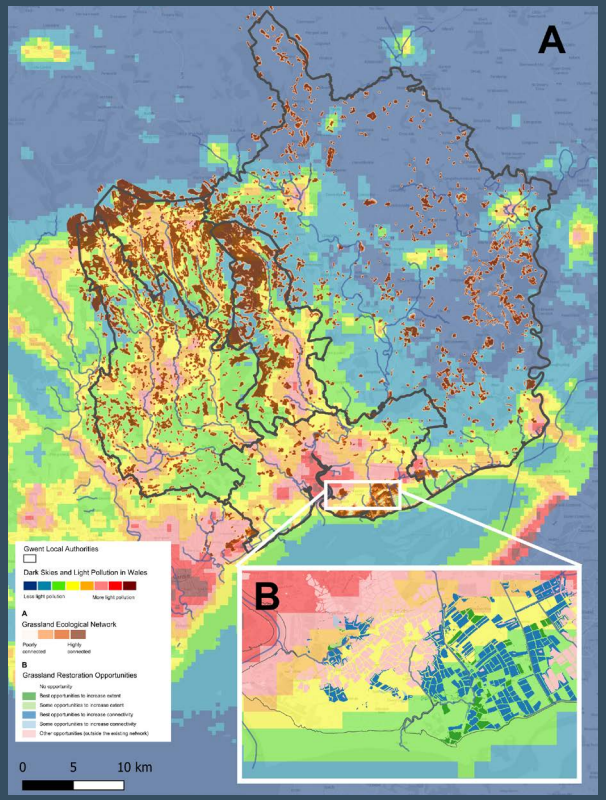
Small sites are likely to be isolated and subject to edge effects, so they are especially vulnerable to the additional impacts of light pollution. Mitigating the effects of light pollution on these SSSIs should be a priority.

A map of South Wales and Bannau Brycheiniog National Park showing Sites of Special Scientific Interest, dark skies and light pollution, native woodlands and Lesser Horseshoe Bat records.

## Case Study Ecological Network Mapping – Gwent Green Grid

The Gwent Green Grid Partnership (GGG) is a collaboration of the five local authorities of Gwent, Natural Resources Wales and other partners and stakeholders. The Gwent Nature Recovery Network Mapper focuses on identifying key areas where habitat restoration and protection can have the most significant impact for nature recovery, including using dark skies and light pollution data. This is a good example of developing work that could be adopted elsewhere in Wales.

- Light pollution is recognised in Gwent as a major pressure on ecosystems and species function, health and resilience.
- Building ecosystem resilience and developing resilient ecological networks (RENs) that considers light pollution, in space and time, will be fundamental to nature recovery and socio-economic and environmental wellbeing in Gwent.
- The Partnership and project is working in collaboration with a range of partners to co-develop RENs, and support 'dark ecological networks'. So that RENs, and dark skies will be prioritised for safeguarding and informing decision making across a range of Gwent's developing strategies, plans and delivery including, but not limited to:
  - local development plans and supplementary planning guidance e.g. Monmouthshire County Council's Draft Deposit Policy (Policy LC5) on Dark Skies;
  - GGG Nature Networks Project identifying opportunities and priority nature based solutions;
  - 'Building a RENs Approach for Gwent' project and delivering NRW's National RENs Guidance (2024-2028), at the landscape scale (which is a South East Area Priority);
  - Gwent Nature Recovery Action Plan and Local Nature Recovery Action Plans where RENs are identified as a priority objective;
  - Welsh Government's Future Wales: 2040 (Policy 9) priority spatial planning for the Living Levels landscape.




**Map A:** Integrating dark skies, light pollution, and grassland networks highlights:

- areas to protect from habitat fragmentation and loss, for resilient ecological networks;
- areas benefiting from low light pollution, targeting ecosystem resilience;
- priority areas with more light pollution and poor connectivity, informing decision making.

**Map B:** Ecological Opportunities in the Gwent Levels highlighting:

- nature based solutions for socio-economic and environmnetal benefits;
- areas of habitat extent, improving connectivity and ecosystem resilience;
- priority zones for light pollution mitigation for people and nature.

## 3.8 Species

ALAN impacts the biodiversity and functioning of whole ecosystems, and therefore it is important to mitigate impacts on the most important sites (e.g. SSSIs) and the functional networks that support and connect them. By doing this a contribution is made to resilient ecological networks.

### Invertebrates

Invertebrates make up the majority of biodiversity on earth and are vital to ecosystems. Many invertebrates are also listed as national priority species for conservation under the UK Biodiversity Action Plan (BAP). It is therefore important to minimise the impacts of artificial light on invertebrate populations.


### Invertebrates can be impacted by ALAN in the following ways:

Artificial light has the potential to significantly disrupt ecosystems, and it is widely observed that some invertebrates, such as moths, are attracted to artificial lights at night. In addition, the polarisation of light by shiny surfaces is a significant problem as it attracts aquatic insects, particularly egg laying females, away from water. Reflected light has the potential to attract pollinators and impact on their populations, predators and pollination rates.

This contributes to the fragmentation of populations, and it has been estimated that as many as a third of flying insects will die as a result of their encounter with ALAN and reflective surfaces. Many invertebrates depend on the natural rhythms of day and night and on seasonal and lunar changes in light levels to trigger vital stages in their life cycles such as oviposition (egg-laying), emergence and diapause (hibernation). For example, some species of insects complete their lifecycle within a lunar cycle of 28 days. The presence or absence of moonlight provides a trigger for the beginning or end of each lifecycle. Some insects such as flying adult mayflies can become disorientated by artificial light and fail to successfully perform important aspects of their life cycle. It is likely that such disruption to essential life events would lead to local fragmentations in populations, extinctions of species and a reduction in abundance of biodiversity.

Research has shown that streetlights have detrimental effects on local caterpillar assemblages and that artificial lighting is likely to be contributing to overall declines in the moth population, reducing prey availability for other species, especially bats and birds.

**Bats**
All UK bat species are protected by European and UK legislation: the Conservation of Habitats and Species Regulations 2010 and amendments and Schedule 5 of the Wildlife and Countryside Act 1981. This affords complete legal protection to all bats and their roosts.

All species of bat rely on a range of habitats for foraging (feeding), commuting and roosting. Bats in the UK are nocturnal mammals with highly sophisticated echolocation systems that allow them to avoid obstacles, socialise and catch insect prey in complete darkness. When flying, bats produce a stream of high-pitched calls (above the range of human hearing) and listen to the echoes, to produce an acoustic picture of their surroundings, commonly called “echolocation”.

## Bats can be impacted by ALAN in the following ways:

**Roosting sites**
A range of structures are used for roosting, e.g. buildings, caves, bridges, and trees. Different species will use different structures and move between them throughout the year as needed for hibernating, raising young, mating, feeding. Illuminating a bat roost can cause disturbance and this may result in the bats deserting the roost, or even becoming entombed within it. Lighting would therefore be considered an obstruction under the legislation protecting bats and their roosts. Light falling on a roost access point will at least delay bats from emerging, and this shortens the amount of time available to them for foraging. As the main peak of nocturnal insect abundance occurs at and soon after dusk, a delay in emergence means this vital time for feeding is missed. This has been shown to have direct impacts on bats’ reproductive ecology, including slower growth rates and starvation of young.

**Flight lines**
Bats largely use linear features, such as hedgerows, woodland edges, and watercourses, to navigate between different roosts and between roosts and foraging areas. These features provide dark, sheltered, safe corridors and sources of insects for foraging. The associated flightpath to and from the access point is just as valuable, and vulnerable, as the roost itself. Severing a key flightpath some distance from the roost could cause desertion, and this loss of a roosting site could constitute an offence under the legislation.

**Foraging**
Bats use a variety of habitats for foraging including grasslands, woodlands, hedgerows, stream corridors and waterbodies. Different species will use different habitats, and individual species will use different habitats at different times of year. Artificial lighting can also affect the feeding behaviour of bats. Many night-flying species of insect that bats hunt are attracted to light, especially those light sources that emit an ultraviolet component (removed by Light Emitting Diodes (LEDs)) or those that have a high blue spectral content (this can include LEDs). The slower-flying, broad winged species have been shown to avoid commuting and foraging routes illuminated with a variety of different street luminaires.

Essential requirements at each stage of the planning process can be found in the BCT guidance Advice for Developers — Buildings, planning and development — Bat Conservation Trust.

**Other mammals and birds**
Mammals rely on a range of habitats for foraging (feeding), commuting and shelter. They also depend on the earth’s daily cycle of light and dark to allow life-sustaining behaviours such as reproduction, nourishment, sleep, and protection from predators.

**Mammals can be impacted by ALAN in the following ways:**
Linear features, such as hedgerows, woodland edges, and watercourses are used to navigate between different areas. These features provide natural dark, sheltered and safe corridors and sources of food for foraging and safety away from roads.

Different species will use different habitats, and individual species will use different habitats at different times of year (for example, migrant visitors and seasonal use for reproduction or hibernation).

Many species of birds are nocturnal migrants using stars and magnetic fields to orientate themselves and can be disorientated by light pollution and poorly located lighting, especially tall, glazed buildings and facades which should not be lit at night either internally or externally.

## For all invertebrates, bats, mammals and birds the Good Practice Guidance recommends:

**Maintaining a network of completely dark corridors and habitats through the landscape, avoiding impacts such as direct loss, fragmentation, disturbance and lighting. Areas with natural or near-natural lighting should be officially conserved. Additional Dark Sky areas should be identified, and light pollution should be reduced and limited with control placed on any new lighting. New lighting in natural cave systems and cliffs should not be permitted.**

Ecological assessments to highlight species and habitats of importance, individual site mitigation/lighting plans should be used taking account of the DECCA framework.

Those involved in planning lighting schemes should always assess whether lighting is necessary and whether alternative solutions are available. The number of lights and brightness/wattage should be kept to a minimum and to avoid light spillage, lamps should not emit light at angles greater than 70°. Lights that emit a broad spectrum of light with a high UV component should be avoided.

Where lighting cannot be avoided altogether then it must be designed to avoid light spill onto roosts, foraging habitat and commuting routes.

Local Authorities and Highway Agencies should audit their street lighting to ensure water bodies and protected sites or those hosting species are not illuminated by light, or by excessive spill from the area required to be illuminated (task area).

Light pollution from domestic security lighting would be reduced through awareness raising. Many members of the public are not fully aware of the environmental impacts of lighting. Information on lighting types, installation and maintenance should be given before purchase to reduce the impact of these domestic lights. Retailers selling domestic security lighting should be properly trained and informed on the issues.

Some locations are particularly sensitive to light pollution and lighting schemes in these areas should be carefully surveyed and planned for to avoid negatively affecting biodiversity.

Lighting should not be installed near ponds, lakes, rivers and the sea; areas of high conservation value; or sites supporting particularly light-sensitive species of conservation significance (e.g. Glow Worms, moths and bats) and habitat used by protected species.

There is a need to avoid illuminating:

burrows, setts, nursery sites or corridors, cliffs and shoreline;

areas with nesting or roosting birds;

glazed buildings and facades;

trees and vegetation; and

waterbodies including rivers, lakes and tidal estuaries.

## 3.9 Landscape

**Landscape character**
Landscapes and seascapes are valued resources and the settings where people live and work. Landscape characteristics and qualities contribute to a sense of place, identity, well-being and quality of life as well as delivering multiple benefits.

Dark skies are most often experienced in the rural landscape. Areas of reduced lighting in built and urban landscapes provide an important contrast, with benefits to quality of life.

Dyfi Biosphere landscape near Ynyslas
© Jill Bullen

### The Good Practice Guidance Recommends:

Recognition of the value and importance of dark skies as an important landscape characteristic.

Understand that dark skies can be a defining characteristic where lighting is absent or at low levels.

Understand that the quality and experience of the dark night sky can contribute to the sense of place.

Protection of landscapes with dark skies where they are associated with outstanding and high LANDMAP Visual and Sensory landscape evaluations.

Protection of intrinsically dark landscapes, these may be characterised by remoteness.

Use published dark sky data; more than two thirds of Wales is associated with the darkest category of night sky.

The Dark Skies data within the landscape contexts of National Parks, National Landscapes (AONBs), National Landscape Character Areas and LANDMAP Visual & Sensory landscape areas can be viewed on the Dark Skies and Light Pollution in Wales interactive web application.

**Tranquillity**
Tranquillity is associated with the degree to which places and ecosystems deliver a state of quiet, calm, peace and well-being. Tranquillity is an important landscape characteristic that is highly valued, dark skies contribute to tranquillity.

### The Good Practice Guidance Recommends:

Protection of the qualities of the natural environment such as tranquillity and dark skies.

Understand that tranquillity includes the experience of the dark night sky, stars and constellations, and the relative freedom from unwanted visual disturbance and signs of human influence such as from light pollution.

Understand that management decisions relating to dark skies can affect tranquillity and place.

Recognition of the wider role that dark skies play in helping to maintain the natural rhythms of day and night for both humans and other species.

### Light in the landscape

The visual intrusion of light, glare and sky glow can adversely affect landscape character and the visual experience of the night sky. Dark skies have limited resilience, subtle changes in light pollution may have marked effects on natural settings and the experience of nature, landscapes and greenspaces and the benefits they provide to us. Light pollution from built areas can be a stark contrast to the relative darkness of rural areas.

PPW paragraph 6.8.1 recognises the need to balance lighting with the retention of dark skies where appropriate, to prevent glare and respect the amenity of nearby land uses.

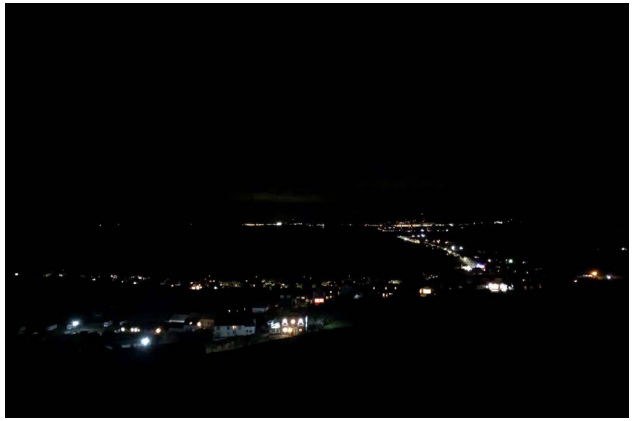
It is a responsibility of all local authorities to reduce light pollution, including in cities and urban areas, brightness negatively impacts the dark sites that surround them and can adversely affect the setting of designated landscapes. Planning authorities can attach conditions to planning permissions for new developments to avoid, or minimise the adverse impacts of lighting.

When considering development proposals planning authorities should ensure that:

Lighting does not detrimentally change the character of the landscape.

Lighting is appropriate and minimises light spillage which may be experienced locally, at distance and from key viewpoints.

It is recommended that the Institution of Lighting Professionals (ILP) environmental zones E0 to E4 for exterior lighting control are adopted by the local planning authority.



Borth in the Dyfi Biosphere by day and night © Jill Bullen

| ILP environmental zone | ILP recommended lighting | Contextual examples |
|---|---|---|
| E0 Protected | Dark<br>SQM 20.5+ | International Dark Sky Reserves; Bannau Brycheiniog National Park; part of Eryri National Park<br>International Dark Sky Sanctuary e.g. Ynys Enlli/Bardsey Island, Llŷn National Landscape (AONB)<br>Dark Sky Park, Elan Valley Estate |
| E1 Natural | Dark<br>SQM 20 to 20.5 | National Parks<br>National Landscapes (AONB)<br>Relatively uninhabited rural areas and some seascapes |
| E2 Rural | Low brightness<br>SQM ~15 to 20 | Sparsely inhabited rural areas<br>Villages or relatively darker suburban areas |
| E3 Suburban | Medium district brightness | Inhabited rural and urban settlements<br>Small town centres |
| E4 Urban | High district brightness | Towns and city centres with high levels of nighttime activity |

**Designated landscapes**

National Parks and National Landscapes are statutory Designated Landscapes, their Special Qualities identify what makes these landscapes special and unique. Tranquillity and dark skies are identified as a Special Quality in many National Parks and National Landscapes as they are especially dark and generally free from light pollution. On average 95% of the three National Parks and five National Landscapes in Wales fall within the two darkest night sky categories, assessed as part of the Tranquillity and Place – Dark Skies evidence.

Planning authorities for National Parks and National Landscapes should ensure that where dark skies are included within the Special Qualities of these designated areas there is a need to:

Conserve and enhance dark skies through development planning and management decisions.

Promote the understanding and enjoyment of dark skies.

Include the conservation and enhancement of dark skies in the statutory management plan produced every five years.

When determining applications for development planning within Designated Landscapes or their settings, planning authorities should ensure that:

Designated Landscapes are treated as a landscape receptor, and an assessment is included to explain how Special Qualities such as dark skies, and/or the purposes of the designation could be affected.

Proposals are not permitted where light pollution would cause unacceptable harm to the character of the landscape and unacceptable visual impacts that relate to the purposes for designation.

Dark Sky Reserves, Discovery Sites and Sanctuaries that are officially recognised places for stargazing and astrotourism and are directly dependent upon landscape character and quality for the visual receptor experience are protected.

It is recommended that the Institution of Lighting Professionals environmental zone E1 for exterior lighting control is adopted outside settlements in Designated Landscapes.

**Seascapes**

Dark skies are most often experienced in the less developed seascapes and marine character areas. The principles for landscape and tranquillity are valid for seascapes too as lighting may also affect their character and visual amenity, especially where there is extensive inter-visibility between land and sea.

**Relatively dark areas within or close to urban areas**

The greater need and expectation for lighting in urban areas relates to many factors including for safety, to improve active travel networks and to illuminate the use and experience of the built environment. However, this can leave local greenspace and nearby countryside susceptible to higher levels of night light intrusion.

Lighting policies and lighting type can still make a difference to radiance levels in and around urban areas, even if they are already bright.

The Tranquillity and Place – Dark Skies data identifies the brighter light levels associated with urban areas. The data also indicates localised changes with some urban areas emitting less/different light and some areas around cities becoming brighter.

These areas are important for people's wellbeing and their experience of nature on their doorstep. Careful siting and design to avoid undue light spill or intrusion is needed and can contribute to areas within or close to urban areas seeming somewhat or significantly darker.

**Landscape and visual impact assessment (LVIA)**

The Guidelines for Landscape and Visual Impact Assessment (GLVIA3) and its subsequent Technical Guidance Note on clarifications are the key resources for setting out the principles and good practice for LVIAs.

LVIAs are used to identify and assess the effects of proposed changes to the landscape as an environmental resource i.e. landscape fabric and character (landscape effects) and, separately to the views and visual amenity experienced by visual receptors i.e. people (visual effects). The LVIA may include an assessment of cumulative landscape and visual effects.

An assessment of effects at night is not a routine requirement within LVIA. It is required when proposed lighting may have a significant influence on dark skies and where these make a particular contribution to landscape character and/or visual amenity. This will be influenced by the sensitivity of the landscape and/or people assessed, and the lighting design.

When a nighttime assessment is required, it should:

- Describe the type, timing and direction of lighting, its location and visibility in the wider landscape taking into account the screening provided by, for example, landform, buildings and vegetation.
- Identify and describe the baseline of dark skies and light pollution.
- Identify landscape characteristics and features which are sensitive to lighting and with reference to available evidence, explain why/how they are sensitive.
- Describe how lighting may adversely affect the characteristics, qualities and visual amenity that can be readily perceived at night.
- Identify the sensitivity of visual receptors (people) at night and whether their activities may be dark sky or low light dependant.
- Identify and describe any potential cumulative effects with other sources of lighting.

Designated landscapes and landscapes with a high or outstanding LANDMAP Visual and Sensory evaluation may be more sensitive to change. The value of the landscape will not vary between day and night, although the visual impact and experience may differ.

**Telecommunications apparatus and their landscape and visual effects**

Natural Resources Wales Standard Advice (2024) advises that to minimise the potential adverse impacts of new telecommunications apparatus on designated or other sensitive landscapes, night lighting should also be considered when preparing planning applications. Whilst security or utility/ warning lighting should not generally be needed on a secure unstaffed rural site, where lighting is necessary night-light pollution should be reduced, and off-site light-spill minimised.

**Aviation lighting impact assessment**

NatureScot has published (2024) Guidance on Aviation Lighting Impact Assessment. The guidance includes a three-stage process for evaluating and illustrating long term lighting effects that is consistent with GLVIA3. Step 1 being defining the lighting proposal, step 2 understanding the baseline and step 3 assessing the effects of the aviation lighting. Mitigation options are intended to significantly reduce lighting effects at night, for example aviation warning lighting on structures such as offshore wind turbines and wind turbines above 150m in height.

### Tourism and recreation

Landscapes characterised by dark skies and low levels of light pollution can be beneficial for health, well-being, spirituality and quality of life and can bring economic benefits from visitors and tourists.

- Visitors coming from urban areas to rural dark skies areas may attach value to what is, for them, a rare experience.
- Those living in urban areas may value having access to local places with a relative sense of darkness, as part of their regular experience of nature.

PPW paragraph 8.8.2 recognises that Dark Sky Reserves can positively contribute to an area, both economically and environmentally, and that their characteristics should be taken into account in development plans, policies and when determining development proposals.

### ☆ The Good Practice Guidance Recommends:

Those areas of Wales associated with the darkest category of night sky as an important resource for health and wellbeing are recognised.

Protection of landscapes with dark skies where there is an intent to become part of the dark sky family of reserves.

Respond to the potential for green tourism and the economic benefits from dark sky reserves.

Recognition of the value of local access to relatively dark areas in or near urban areas, as part of people's regular experience of nature and the wellbeing benefits this provides.

Caer Drewyn, Corwen

## Culture and heritage

### The Good Practice Guidance Recommends:

Recognition that the sky at night has inspired and influenced our cultural connections with the dark sky and with the landscapes beneath it.

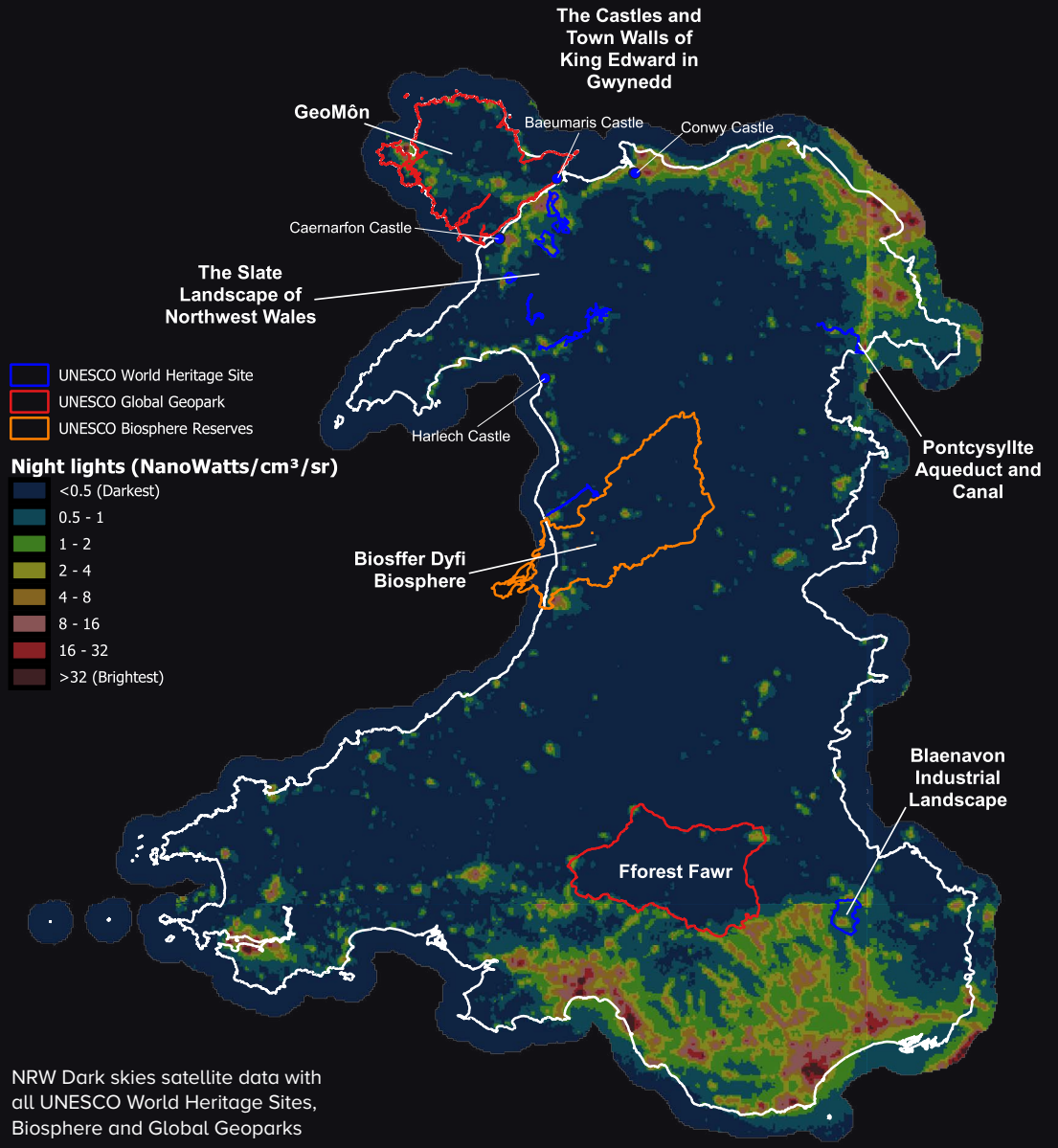
Recognition that the night sky, planets and stars may be important to the understanding of monuments and archaeological landscapes.

Understand that identifiable landscapes may be depicted, described or recognised through cultural media, including art, literature, music, film and folklore and that these should be conserved.

Recognition that external lighting of historic buildings, monuments, features and structures is to draw attention to their heritage significance, architectural design and character, this may be permanent or temporary as part of an event and may be a positive addition to visual amenity and key views to landmark assets.

Ensure that any consents required for fixing exterior lighting fittings are assessed for their light pollution potential as well as historic fabric suitability.

Be considerate and appropriate in the management of lighting type, direction and timing to minimise the impact of light pollution whilst delivering for after dark visual amenity and experience.




NRW Dark skies satellite data with all UNESCO World Heritage Sites, Biosphere and Global Geoparks

# 4.0 Poor and Improved Design Examples

Aurora over Eryri taken from Ynys Mon
© Dani Robertson

## 4.1 Landscape scale dark sky visualisations

Two landscape scale visualisations, depicting ‘before’ and ‘after’ dark sky friendly actions help to convey the benefits of taking action. The ‘before’ visualisation identifies contributors to light pollution in communities and landscapes and the ‘after’ visualisation shows what our communities and landscapes could look like, and benefit from, when action is taken to reduce light pollution. The landscape visualisations bring together examples relating to residential, commercial and industrial areas, farm buildings, sports pitches, business lighting and sensitive street lighting.

1. Roof lights spill lights upwards.
2. Overly bright sports lighting and spillage beyond where it is needed.
3. Overly bright unshielded light, glare extending beyond area required.
4. Light intrusion in rural landscapes and wildlife habitats.
5. Security light glare.
6. Lights left on out of hours of work.
7. Intrusive illuminated neon LED signs.
8. Artificial light along river corridor affecting wildlife.
9. Limited or no visibility of astronomical features in night sky.
10. Cumulative light spill.
11. Bright external LED decorative illumination affecting nocturnal wildlife.
12. Upward sky glow.
13. Unshielded lights with unnecessarywall lighting.
14. No curtains or blinds making light visible at distance.
15. Streetlight intrusion into properties, gardens, trees and other habitats.




1. Blinds on roof lights or low Visible Light Transmission (VLT) glazing.
2. Lighting is directed downwards to illuminate only the sports area.
3. Shielded programmable lights on sensors directed downwards to task areas.
4. No unnecessary light intrusion in the landscape.
5. Directed security lights with proximity sensors.
6. Lights are switched off at close of business.
7. Low powered illuminated signs to lighting standards, turned off outside business opening hours.
8. Minimising artificial light along river corridor and floodplain for wildlife.
9. Improved visibility of astronomical features in night sky. Improved sense of dark sky related tranquillity.
10. Minimal and well-designed external lighting only where essential.
11. Low powered or no garden lighting. Decorative lights are programmed to be turned off through the night.
12. Warmer coloured lights (<2700K) directed downwards, reduced light scattering.
13. Retrofit of shielded lights directing light downwards to where it is needed.
14. Lights are switched off when not needed. Curtains and blinds are used and closed at night.
15. Warm spectrum (<2700K) programmable streetlights with peak wavelengths higher than 550nm; shields used where necessary to direct light only to where needed.

## 4.2 Design suggestions and precedents

Lighting solutions are outlined below for differing built environment scenarios.

## 4.3 Residential lighting

Poorly installed lighting can be illegal as a statutory nuisance. Under section 79(1) (fb) of the Environmental Protection Act 1990, local authorities have a duty to take reasonably practicable steps to investigate complaints of 'artificial light emitted from premises so as to be prejudicial to health or a nuisance'. If satisfied that a statutory nuisance exists or is about to occur or recur, the local authority must serve an abatement notice under section 80 of the Act requiring that the nuisance is abated or restricted to prevent its occurrence or recurrence. Local authorities consider several things when assessing complaints including the reasonableness of the activity being carried out, the time of day of the occurrence, its duration, its frequency of occurrence and whether best practicable means was being employed. Environmental nuisance can be reduced or avoided if the design steps are followed in this document.

### Internal lighting and glazing

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, and 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 harmful paths of light. Internal sourced 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 concerns about the impacts of the internal lighting spilling through large feature windows or glazed walls.

Glazing should be kept 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.

There are several technologies available to reduce the light pollution through glass, these include:

- 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.

Where floor to eaves glazing cannot be avoided, eaves should wherever possible overhang the glazing sufficiently to block the upward spillage of light.

Llangwyfan, Clwydian Range and Dee Valley

## 4.4 Industrial and Commercial lighting

It is important that work areas are well lit in order to make safer working environments, but bright lights do not always make our working areas safer. There is no evidence to suggest that brightly lit areas are more secure. Bright lights can create glare and dark shadows. However, a dark sky does not necessarily mean a dark ground. Smart lighting that directs light to where it is needed can create a balance between safety and natural ambient light.

The following principles should be applied:

- Fully shielded and properly angled lighting that directs light to where it's needed.
- Select correct colour temperature <3000k to reduce glare.
- Fully controllable – PIR movement sensors improve security.
- Avoid tall lighting columns.

Capel Curig Training Camp

## 4.5 Agricultural and rural lighting

The farmyard is a busy workspace operating all times of the day and night, flood lighting or excessive light does not always throw light to where it is needed and can create shadows and glare. A dark sky does not have to mean a dark ground. Smart lighting directs light to where it is needed, when it is needed, creating a balance between safety and star light.

- Fully shielded — select fully shielded light fittings for all areas.
- Brightness — it is important to consider the appropriate amount of light for the intended task. Less light more efficiently directed can be more effective than brighter lights.
- Height and angle — keep the height of the fittings as low as possible.
- Colour temperature — a colour temperature of 3000k or below should be chosen for all external highting and internal lighting which is visible from external spaces.

Farm before

Farm after

## 4.6 Sports lighting

The required light levels for professional playing standards will be different between various sports but the following principles should be applied:

- Properly angled and fully shielded lighting that directs all light to the playing surface. No upward spill.
- Consider using low reflective playing surfaces.
- Ensure lighting is fully controllable – lights off when pitches are not in use – light levels dimmable for practice/training sessions.
- Colour Temperature < 3000k will reduce glare.
- Limit hours of use.

**Clwb Rygbi Rhuthun**

**Rhuthun Lawn Tennis Club**

## 4.7 Cultural and heritage site lighting

Sites of historic and cultural importance rarely require artificial light, and it is considered these should only be lit where it is necessary and in a sensitive manner considering the recommendations in this guide.

The historic environment is made up of individual historic features known as historic assets. Examples include:

- Listed Buildings.
- Conservation Areas.
- Historic assets of special local interest.
- Registered historic parks and gardens.
- Registered historic Landscapes.
- World Heritage Sites.
- Archaeological remains (including Scheduled Monuments).

The Historic Environment (Wales) Act 2023 and its supporting secondary legislation came into full effect on 4 November 2024. The Act provides the legislative framework for the management and protection of the Welsh historic environment. As consolidated legislation it replaces the Ancient Monuments and Archaeological Areas Act 1979 and the Planning (Listed Buildings and Conservation Areas) Act 1990, these no longer apply in Wales.

PPW sets out the Welsh Government policies and objectives for the historic environment as part of Distinctive and Natural Places. Technical Advice Note 24 (TAN 24) on the Historic Environment provides guidance on how the planning system considers the historic environment, and how aspects of the historic environment should be considered.

Bryn Alyn – ©Clwydian Range and Dee Valley

## 4.8 Active travel and open space lighting

### Plas y Brenin, Capel Curig

Plas Y Brenin is the UK's National Outdoor Centre, with customers travelling from all over to attend their courses. Having a visible presence was important for navigation purposes so customers are able to locate the premises.

The old signs were uplit, with cold, white/blue light, adding to the problems of light pollution on site. By making simple changes such as installing lights above the sign and aiming them down and using warm colour temperatures of 2700K, the business remains easily recognisable from the roadside for navigation purposes. Installing sign illumination this way eradicates any upward light spill and minimises the environmental impacts of the signage.


## 4.9 Public buildings

### Loggerheads Country Park Information Centre, Mold

Loggerheads Country Park is the main visitor centre for the Clwydian Range and Dee Valley National Landscape. The old halogen flood lighting was unshielded cold blue/white light creating a strong glare, dark shadows and significant light pollution. The lights were permanently switched on during hours of darkness. By making simple changes and installing fully shielded warmer 2700K LED lights placed to direct lights only where it is needed minimises the environmental impacts of the lighting. There is no upward spill or glare and the lights are fitted with PIR motion and photocell light sensors. They are only on when required.

## 4.10 Sensitive street lighting

Trunk roads and motorways and their lighting is managed by Welsh Government through either the North & Mid Wales Trunk Road Agency, or South Wales Trunk Road Agency. All other roads, and the lighting on them are managed by one of the 22 County, City or County Borough Councils.

There is no statutory requirement on local authorities to provide public lighting. Street lighting is not always necessary. Where there is a proposed street lighting scheme, refer to the Dark Skies Community Appendix for the North Wales Lighting Design Guide and Specification to determine design parameters, as this will satisfy Dark Skies International (DSI) requirements.

Street lighting on adopted routes should include amber LED lanterns specified as low UV (including shields to protect adjacent habitat from light spill) along with timed dimming. Lighting on unadopted routes is dissuaded but should be lower level (power output and height) with <2700K, and a different appropriate unit to those on adopted routes. Tungsten halogen and CFL sources must have appropriate UV filtering to reduce UV to low levels.

Street lighting before

Street lighting after

## 4.11 Lighting near rivers and waterbodies

Other than at formal urban water features lighting near rivers and water should avoid illuminating the water or reflective surfaces, avoid the direct illumination of ecologically sensitive areas, use lighting of no more than 2700K and reduce the duration of lighting in the areas adjacent to water bodies.

The following principles should be applied:

1. Blinds on roof lights or low Visible Light Transmission (VLT) glazing.
2. Warmer coloured lights (2700K Max) directed downwards, reduced light scattering.
3. Lights are switched off when not needed. Curtains and blinds are closed at night.
4. Low powered illuminated signs to standards.
5. Directed security lights with proximity sensors.
6. Sensitive spot lighting on riverside path.
7. Sensitive and subtle lighting on the bridge.
8. Lighting is directed downwards to where it is needed.
9. Maintenance of dark areas under bridges for wildlife.
10. Minimising artificial light along the river corridor for wildlife.
11. Lights are switched off at close of business.

## 4.12 Temporary lighting

Due to its design and general use, temporary lighting can create significant light pollution. Temporary lighting 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. Assessments should be made to ensure that impact is reduced to dark skies, residential amenity and that the step wise approach and DECCA framework has been followed to avoid impact on biodiversity.

- Where temporary lighting is likely to be in use beyond 28 days or with consistent regularity over some years, planning permission should be sought.
- Temporary and portable floodlighting should not be used in dark areas, nor for community facilities and sports fields, a permanent design should be agreed.
- Uplighting, skyscanners, lasers, and video displays should be avoided and particularly any light above 2700K.

## 4.13 Retrofit and improving existing lighting

There may be instances where existing lighting can be improved without replacing the light fittings. There are a number of ways existing fittings can be improved to reduce light pollution and unwanted light spill.

- Remove – is the fitting needed? If not remove it altogether.
- Ensure lights are angled downwards – fit horizontal plane shields if necessary to avoid light spill.
- Ensure light is only on when needed – fit PIR motion and Photocell Light sensors.
- Colour Temperature – it may be possible to fit a filter to the lens to achieve < 2700k.

# 5.0 Appendices

Comet Neowise over Moel Arthur, Clwydian Range and Dee Valley National Landscape'
© Harry Miller

## 5.1 Measuring dark skies

There is no single method that accurately measures light pollution. The three methods frequently used are the Bortle scale, Naked-eye Limiting Magnitude (NELM) and Sky Quality Meter readings (SQM). Bortle and NELM scales are useful for assessment with no technical equipment, but they are subjective. Differences will also arise based on the eyesight of the observer.

SQMs measure how much visible light is in the sky, with the unit given in magnitude per square arcsecond (MPSS). They are very effective in urban and rural areas, but issues arise when trying to differentiate between very dark sites. This is due to the night sky having its own natural light sources, such as the Milky Way, solar activity and airglow, which is a faint emission of light by planetary atmosphere. SQMs have a scale of 16-22, with 16 being very light polluted and 22 being complete absence of light. Even at the darkest sites, a reading of 22 should be nearly impossible as that would mean there was no natural light from celestial bodies in the night sky.

The designated landscapes in Wales have been using the method recommended by DarkSky International (DSI), they recommend using the Unihedron Sky Quality Meter-Lens (SQM-L) as it is the most widely used device for taking scientific quality measurements of sky brightness. The SQM-L is simple and quick to use; hold the device above the head, point the photometer (glass section) at the zenith (straight up), and push the button. The screen will then display the sky brightness at that point in astronomer units (magnitudes per square arcsecond). This unit is somewhat counterintuitive in that the higher the number, the darker the sky is.

Spot measurements can be conducted of one location or a survey of a wider area by taking multiple readings from a variety of locations. These should be a mix of darkest and brightest areas to give a good average of the overall area and include areas identified for dark sky friendly lighting improvements. Taking 5 to 6 SQM measurements per survey point per visit (discarding the first less accurate measurement) over a few weeks can improve accuracy. The same survey points should be used to monitor sky quality over time. The data points can be plotted on a map.

Atmospheric and ground conditions also have an impact on readings as they can accentuate light pollution, such as snow cover on the ground, high humidity and an active peak of the solar cycle. It is important to keep a record of measurements over a long period of time, so that cycles can be identified. Records of the weather conditions should be kept along with readings. These will help explain anomalies if no ground-based reason can be found, such as a new light installation.

Another helpful resource are light pollution maps. These are usually created by satellite data. These can also have inaccuracies, as not all the wavelengths from LED lighting can be picked up by imaging equipment on satellites. This may make an area seem darker on the map than has been observed on the ground. By combining these methods, it is possible to get a reasonably accurate, if not absolute, measurement of darkness at any given site.

Measurements should only be taken when there is a clear open sky with no cloud cover, the moon must be below the horizon and measurements should be during astronomical darkness/true nighttime.

Photos of the night sky give a visual record of the nighttime conditions and verify that SQM-L measurements accurately reflect conditions. Documenting the night sky visually will also capture any light domes on the horizon which are not always reflected in SQM-L readings.

When taking photographic evidence of the night sky, ensure images are saved along with the camera settings used to capture the image. Images should not be edited in any postproduction software or enhanced, they should be an accurate representation of the night sky, not an artistic representation. Any editing should be noted, such as cropping. When using edited images, it must be noted what editing was used. It is good practice to gather consent to use images not personally taken.

**Example**

| | |
|---|---|
| Photographer: | Dani Robertson |
| Date and Time: | 18/11/2024<br>22:32 |
| Location: | Eglwys St. Cwyfan |
| SQM Reading (if known): | 21.32 |
| Phenomenon Shown: | Milky Way |
| Camera and Lens: | Canon 6DIII<br>Irix 15mm F/2.4 Firefly |
| Exposure: | 10 seconds |
| Aperture: | F/3.0 |
| ISO: | 3200 |
| Focal Length: | 15mm |
| Editing: | None |
| Permission to use: | Yes – 18/11/2024 |

## 5.2 Technical information on lighting

The Institution of Lighting Professionals (ILP) produce professional lighting guides and technical reports on a wide range of topics, many of which are available as free resources. This guidance recommends using this resource for technical and topical information.

This guidance also recommends referring to the appendices published in the Good Lighting Technical Advice Note (2023) Designing out light pollution in Cumbria, the Yorkshire Dales National Park and the Arnside and Silverdale AONB for the following technical details and advice.

Understanding light, refer to appendix 6.1, page 35.

Lighting specification, refer to appendix 6.12, page 45.

Lighting details, refer to appendix 6.13, page 46.

Lighting calculations, refer to appendix 6.14, pages 47 to 48.

Luminaire and source selection, refer to appendix 6.16, page 50.

Fieldfare and moon

# 6.0 References

Northern Lights visible near Ebbw Vale, Wales.
4 November 2021 — Stock image

Clwydian Range and Dee Valley National Landscape 2022. Planning for the Dark Night Sky: Supplementary Planning Guidance for Lighting in the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty. 24pp. Available at: www.clwydianrangeanddeevalleyaonb.org.uk/projects/planning/

Clwydian Range and Dee Valley National Landscape 2021. Good Lighting: Business and community guidance. 12pp. Available at: www.clwydianrangeanddeevalleyaonb.org.uk/projects/planning/

Friends of the Lake District 2023. Good Lighting Technical Advice Note (TAN) – Full Version. 54pp. Available at: www.issuu.com/friendsofthelakedistrictpublic/docs/cumbria_-_good_lighting_tan?fr=sYzU0MjY3Njg2NjY

Green C, Manson D, Chamberlain K 2021. Tranquillity and Place – Dark Skies. NRW Report No: 514, 70pp. Available at: www.lucmaps.co.uk/NRWDarkSkies/

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Institution of Lighting Professionals 2021. The Reduction of Obtrusive Light. Guidance Note 1, 25pp. Available at: www.theilp.org.uk/publication/guidance-note-1-for-the-reduction-of-obtrusive-light-2021/

Natural Resources Wales. Tranquillity & Place - Dark Skies StoryMap. Available at: www.storymaps.arcgis.com/stories/f66a917270894e8e9f194a1b75e83c28

UK Dark Skies Partnership 2021. Towards a Dark Sky Standard. A lighting guide to protect dark skies: from local need to landscape impact. Available at: theilp.org.uk/new-resource-towards-a-dark-sky-standard/

Natural Resources Wales. Practioners' guide to Resilient Ecological Networks, available at: naturalresources.wales/guidance-and-advice/environmental-topics/land-management/practitioners-guide-to-resilient-ecological-networks/?lang=en

Dark Skies and Light Pollution in Wales interactive web application. Available at: luc.maps.arcgis.com/apps/dashboards/1cd6ba8a1d7d4a62aff635cfcbaf4aec