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Transport Infrastructure Ireland

TII Publications

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Design of Road Lighting for the National Road Network

DN-LHT-03038
December 2023

DN Design

Standards

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TII Publications

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Design of Road Lighting for the National Road Network DN-LHT-

Date: August 2018

Amendment Details:

This Standard supersedes the version of DN-LHT-03038 published in February 2012.

The title of this Standard has been renamed and the contents have been rewritten in its entirety to reflect the following:

a) Reference to current standards and best practice guidance;
b) TII strategic approach to lighting;
c) Lighting requirements that are applicable to the Irish National Road network;
d) Identification of design processes and handover requirements;
e) Provision for current light source technologies and methods of operation; and
f) Inclusion of guidance for electrical supplies, cabling and earthing.

Date: August 2022

Amendment Details:

This Standard supersedes the version of DN-LHT-03038 published in August 2018.

Contents have been amended to reflect lighting requirements that are applicable to the Irish Road network in the following section(s):

- Section 3.2 – Figure 2
- Section 4.3 Compact Grade Separated Junctions
- Section 4.4 Free Flow Interchanges

Date: December 2023

Amendment Details:

This Standard supersedes the version of DN-LHT-03038 published in August 2022.

Contents have been amended or added to reflect lighting requirements that are applicable to the Irish Road network in the following sections:

a) Section 1.4 Definitions

b) Section 2.4 – Figure 1 updated to align with PE-PMG-02041

c) Section 3.2 – Figure 2

d) Section 3.3 Selection of Lighting Class for Road Lighting – minor update to reference active travel/greenways/rural cycleways lighting

e) Section 3.12 Correlated Colour Temperature (CCT) – stipulates the use of warm colour temperatures (<3,300K)

f) Section 3.17 Metered and Unmetered Supplies from the Distribution System Operator – updated reference to National Energy & Climate Plan 2021-2030

g) Section 4.3 – Figure 10 updated to show roundabouts between slip road/local road as per DN-GEO-03060

h) Section 5.6 Lighting of Active Travel Infrastructure / Greenways / Rural Cycleways- updated to set out active travel, greenways, and rural cycleway lighting requirements

i) Appendix C2 – Refinement of the Active Travel/Greenways/Rural Cycleways Lighting Class Selection (or P class)

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1. Introduction

1.1 General

This Standard contains requirements and guidance for the design of road lighting systems on the National Road network. The lighting on Regional and Local roads that form part of a National Road scheme shall also be developed in accordance with this Standard.

1.2 Scope

This Standard sets out the objectives and procedures that shall be adopted for the design of lighting on roads and other areas of the network and for handover into operation on the National Road network.

The following aspects of road lighting are not included in this Standard:

a) The design of lighting for long and short road tunnels (refer to BS 5489-2: Code of Practice for the Design of Road Lighting – Part 2: Lighting of Tunnels and DN-STR-03015: Design of Road Tunnels); and

b) Performance requirements for the maintenance of the road lighting.

1.3 Implementation

This Standard shall be used forthwith for the design of lighting for the National Road network. It shall be applied to:

a) New lighting schemes;

b) Renewals where lighting columns and lanterns are to be replaced; and

c) Lantern replacement only schemes.

For lantern replacement schemes, only the relevant parts of this Standard shall be applied.

This Standard supersedes the earlier version of DN-LHT-03038.

Where a scheme is already under construction or currently being prepared and application of this Standard would result in significant additional cost or delay, the advice of Transport Infrastructure Ireland (TII) shall be sought.

1.4 Definitions

For this Standard, the following definitions shall apply:

i. **Active Travel:** Walking, wheeling, and cycling for all users for all trip purposes where walking, wheeling, and cycling mean:

ii. **Walking and Wheeling:** Engaging in the typical act of walking plus jogging, using mobility aids (i.e., manual and electric wheelchairs as well as motorised mobility scooters), and using non-motorised scooters; and

iii. **Cycling:** Cycling using any type of cycle, such as bicycles, electric cycles, adapted cycles, and cargo cycles. Cycles should, except for specific situations, be treated as 'vehicles', not as 'pedestrians'.

iv. **Active Travel Infrastructure**: All types of pedestrian and cycle facilities for people walking, wheeling, and cycling.

v. **C/CE Lighting Class**: Illuminance based criteria used for the lighting of Conflict Areas such as junctions and roundabouts. In certain instances, particularly for roads with irregular geometry, industry standard lighting software used to model the exact luminance parameters can be challenging (e.g. differences in lane widths). In these instances, the application of illuminance based criteria can help inform the design;

vi. **Clear Zone**: The Clear Zone is the total width of traversable land on the nearside or offside which is to be kept clear of unprotected hazards.

This width is available for use by errant vehicles. The zone is measured from the nearest edge of the trafficked lane: i.e. the hard shoulder or hard strip forms part of the Clear Zone;

vii. **Conflict Area**: Junctions, Interchanges, roundabouts and pedestrian crossings, where streams of motorised traffic intersect with each other or with other road users such as pedestrians and cyclists from different approaches. The extent of a Conflict Area will be determined on a project specific basis and by following the guidance in this Standard;

viii. **Cycle Facilities:** All types of facilities which improve conditions for people cycling.

ix. **Cycleway**: An offline public road reserved for the exclusive use of people cycling or people walking, wheeling, and cycling. All mechanically propelled vehicles, other than mechanically propelled wheelchairs and electric bikes, are prohibited from entering except for the purpose of maintenance and access.

x. **ESB Networks Limited**: The Distribution System Operator, licensed pursuant to section 14(l)(g) of the Electricity Regulation Act, 1999;

xi. **Greenway**: A cycleway, or other, that caters for people walking, wheeling and cycling in a mainly recreational environment.

xii. **Interchange**: A grade separated junction that provides free flow of traffic from one Mainline carriageway to another;

xiii. **Institute of Lighting Professionals (ILP):** The ILP is the UK and Ireland's professional lighting association, dedicated solely to excellence in lighting.

xiv. **Lighting Design File**: This is developed during the lifecycle of the project and will contain the information associated with the lighting design;

xv. **Lighting Impact Assessment**: A good practice approach based on the application of ILP PLG-04 when assessing the impact of road lighting on the surrounding environment at the planning stage;

xvi. **Local Road**: This is a public road or a proposed public road other than a national road or a regional road;

xvii. **Mainline**: The carriageway carrying the main flow of traffic (generally traffic between or passing straight through a junction or Interchange);

xviii. **M/ME Lighting Class**: Luminance based criteria used for the lighting of the Mainline carriageway on the National Road network;

xix. **National Road:** This is a public road or a proposed public road which is classified or is intended to be classified as a national road under Section 10 of the Road Act (1993);

xx. **Non-motorised users (NMU):** road users not in motor vehicles such as pedestrians, cyclists, and equestrians;

xxi. **P Lighting Class**: P lighting classes are intended for pedestrians and pedal cyclists on footways, cycleways, and other road areas lying separately or along the carriageway of a traffic route, and for residential roads, pedestrian streets, parking places, etc;

xxii. **Pedestrian Facilities:** All types of measures which improve conditions for people walking and wheeling.

xxiii. **Priority Junction**: An at grade junction between a major road and a minor road whereby the traffic on the minor road must yield to the traffic on the major road;

xxiv. **Professional Lighting Guide (PLG)**: Guidance notes developed by the ILP in relation to lighting best practice; and

xxv. **Regional Road**: This is a public road or a proposed public road which is classified or is intended to be classified as a regional road under Section 10 of the Road Act (1993).

xxvi. **Rural**: Outside of urban town and village centres and generally controlled by speed limits greater than 60 km/h.

1.5 Relaxations and Departures

The standards contained in this document represent a level of lighting the incorporation of which into the design would achieve a desirable level of performance in average conditions in terms of:

a) Traffic safety;

b) Operation;

c) Economy;

d) Environmental effects; and

e) Sustainability.

In exceptional situations, owing to economic, environmental or engineering constraints, the standards may not realistically be achievable in terms of buildability or maintainability. In such cases, sufficient advantages might justify either a Relaxation within the Standards or, in more constrained locations, a Departure from the Standards.

Relaxations and Departures shall be assessed in terms of their effects on:

a) The economic worth of the scheme;

b) The environment; and

c) The safety of the road user.

Further information in relation to Departures and Relaxations, including the process for submitting an application for a Departure from Standards can be found in GE-GEN-01005 Departures from Standards and Specification.

2. Lighting Design Process & Documentation

2.1 Purpose of Lighting

The provision of lighting can:

a) Enhance safety on the road network particularly in Conflict Areas;

b) Help in reducing crime and the fear of crime particularly in the urban environment;

c) Enhance the night-time environment and night-time economy;

d) Encourage the use of active travel routes during hours of darkness

e) Reduce severance between population settlements; and

f) Improve journey ambiance.

It should also be noted that the provision of lighting may not be the most cost-effective method of reducing night time accident rates and that improvements to road alignment, improvements in carriageway markings, delineation of traffic and signing may offer a better solution.

Consideration of alternative measures likely to have a lower lifecycle cost or less adverse environmental impact shall be assessed when determining the requirements for lighting on a scheme.

2.2 The Forgiving Roadside

Mitigation of roadside hazards at an early stage in the design process can have a significant positive effect on road safety. Design organisations shall follow the principles of providing a forgiving roadside for errant vehicles when undertaking route lighting design in terms of lighting column positioning. To avoid the need for provision of a road restraint system, lighting columns shall be positioned outside of the Clear Zone, as defined in DN-REQ-03034, where possible.

If owing to land constraint issues the positioning of lighting columns within the Clear Zone is the only option, passively safe lighting columns shall be provided.

2.3 Health and Safety

Design work with regards to safety in design, construction and future maintenance of road lighting schemes for the National Road network shall be carried out in accordance with the requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013, S.I. No.291 of 2013 and comply with all current Health & Safety Standards.

Legislation and Codes of Practice of particular note to be considered by the designer during the design, construction and future maintenance periods are, but not limited to, the following:

a) Safety, Health and Welfare at Work Act 2005, Number 10 of 2005;

b) Safety, Health and Welfare at Work (General Application) Regulations 2007, S.I. No.299 of 2007, as amended 2013;

c) HSA Code of Practice for Avoiding Danger from Underground Services, May 2016;

d) ESB Networks Code of Practice for Avoiding Danger from Overhead Electricity Lines, September 2008; and

e) The relevant guidelines applicable to the design and implementation of Temporary Traffic Management.

2.4 Design Process

The lighting design process is considered to comprise of three key stages:

a) Concept;

b) Preliminary; and

c) Detailed.

The application of the concept, preliminary and detailed lighting design stages will be very much dependent upon the form of contract and procurement method and may differ between schemes.

For National Road Capital Projects the lighting design stages will generally align with the following project phases that are identified in the Project Management Guidelines (PE-PMG-02041).

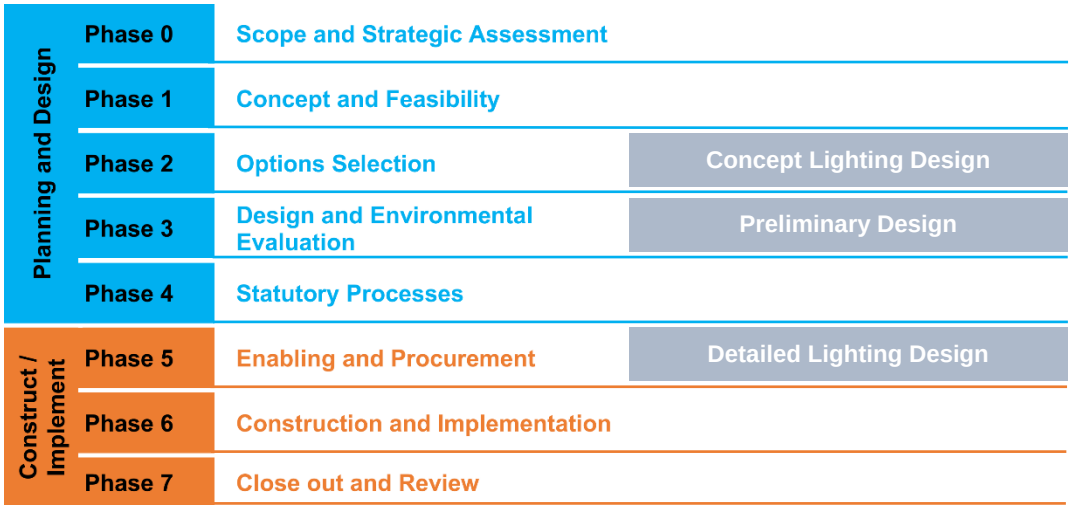


Figure 1 PE-PMG-02041 Process and Lighting Stage Alignment

2.5 Competency for Designers & Quality Assurance

The design of lighting is a specialist activity and shall be undertaken by competent and experienced persons who can demonstrate an appropriate understanding of road lighting design principles.

Electrical design applicable to road lighting systems shall only be undertaken by someone with appropriate formal training in electrical design and who can demonstrate that they have experience in undertaking electrical design for highways electrical systems and infrastructure.

2.6 Concept Design

The concept design stage is the first stage of the lighting design process that shall be used to develop the following aspects:

a) Undertake an initial evaluation to understand whether or not to light the Mainline (refer to Section 3.2 and Appendix B) and other areas of the network (including Active Travel infrastructure/Greenways/rural Cycleways);

b) Identify the approximate extents of the area to be lit;

c) Identify the options for lighting and short list design solutions including an initial assessment of lifecycle costs, where possible;

d) Undertake an initial assessment for the options using the energy performance indicators identified in IS EN 13201-5;

e) Identify constraints and hazards;

f) Initial risk assessments;

g) Derive the IS EN 13201 and BS 5489-1 lighting classes that are likely to be implemented for the scheme;

h) Undertake initial photometric calculations using industry standard software;

i) Provide an indicative design for column spacing, layout, column heights and approximate wattages of lamps and light sources;

j) Consider environmental aspects and sensitive receptors;

k) Identify possible electrical supply points. Commence discussions with ESB Networks Limited to understand viability of proposed locations and understand budget costs, if available;

l) Prepare an outline budget costing for the lighting;

m) Prepare an outline design methodology summarising lighting aspects to be included as part of the design file and the assumptions that have been made in developing the concept lighting design; and

n) Prepare the Lighting Design File.

2.7 Preliminary Design

At the preliminary design stage the concept design(s) will be further developed as follows:

a) If applicable, refine the lighting evaluation for lighting of the Mainline and other areas of the network (including Active Travel infrastructure/Greenways/rural Cycleways);

b) Analyse the design options further to identify a preferred solution including an analysis of lifecycle costs for the design options considered;

c) Undertake further assessment of the options in order to ensure an energy efficient design solution using the energy performance indicators identified in IS EN 13201-5;

d) Refine the extents of the area to be lit and understand how this interfaces with any existing lighting systems at scheme boundaries;

e) Undertake environmental assessment, where applicable;

f) Undertake surveys where possible;

g) Undertake further discussion with ESB Networks Limited, where applicable;

h) Identify requirements for electrical supplies for the National Road lighting. These shall be metered connections and segregated from the electrical supplies for Regional Road and Local Road lighting;

i) Undertake a safety review;

j) Ensure requirements for passive safe columns and associated electrical disconnection systems etc. have been considered, where required;

k) Develop the design layout and prepare general arrangement drawings;

l) Undertake more detailed photometric lighting design calculations using industry standard software;

m) Where required, develop electrical design calculations associated with private cable networks and understand earthing arrangements;

n) Co-ordinate the lighting layout with other engineering disciplines and environmental team;

o) Refine cost estimate; and

p) Update the Lighting Design File.

2.8 Detailed Lighting Design

The detailed design stage will further develop the preliminary design suitable for construction that includes the following:

a) Undertake further project and safety risk assessment;

b) Consider opportunities in terms of light source selection and any opportunities to minimise energy consumption and lifecycle costs if a reasonable amount of time has elapsed between the preliminary and detailed design stages;

c) Finalise General Arrangement (GA) drawings;

d) Prepare supporting schematic drawings detailing cable network arrangement and any duct and chamber requirements;

e) Prepare standard construction detail drawings;

f) Compile Lighting Specification Appendices Series 1300 and 1400 and any other tender documentation;

g) Undertake detailed co-ordination exercise with other engineering disciplines;

h) Finalise environmental assessment, where applicable;

i) Finalise requirements for electrical supply points with ESB Networks Limited including segregation of the metered electrical connections for National Road lighting and the Regional Road and Local Road lighting electrical supplies;

j) Finalise safety reviews;

k) Finalise/refine photometric lighting and electrical calculations;

l) Prepare final cost estimates and bills of quantity (if required) for the lighting; and

m) Finalise the Lighting Design File.

2.9 Environmental Impact Assessment and other Planning Requirements

Where a scheme is subject to planning requirements such as an Environmental Impact Assessment under EU Directive 2014/52/EU then a Lighting Impact Assessment may be required.

Lighting Impact Assessments shall only be undertaken by competent lighting professionals. The Institute of Lighting Professionals (ILP) Professional Lighting Guide PLG-04 – Guidance on Undertaking Environmental Lighting Impact Assessments outlines a good practice approach for undertaking and assessing the impact of road lighting on surrounding land and impact on humans, flora and fauna.

2.10 Designing for Maintenance

2.10.1 General

The lighting design shall consider the health and safety risks around maintenance operatives with a specific aim to:

a) Reduce exposure to risk by operatives;

b) Reduce level of site accident rates and ill-health arising from maintenance activities;

c) Create a more efficient and cost-effective approach to maintenance;

d) Consider the re-use of materials and other infrastructure aspects (e.g. cross-carriageway road crossings) to minimise the need to undertake non-essential construction works; and

e) Reduce congestion and delay to the motorist.

Wherever possible maintenance operations on the National Road network shall be integrated within a co-ordinated maintenance programme that includes planned traffic management.

2.10.2 Maintenance Access

The siting of feeder pillars shall allow for maintenance access. The requirement is that access shall be readily and easily available.

A risk assessment shall be undertaken on a location-by-location basis in order to determine the most appropriate method for maintenance access to feeder pillars.

The placement of feeder pillars shall take cognisance of locations where maintenance access can be provided that will make best use of existing and/or proposed infrastructure provision and minimise construction works associated with parking areas, paved areas, access steps and any retaining structures.

If a maintenance vehicle layby is required, a typical maintenance vehicle lay-by as shown on standard construction detail CC-SCD-01524 can be provided.

Feeder pillars which are sited remotely from the carriageway may require the additional provision of access steps, pathways and handrail.

Maintenance staff may be required to carry difficult to handle and heavy test equipment to feeder pillars to undertake routine and reactive maintenance and steps shall be provided where access involves a gradient exceeding 1 in 2 for a height exceeding 400mm. Paved areas, constructed from standard paving slabs, shall be constructed between access steps, cabinet hardstandings, the hard shoulder and any maintenance parking bays to provide a continuous, safe path. In some instances, it may be appropriate to provide localised lighting to support maintenance activities at feeder pillar locations during the hours of darkness.

2.10.3 Overhead Electricity Supply Lines

Safe working clearance shall be ensured on all road lighting near overhead electricity supply lines.

The design shall seek to minimise the number of affected lighting columns.

The operator of the line shall be consulted regarding safe working clearances and to establish the accurate position and height of the line.

Lower mounting heights shall be used as needed and columns shall normally be hinged in order to provide safe access for maintenance in the vicinity of the overhead line with the fixing of suitable warning signs to warn operatives of the dangers.

The lighting designer shall aim to maximise the spacing between lighting columns and overhead electricity supplies where possible.

ESB Networks Code of Practice for Avoiding Danger from Overhead Electricity Lines shall be consulted for further requirements and guidance.

2.11 Design File

A Lighting Design File shall be prepared at concept stage and this shall be developed during the preliminary and detailed design phases.

The Lighting Design File shall include a design methodology that sets out in clear detail the decisions taken during the design life cycle. This is particularly important when design organisations change as the phases of the design change and helps in ensuring a 'lean process' that will minimise revisiting aspects of the design that have already been considered and eliminated.

A proposed template for a Lighting Design File is provided in Appendix A1.

2.12 Collaborations and Consultations

It is important that due consideration is given to the lighting at the early stage and during the project lifecycle so that the lighting and electrical design is co-ordinated with other engineering disciplines such as highways, geotechnical, structural and environmental.

Consultations shall be undertaken as necessary during the design process with other parties. All discussions undertaken and the design decisions made during the project design lifecycle shall be clearly identified and documented and shall form part of the Design File information.

3. Lighting Provision & Performance Requirements

3.1 General

The design of new, replacement or the modification of existing lighting shall:

a) Consider energy efficient lighting systems that are available;

b) Give consideration to the maintenance requirements of the proposed lighting;

c) Reduce maintenance where possible compared to previous lighting schemes; and

d) Be undertaken by competent and suitably qualified lighting and electrical designers.

The lighting shall be designed in accordance with the recommendations of BS 5489-1: Code of Practice for the Design of Road Lighting, together with the additional requirements set out in this Standard.

3.2 Lighting Provision

Mainline road lighting on the National Road network is generally restricted to urban locations with the Mainline on the remaining network being predominantly unlit.

Lighting of the Mainline shall only be provided where a lighting evaluation has been undertaken and it has been justified that lighting should be provided. A Departure from Standard is required. The lighting evaluation process and method of assessment is detailed in Appendix B1 of this document.

Appendix B2 of this document describes the process for applications to be made for small minor lighting improvement works and is used to support applications for a Departure from Standard.

These lighting assessment tools are available for download from the downloads section of the TII publications website (www.tiipublications.ie).

If the Mainline is to be lit, then all at grade junctions, grade separated junction and interchanges within that section of main carriageway and at either end shall also be lit in accordance with the requirements of this section.

It is a requirement on all rural motorways and dual carriageways to light grade separated junctions.

Grade separated junctions where the Mainline rural motorway or dual carriageway is unlit shall follow the requirements for the extents of lighting as described in Section 4 of this Standard.

Where a new grade separated junction is to be constructed on an existing Mainline, and the Mainline is already lit, then the grade separated lighting shall be extended to the Mainline to ensure that no short unlit gaps are present on the National Road network. There shall not be an unlit gap of less than four times the desirable minimum Stopping Sight Distance (SSD) between lit sections on the Mainline. This requirement is not applicable for side roads.

Mainline, grade separated and priority junctions on single carriageways in rural locations are unlit with the exception of at grade roundabouts. A Departure from Standard is required if lighting is to be provided on the Mainline and/or priority, grade separated junctions of single carriageway roads.

The lighting of other areas of the network is described in Section 5.

Lighting provision on the National Road network is summarised in the following illustration:

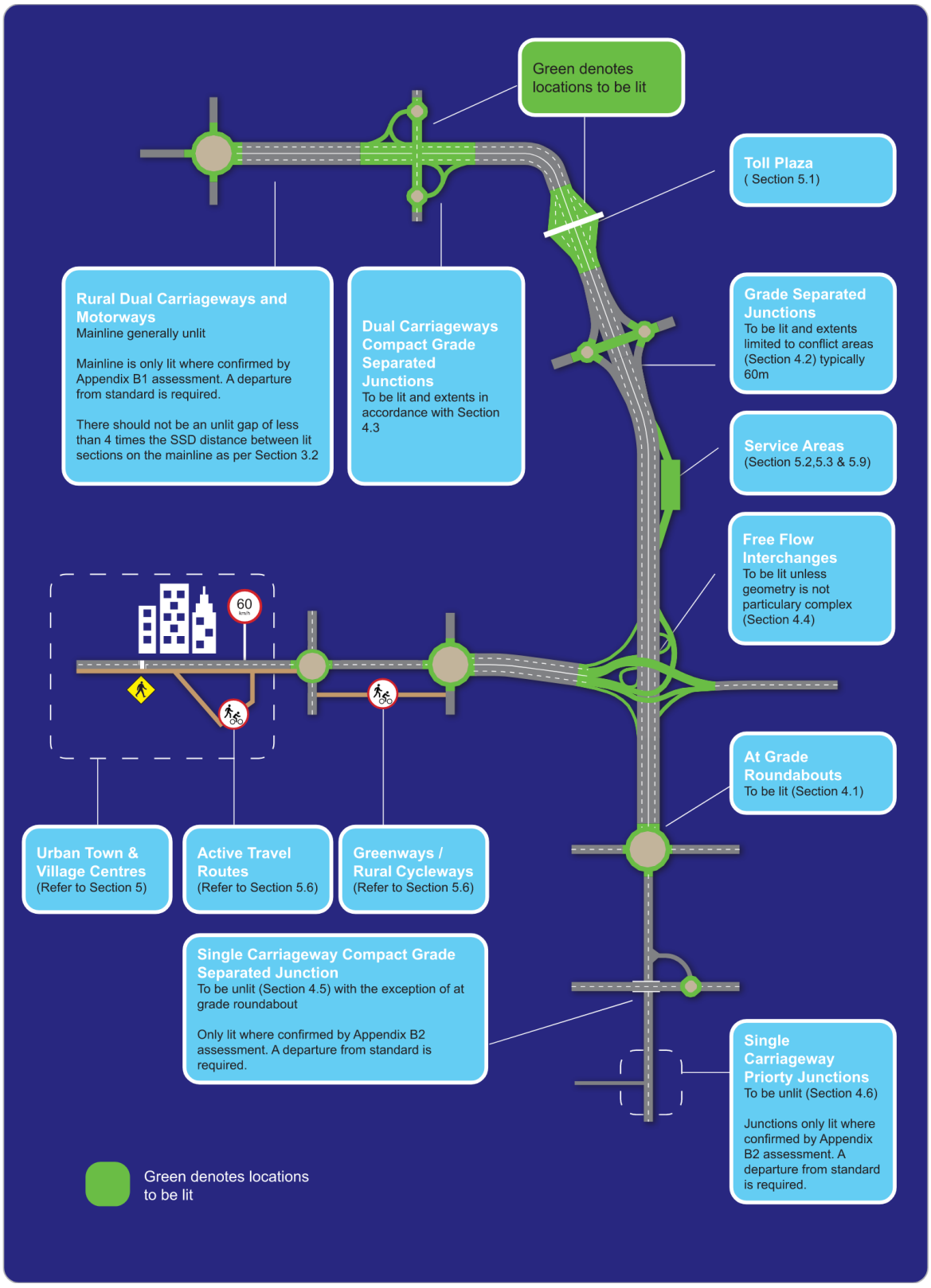


Figure 2 Representation of the Lighting Provision on the TII National Road Network

Note: *Guidance is provided in Section 4 for extending lighting at junctions and roundabouts when 60m extents is considered not to be appropriate.*

3.3 Selection of Lighting Class for Road Lighting

The lighting designer shall determine the appropriate lighting performance parameters in accordance with IS EN 13201 and BS 5489-1. Guidance on the selection of lighting classes is given in Annex A of BS 5489-1.

The lighting of traffic routes shall be based on the M/ME classification using luminance criteria. The lighting of conflict areas shall be based on the CE/C classes and use illuminance criteria. The lighting of Active Travel infrastructure/Greenways/rural Cycleways shall be based on P classes, refer to Section 5.6.

The selection process for the lighting classes uses the applicable table in Annex A of BS 5489-1 to provide an initial determination of the lighting class.

As part of the selection of the lighting class, the initial determination of the lighting (based on BS 5489-1 Annex A Table A.2 or Table A.3) for the Mainline shall be assessed further in order to refine the lighting class either up or down. This will ensure the right light in the right place.

This refinement of the lighting class is based around a range of parameters that include:

a) Traffic volume;
b) Traffic composition;
c) Separation of traffic;
d) Visual guidance; and
e) Ambient luminance.

Appendix C provides a quantitative approach for undertaking a refinement of the lighting class for traffic routes which are the principle road type on the National Road network. Appendix C is available as a tool for download from the downloads section of the TII publications website (www.tiipublications.ie).

The lighting of Conflict Areas (CE/C) can then be derived following BS 5489-1 (Table A.1 or Table A.4) as follows:

Table 1 Conflict Area Lighting Classes on the National Road Network

Mainline National Road Illumination	Lighting Class Requirements	Rationale
Lit	BS 5489-1 Table A.4 applies	Where the Mainline or adjoining road lighting is lit then the Conflict Area will be lit to a higher intensity of light compared to the Mainline or adjoining road.
Unlit	BS 5489-1 Table A.1 applies	For an unlit Mainline the requirement for an increase in Conflict Area lighting compared to the mainline lighting is not needed and an equivalent lighting class (ME/M or CE/C) can be applied. If the Conflict Area has adjoining roads then the Conflict Area lighting class will be selected as a class higher than the adjoining road with the highest class.

It is recognised that the Mainline National Road network in Ireland is predominately unlit and that the adjoining roads at junctions may also be unlit but the approach in deriving M/ME lighting classes can still be followed as a method of determining the lighting class requirements for Conflict Areas and applying the requirements stated in Table 1.

Maintenance factors shall be derived in accordance with BS 5489-1 and shall take cognisance of manufacturers' recommendations to ensure minimum maintained lighting levels are achieved.

3.4 Energy Efficiency

The lighting design needs to ensure the right light in the right place at the right time and the lighting designer shall ensure the proposed design has considered energy efficiency as part of the design solution. The calculation of energy performance indicators will assist the designer in selection of the preferred technical solution particularly when considering options for the lighting.

IS EN 13201-5 Road Lighting Energy Performance Indicators shall be followed and the calculations shall be clearly documented in both the Lighting Design File and the handover into maintenance documentation.

The IS EN 13201-5 energy performance metrics are calculated based on the Power Density Indicator (PDI) and the Annual Energy Consumption Indicator (AECI).

3.5 Lighting Arrangement

The lighting arrangement to be selected will generally comprise of the following types:

a) Road lighting columns in a single sided, staggered or opposite arrangement;

b) High Mast; and

c) Catenary.

Where possible, lighting columns shall be installed within the verge rather than the central reserve to minimise the requirement for traffic management. The provision of lighting in the central reserve shall only be used in exceptional circumstances and where significant safety improvement, reduced cost and reduced construction delay can be demonstrated. A Departure from Standard is required for the provision of central reserve lighting.

Columns located on slip roads shall be single sided.

Catenary lighting is only permitted in exceptional circumstances, where it can be demonstrated that it is the only practical solution and shall be agreed with TII and will require a Departure from Standard.

High mast lighting is an alternative to the use of standard lighting columns and may be a suitable solution at complex intersections and junctions. Its application shall be used only in exceptional circumstances and where significant safety improvements, reduced cost and reduced construction delays can be demonstrated. A Departure from Standards is required for high mast lighting.

High mast lighting systems will generally require fewer lighting support structures but the mechanical, hydraulic and electrical equipment is more complex and has additional maintenance requirements.

High mast lighting shall be in accordance with ILP PLG-07 High Masts for Lighting and CCTV.

3.6 Light Pollution

Light pollution such as sky glow, glare and light trespass shall be minimised wherever possible.

The ILP Guidance Notes for the Reduction of Obtrusive Light (GN01) provides further detail on the different causes of light pollution and provides examples of a good practice approach relating to the positioning of light sources, the methods and accessories to limit obtrusive light and stated values of lighting levels.

The control of lighting to minimise light pollution and the permitted lighting values are dependent upon environmental zones that are set out in GN01.

To minimise unwanted glare and light spill in the immediate surrounds of the National Road network, the luminous intensity of lighting sources at critical angles have been restricted (Glare (G) ratings) and these are set out against each type of environmental zone in the following table:

Table 2 Luminous Intensity Glass Requirements by Environmental Zone

Zone	Surrounding	Lighting Environment	Examples	Luminous Intensity Classes
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks	G6
E1	Natural	Intrinsically Dark	National Parks, Areas of Outstanding Natural Beauty	G5 or higher
E2	Rural	Low District Brightness	Villages or relatively dark outer suburban locations	G4 or higher
E3	Suburban	Medium District Brightness	Small town centres or suburban locations	G3 or higher
E4	Urban	High District Brightness	Town/city centres with high levels of night time activity	G2 or higher

The G2 to G6 glare rating values set out in the table are identified in IS EN 13201-2 Annex B.

All light sources in Zones E0, E1 and E2 shall use flat glass luminaires. All luminaires shall in general be positioned at 0º inclination to either minimise upward light (G2 to G3 glare classes) or ensure that no direct light above the horizontal will be emitted (G4 to G6 glare classes).

3.7 Lighting Columns

Design organisations shall follow the principles of providing a forgiving roadside for errant vehicles as stated in Section 2.2 when undertaking National Road lighting design. To avoid the need for the provision of a road restraint system, lighting columns within the Clear Zone shall be passively safe and follow the requirements in Section 3.8 of this Standard.

The requirements for lighting columns and other support structures are stated in the Design of Support Structures for Roadside Furniture (DN-STR-03018).

Column height selection shall be considered and balanced in terms of maximising spacing and reducing visual impact.

Where the reuse of existing lighting columns for LED retro-fit schemes is considered, the structural integrity of those existing columns shall be assessed. Inspection and testing of columns shall follow the guidance and best practice detailed in ILP Guidance Note TR22 Managing a Vital Asset: Lighting Supports.

3.8 Passively Safe Columns

All passively safe lighting columns shall comply with IS EN 12767 with the appropriate energy absorption category and performance class selected based on speed limit and surrounding location.

The electrical supply to passively safe columns shall automatically electrically disconnect within 0.4 seconds to ensure that any vehicles that strike the columns do not become live upon impact.

Additional guidance on the implementation of passively safe columns can be found in ILP TR 30.

3.9 Bracket Arms

Luminaires can be post top mounted or fixed to bracket arms on lighting columns.

The preference is generally for post top mounted.

The lack of a bracket for tall (typically 12m and above) tubular lighting columns in exposed sites may result in an increase in vibration that could reduce the life of equipment in the luminaire.

Where bracket arms are used, projections shall be limited to 2m or 25% the height of the column whichever is the lesser.

3.10 Road Surface

It is important to understand that the road surface forms an integral part of a lighting installation when luminance based criteria is applied. The lighting of traffic routes is normally based on luminance criteria.

Luminance criteria is calculated based on reduced luminance co-efficient values for a road surface and these values are provided in the form of an r-table (refer to IS EN 13201). The r-table is primarily based on two key metrics for diffuse reflection (Q_0) and specular reflection (S1).

The selected r-table for the road surface used for the luminance design shall be chosen that represents the road surface that exists or is proposed for the scheme as there can be significant variations in reflection when different road surfaces and aggregates are used.

The r-table, CIE type C2 (average luminance coefficient (Q_0) of 0.07) tends to be used for a standard asphalt road surface and is the most widely adopted one used by lighting designers. There are a range of road surfaces deployed on the National Road network however, and these different road surface types can have an impact in terms of luminance, uniformity and glare parameters based on different Q_0 and S1 values.

Consultation shall be undertaken with a pavement engineer to obtain information for the proposed or existing road surface in order to apply the most appropriate r-table values when undertaking the lighting design.

3.11 Light Sources

Lighting sources shall have a colour rendering index (Ra) greater than or equal to 20 and shall be selected to minimise whole life cost and energy consumption.

LED luminaires shall be equipped with surge protection equipment that shall meet the requirements stated in Specification for Road Works Series 1400 – Electrical Work for Road Lighting and Traffic Signs (CC-SPW-01400).

3.12 Correlated Colour Temperature (CCT)

The Correlated Colour Temperature (CCT) to be used on the National Road network shall be warm (<3,300K).

The intermediate CCT >3,300K up to 4,000K shall require a Departure from Standard.

A cool colour appearance (>4,000K) is not permitted on the National Road network.

Colour temperature tolerances shall be within a 5 step MacAdam ellipse.

Information on CCT is included in Informative Appendix E.

3.13 Operation and Control - General

There are a number of methods to control and operate the public lighting to ensure the right light in the right place at the right time. Methods of control include:

a) Photoelectric Control Units (PECU);

b) Variable Lighting Levels (such as Central Management Systems (CMS) and Dimming);

c) Time Switches; and

d) Power Controllers.

Constant Light Output (CLO) is a method used to drive an LED light source that helps reduce energy consumption. CLO consists of adjusting the LED drive current to compensate for the light output depreciation of the LED as it ages to ensure that a constant lumen output is maintained.

3.14 Photoelectric Control Units (PECU)

The operation of lighting on the National Road supplied by a feeder pillar private cable network shall be by group control PECU. Individual PECU control is to be provided where an ESB Network connection is provided direct into a column.

PECU sockets shall be of the 7 pin NEMA or System Ready (SR) type to facilitate remote connection to a CMS at a future date.

The switch on/switch off period for PECUs shall be dependent upon lighting source types as follows:

a) 35/18 Lux for High Intensity Discharge (HID); and

b) 35/18 Lux or 20/20 Lux for LED.

3.15 Variable Lighting Levels

3.15.1 Central Management Systems (CMS) and Dimming

The lighting standards have evolved and support the application of variable lighting levels during the hours of darkness based around traffic flows. This can be achieved through either pre-set dimming equipment installed at the point of installation or through the connection to a Central Management System (CMS).

Currently TII does not have a policy for the implementation of CMS technology.

The scheme designer shall undertake an evaluation of a variable lighting level regime using historical or predicted traffic data for all schemes in order to identify opportunities to dim the lighting during period of darkness when traffic flows decrease. Any dimming regime applied shall always ensure the minimum levels are achieved to a specific lighting class.

ILP PLG-08: Guidance on the application of adaptive lighting within the public realm provides guidance on the application of adaptive lighting classes based on traffic flow and undertaking risk assessments.

A limited range of dimming profiles has been agreed with ESB Networks which can be used for unmetered supplies for LED (refer to Appendix D) however it should be noted that unmetered connections are not permitted for new electrical supplies on the National Road (see Section 3.17). The application of unmetered supplies for LED as stated in Appendix D will be for lighting on Regional and Local Roads forming part of a National Road scheme or where the replacement of existing unmetered supplies to metered supplies is not feasible on the National Road network.

Unless the lowest lighting class is being adopted, as a minimum, a pre-set dimming regime shall be applied with at least a 1 step down in the lighting class that is to be applied during the period of darkness. This shall be determined by the lighting designer in consultation with the traffic engineering team and agreed with TII on a scheme specific basis.

The application of dimming will help address key aims of improving energy efficiency and minimising light pollution and impact on the environment.

3.15.2 Time Switches

Time switches are generally not used on the National Road network; however, the requirements are detailed in Specification for Road Works Series 1400 – Electrical Work for Road Lighting and Traffic Signs (CC-SPW-01400).

3.15.3 Power Controllers

The implementation of LED on the National Road network is not a mandatory requirement and other light source types can be used.

Where existing high-pressure sodium (SON) lights are to be retained under a scheme and supplied by a private cable network, then a method of adjusting the lighting levels can be achieved by the use of power controllers that are installed at the start of the private cable network (generally in a feeder pillar cabinet).

The extent of how much a SON lamp can be dimmed is technically constrained but the implementation of power controller can offer an opportunity to retain existing lighting equipment whilst improving energy efficiency.

3.16 Other Infrastructure - General

ET101:2008 shall be followed for the design of the electrical installation associated with the road lighting.

Electrical supplies for the road lighting to be either 230 volt (+10%, -10%) single phase AC mains power supply or 400 volt (-6% to +10%) three phase AC mains power supply.

3.17 Metered and Unmetered Supplies from the Distribution System Operator

Public lighting connections are provided by ESB Networks Limited and will have either unmetered or metered supplies.

Energy consumption on the National Road network is monitored in line with the statutory obligation placed upon TII as a public body to report energy consumption under S.I. 426: 2014 (European Union (Energy Efficiency) Regulations 2014) and in line with the National Energy & Climate Plan 2021-2030. All new public lighting connections for National Roads shall therefore be metered only as metered supplies offer greater certainty for this purpose.

Application for new supplies will need to be made to ESB Networks Limited and the commencement of this process shall be done at an early stage of the design process to understand budget costs and timescale for completion. Applications shall be based on a kVA load that is representative of the expected kVA load required for a scheme in order to negate unnecessary costs being applied. A nominated electricity supplier will also be required prior to ESB Networks Limited switching on the electrical supply.

Electricity connections from ESB Networks Limited will be terminated in either a lighting column or feeder pillar cabinet. For the National Road network, in most instances the electricity connection will be provided within a feeder pillar cabinet. Electrical cable networks will be provided between the feeder pillar cabinet and the individual lighting units and installed by the Road Lighting Installation Contractor.

3.18 Electrical Cable Networks

Armoured power cables shall be used for the electrical cable network associated with the road lighting on the National Road network.

Cable types shall be as stated in the Specification for Road Works Series 1400 – Electrical Work for Road Lighting and Traffic Signs (CC-SPW-01400) and shall generally be 3 core or 5 core.

A single-phase cable distribution is generally the preferred option for the public lighting cable network.

Where ESB Networks provide a single-phase supply, a loop in-loop out within each column can be adopted.

The loop in-loop out can be applied to consecutive columns, every other column or every third column to offer some resilience in terms of keeping lighting operation in the event of a cable fault.

In order to facilitate the installation and termination within each column, the conductor size shall generally be limited to 25mm to overcome difficulty due to the stiffness of the cables when installing and the termination space in the public lighting cut-outs.

Where ESB Networks provide a three-phase supply, two options for cabling are available:

a) Single-phase distribution using 3 core cables; and

b) Single-phase distribution using 5 core cables.

Single phase distribution using 5 core cables will require breeches joints adjacent to every column location. Each column can be connected to alternative phases so that in the event of a phase failure on the ESB network then only 1 in 3 columns will be unlit.

Electrical cable networks for lighting columns on National Roads, Regional Roads and Local Roads shall be segregated and shall be separately connected to the ESB Network.

3.19 Ducting & Chamber Networks

Road lighting cables shall be installed in underground ducts.

Suitable duct chambers shall be used at all transverse road crossing locations. Duct chambers shall also be considered at locations where there is significant deviation along the route that would make cable pulling difficult and be prone to cable damage during installation. Intermediate duct chambers shall be provided at least every 125m on long duct routes.

Chambers are not required at each lighting column unless they are required based on the electrical disconnection method used where passively safe columns are deployed.

3.20 Feeder Pillars

Feeder pillar cabinets shall be used to house the ESB Network Limited electrical supply incoming cable and circuit protection equipment, metered equipment, earthing and the outgoing distribution equipment and cables for the road lighting units.

Lighting feeder pillars shall be used to supply only the road lighting system and no other connection for other systems shall be permitted.

Maintenance access arrangements at feeder pillars shall be as described in Section 2.10.2.

3.21 Earthing Arrangements

The earthing arrangements, protective conductors and equipotential bonding shall be in accordance with Chapter 54 of ET101:2008 National Rules for Electrical Installations, Fourth Edition' and subsequent updates.

ESB Networks shall be consulted on the type of earthing arrangement (TN-C-S (PME) or TT) that will be available for new supplies.

A TT earthing arrangement provided by ESB Networks will generally mean a higher external impedance (Ze) will be present at the source (feeder pillar) and this may require larger conductor sizes, extensive earth rods/mats at the feeder pillar and the use of residual current devices (RCD) to ensure suitable disconnection times in the event of an earth fault.

Separation between TII feeder pillars and ESB Networks supply cabinets or ESB Networks Pillars and Customer Service Pillars (Public Lighting Section Pillars) will be subject to a minimum distance in terms of separation. ESB Networks shall be consulted for requirements.

In some instances, due to spacing constraints, ESB Networks may permit closer separation than the minimum requirement providing the pillars are equipotentially bonded in accordance with ET:101. This will only be permitted with the explicit permission of ESB Networks.

3.22 Illuminated Traffic Signs and Bollards

Illuminated bollards are not permitted.

Illumination of individual traffic signs other than by general route lighting will not be permitted. A Departure from Standard will be required.

3.23 Renewable Power Supplies

Where the possibility exists to utilise a renewable power supply source as a means to energise a road lighting system, the agreement of TII is required before proceeding with this option. Typical forms of renewable power sources may include wind energy generation and solar power.

Renewable power sources shall ensure that continual power is provided that will meet the electrical demand of the equipment at all times when the road lighting is in operation.

The use of a renewable power supply source and a standard electrical supply combined is permitted.

4. Lighting of Roundabouts, Junctions & Interchanges

Roundabouts, junctions and interchanges are considered to be Conflict Areas where the different streams of traffic intersect with each other from different approaches.

The extent of the lighting of Conflict Areas on the National Road network shall be limited where possible to:

a) Minimise maintenance operative risks;

b) Reduce impact on the environment; and

c) Help reduce energy consumption.

Sections 4.1 to 4.6 set out the extent of lighting to be applied for roundabouts, junctions and interchanges.

For motorways and dual carriageways, in most instances the extents of the lighting for Conflict Areas at roundabouts and grade separated junctions shall be limited to 60m (1 or 2 columns) from the conflict point where traffic streams intersect. The lighting extents for free flow interchanges will also generally be limited to 60m from merge and diverge locations.

For the single carriageway network, the provision of lighting and the extents at junctions are set out in Sections 4.5 and 4.6.

It is recognised however that the lighting extents in certain locations may need to be greater than the 60m extents. A number of factors such as how compact the junction is, the radius of curves, road complexity, proximity of NMU crossing points and environmental factors may require consideration of extended lighting extents. Sections 4.7 and 4.8 provide guidance for when the 60m extents is not considered appropriate.

4.1 Roundabouts

The extents of lighting of at grade roundabouts is as depicted:

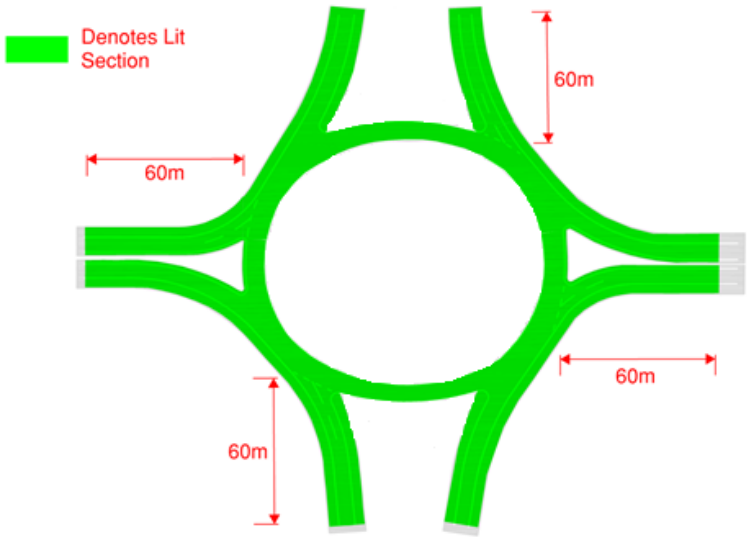


Figure 3 Lighting Extents for an at grade Roundabout

4.2 Standard Grade Separated Junction Types

The required extents of lighting for common junction types is as depicted:

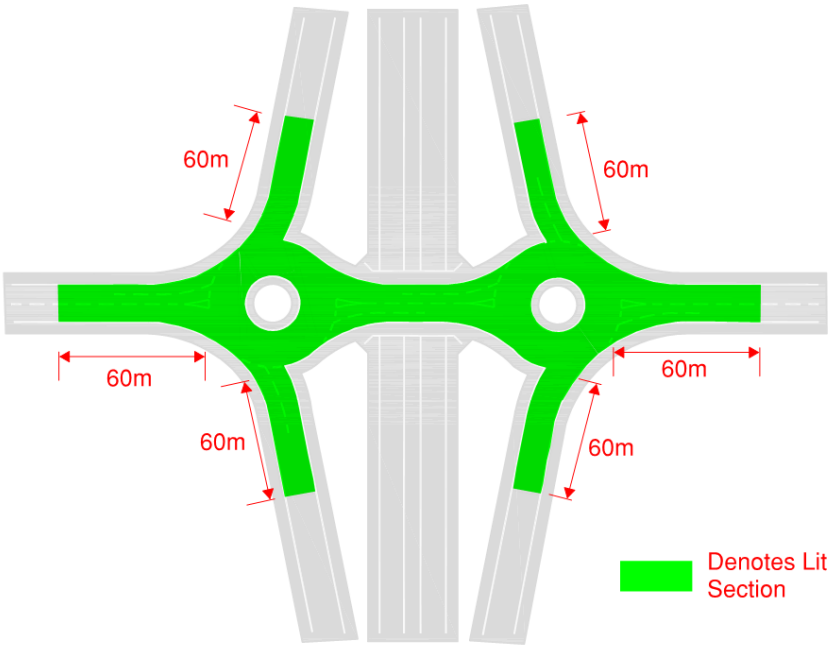


Figure 4 Lighting Extents for a Dumb-bell Junction Arrangement

Lighting shall be provided between the two dumbbells to ensure that no short lengths of unlit road that are less than four times the desirable minimum SSD are present as stated in Section 3.2.

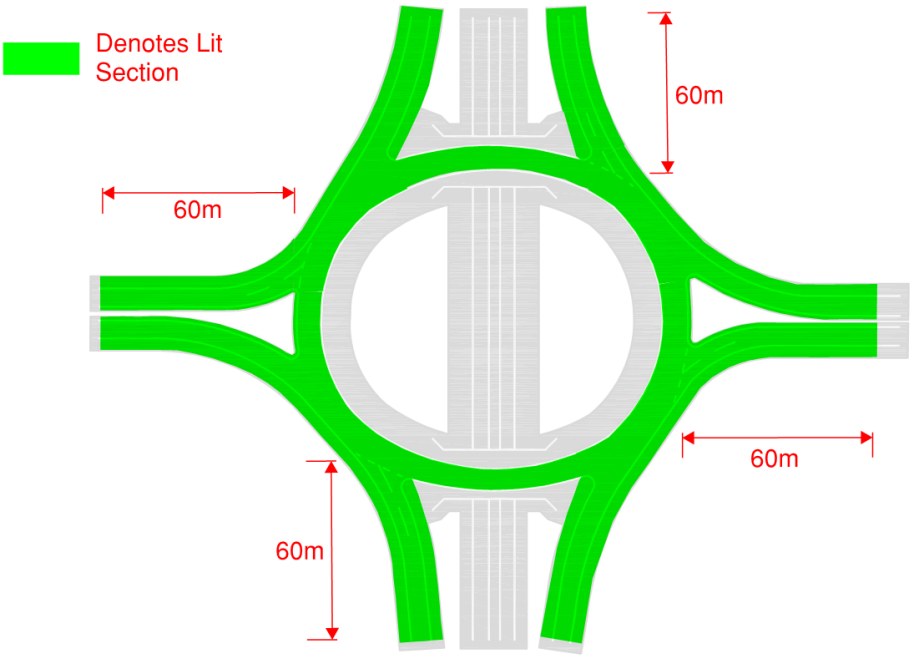


Figure 5 Lighting Extents for a Two Bridge Roundabout Junction

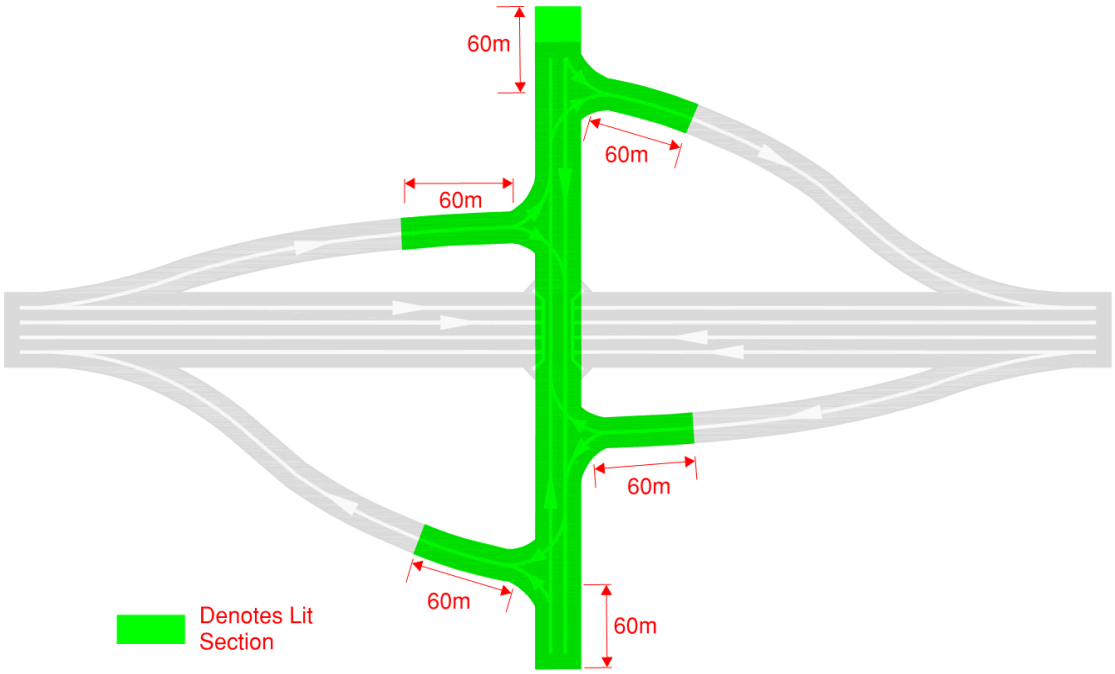


Figure 6 Lighting Extents for a Typical Layout of a Diamond Junction

The diamond junction depicted in Figure 6 is not permitted on National Roads in rural areas and is only provided in urban locations incorporating traffic signals at the connector road junction with the minor road.

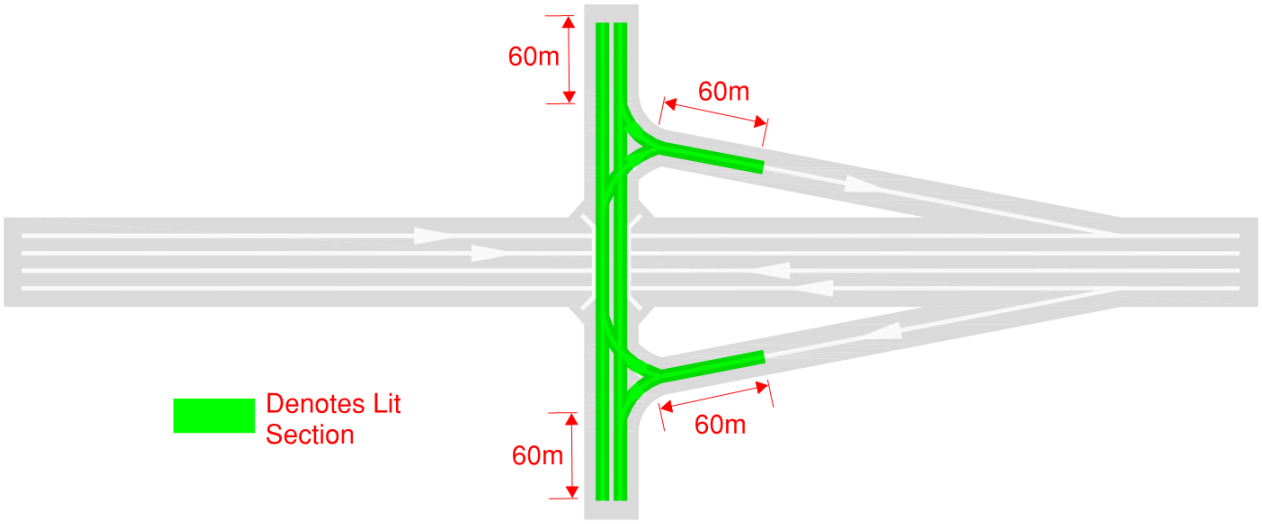


Figure 7 Lighting Extents for a Typical Layout of a Half-Diamond Junction

The half diamond junction depicted in Figure 7 is also not permitted on National Roads in rural areas and, again is only provided in urban locations incorporating traffic signals at the connector road junction with the minor road.

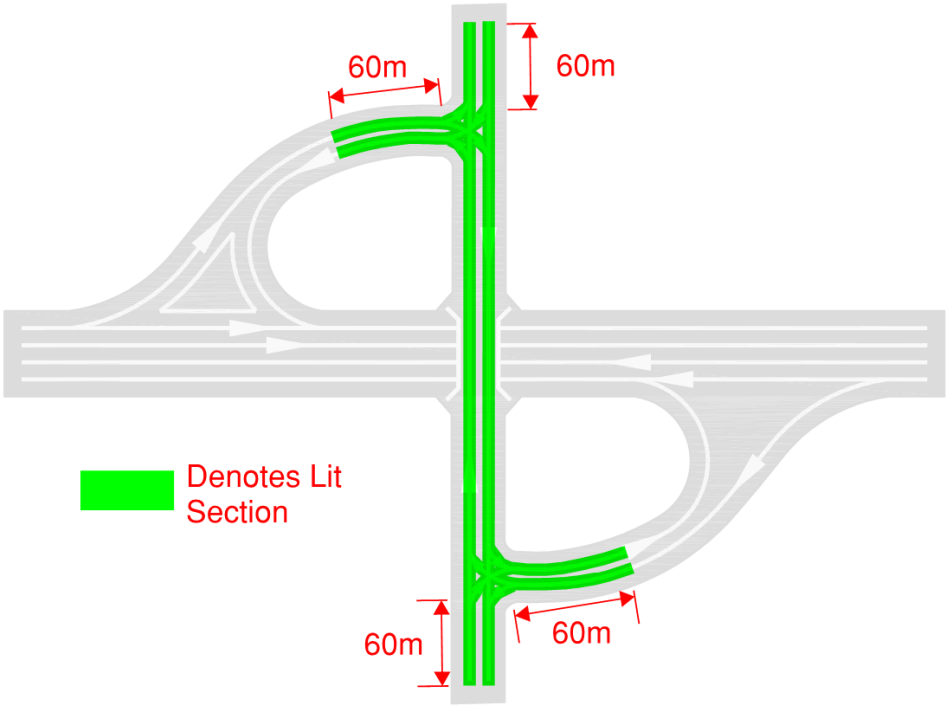


Figure 8 Lighting Extents for a Typical Layouts of a Half Cloverleaf Quadrant 1 and 3 Junction

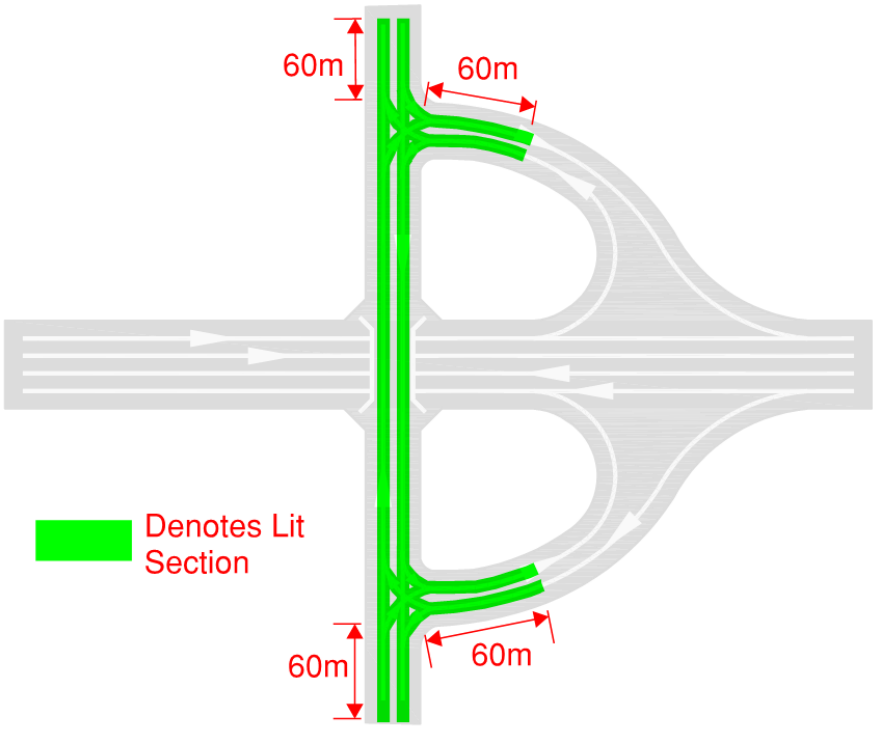


Figure 9 Lighting Extents for a Typical Layouts of a Half Cloverleaf Quadrant 2 and 3 Junction

Lighting shall also to be provided on the road that crosses over the Mainline between the carriageway slip roads to ensure that no short lengths of unlit road that are less than four times the desirable minimum SSD are present as stated in Section 3.2.

4.3 Compact Grade Separated Junctions

A compact grade separated junction is a grade separated junction designed with a two-way unsegregated link road between the major and minor road. The connector road joins the minor road via a priority junction.

Figure 10 depicts the lighting extents to be applied to a compact grade separated junction and generally incorporates the lighting of the Mainline. The lighting on the Mainline will be extended past the merge and diverge points to a distance commensurate with 5 seconds of travel at a particular speed limit as depicted in **Table *3*** under Section 4.8.

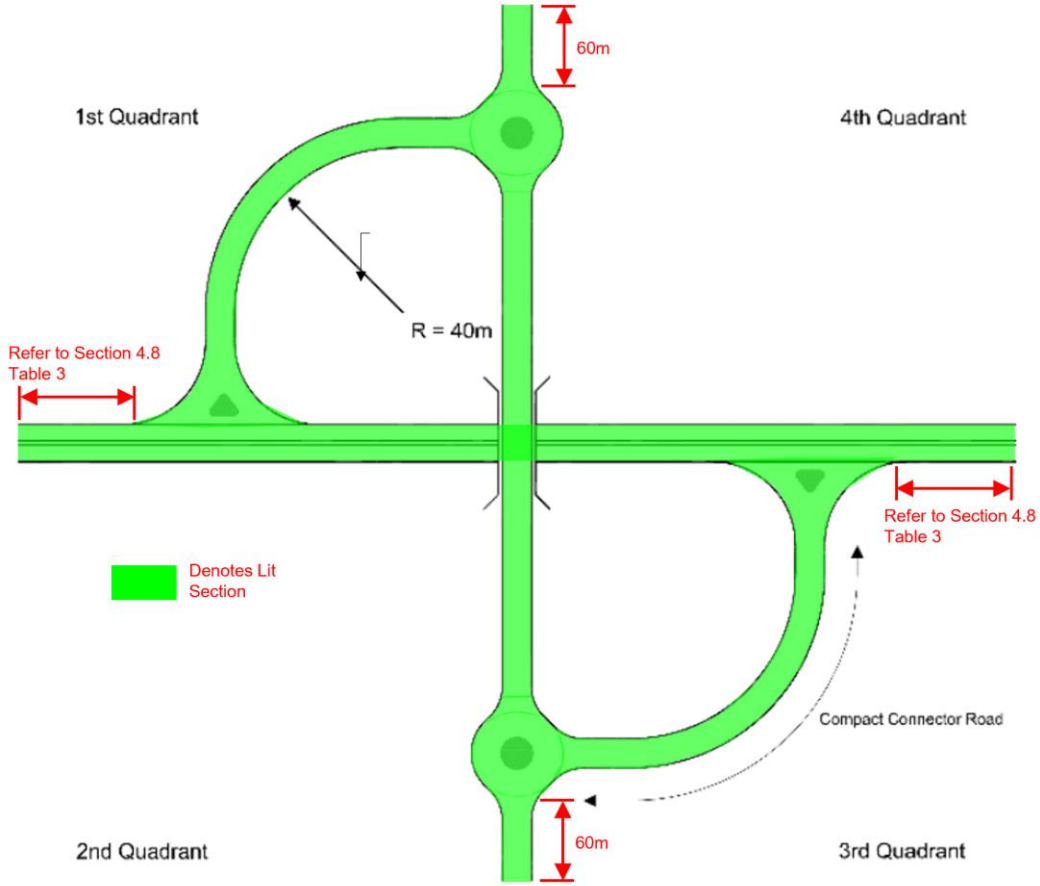


Figure 10 Lighting Extents for a Compact Grade Separated Junction

The extent of lighting at compact grade separated junctions needs to be assessed on a scheme by scheme basis in consultation with a road safety engineer. The scheme designer should undertake a risk assessment for not including Mainline lighting taking into consideration the following:

- Road alignment;
- Road complexity;
- Gradients;
- Lane widths;
- Radii of slip roads; and
- Configuration of splitter islands.

If a risk assessment suggests that Mainline lighting is not justified, a Relaxation from Standard is required.

For compact grade separated junction types the designer shall ensure that there are no short lengths of unlit road that are less than four times the desirable minimum SSD as stated in Section 3.2. where lighting is not provided on the Mainline, lighting on slip roads shall extend to the back of the merge/diverge nose.

4.4 Free Flow Interchanges

Free flow interchanges are defined as grade separated junctions that provides free flow from one Mainline to another.

Typical examples of the extents of the lighting for free flow interchanges on the National Road network are depicted below.

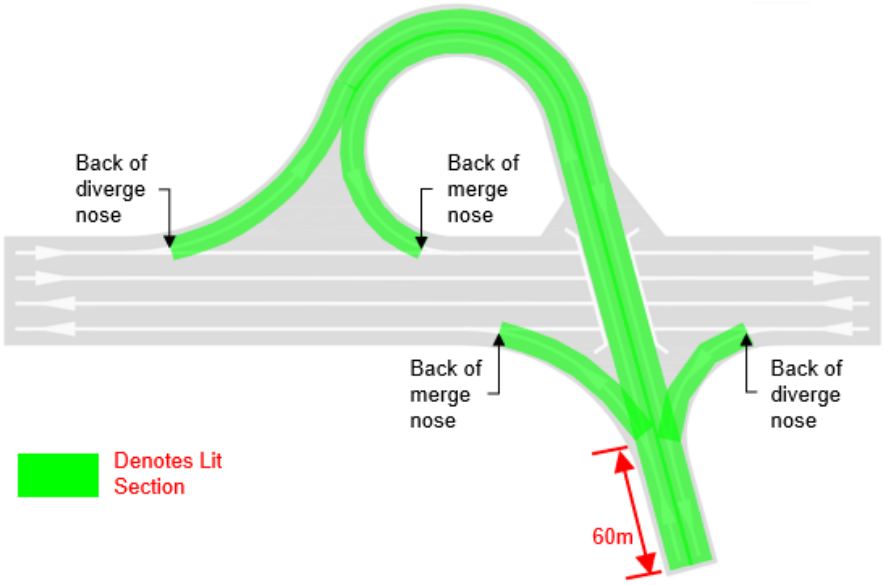


Figure 11 Lighting Extents for a 3 Way/2 Level "Trumpet" Interchange

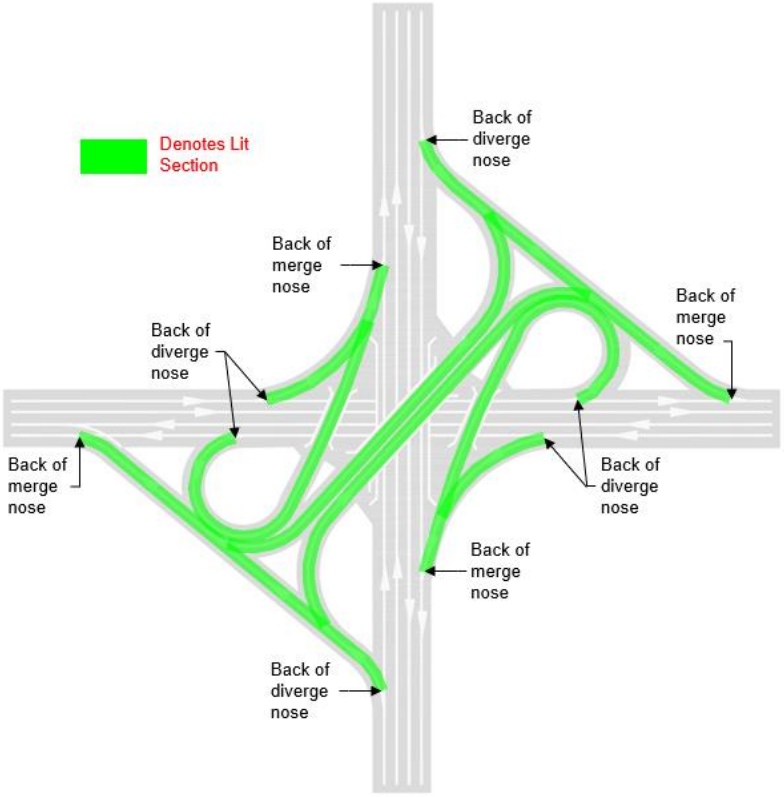


Figure 12 Lighting Extents for a 4 Way/3 Level Interchange

The extent of lighting at free flow interchanges will be determined on a scheme by scheme basis and will be very much dependent upon the complexity of the intersection layout, the radius of curves on link roads, the extent of merge/diverge locations and design speed.

Where free flow link roads have a design speed of 80kph or greater, lighting the link roads may not be justified and should be evaluated through a risk assessment.

Generally, where lighting is required on link/slip roads it shall be extended to the back of the merge/diverge nose. The scheme designer shall ensure that there are no short lengths of unlit road that are less than four times the desirable minimum SSD as stated in Section 3.2.

Lighting of the Mainline shall only be provided where a lighting evaluation has been undertaken and it has been justified that lighting should be provided. If an evaluation suggests that Mainline lighting is justified, a Departure from Standard is required.

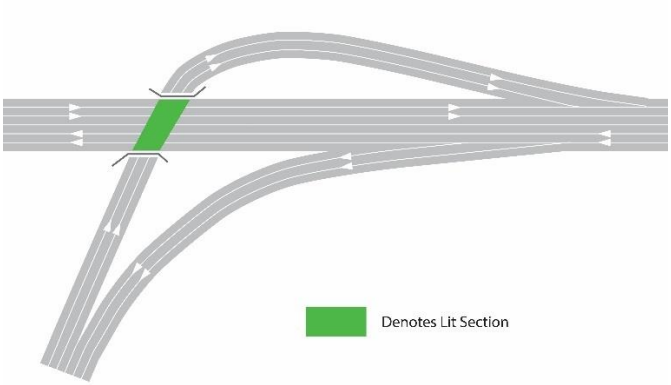


Figure 13 Illustration of a non-complex interchange that will generally be unlit

Lighting within these non-complex interchanges would be restricted to locations within the interchange footprint such as underpasses where the requirement for daytime lighting may be needed. An example of this arrangement can be found on the M7/M9 interchange.

4.5 Single Carriageway Compact Grade Separated Junctions

Generally, single carriageway compact grade separated junctions will be unlit with the exception of the roundabout between the slip road and local road as shown in Figure 2.

The provision of lighting for compact grade separated junctions on the single carriageway road network will require a Departure from Standard and shall be assessed on a project by project specific basis.

Where lighting is to be provided, the determination of the extents of the lighting shall follow the principles set out elsewhere in this Section.

4.6 Single Carriageway Priority Junctions

The provision of lighting for priority junctions on the single carriageway road network will require a Departure from Standard and shall be assessed on a project by project specific basis.

Where lighting is to be provided then the determination of the extents of the lighting shall follow the principles set out elsewhere in this Section.

4.7 Extending the Lighting at Roundabouts, Junctions and Interchanges

In some instances, it is recognised that additional lighting may be required where the standard guidance identified in Sections 4.1, 4.2 and 4.4 may not be suitable due to other factors.

The scheme designers shall determine if the lighting extents should be extended particularly in regard to the potential of vehicle collisions and non-motorised usage.

The flowchart in Figure 14 gives further guidance along with the application of ILP PLG-02 (refer to Section 4.8) when determining the extents of lighting when the 60m extents may not be considered appropriate.

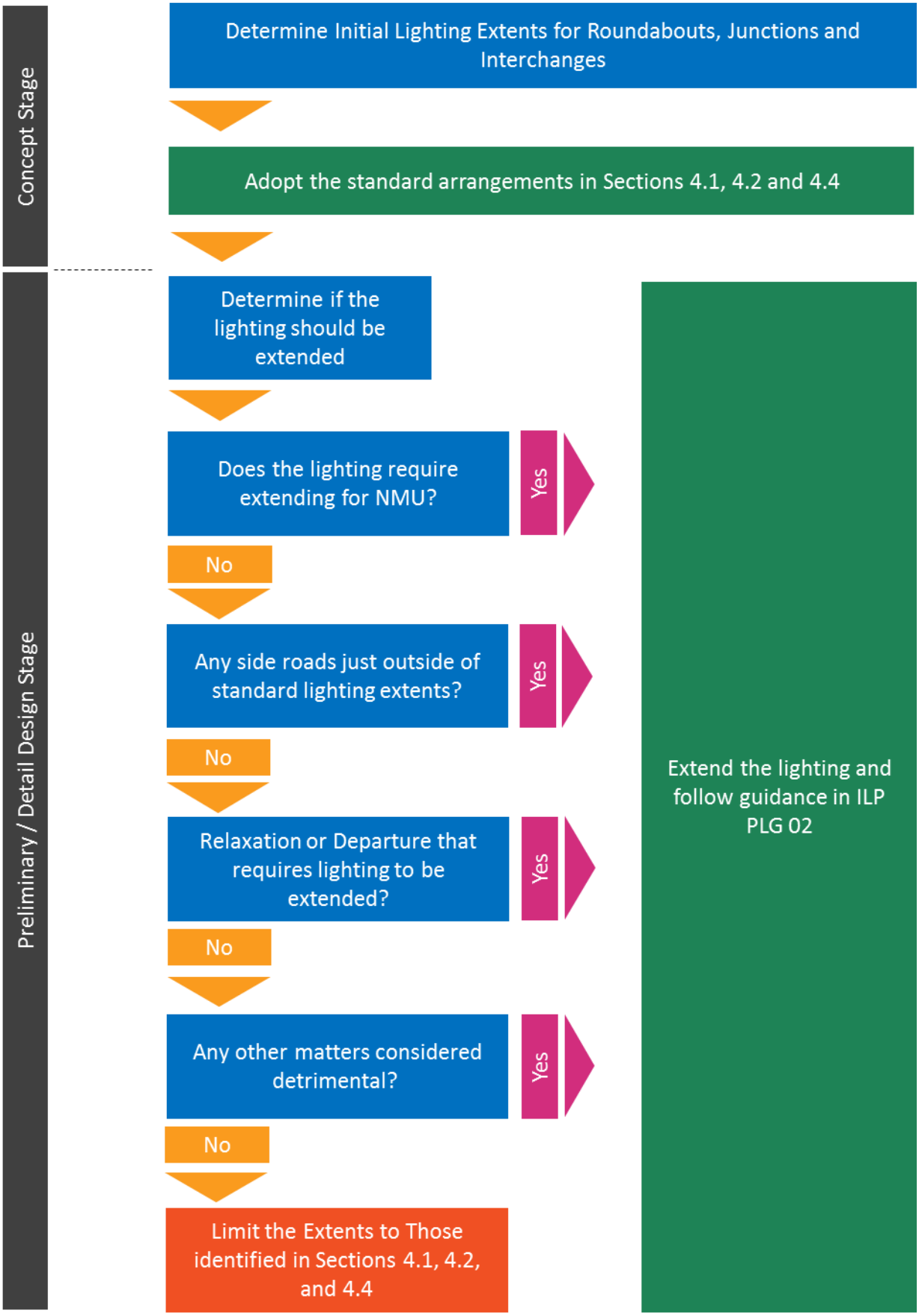


Figure 14 Lighting Extents Flowchart

4.8 Application of ILP PLG-02

BS 5489-1 references ILP PLG-02 which provides guidance on the extent of the lighting that can be applied for Conflict Areas where it is deemed that the 60m stipulated in Sections 4.1, 4.2 and 4.4 is not appropriate.

In particular, ILP PLG-02 identifies that where no lighting is otherwise provided on the approach to a lit Conflict Area the extent of the lighting shall generally be installed to provide around 5 seconds of driving at a particular traffic speed.

A summary of the 5 second rule applied to the speed limit of the road is as follows:

Table 3 Distance of 5 Seconds at Speed Limits

Speed Limit (kph)	Distance of 5 seconds at speed limit (m)
30	42
50	69
60	83
80	111
100	138
120	166

The guidance in ILP PLG-02 can be followed along with the application of the 5 second rule where the standard lighting extents depicted in Sections 4.1, 4.2 and 4.4 may not be deemed appropriate.

5. Lighting of other areas on the Network

5.1 Lighting of Toll Plaza

The extent of lighting at toll plazas shall cover the following areas:

a) Approach, Queue, Recovery and Departure Zones; and

b) Toll Island Canopies; and

c) Toll Booths.

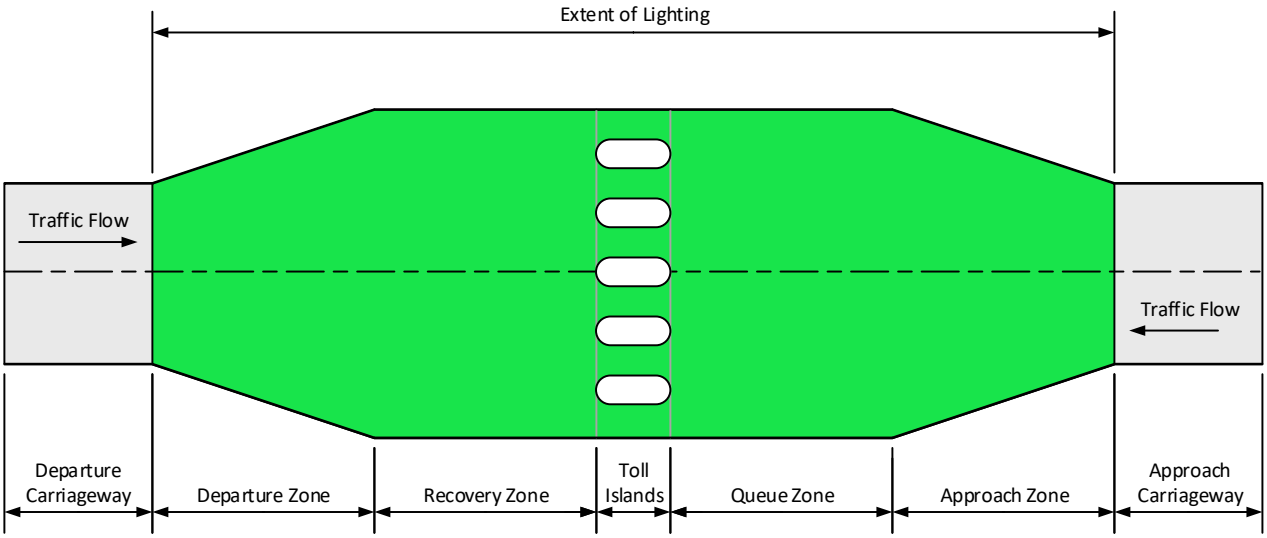


Figure 15 Toll Plaza Layout and Terminology

Where toll plazas are situated on ramps then they shall be lit with the extents of lighting determined on a scheme by scheme basis following the principles set out in this Standard.

Where the Mainline is lit then the approach, queue, recovery and departure zones shall be treated as a Conflict Area with the lighting class (C/CE) one step higher than the lighting on the Mainline.

For locations where the Mainline is unlit then the lighting class shall be determined by assessing the appropriate lighting class on the Mainline (M/ME) and then applying an equivalent C/CE class (i.e. the one step higher lighting class is not applied).

The footprint of the Toll Island under the canopy shall be lit to C/CE0.

The internal lighting within toll booths shall comply with IS EN 12464-1: Light and Lighting – Lighting of work places. Part 1: Indoor work places, Table 5.34 Ref. 5.34.5.

5.2 Lighting at Service Areas

Motorway Service Areas (MSAs), Type 1, Type 1 (Terminal) and Type 2 (as defined in DN-GEO-03028) shall be lit in accordance with the following:

a) Lighting on entry and exit slip roads of MSAs shall follow the same approach when determining the appropriate lighting class (Section 3.3) and the lighting extents used for the lighting of Conflict Areas described in Section 4 where the main carriageway is unlit;

b) Where the main carriageway is lit the lighting shall be extended to the Mainline lighting to ensure there are no short unlit gaps as described in Section 3.2; and

c) The lighting within the service areas for access roads and parking areas shall follow the guidance and recommendations in BS 5489-1 and IS EN 12464-2.

Service areas in some instances may be located within environmentally sensitive areas and careful selection of light sources and luminaires is required to minimise obtrusive light and visual impact and the requirements of Section 3.6 shall be followed.

Careful consideration is required in terms of column height and where columns are placed to avoid damage by vehicles, particularly in parking areas.

Careful consideration is required in terms of the selected light source and location in order to complement any security and surveillance features that may be in place.

5.3 Lighting of Outdoor Car Parks

The illuminance levels of outdoor car park areas will be dependent upon the type of area and usage and shall follow the requirements of BS 5489-1.

5.4 Lighting of Subways for Pedestrians

The lighting of pedestrian subways is to be in accordance with BS 5489-1.

5.5 Lighting of Footbridges, Stairways and Ramps

Footbridges shall be illuminated if located in areas where public lighting is provided.

Recommendations for the lighting levels of footbridges, stairways and ramps shall follow the guidance in BS 5489-1.

Consideration shall be given to illuminating footbridges by means of the road lighting where possible and additional lighting only provided for the footbridge to ensure recommended lighting levels are achieved.

The mounting of lighting columns on footbridge structures, whilst not prohibited, does need careful consideration in terms of maintenance access and any safety implications when mounted on structures above the National Road network.

5.6 Lighting of Active Travel Infrastructure / Greenways / Rural Cycleways

Infrastructure for non-motorised users is set out and defined in the following documents:

- DN-GEO-03031 Rural Road Link Design
- DN-GEO-03036 Cross Section and Headroom
- DN-GEO-03060 Geometric Design of Junctions and Accesses
- DN-GEO-03047 Rural Cycleway Design (Offline & Greenway)

This section details the requirement for the lighting of active travel / greenways / rural cycleways.

The provision of lighting on pedestrian and cycle facilities (active travel, greenways, rural cycleways) shall be considered on a case-by-case basis and agreed with relevant stakeholders, but in general the following shall apply.

- Pedestrian and cycle facilities within the urban environment shall be lit by default.
- Pedestrian and cycle facilities in rural environments shall by default not require lighting given they are typically used for recreational purposes; therefore, it is not anticipated they will be utilised during hours of darkness. However, where a route (active travel, greenway, rural cycleway) is serving active travel needs the provision of lighting may be justified. In such cases, a Departure from Standard is required.

The purpose of lighting routes serving active travel needs is to enable users to orientate themselves, identify other users, identify hazards and to discourage crime and ensures users feel safe and secure.

In urban locations, the lighting designer should utilise adjacent urban road lighting to light routes serving active travel needs where practicable, to minimise light sprawl and additional infrastructure.

Where a route serving active travel needs crosses an illuminated vehicular carriageway, consideration should be given to providing positive illumination at these conflict points, similar to the approach taken for pedestrian crossings in order to provide greater visibility to motorists during the hours of darkness. The consideration of positive illumination will be dependent on the lighting classification on the road and the principles set out in Section 5.8 and is to be determined by the designer on a case-by-case basis.

Where a greenway or rural cycleway routes cross an unlit carriageway, the crossings shall generally be unlit but should be assessed on a case-by-case basis. Where lighting is provided on greenways or rural cycleway routes, crossing points located on unlit carriageways should also be lit. The illumination of pedestrian crossings shall follow the principles set out in Section 5.8. The provision of lighting to illuminate the carriageway on approaches to crossing points is not deemed to be required, nor does the four times the desirable minimum Stopping Sight Distance (SSD) referred to in Section 3.2 need to be applied.

Tunnels, underpasses, and bridges may require lighting during nighttime and daylight hours if there is an insufficient level of natural light ingress.

Further guidance on the lighting of cycling infrastructure is also provided in ILP PLG 23.

The lighting designer shall determine the appropriate lighting performance parameters in accordance with IS EN 13201 and BS 5489-1. Guidance on the selection of lighting classes is given in Annex A of BS 5489-1.

To provide a sense of security and aid orientation and detection at night, pedestrians and cyclists need a sufficient level of uniformity and illuminance when using active travel infrastructure during hours of darkness. This level of uniformity and illuminance is generally satisfied by the levels of illuminance set out in the P-series of lighting classes.

The selection process for the lighting classes uses the applicable table in Annex A of BS 5489-1 to provide an initial determination of the lighting class.

As part of the selection of the lighting class, the initial determination of the lighting (based on BS 5489-1 Annex A Table A.4) for active travel infrastructure shall be assessed further in order to refine the lighting class either up or down. This will ensure the right light in the right place.

This refinement of the lighting class is based around a range of parameters that include:

a) User volume;

b) User composition;

c) Ambient luminance; and

d) Facial recognition

Appendix C2 provides a quantitative approach for undertaking a refinement of the P lighting class for active travel routes.

Generally, the control of lighting shall apply one of the following:

- 1- or 2-step dimming,
- Part night switch off,
- Motion sensors, or
- Dynamic control using a Central Management System (CMS).

The method of control will need to be discussed and agreed with stakeholders on a case-by-case basis given that CMS may not be available or due to other local constraints.

Illumination of active travel routes shall ensure facial recognition using lighting columns and bollards.

The lighting designer shall take cognisance of the requirements set out in Section 3.6 Table 2 in terms of environmental zones.

The lighting designer should consider designing for maintenance during early stages of design development in accordance with Section 2.10 of this standard.

5.7 Lighting for Traffic Calming Features

Gateways, as described in DN-GEO-03084 Transition Zone Treatment of Towns and Villages on National Roads, that are positioned between the rural fringe and the transition zones to towns and villages to inform drivers that they are arriving in an urban area with an associated reduction in speed are to be illuminated.

The lighting shall extend for two columns (approx. 60m) on the approach to the gateway leading into the lit urban area and shall be lit to the same BS 5489-1 lighting class that exists on the section of road immediately beyond the gateway.

In the immediate locality of the traffic calming gateway, which is generally the demarcation between a rural and urban environment, a higher level of illuminance is required. For further guidance on the layout of traffic calming gateways refer to DN-GEO-03084.

Lighting sources on the approach to the gateway and at the gateway location as described earlier in this Section shall have a minimum colour rendering index of 65.

The gateway locations shall be considered as Conflict Areas and follow the principles of BS 5489-1 in applying a step up in lighting class compared to the lighting class that has been adopted for the road lighting on the section of road that passes through the gateway.

Illuminance based criteria (CE/C lighting class) shall be applied to the lighting of gateways. The minimum lighting class shall be C/CE4.

The step up in lighting class can be achieved by either the reuse of the existing road lighting system, the retrofit of lanterns in the immediate vicinity of the gateway or the installation of supplementary lighting directly adjacent to the gateway.

For the reuse of the existing road lighting, the designer shall undertake BS 5489-1 calculations to satisfy that the appropriate illuminance and uniformity values of the step up in lighting class can be achieved in the immediate locality of the traffic calming gateway.

Lighting columns shall be kept clear and to the rear of footpaths and cycleways and shall not be located on central gateway islands.

For areas subject to a speed limit greater than 85kph or at or in close proximity to a gateway, lighting shall conform to the requirements of Section 3.8 in relation to the use of passively safe columns.

Gateways will generally not be used as pedestrian crossings however, where gateways are used for the purpose of a pedestrian crossing, then the requirements of Section 5.8 shall be followed.

5.8 Lighting of Pedestrian Crossings

The provision of lighting at pedestrian crossings shall be considered in conjunction with the guidance contained in DN-GEO-03084 Transition Zone Treatment of Towns and Villages on National Roads.

5.8.1 Zebra Controlled Crossings

All zebra controlled crossing locations are to be provided with additional local lighting and illuminated to provide both vertical and horizontal illuminance as detailed in Section 5.8.3.

The additional local lighting arrangement on a belisha beacon pole shall be as shown in DN-GEO-03084.

5.8.2 Controlled Signalised and Uncontrolled Crossings

Street lighting normally provides an adequate level of illumination on to the road surface so that objects can be seen in silhouette (negative contrast).

Controlled signalised crossings, with a pushbutton facility for pedestrians shall normally have an adequate level of illumination where the traffic route lighting has been designed to BS 5489-1 and will not generally require any additional localised lighting at the crossing point.

For uncontrolled crossings with a lit area designed to BS 5489-1 lighting class ME3/M3 or higher, and with the placement of street lighting in proximity to the crossings that provides good negative contrast, additional localised lighting at the crossing may not be required.

Consideration shall be given to the use of additional localised lighting where the existing road lighting arrangements cannot provide illumination that ensures good negative contrast, and where positive illumination would enhance the ability of motorists to observe pedestrians approaching and crossing the road during the hours of darkness.

Situations that may require additional localised lighting include where crossings are located on a bend or on the brow of a hill and in situations where the crossing may be inconspicuous or obscured. Additional local lighting shall also be considered for uncontrolled crossings that are lit to a BS 5489-1 lighting class lower than ME3/M3. Section 5.8.3 details the requirements for additional local lighting. Further guidance can be found in the ILP Technical Report No. 12.

For lighting of crossings on active travel routes / greenways / rural cycleways, refer to Section 5.6.

Controlled signalised and uncontrolled crossings within the confines of a Conflict Area that have a step up in lighting class applied may have an adequate level of illumination that will negate the need for additional localised lighting at the crossing point.

In some instances, a traffic route may consist of several uncontrolled crossings in close proximity to each other. Providing dedicated supplementary localised lighting at each crossing location to provide positive illumination needs to be balanced in terms of its day time appearance and unnecessary street clutter. The lighting designer shall take cognisance of DMURS when considering lighting within urban areas and the built environment.

5.8.3 Additional Localised Lighting Illumination Requirements

Where additional localised lighting is being provided it shall be illuminated to the following parameters:

a) The minimum average horizontal illuminance on the crossing carpet to be 3.5x greater than the designed average horizontal illumination of the road with an overall uniformity of 0.6; and

b) The minimum vertical illuminance shall be as follows:

   i) Centre of crossing to be 2x nominal average horizontal road illuminance;

   ii) Kerb edge to be 2x nominal average horizontal road illuminance; and

   iii) Rear of waiting area to be 1.5x nominal average horizontal road illuminance.

Lighting sources used for additional localised lighting at crossings shall have a minimum colour rendering index of 65.

The illumination areas and grids for the additional localised lighting are detailed in the ILP Technical Report No. 12.

5.9 Lighting of Roadworks on National Roads

The requirements for the temporary lighting of roadworks on National Roads shall be as per the Traffic Signs Manual (TSM) Chapter 8, Temporary Traffic Measures and Signs for Roadworks and its associated guidance documents.

Where roadworks are planned on a National Road at a location where there is existing permanent road lighting, such lighting shall be either maintained or temporary lighting be provided for the duration of the construction works. Temporary lighting shall provide an equal intensity and uniformity of light when compared to the existing permanent road lighting.

The temporary lighting design shall also minimise disability glare for the motorist and take cognisance of the requirements for environmental control as stated in Section 3.6.

Where cross overs are provided with temporary lighting during the construction works, these locations shall be treated as conflict areas with the principles set out in Section 3.3 followed when deriving the appropriate lighting class.

Project specific requirements for temporary lighting units shall be specified in CC-SPW-01400 Specification for Road Works Series 1400 - Electrical Work for Road Lighting and Traffic Signs Appendices.

6. Handover and Documentation

6.1 Handover Documentation

The handover into operation documentation shall follow the format as listed in Appendix A2.

The preparation and delivery requirements for As-Built lighting drawings shall be in accordance with CC-CMG-04001.

6.2 National Public Lighting Inventory

Accurate and fully completed public lighting inventories are essential to ensure optimal performance during the operational period of the public lighting installation.

It is essential that suitable rigour is given to this aspect during design development, handover and maintenance, particularly given the range of light sources now available and the different operating regimes and parameters that lighting can work under.

Lighting inventory information shall be provided in the handover documentation in the format detailed in the National Public Lighting Inventory.

The National Public Lighting Inventory has a number of data fields falling under the following sub headings:

a) Geographical;

b) Asset;

c) Risk Assessment;

d) Operational; and

e) Energy.

Further details can be found in AM-LHT-06058 Standardised Public Lighting Inventory Template User Manual. An excel version of the Standardised Public Lighting Inventory Template itself is also available for download from the Downloads section of the TII Publications website.

7. References

7.1 TII Publications (Standards):

CC -SCD-01524 – Maintenance Vehicle Lay-By Typical Lay-By Layout

CC-CMG-04001 – Preparation and Delivery Requirements for As-Built Records

CC-SPW-01300 - Specification for Road Works Series 1300 – Road Lighting Columns and Brackets, CCTV Masts and Cantilever Masts

CC-SPW-01400 - Specification for Road Works Series 1400 – Electrical Work for Road Lighting and Traffic Signs

DN-GEO-03028 – The Location and Layout of Service Areas

DN-GEO-03031 - Rural Road Link Design

DN-GEO-03036 - Cross Section and Headroom

DN-GEO-03060 - Geometric Design of Junctions

DN-GEO-03047 – Rural Cycleway Design (Offline & Greenway)

DN-GEO-03084 – Transition Zone Treatment of Towns and Villages on National Roads

DN-REQ-03034 – Safety Barriers (including Amendment No. 2 dated January 2016)

DN-STR-03015 – Design of Road Tunnels

DN-STR-03018 – Design of Support Structures for Roadside Furniture

GE-GEN-01005 – Departures from Standards and Specification

7.2 TII Publications (Technical):

PE-PMG-02041 – Project Management Guidelines

7.3 IS EN Standards and British Standards:

IS CEN TR 13201-2: Road Lighting – Part 1: Guideline on selection of lighting classes

IS EN 13201-2: Road Lighting – Part 2: Performance requirements

IS EN 13201-3: Road Lighting – Part 3: Calculation of Performance

IS EN 13201-4: Road Lighting – Part 4: Methods of Lighting Performance

IS EN 13201-5: Road Lighting – Part 5: Energy Performance Indicators

IS EN 60529: Specification for degrees of protection provided by enclosures (IP code)

IS EN 12464-1: Lighting and Lighting – Lighting of workplaces Part 1 Indoor Workplaces

IS EN 12464-2: Lighting and Lighting – Lighting of workplaces Part 2 Outdoor Workplaces

IS EN 12767: Passive Safety of Support Structures for Road Equipment. Requirements, classification and test methods

IS EN 12899: Fixed, Vertical road traffic signs. Fixed Signs

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

BS 5489-2: Code of Practice for the Design Road Lighting – Part 2: Lighting of Tunnels

BS EN 40: Lighting Columns

CIE 115: Lighting of roads for Motor and Pedestrian Traffic

CIE 140: Road Lighting Calculations

CIE 150: Guide on the limitation of the effects of obtrusive light from outdoor lighting installations

PD 6547: Guidance on the use of BS EN 40

7.4 Other Documents:

Professional Lighting Guide (PLG) 01: Central Management Systems, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 02: The Application of Conflict Areas on the Highway, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 03: Guidance on Lighting for Subsidiary Roads, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 04: Guidance on Undertaking Environmental Lighting Impact Assessments, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 05: The Brightness of Illuminated Advertisements, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 06: Guidance on Installation and Maintenance of Seasonal Decorations and Lighting Column Attachments

Professional Lighting Guide (PLG) 07: High Masts for Lighting and CCTV, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 08: Guidance on the Application of Adaptive Lighting within the Public Realm, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 09: Ensuring Visibility Within Short Tunnels, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 23: Lighting for Cycling Infrastructure, by the Institution of Lighting Professionals

Professional Lighting Guide (PLG) 26: Corrosion Protection of Minor Structures, by the Institution of Lighting Professionals

Technical Report (TR) 12: Lighting of Pedestrian Crossings, by the Institution of Lighting Professionals

Technical Report (TR) 22: Managing a Vital Asset: Lighting Supports, by the Institution of Lighting Professionals

Technical Report (TR) 25: Lighting for Traffic Calming Features, by the Institution of Lighting Professionals

Technical Report (TR) 30: Guidance on the Implementation of Passively Safe Lighting Columns and Signposts, by the Institution of Lighting Professionals

Institute of Lighting Professionals GP10: Safety During the Installation and Removal of Lighting Columns and Similar Street Furniture in Proximity to High Voltage Overhead Lines

Institute of Lighting Professionals GP12: Towards Understanding Skyglow

Institute of Lighting Professionals Guidance Note 1 (GN01) The Reduction of Obtrusive Light

Institute of Lighting Professionals Guidance Note 3 (GN03) Measurement of the photometric performance of LED lighting

Institute of Lighting Professionals Guidance Note 5 (GN05) Using LEDs

Institute of Lighting Professionals Guidance Note 6 (GN06) Retrofitting LED luminaires on existing lighting columns

Institute of Lighting Professionals Guidance Note 8 (GN08) Bats and artificial lighting in the UK

Institute of Lighting Professionals Guidance Note 11 (GN11) Determination of Maintenance Factors

Institute of Lighting Professionals Guidance Note 12 (GN12) The Smart Lighting Column

Institute of Lighting Professionals Guidance Note 13 (GN13) Surge Protection for Exterior Lighting Installations

Institute of Lighting Professionals Lighting Against Crime

IS 10101:2020 ‘National Rules for Electrical Installations, Fifth Edition’ by the National Standards Authority of Ireland

Current ESB and ESBN Regulations, Codes of Practice and Guidelines including ESB National Code of Practice for Customer Interface ~~Version 5 2021~~

UK HSE Guidance Note GS6 – Avoiding danger from overhead power lines

EU Directive 2014/52/EU Environmental Impact Assessment

Design Manual for Urban Roads and Streets (DMURS), Department of Transport~~, Tourism and Sport~~

Appendix A1 – Lighting Design File

Section 1: Introduction

Section 2: Project Team Overview

Section 3: Executive Summary of the Scheme Lighting Design

Section 4: Lighting Appraisal

Section 5: Lighting Design Methodology and Lighting Class Selection

Section 6: Electrical Design

Section 7: Lighting Specification

Section 8: Constraints

Section 9: Stakeholder Consultations

Section 10: Risk Assessment

Section 11: Calculations

Section 12: Drawings

Section 13: Cost Estimate

Section 14: IS EN 13201-5 Energy Efficiency Indicators (Life Cycle Costing)

Section 15: Miscellaneous

Section 16: Reserved for Historical Information (for reference purposes only)

Appendix A2 – Lighting Design Handover Documentation

Section 1: Introduction

Section 2: Executive Summary of the Scheme Lighting

Section 3: Testing & Commissioning Results

Section 4: As Installed Drawings

Section 5: Manufacturers Data Sheets

Section 6: Health & Safety

Section 7: Maintenance Schedules

Section 8: IS EN 13201-5 Energy Performance Indicators (Life Cycle Costing)

Section 9: Lighting Inventory in accordance with the National Public Lighting Inventory

Section 10: Miscellaneous

Appendix B1 – Lighting Evaluation Tool & Justification for Lighting the Mainline

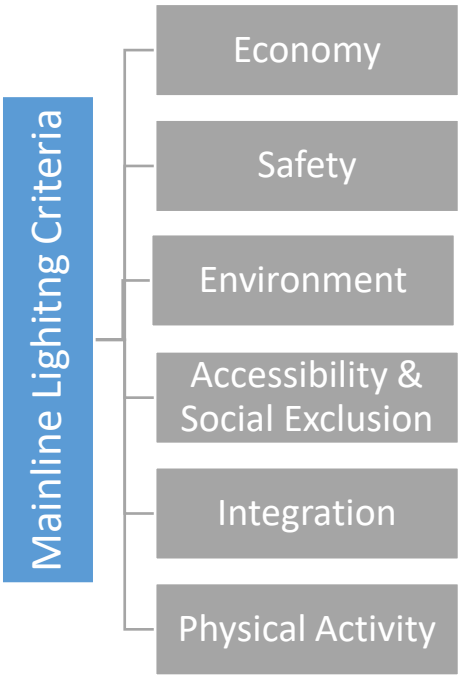
The Appendix B1 lighting evaluation tool is more applicable when considering lighting of the Mainline for major National Road projects. Appendix B2 can be used to support applications for a Departure from Standard for the provision of minor additional lighting on the National Road network.

Mainline road lighting on the National Road network is generally restricted to urban locations with the Mainline on the remaining rural network being predominately unlit.

Road lighting on the Mainline outside of urban locations shall only be provided where a lighting evaluation has been undertaken and there is sufficient justification to provide lighting. This information will be required to provide justification for a Departure from Standard that will be required for the provision of Mainline lighting in rural locations on National Roads.

The lighting evaluation described under this Appendix is restricted to the Mainline only and is generally associated with evaluating the provision of lighting on motorways and dual carriageways. It can also be used to evaluate the provision of lighting on new single carriageway bypass roads in rural locations.

Justification for Mainline lighting shall be considered based on the following six key criteria:



The six criteria are further split down into sub-criteria to ensure a balanced assessment when considering the lighting on the Mainline National Road network.

The main purpose of lighting on the National Road network is to provide enhanced safety with its prime purpose in reducing traffic collisions during darkness. The quantifiable benefits in terms of the predicted traffic collision savings during darkness shall be greater than the scheme costs in order to provide economic justification.

Whilst safety is the primary purpose, other benefits and dis-benefits shall also be considered as part of the lighting evaluation to ensure a balanced assessment.

Consideration of alternative measures likely to have a lower lifecycle cost or less adverse environmental impact shall be assessed when determining the requirements for lighting on a scheme.

The lighting evaluation tool for Mainline lighting has been developed and is available for download from the downloads section of the TII publications website (www.tiipublications.ie).

This tool shall be used to derive a quantitative approach to assessing the requirement for lighting on the Mainline National Road in order to calculate the following as part of the economic criteria:

a) PVB (Present Value of Benefits),

b) PVC (Present Value of Costs); and

c) NPV (Net Present Value)

The tool can also be used to identify budget figures for understanding capital expenditure and operating costs. The tool has been compiled to automate various aspects to ensure a consistent approach across different schemes when the assessment tool is used and will allow user defined requirements to be entered in part to allow sensitivity analysis to be undertaken.

The balanced assessment for the six criteria and sub-criteria consists of a 1-page score card. Scores shall be allocated as follows:

a) 7 – Major or highly positive;

b) 6 – Moderately positive;

c) 5 – Minor or slightly positive;

d) 4 – Not significant or neutral;

e) 3 – Minor or slightly negative;

f) 2 – Moderately negative; and

g) 1 – Major or highly negative.

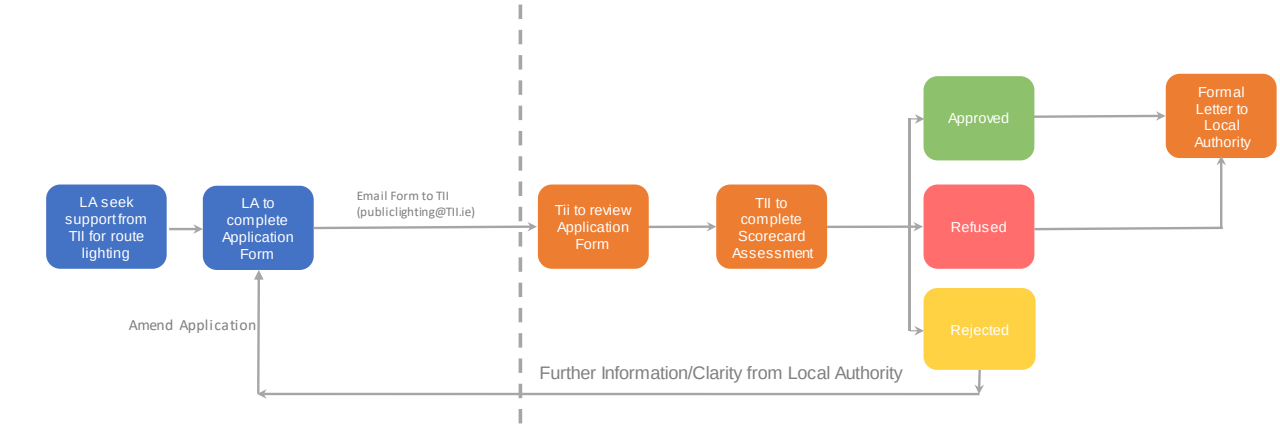
The 1-page balanced scorecard shall be submitted to TII for approval as part of the Departure from Standard process unless a conclusion is reached that lighting is not justified.

In most instances, it is expected that lighting on the Mainline will not be justified.

Appendix B2 – Application and Assessment for Minor Lighting Improvement Schemes on the National Road Network

The Appendix B1 lighting evaluation tool is more applicable when considering lighting of the Mainline for major National Road projects. Appendix B2 can be used to support applications for a Departure from Standard for the provision of minor additional lighting on the National Road network. This will typically be either for the provision of new lighting or for an extension of existing lighting on the existing single carriageway network.

A Departure from Standard shall be sought by the respective local authority (or design organisation) who are proposing to provide lighting, which can be justified using the application form for Minor Lighting Improvements on the National Road network described in this Appendix. The process is depicted below:



An application will be assessed against the following criteria:

a) Safety;
b) Accessibility & Integration;
c) Environment; and
d) Other supporting information.

Consideration of alternative measures likely to have a lower cost or less adverse environmental impact shall be assessed when determining the requirements for lighting on a scheme.

An application form for Minor Lighting Improvements on the National Road network is available for download from the downloads section of the TII publications website (www.tiipublications.ie).

Appendix C1 – Refinement of the Traffic Route Lighting Class Selection

Parameters for the selection of M/ME lighting class.

Parameter	Options	Weighting Value V_W	V_W Selected
Speed	Very High (>100 kph) High (70 kph to 100 kph) Moderate (40 kph to 70 kph) Low (< 40 kph)	2 1 -1 -2	
Traffic volume	Very High to High (ADT>40,000) Low to Moderate (ADT between 7,000 and 40,000) Very low (ADT <7000)	1 0 -1	
Traffic Composition (Note 1)	Mixed with high % of non-motorised Mixed Motorised only	2 1 0	
Separation of carriageways	No Yes	1 0	
Junction Spacing (Note 2)	High (<3km) Moderate (>3km)	1 0	
Parked Vehicles	Present Not present	1 0	
Ambient Luminance	High Moderate Low	1 0 -1	
Visual guidance/ traffic control	Poor Moderate or Good	1 0	
		Sum of Weighting Values (Vws)	
		M - Lighting Class (M=6-Vws)	

Notes:

1. *There is no specific % figure applied under traffic composition. This category is applicable to town and village centres where there is a high proportion of NMUs.*
2. *Not applicable when determining the lighting class for single carriageways. Refer to BS 5489-1 Annex A Table A.2 Note 2 for further guidance.*

Appendix C2 – Refinement of the Active Travel/Greenway/Rural Cycleway Lighting Class Selection (or P class)

Parameters for the selection of P lighting class.

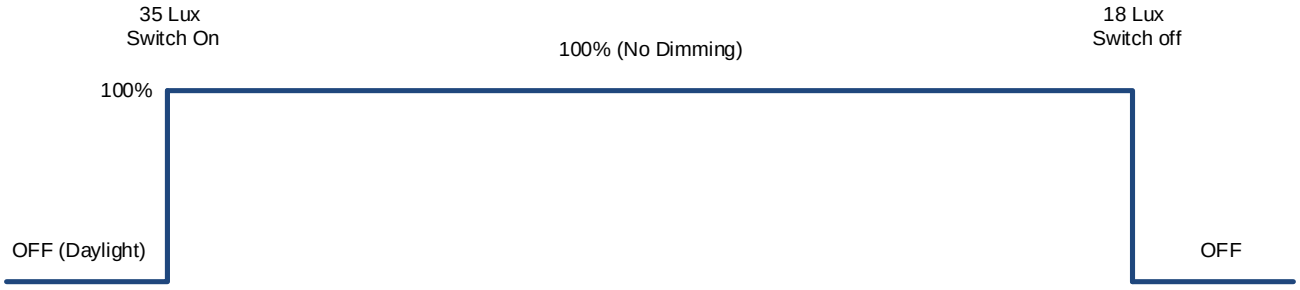
Parameter	Options	Weighting Value V_W	V_W Selected
Speed	Low Very Low (walking speed)	1 0	
Traffic volume	Very High High Moderate Low Very Low	1 0.5 0 -0.5 -1	
Traffic Composition	Pedestrians, cyclists and motorized traffic Pedestrians and motorized traffic Pedestrians and cyclists only Pedestrians only Cyclists only	2 1 1 0 0	
Parked Vehicles	Present Not present	0.5 0	
Ambient Luminance	High Moderate Low	1 0 -1	
		Sum of Weighting Values (Vws)	
		P - Lighting Class (P=6-Vws)	

Appendix D – Unmetered Dimming Profiles

The unmetered dimming profiles that have been agreed with ESB Networks Limited and as described in Section 3.15.1 are illustrated below. These may be applied to Regional and Local Road lighting or where it is not feasible to switch existing electrical supplies from unmetered to metered on the National Road network.

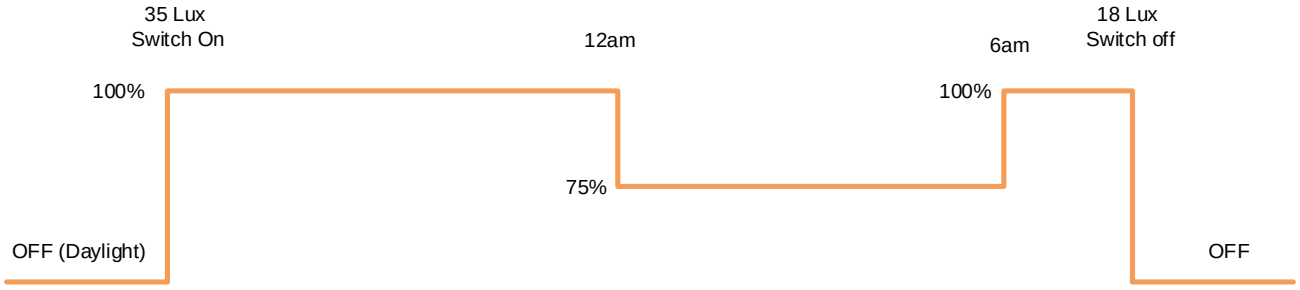
Trimming Only (LED)

Profile 1

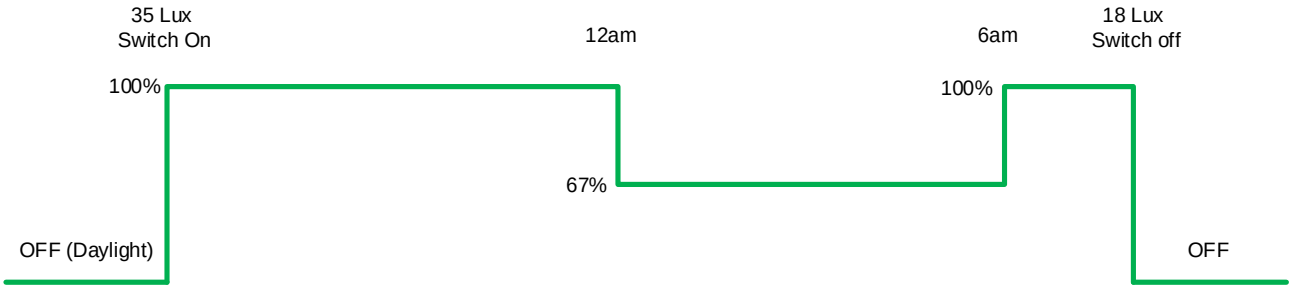


1 Step Dimming – Standard Period (LED)

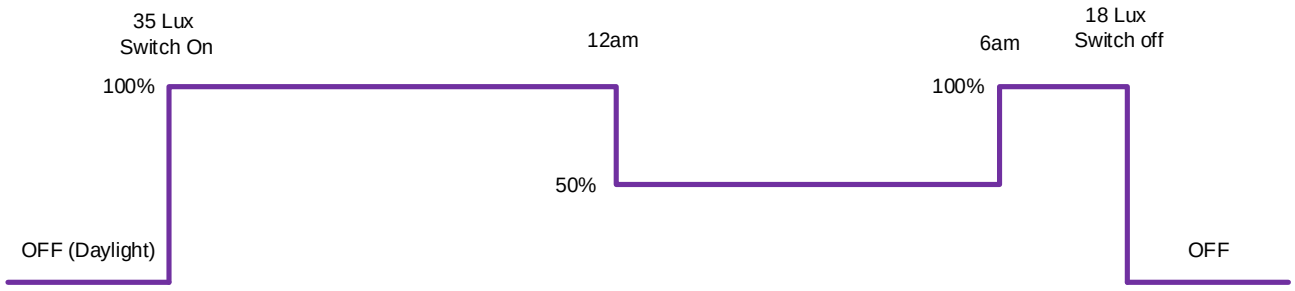
Profile 2A



Profile 2B



Profile 2C

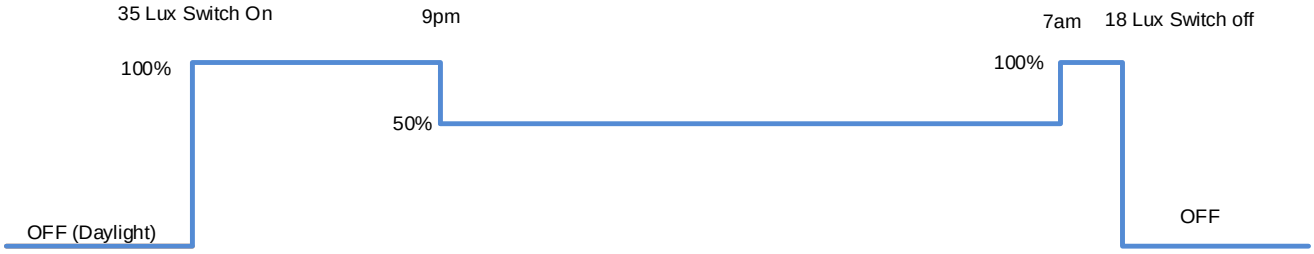


1 Step Dimming – Extended Period (LED)

Profile 3A

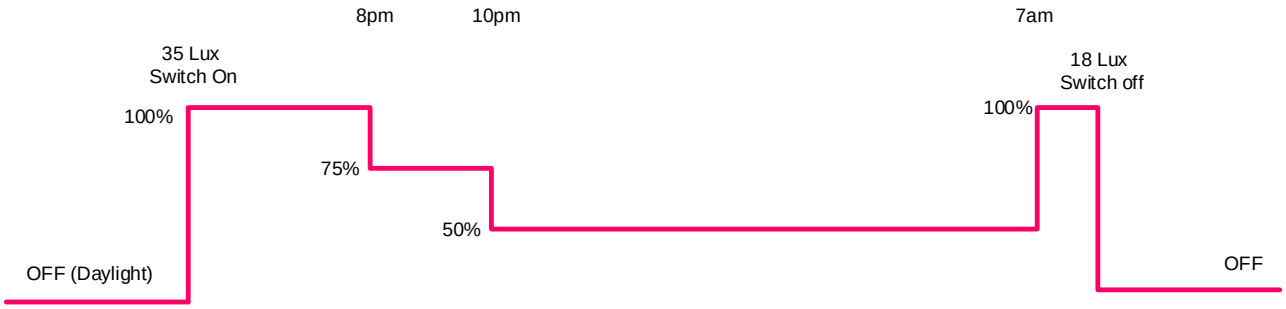
Profile 3B

Profile 3C

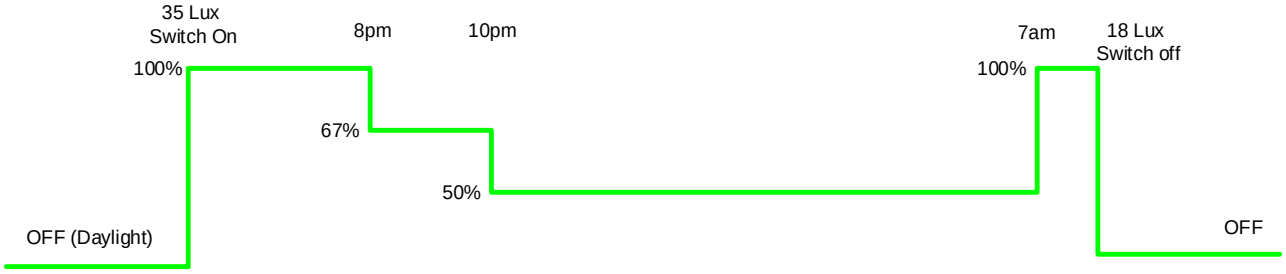


Multi Step (2-steps) Dimming (LED)

Profile 4A



Profile 4B



Profile 4C

Profile 4D

A summary of the dimming profiles by lighting class reduction for M/ME, S and P Classes are tabulated below:

A one-step lighting class reduction

From	To	Output	Profile
M/ME1	M/ME2	75%	2A
M/ME2	M/ME3	67%	2B
M/ME3	M/ME4	75%	2A
M/ME4	M/ME5	67%	2B
M/ME5	M/ME6	60%	2B

RA < 60			
From	To	Output	Profile
S1	S2	67%	2B
S2	S3	75%	2A
S3	S4	67%	2B
S4	S5	60%	2B
S5	S6	67%	2B

S/P = 1.2			
From	To	Output	Profile
P1	P2	64%	2B
P2	P3	73%	2A
P3	P4	63%	2B
P4	P5	55%	2B
P5	P6	64%	2B

S/P = 2			
From	To	Output	Profile
P1	P2	63%	2B
P2	P3	71%	2A
P3	P4	62%	2B
P4	P5	53%	2B
P5	P6	61%	2B

A two-step lighting class reduction

From	To	Output	Profile
M/ME1	M/ME3	50%	2C
M/ME2	M/ME4	50%	2C
M/ME3	M/ME5	50%	2C
M/ME4	M/ME6	40%	2C

RA < 60			
From	To	Output	Profile
S1	S3	50%	2C
S2	S4	50%	2C
S3	S5	40%	2C
S4	S6	40%	2C

S/P = 1.2			
From	To	Output	Profile
P1	P3	47%	2C
P2	P4	47%	2C
P3	P5	35%	2C
P4	P6	35%	2C

S/P = 2			
From	To	Output	Profile
P1	P3	45%	2C
P2	P4	44%	2C
P3	P5	33%	2C
P4	P6	32%	2C

Notes:

The Profiles denoted in the tables above refer to the illustrations depicted in this Appendix.

RA refers to the colour rendering index of a light source. The higher the number the more the light source can display natural colours.

An RA<60 is considered to have a poor colour rendering ability.

An S/P ratio of 1.2 provides a warm CCT. An S/P ratio of 2 is for cooler CCT light sources. The application of S/P ratios and the reduction in illuminance values is not permitted for traffic routes. S and P classes are shown for information purposes only.

M/ME lighting classes are generally applied to traffic routes. Conflict Areas generally apply a C/CE lighting class.

Appendix E – Informative Appendix on Correlated Colour Temperature (CCT)

The implementation of LED to replace high and low pressure sodium has resulted in an ability to improve colour rendering and there is a greater range of correlated colour temperatures (CCT) that can be applied when compared to the monochromatic and warm CCT sources associated with SON and SOX.

Spectral Power Distribution (SPD) provides a measure of the power of each wavelength produced by a light source and whilst this is a fundamental and more informative metric, the general metric of CCT tends to be used when differentiating between the colour quality of light sources.

The initial range of LED light source that became available had a cool CCT (>5300K) appearance and these offered the greatest opportunity to maximise efficiency in terms of reducing energy consumption. Early adopters of LED tended to use the cool CCT as at that time these provided the most significant energy efficiency savings.

As LED technology has evolved, intermediate colour temperatures (typically 4,000-4,300K) became available with only a marginal reduction in energy efficiency and have been considered and adopted by many lighting designers as the view is that they offer a less stark appearance when compared to cool CCT but still offered good colour rendering ability.

Further advances in LED technology has seen the availability of warm CCT (<3,300K) and the difference in energy efficiency is now comparable with intermediate CCT LED given that manufacturers have undertaken further development in lower CCT given LED technology is now better understood, in particular the negative impact when using higher CCT.

Research undertaken to date shows improvements such as performance in poor weather conditions and having less adverse impact on some species of flora and fauna when a lower CCT is used.

The warm light source colour is considered to offer a balance between maximising energy savings and taking into consideration environmental factors and impact on road users, particularly performance in poor weather conditions and for the ageing population.

Availability of LED products using a warm CCT (<3,300K) is now prevalent across the street lighting industry and in particular in environmentally sensitive areas, temperatures <2000K (monochromatic light source) are also now available and should be considered by the lighting designer on a project by project basis and particularly in sensitive areas such as bat flight routes.

The lighting designer shall use a warm CCT light source. CCT temperatures >3,300K shall not be used for the lighting design when using LED.

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