M30
Specification and Guidelines for Road Lighting Design

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More information

NZ Transport Agency
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PART 1 GENERAL

1 SCOPE AND GENERAL

This Specification sets out requirements for the lighting design brief, the technical performance, design, approval, reviews, and luminaire selection and installation requirements for the lighting of roads, cycle ways, footpaths, tunnels, underpasses, overpasses and bridges built as part of the State Highway network or under New Zealand Transport Agency (Transport Agency) control. It has been written for wider application, including full or part adoption by local authorities.

It encourages the development of energy efficient designs, which minimise operating costs for the service life of the road and public space lighting asset resulting in less consumption of resources.

This specification shall apply in all situations, except where in the opinion of the designer, or the Road Controlling Authority (RCA), the technical requirements require alteration. Should the designer request a departure or modification to technical requirements in a particular instance, they shall apply in writing to the RCA listing the circumstances, and specific departure requested. In such instances, the RCA shall specify technical requirements that shall be used by the designer in that particular instance. This specific technical requirement shall be noted on all design and as-built information.

Any aspects relating to good urban design are in addition to the technical requirements detailed in this specification and are to be agreed separately with the asset owner. Reference www.nzta.govt.nz/resources/bridging-the-gap/docs/bridging-the-gap.pdf

The scope is not limited by the material type or the appearance or shape of the column, outreach arm or luminaire.

Minimum levels of luminaire performance are specified with respect to:

- Photometric performance
- Maintenance factor
- Durability
- Expected life
- Safety

This Specification covers the lighting scheme in respect to design brief, design performance, design criteria, acceptable practices, installation and audit. It **DOES NOT** cover the following:

- Manufacture and procurement of columns
- Manufacture and procurement of luminaires
- Columns with provision for the attachment of flags and/or banners unless specifically allowed for by the respective manufacturer
- CCTV camera columns
- Electrical power distribution poles where the lighting is supplied via overhead aerial conductors

- Joint use columns for lighting and electricity distribution, telecommunications, traffic signals or tramway services
- Street or road signage columns
- Electrical supply network modifications required for the Lighting Installation

1.1 Application

This Specification applies to the design process, approval process, peer reviews and specification requirements of a lighting installation for **ALL** lighting of roads, cycle ways, footpaths, tunnels, underpasses, overpasses and bridges built on the State Highway network or under Transport Agency control.

This specification serves as a basis of compliance for lighting projects carried out by the Transport Agency as part of its works programmes. It covers both Transport Agency funded projects and privately funded developments.

It is consistent with and supports the Transport Agency strategic documents, e.g. Community Outcomes, State Highway Asset Management Plan (SHAMP), RCA LTCCPs, Activity Management Plans, Asset Management Plans, Strategies and Policies, etc.

Road lighting projects that meet the criteria for funding assistance from the Transport Agency shall be carried out in accordance with the Transport Agency's Procurement Manual, its Planning, Programming & Funding Manual and this specification.

Appendix I provides an overview flow diagram of the complete design and construction process.

1.2 Associated Documents

The documents listed below are relevant to road lighting design:

- AS/NZS 1158 Series - Lighting for Roads and Public Spaces
- AS 4282 - Control of Obtrusive Effects of Lighting
- AS/NZS 1100 Set - Technical Drawing
- AS/NZS 3000 - Electrical Installations (known as the Australian/New Zealand Wiring Rules)
- AS/NZS 3008 - Electrical Installations – selection of cables. Cables for alternating voltages up to and including 0.6/1kV
- AS/NZS 3439 Set - Low voltage switchgear and control gear assemblies
- AS/NZS 5000 Set - Electrical cables – Polymeric insulated
- AS/NZS 60598-1 Luminaires - General requirements and tests
- AS/NZS 60598.2.3 Luminaires for road and street lighting - particular requirements
- AS/NZS 60898 Electrical accessories - Circuit breakers for overcurrent protection for household and similar installations
- AS/NZS 3000 Electrical installations - Buildings, structures and premises
- BS 5489-11 - Code of Practice for the Design of Road Lighting
- BS 5489-2 - Lighting of Tunnels
- Crime Prevention Through Environmental Design (CPTED)
- Electrical Codes of Practice (ECP's)
- Electricity Act including all amendments
- Electricity Distribution Company Standards and Requirements
- Electricity Safety Regulations including all amendments

- EN 61547 - Equipment for general lighting purposes, EMC immunity requirements
- Health and Safety in Employment Act
- IESNA LM79-08, LM80-08 and TM21-11
- IPENZ Guideline on the Briefing and Engagement for Consulting Engineering Services
- IPENZ Practice Note 02 Peer Review - Reviewing the work of another engineer
- MfE Urban Design Protocol
- MSSLC Model Specification for LED Roadway Luminaires
- MSSLC Model Specification for Adaptive Control and Remote Monitoring of LED Roadway Luminaires
- National Asset Management Steering Group (NAMS) NZ Infrastructure Asset Valuation and Depreciation Guidelines
- NZ Building Act
- NZ Building Code
- NZ Building Regulations
- NZTA Technical Memorandum TM-2013 - Guidelines for Flag Lighting (in preparation)
- NZTA Specification M26 Lighting Columns
- NZTA Planning, Programming and Funding Manual
- NZTA Procurement Manual
- Radio Interference Regulations
- Resource Management Act

Where a conflict exists between any reference documents indicated above and this Specification this Specification takes preference (at the discretion of the Transport Agency).

1.3 Definitions and Acronyms

Term/Acronym	Definition
AHC	Authorisation Holders Certificate
BCR	Benefit Cost Ratio (refer Transport Agency Economic Evaluation Manual)
CFL	Compact Fluorescent Lamp
CMS	Central Management Software (may also be referred to as a Tele-Management System or TMS)
Column	A dedicated support for a road lighting luminaire. It is usually owned by the Transport Agency or RCA and can be a free standing vertical structure of appropriate material, which is designed to support luminaires either directly or by the use of outreach arms or mounting frames and includes such elements as foundations, column, outreach arms, connections and accessories
Competent Person	A person, who has acquired, through training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the required task correctly
CoPTTM	Code of Practice for Temporary Traffic Management
Driver	Is a collection of electrical and electronic components used to transform standard electrical voltage, current and frequency to that required providing suitable voltage, and/or current and/or frequency to run (in this case) an LED light source
Electricity Distribution	They are the 'person who supplies line function services'. A line owner is a person who owns 'works' that are used or intended

Company	for use for the conveyance of electricity. This may not necessarily be an electricity distributor
EWPV	Elevated Working Platform Vehicle
Gateway	An electronic programmable device that communicates between Lighting Point Controllers (LPC) and Central Management Software (CMS)
HPS	High Pressure Sodium
IDS	Infrastructure Design Standard
IDA	International Dark-Sky Association
IESANZ	Illumination Engineering Society Australia and New Zealand
IES-NA	Illumination Engineering Society North America
ILP	Institution of Lighting Professionals
IPC	Insulation Piercing Connection
LED	Light Emitting Diode
LED Light Source	Broadly covers an LED package, module and array of LED's
LPC	Lighting Point Controller or Luminaire Controller is the interface modal between the communication network and the power supply/controller
LTCCP	Long Term Council Community Plan
MH	Metal Halide
MSSLC	U.S. Department of Energy (DOE) Municipal Solid-State Street Lighting Consortium (an American Department of Energy based organisation)
MV	Mercury Vapour
NAMS	NZ National Asset Management Steering Group
NGMH	New Generation Metal Halide
OLN	Outdoor Lighting Network
Pole	A utility distribution pole suitable for attaching an outreach arm and road lighting luminaire. This is not usually owned by the Transport Agency and the condition of re-use shall be confirmed with the Electricity Distribution Company
RCA	Road Controlling Authority (usually the local council but it may be others, for example, NZ Defence Force and NZ Forestry for roads around their campus, private developers). Includes the Transport Agency Highways & Network Operations Group
SHAMP	State Highway Asset Management Plan
TALQ	TALQ Consortium is a global initiative by several lighting companies from the industry with the aim of creating a globally accepted standard for management software for outdoor lighting applications
Whole of Life Cost	Is the term used to describe the cost analysis of a scheme including capital costs, operating and maintenance costs and end of life costs

The following definitions shall be as described in AS/NZS 1158.0

Term/Acronym	Definition
Luminaire Mounting Height	The luminaire mounting height is the vertical distance between the photometric centre of a luminaire and the surface which is to be illuminated, e.g. the road surface
Nominal Mounting	The nominal mounting height dimension shall be the distance

Height	between the centreline of luminaire mounting spigot, and the intended finished ground level for a ground planted column, or the bottom of the base plate for a column with base plate
Outreach Arm Length	The outreach arm length shall be the horizontal distance from the point of entry to the luminaire, to a vertical line passing through the centre of the column cross section at the finished ground level
Passively Safe or Frangible Column	A column designed to perform such that in a vehicular impact, the occupants are unlikely to suffer injuries. This involves either a breakaway support (e.g. slip base or couplings) or a yielding or progressive material collapse type that does not separate from the base
Rigid Column	A column designed to withstand vehicular impacts without undue deformation while remaining upright

2 GENERAL

The Transport Agency has a commitment to achieve quality environmental and social outcomes. This reflects the requirements of the Land Transport Management Act 2003 and the Resource Management Act 1991 as well as the commitments made in the Government Policy Statement, our Environmental and Social Responsibility Policy and the State Highway Environmental Plan. Specifically our Environmental plan contains objectives regarding resource efficiency to *manage energy consumption and waste associated with the Transport Agency's business in a cost effective and sustainable manner* and to *make resource efficiency an integral part of all state highway activities*.
www.nzta.govt.nz/resources/environmental-plan/docs/environmental-plan.pdf.

This specification gives effect to these statutory and policy obligations.

The Transport Agency wants to protect the night sky environment on behalf of all New Zealand citizens by ensuring that any public lighting is designed, installed and operated in a manner that avoids unnecessary light spill and light pollution. The standards referenced stipulate minimum compliance requirements; however the Transport Agency and its nominated agents reserve the right to vary these to ensure the best outcome possible for the environment where there are clear benefits to do so on a case-by-case basis.

Overall, any lighting provided must "maximise safety and energy efficiency while minimising the life cycle cost and impact on the environment".

Lighting schemes should blend in with adjacent road lighting, complement the neighbourhood character and, as far as is reasonably practicable, minimise the impact on the neighbouring properties and environment with regard to spill light, glare and aesthetics. The principles of the Ministry for the Environment's Urban Design Protocol shall be considered. This suggests that the lighting design shall be; strong in context, enhancing character, provide a choice, provide a link connection, encourage creativity and be environmentally sustainable i.e. compliance with the AS/NZS 1158 road and public space lighting series of standards should not be the only consideration.

The design must comply with all appropriate New Zealand standards, in particular the requirements of AS/NZS 1158 current series. Anything not specified to a greater degree within this specification shall be that specified in those standards.

This standard defines the minimum requirements but it is important not to over-design and provide a level of lighting higher than that needed.

Reticulation of all 'green fields' developments should be via underground cabling. In areas where the existing overhead network is for road lighting only, or where the Electricity Distribution Company network is underground, cabling of the power supply for new lighting should be underground. The overhead network should not be extended unless there are special circumstances.

The Designer, in conjunction with the Electricity Distribution Company, shall determine if the lighting will have an overhead or underground power supply. Where lighting is provided in areas with overhead power reticulation, the number of new columns required should be minimised by utilising existing network utility provider's overhead poles. Permission shall be gained from the pole owner by the designer prior to construction proceeding.

Where the new lighting meets or intersects with an existing scheme, new lighting shall be carefully integrated with the existing scheme.

The EECA RightLight road lighting resource (www.eecabusiness.govt.nz/content/road-lighting) has been developed to provide a complete online source of tools and information to achieve optimal standards, designs and technical solutions for cost-effective road lighting in New Zealand.

Developed in conjunction with councils, the Transport Agency, road lighting specialists, Local Government New Zealand and members of the AS/NZS 1158 Standards committee, the resource has been designed to assist with planning and implementing upgrades of existing road lighting and public space lighting while also ensuring efficient lighting solutions are considered for new installations.

The information and applications contained in this site has been designed to provide practical assistance to all those involved in road lighting in New Zealand.

3 OWNERSHIP OF ASSETS

There are five types of lighting installations in New Zealand:

a) Luminaires and columns installed, owned, operated and maintained by the Transport Agency or on behalf of the Transport Agency
b) Luminaires and outreach arms attached to electricity distribution poles installed, owned and operated by the Transport Agency but maintained by RCA or Electricity Distribution Company on behalf of the Transport Agency
c) Luminaires and columns installed by the Transport Agency but on completion of project ownership is passed back to the RCA to own, operate and maintain
d) Luminaires owned by the RCA
e) Luminaires owned by the Electricity Distribution Company

Off/On control of lighting is either via an individual Light point Controller attached to each luminaire or via a dedicated street lighting network that has an unmetered energy calculated by an agreed formula or is separately metered.

Demarcation point of ownership between RCA and the Electricity Distribution Company is generally the fuse carrier on the column switchboard or the IPC in an overhead aerial situation. The RCA normally owns the fuse cartridge.

4 ELECTRICAL STANDARDS AND REQUIREMENTS

Ensure that all parts of the lighting scheme conform to the following:

- The Electricity Act, Electricity Regulations, AS/NZS 3000 and approved Codes of Practice issued by the Minister
- The Electricity Distribution Company requirements for connection, supply and installation of cables, and attachment of lighting equipment to their poles
- The Electricity Distribution Company conditions for connecting equipment to their network are fully complied with

5 HEALTH AND SAFETY AND ENVIRONMENTAL MANAGEMENT

All State Highway construction projects, network maintenance areas and bridge maintenance contracts are required to develop an Environmental and Social Management Plan. The plans establish the environmental management system between the contractors, consultants and the Transport Agency. They clarify accountability and how we will achieve compliance under our legal obligations. For further information please refer to http://www.nzta.govt.nz/network/operating/sustainably/plans.html

All work shall comply with the Transport Agency's health and safety and environmental management requirements in relation to construction, operation and maintenance. Our minimum standard for social and environmental management plans is Z/4 and health and safety compliance notice is Z/5. The documents are available from: http://www.nzta.govt.nz/resources/state-highway-professional-services-contract-proforma-manual/standards/z-series.html

6 HEALTH AND SAFETY

The requirements of Health and Safety in Employment Act plus any amendments shall be met at all times. An onsite Safety Management Plan is to be implemented and a record sheet must be available on site at all times for all personnel to sign onto.

Any accidents, near miss and remedial actions are to be reported in writing to the Engineer's representative as soon as possible after the accident or near miss occurring. This **SHALL** occur within 48 hours of the incident occurring.

The Code of Practice for Temporary Traffic Management (CoPTTM) is to apply to all activities within the road reserve or adjacent to and affecting the road reserve users.

7 LIGHTING EQUIPMENT

7.1 Outreach Brackets (Arms) for Overhead Installations

All outreach brackets shall be designed to have a design life as noted below in Table 1, to meet loads imposed by AS/NZS 1170 and have corrosion protection to AS/NZS 4680.

The electrical connection to the overhead conductor via an IPC connection (demarcation point) must be to the Electricity Distribution Company requirements.

7.2 Lighting Equipment

The design life of equipment is shown in Table 1 below:

Component	Design life
Columns[1]	40 years[2]
Outreach arms[1]	40 years[2]
Luminaires[1]	20 years[2]
Lamps LED	85,000 hours[3]
HPS HO twin arc	16,000 hours[4]
Painted/powder coated surfaces (non-luminaire)	20 years

Notes:

1. Includes all bolts and fixings associated with the component.
2. The NAMS "NZ Infrastructure Asset Valuation and Depreciation Guidelines" lists 25 to 50 years for lighting columns and outreach arms and 10 to 25 years for luminaires.
3. Expected service life of 20 years for LEDs based on operating hours of approximately 4,250 hours per annum.
4. Expected service life based on manufacturers data and expected 5% failure rate. Note: lamp manufacturers may publish average rated life at 50% failure rate; this is too long if a periodic lamp replacement programme is implemented. Typical operating hours of road lighting networks within New Zealand is approximately 4,250 hours per annum.

Luminaires, columns and outreach brackets that are used in new projects or are extensions of existing stages should be compatible with adjacent lighting and, where practicable, visually match.

For efficient maintenance, the types of lighting equipment used are usually limited to those already in the lighting network. Introduction of new equipment requires approval from the RCA prior to use. Review of existing approved equipment will occur annually.

8 PAINTING OF COLUMNS AND LUMINAIRES

Painting of lighting columns is generally **NOT** permitted but if there is a particular reason for doing so approval shall be obtained from the RCA. The colour shall be consistent throughout the area, blending in with adjoining roads or environment and shall be identified as part of the design submission.

Painting of ANY luminaires shall be carried out by the luminaire manufacturer during the assembly/construction of the luminaire in a controlled factory environment. The painting of any luminaire to an alternative colour will not exempt the manufacturer from any warranty or guarantee responsibilities nor have a reduced life expectancy of less than 20 years.

When using painted columns/luminaires in new developments the lighting designer should factor into the whole of life costing of comparison schemes to allow painting the column three times throughout the life of the column (based on 40 year expected life). The RCA will require an upfront contribution from the Developer based on current prices for the additional maintenance work.

Segmental steel road lighting columns complying with the Transport Agency Specification M26 do not generally require partial painting or hazard markers as detailed in the Traffic Control Devices Manual.

9 SIGNS

Identify any existing signs that need to be relocated onto lighting columns or onto their independent columns. If the signage is being transferred onto the lighting column ensure the column will support the added load and windage from the sign.

Comply with the Transport Agency requirements regarding location or size of signs.

Position all new lighting to minimise shadows from any new or existing signage.

If existing signs are being transferred onto slip based columns they shall not interfere with the flight/dynamic loading of the column when struck by an out of control vehicle.

10 EMERGENCY ASSISTANCE TELEPHONES

Where an emergency assistance telephone is provided, a luminaire shall be located within 15m on the traffic approach side of the telephone.

Where a median located column scheme is chosen, an area not less than 5m in length either side of the telephone and 3m wide (measured from the edge of the carriageway) shall be lit to V3 illuminance requirements.

11 BUS STOPS

Bus stops on a road classification and subcategory V road shall have a luminaire located within 10m of the approach side of the marked bus stop area.

12 HAZARDOUS GAS MITIGATION

Where new columns are to be installed within a contaminated soil zone protective foam is to be installed within the base of the column to prevent the escape of hazardous gas entering the column from the contaminated ground below.

13 TRAFFIC MANAGEMENT DEVICES

Traffic management devices shall be considered as part of the lighting design. See AS/NZS 1158.1.1:2005 section 3.4.3 and AS/NZS 1158.3.1:2005 section 3.2.

14 FLAG LIGHTING

Lighting of an isolated intersection on an otherwise unlit route should only be considered after all options to highlight the intersection with passive devices such as signs, road markings, and delineation have been explored and implemented.

In a completely dark, unlit rural environment LED full cut off (flat optic) luminaires are usually unsuitable for flag lighting as motorists may not be able to see direct light from the luminaire at a sufficient warning distance.

Issues surrounding the use of flag lighting (single luminaires) and full intersection lighting design at isolated intersections are addressed in NZTA Technical Memorandum TM-2015. A summary is given below.

Full isolated intersection lighting or flag lighting should be considered when:

- There is evidence of a high history of night time crashes
- There are raised islands that could be a hazard
- In the presence of pedestrians
- An intersection has limited visibility, complex geometry, confusing background, unusual traffic patterns
- In a highly trafficked tourist route where drivers may not be familiar with the road
- Two main traffic routes meet or there is channelization on either road
- There are right turn movements or related turning bay
- There are other special safety or layout factors that warrants a full intersection lighting design

If there is no electricity network available consider alternative energy sources such as solar, wind or micro-hydro powered lighting.

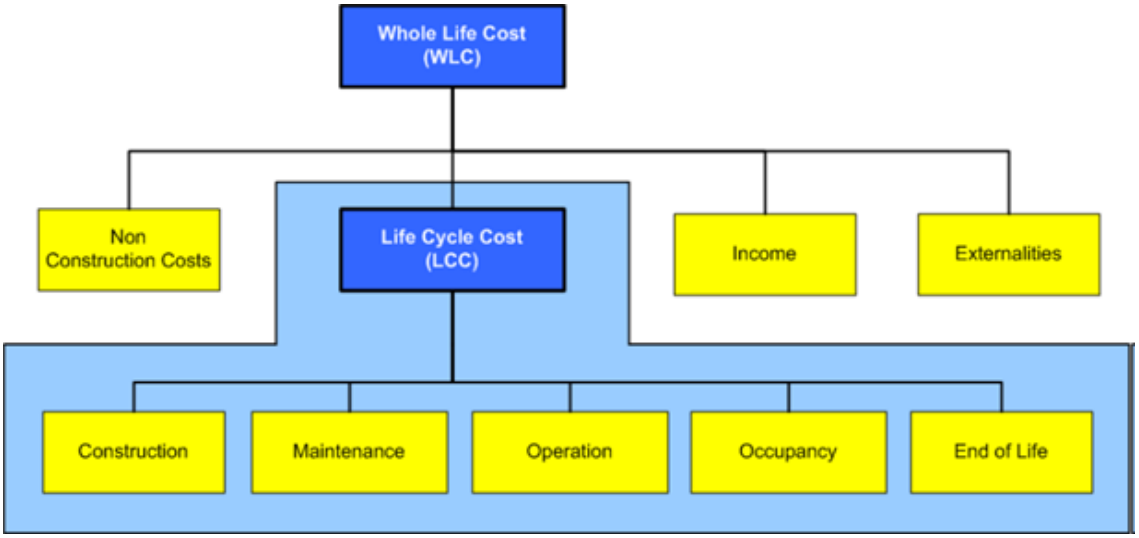
15 WHOLE OF LIFE COSTING

The "whole of life" cost of an activity must be calculated as required by the Transport Agency's Economic Evaluation Manual (EEM). The definition from the EEM is:

The costs taken into account in an economic efficiency evaluation include all costs incurred in providing the transport infrastructure or service, and depend on the type of activity being evaluated. Costs are identified in the relevant sections of [the economic evaluation] manual for each of the different investment types. In all cases costs are whole-of-life costs and are to include all costs, including capital, operating and maintenance costs that are likely to be incurred at any time in the evaluation period.

www.nzta.govt.nz/resources/economic-evaluation-manual/economic-evaluation-manual

Referring to the ISO definitions diagram below, the EEM 'whole-of-life-cost' is commonly identical to the 'life cycle cost' (LCC).



Source – BS ISO 15686-5

The Transport Agency's EEM uses social cost-benefit analysis and considers both costs and benefits to determine a benefit cost ratio (BCR).

Road lighting renewal projects, in which the customer level of service is not changing, will usually not require a full cost-benefit analysis. A net present value (NPV) analysis, in which the present value of future costs are used to establish the long term least cost option, may be used instead. Again, whole of life costs must be calculated as required by the Transport Agency's EEM.

Energy savings calculations must ensure the total luminaire wattage is used.

Whole of life costs for the scheme shall be used to ensure best value (BV) is being used.

Whole of life costing may be used to consider options within a scheme, luminaire selection or a scheme as a whole. In undertaking whole of life costing analysis, consider the initial costs borne by the capital cost of the development **AND** the ongoing maintenance and replacement costs borne by the RCA, *PLUS* the disposal costs at end of life. This shall include the maintenance costs associated with painted columns verses galvanised columns or decorative luminaires verses functional road lighting luminaires, i.e. aesthetics verses operating and maintenance costs.

16 CENTRAL MANAGEMENT SYSTEM (CMS)

16.1 General

Refer to Appendix VIII for a generalised Road Lighting Central Management System (CMS) schematic and terminology.

The use of a CMS shall be considered on a project-by-project basis and as part of the RCA Intelligent Transport System (ITS) or if the asset owner specifies it as a requirement within the design brief. As a guide the designer shall consider the use of a CMS within their specification based on the following considerations:

- The results from whole of life cost analysis comparing likely changes in energy use and crash risk against the capital and operating costs of a system
- Requirement for dynamic lighting levels. Where varying lighting levels are required on the scheme, however, it is not seen as appropriate to install a fixed regime that cannot be controlled remotely. A CMS would be used in this situation to provide a quick and flexible solution
- The benefits of installing a CMS can be economically justified, refer section 15

Use of a CMS shall be considered where there is electricity metering, or the system includes energy metering, as the energy usage can easily be confirmed.

16.2 Communication Protocols

It is important that a CMS uses publically available communications (open source) protocol between all devices to ensure Gateway and Light Point Controller hardware is available from at least four different suppliers – thereby avoiding vendor dependency.

16.3 Luminaire Controller / Light Point Controller (LPC)

The Luminaire Controller/Light Point Controller shall be installed as part of the luminaire by one of the following methods:

a) 7 contact point NEMA ANSI C136.41 receptacle;
b) Permanently fixed via conduit entry; or
c) Mini/Micro aerial

The IP66 rating of the luminaire shall be maintained with the LPC installed.

The RCA shall specify their preference within the design brief.

16.4 Maintenance Considerations

CMS could be an acceptable solution where the existing or proposed installation might be difficult to maintain.

This could be for a variety of reasons, for example:

- Remote location of the scheme
- Difficulty accessing the scheme due to traffic volumes
- Geometry of the road

In situations like this the cost of installing a CMS shall be considered against the benefit of having the system in place. This would be done by producing a 'whole of life costing' for the scheme, which takes into account the costs associated with attending site and maintaining the installation.

16.5 Future Network Maintenance

CMS should be considered on any project if the RCA intends to have all of the lighting stock on CMS as part of their long-term maintenance policy.

16.6 Variable Lighting Levels

All schemes should be considered for variable lighting levels by the Asset Owner to limit the environmental impact of the lighting installation. The Lighting Designer should

discuss the available options with the Asset Owner. Variable lighting levels may not always be appropriate, and each lighting scheme's requirements will have differing needs.

The designer is responsible for demonstrating their rationale in making a recommendation. The following aspects should be considered when making an assessment:

a) Traffic Crash Report (TCR) statistics and whether night time incidents are a consideration
b) Potential energy and crash savings
c) Cost of providing variable lighting capabilities
d) Associated cost benefit analysis
e) Condition of the existing road infrastructure, e.g. does it meet current standards

A risk assessment should be carried out to determine whether variable lighting is appropriate. If variable lighting is deemed to be a viable course of action then financial benefit will have to be demonstrated to justify the additional capital expenditure associated with its inclusion. This is done by a 'whole of life' costing which takes into account energy usage, effect on crash frequency and the design life of the luminaire and Tele-Management System.

Note that additional energy savings may be possible by dimming the luminaire to the required light level.

Often the preferred luminaire for each situation is not available or optimised for each individual road hence the next highest lumen output luminaire is chosen. This means the designer shall consider variable (dimming) lighting levels from initial switch on.

Additional savings will also result by counteracting the effects allowed for in the initial maintenance factor from lumen depreciation, dirt accumulation and premature failure.

16.7 Selecting a Lighting Level Profile

Variable lighting levels aren't a new concept however there is not a wealth of guidance about how best to go about it. It should be considered that variable lighting is about lighting the road to the correct level for the appropriate conditions at a specified time.

16.8 Light Point Controller

The use of a light point controller on the luminaire requires different specifications for different light sources. HID luminaires require a switch on level of around 50 - 70 lux to allow time for the lamp to run up to full brightness. With instant start up light sources, such as LED, the switch on threshold can be lower.

Light point controllers with a negative switching differential can be specified for HID. These should not be used for instant start up light sources.

Example:
For a V1 Road where the average lighting level is 15 lux, the switch on level could be trimmed to 20 - 30 lux. This can be achieved by using a CMS system or a lower switch level photocell.

17 ENVIRONMENTAL LIGHTING EFFECTS

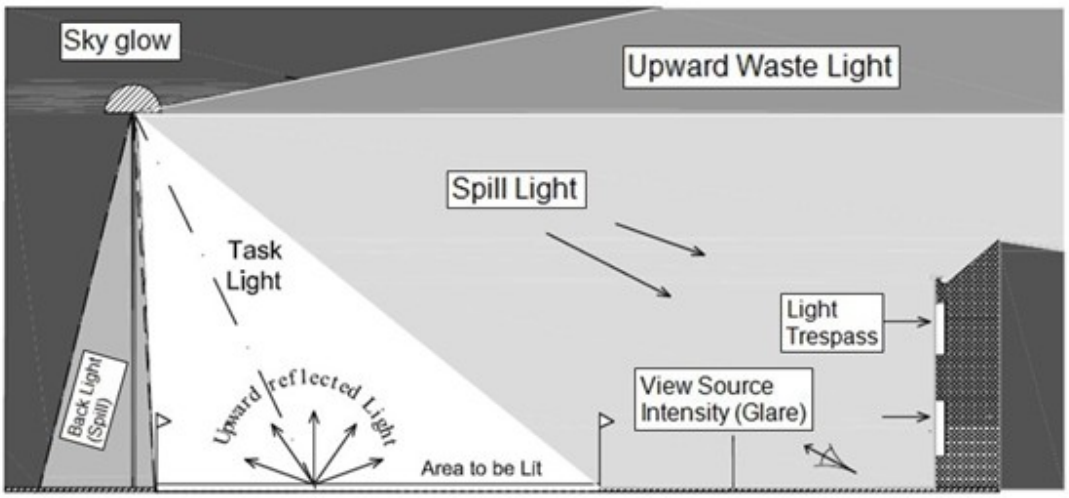
17.1 Forms of Potential Adverse Lighting Effects

There are three main types of lighting effects that have the potential for varying degrees of intrusiveness to both vehicles and residents living near lighting installations. They shall be considered when designing lighting schemes and are:

- Spill light, which can also be backlight
- Glare
- Sky glow (upward light)

These effects are illustrated in Figure 2:

Figure 2 – Types of Obtrusive Light



Source – ILP Guidance Notes for the Reduction of Obtrusive Light. GN01:2011

The AS/NZS 1158 series provides guidance on the spill lighting levels for Category P roads.

To help mitigate these adverse effects from new lighting schemes, luminaires **MUST** be installed at either tilt angles of no more than 5 degrees. Higher tilt angles, if required for special circumstances, will require specific approval by the RCA.

All luminaire applications must demonstrate adherence to the principles of the International Dark-Sky Association (IDA); refer to www.darksky.org.

For further information on achieving Greenroads credits refer:
www.greenroads.org/1429/18/light-pollution

17.1.1 Spill Lighting

Spill lighting, Backlight or Light Trespass can be both obtrusive and beneficial and can be described as the effects of light or illuminance that strays from its intended purpose. On a roadway lighting system it is desirable to have most of the light directed onto the roadway and only a small amount directed onto the surrounding area, for example

footpaths and kerbed areas. Lighting designs that allow excessive light to fall on areas away from the road and onto private land will not be acceptable for any project.

As a general guide the maximum level permitted for spill light is 10 lux either horizontal or vertical 3m inside the property boundary at 1.5m above the ground or at window height if the building is located closer than 3m from the boundary.

17.1.2 Glare

Glare is the brightness of a luminaire when compared with the brightness of the background against which they are seen.

Glare can also be described as unwanted source luminance, and is defined by the Illuminating Engineering Society (IES) as the sensation produced by luminance in the visual field that is sufficiently greater than the luminance to which the eye has adapted to cause annoyance, discomfort, or loss of visual performance and visibility.
Glare can be categorised as follows:

Disability glare - Disability glare results from the scattering of light within the eye so reducing contrasts of the retinal image (refer CIE 115:2010).

Discomfort glare - does not typically cause a dangerous situation in itself, though it is annoying and irritating at best. It can potentially cause fatigue if experienced over extended periods.

Threshold Increment (TI) - a measure of the loss of visibility caused by the disability glare from the road lighting luminaires (refer CIE 115:2010).

If the glare value can be kept below the 10% maximum of Threshold Increment (TI) then glare is considered to be controlled.

17.1.3 Sky Glow

Urban sky glow is the result of stray light being scattered in the atmosphere brightening the natural sky background level. This effect is extremely detrimental to astronomers as well as annoying to many people in the general public.

This effect is difficult to mitigate fully as some light will always be reflected upwards off the road surface. Sky glow will also be reduced by the specification of luminaires that are able to provide good optical control.

To minimise direct light spill into the upper hemisphere, it is recommended that only luminaires with an Upward Waste Light Ratio (UWLR) below 1% of the total light output are used.

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PART 2 DESIGN

18 LIGHTING CLASSIFICATION AND SUBCATEGORY SELECTION

18.1 General

The lighting hierarchy for various Roads and/or Public Spaces can be selected from the criteria outlined in AS/NZS 1158.1.1 or AS/NZS 1158.3.1. For Category V lighting, the sub category selection tool available on www.eecabusiness.govt.nz/content/road-lighting will provide additional guidance.

To ensure consistency across the road network determine the road classification and lighting subcategory for each route in the network rather than one section of road at a time as this may produce varying lighting levels along a route with the same operating characteristics.

Rural Roads

For rural road lighting consider if the road classification and subcategory selected will be appropriate over the life of the installation, e.g. do not over light if demand for lighting will not be justified for several years (it may be more cost effective to upgrade later). If the result is bordering on a higher road classification and subcategory and road user demand is expected to increase it may be appropriate to select the higher level.

The decision to provide category V lighting on rural roads should be based on benefit cost considerations where the benefits are the potential crash savings from the subcategory of lighting to be provided. Compared to urban roads rural roads tend to have fewer crashes per vehicle kilometre travelled and fewer crashes of the type most influenced by road lighting (e.g. pedestrians). Depending on the traffic makeup lighting on rural roads may not be economically justified until the traffic volume is many times (often 3 or 4 times) the traffic volume of equivalent urban roads.

Rural Intersections

For isolated rural intersections, the use of "flag lighting" (refer section 14) to identify the intersection at night may be considered appropriate.

Column Types

For preferred column types, refer to Transport Agency Specification M26. Note that the use of decorative or semi-decorative luminaires is discouraged but can be used in certain situations with prior written approval from the RCA.

Light Sources

LED luminaires are the preferred option. Other technologies may be considered but shall be confirmed by the RCA before final design is finalised. Care should be taken to avoid mixing lighting technologies where this could cause confusion or inconsistency.

The use of MH, NGMH and MV lamps is **NOT** permitted.

For preferred column types, refer to Transport Agency Specification M26.

19 CATEGORY V LIGHTING

19.1 General

Category V lighting should provide a lit environment conducive to the safe and comfortable movement of vehicular and pedestrian traffic at night and discourage illegal acts. The visual requirements of motorists predominate.

Design the lighting to comply with AS/NZS 1158.1 *Road lighting - Vehicular traffic (Category V) lighting*.

LED luminaires are the preferred option for Category V lighting but that choice remains subject to any "whole of life" analysis of costs. Alternatively high output twin arc, high output high pressure sodium (HPS) lamps may be considered if superior whole of life cost can be demonstrated, subject to any local restrictions/controls.

Permissible light sources and luminaire types must meet the requirements detailed in this document.

20 CATEGORY P LIGHTING

20.1 General

Category P lighting provides a lit environment to help pedestrians orientate themselves and detect potential hazards, and discourage fear of crime and crime against the person.

Design the lighting to comply with AS/NZS 1158.3.1 *Road lighting - Pedestrian area (Category P) lighting.* The principles of "Crime Prevention through Environmental Design" (CPTED) shall be considered.

LED lighting is the preferred option for all Category P installations but that choice remains subject to any "whole of life" analysis of costs.

Calculations shall be undertaken during the design process to ensure the use of system wattages and technologies that maximise efficiency but also minimise the number of luminaires installed for the particular situation.

Important considerations in luminaire selection are system wattage, lumen depreciation, maintenance factors, reliability, performance, operating criteria, compatibility, compliance, effect on environment and whole of life cost.

20.2 Category P Lighting – Cycleway and Pathway Lighting

Design the lighting to comply with AS/NZS 1158.3.1 *Road Lighting - Pedestrian Area (Category P) Lighting*. The principles of "Crime Prevention through Environmental Design" (CPTED) should be considered.

The RCA prefers to illuminate only those paths and cycle ways that are designated safe routes.

The luminaires must meet the requirements for Type 4 or 5 as detailed in AS/NZS 1158.3.1, to help control upward waste light, glare and spill light. The minimum mounting height is 6.0 metres and the maximum is 8.0 metres.

Bollard lighting is not an acceptable method of lighting paths and cycle ways within reserve areas.

20.3 Underpasses or Pedestrian Tunnels

In areas of high pedestrian activity or areas of high risk of crime lighting shall be designed in accordance with AS/NZS 1158.3.1.

In areas of low pedestrian activity, the minimum horizontal point illuminance shall not be less than 10 lux and the minimum vertical point illuminance shall not be less than 3 lux.

Vandal resistant or purpose built luminaires with a minimum IK08 rating shall be used.

20.4 Pedestrian Overpasses

Where open pedestrian overpasses are required to be lit, lighting shall be provided to meet the requirements of AS/NZS 1158.3.1 road classification and to be consistent with the connecting elements unless otherwise specified in the project design brief.

20.5 Traffic Underpasses or Short Tunnels

Traffic Underpasses and Short Tunnels should be lit in accordance with AS/NZS 1158.5. Where underpass lighting is to be provided, provision for lighting shall be included via the installation of concealed conduits (with draw wires) installed within the structure.

The mounting location of luminaires will determine if any extra attention needs to be given to the issue of luminaire vibration.

Luminaire location and mounting techniques are likely to significantly affect maintenance costs and effects of traffic management.

21 PERFORMANCE REQUIREMENTS

21.1 Maximum Energy Density for Category V

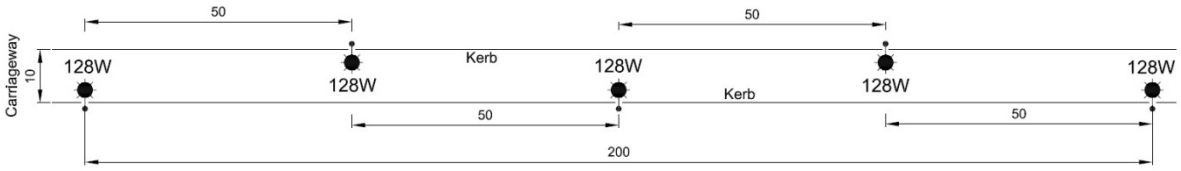
To maximise efficiency and minimise the number of luminaires installed the minimum design spacing is required to maximise energy efficiency.

Calculations are completed in the normal way to determine maximum straight road design spacing for compliance with AS/NZS 1158. In conjunction with the layout drawings, using a sample area, the maximum energy density values indicated in Table 2 below shall also apply to ensure minimum column spacing are practical.

Table 2 – Maximum Energy Density (W/m²) for Vehicular Straight Roads

	Road Classification (SUB CATEGORY)			
	V4	V3	V2	V1
≤ 100W LED	≤ 0.23 W/m²	≤ 0.38 W/m²	≤ 0.39 W/m²	≤ 0.41 W/m²
101W – 120W LED	≤ 0.27 W/m²	≤ 0.43 W/m²	≤ 0.45 W/m²	≤ 0.46 W/m²
121W – 140W LED	≤ 0.28 W/m²	≤ 0.44 W/m²	≤ 0.47 W/m²	≤ 0.51 W/m²
141W - 185W LED	≤ 0.3 W/m²	≤ 0.45 W/m²	≤ 0.51 W/m²	≤ 0.57 W/m²
186W - 200W LED	NA	≤ 0.49 W/m²	≤ 0.55 W/m²	≤ 0.64 W/m²
≤ 150W HPS lamp	≤ 0.31 W/m²	≤ 0.38 W/m²	≤ 0.48 W/m²	≤ 0.58 W/m²
≤ 250W HPS lamp	≤ 0.48 W/m²	≤ 0.57 W/m²	≤ 0.62 W/m²	≤ 0.78 W/m²

Example:
Maximum design calculation (from AS/NZS 1158) is, say, 55m (average spacing) for a 128W LED luminaire. Over an area of 200m, columns could be spaced at 50m intervals. From Table 2 above, confirm that the energy density figure is equal to or less than 0.28W/m².



$$\frac{4 \times 128W}{200 \times 10} = 0.256W/m^2$$

21.2 Minimum Spacing Requirement for Category P

Note that different energy performance metrics are used in this specification for Cat V (energy density basis) schemes and for Cat P (minimum spacing basis) schemes. This approach acknowledges that for Cat V schemes (luminance based calculations) the design width (and therefore area) is subject to many dimensional variables and the energy density method is most appropriate. For Cat P schemes the column spacing approach is already well established, as it was part of the 2010 RightLight programme.

To maximise efficiency and minimise the number of luminaires installed, apply Table 3 below.

The spacing in this table limits the types of luminaires that are acceptable by ensuring only high performing luminaires are used at appropriate mounting heights. The effects of trees causing shadowing shall also be taken into account, and specific design is required at curves and bends.

Table 3 - Minimum Design Spacing for Local Roads

	Legal road width (m)	20	18	16	14	12	10
LED System Wattage	20W-29W	50	50	50	52	53	55
	30W-35W	50	50	52	54	55	58
	36W-45W	52	52	56	58	60	62
	46W-65W	54	58	58	64	-	-
	66W-80W	64	66	68	-	-	-
Existing HID lamps	P3 minimum spacing	42	45	50	50	50	60

For walkways and cycle ways the minimum design spacing for straight sections is 30m for P3 and 50m for P4. Where walkways curve specific design is required.

21.3 Mounting Heights

	Minimum	Maximum	Preferred
Cat P	6	8	7 - 8
Cat V	8	14	9 - 12

Note: Higher mounting heights may be appropriate for Cat V but will need approval prior to detailed design

22 ROAD LIGHTING DESIGN

22.1 Project Brief or Principal's Requirements

The Lighting Design Project Brief or Principal's Requirements shall contain the lighting design requirements for the project to be designed. This will also include the anticipated cleaning interval for the luminaires for confirmation of the Luminaire Maintenance Factor (LMF) in determining the overall Maintenance Factor. The Project Brief or Principal's Requirements for the project must be peer reviewed in both context and relevance, with particular regard to aspects of urban design, environmental considerations, walking and cycling, and social objectives.

The Project Brief or Principal's Requirements should not be older than 12 months and must be updated within 12 months of commencement of design.

The Project brief shall consider the following:

a) Resource consent requirements
b) Scope and location of the project
c) Purpose and objective of the lighting scheme
d) RCA project manager
e) Lighting classification and subcategories for each and every road and intersecting road that apply to the project
f) Specific requirements (if any), such as: a particular type of column (e.g. passively safe) or luminaire, restrictions on light locations, special features of the proposed

road layout or landscaping that may influence the lighting design, traffic management devices that require supplementary lighting
g) Spill light restrictions, if any
h) Maximum Threshold Increment (TI)
i) Upward Waste Light Ratio (UWLR) restrictions, if any

The shelf life for **ALL** completed designs (date of acceptance of design by the RCA) shall be less than 12 months before the date of ordering of materials.

22.2 The Lighting Designer

The selection process of The Lighting Designer needs to be based on this disciplines requirement. If a large construction or renewal project calls for an Expression of Interest (EOI) and the selection of the Lighting Design carries no or little importance in the selection process then Lighting should be excluded from this EOI and the appointment of a Lighting Designer is done on ***lighting experience, ability and attributes***.

All project designs shall be completed by lighting design companies with individual experienced Lighting Designers that have the following pre-requisites:

a) Be a suitably qualified and a competent person. A competent lighting designer is a person, who has acquired, through training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the required task correctly
b) Be conversant with Australian/New Zealand Standards and local practices concerning lighting design for public outdoor areas (preferably with a minimum of 3 years' experience)
c) Have an established track record of competent road lighting design from similar projects
d) An appropriate level of membership from the IESANZ is encouraged. (Note: A list of MIES and RLP qualified members and their specific lighting design discipline is held on the IESANZ website)
e) Have an appropriate level of professional indemnity insurance (minimum NZ$500,000)
f) Undertake the complete lighting design, including being responsible for preparing estimates, tender documents, whole of life cost analysis and assisting with tender evaluation
g) Provide a Lighting Design Report and Lighting Design Statement - see Appendices II and III
h) Ensure the lighting scheme meets all the requirements of this document
i) Manage the lighting construction works to a successful conclusion, including regular site observation to ensure the installation meets the intention of the design documents
j) Check and approve payment of all progress and final invoices
k) Resolve any complaints to the satisfaction of RCA prior to final acceptance by the RCA
l) Sign off the project as being practically complete on completion

22.3 Lighting Design Peer Review

The RCA shall decide if independent peer review is needed for each and every project and appoint the nominated peer reviewer as required.

The peer reviewer shall be independent of the Designer, shall be from an unrelated company to that of the Designer and should have a level of qualification or experience equal to or above that of the Lighting Designer as described in (section 22.2 above).

The nominated Peer Reviewer shall undertake his/her duties at each of the design phases as defined by the NZ Construction Industry Council Guidelines i.e. Concept, Preliminary, Developed and Detailed Design.

All design calculations undertaken by a luminaire supplier **SHALL** be peer reviewed by at least one independent, unrelated designer with the qualifications and experience described in (section 22.2 above).

All Peer reviews shall be carried out less than one year prior to lighting equipment purchase.

Any safety audits of the lighting design shall be carried out by a qualified road safety auditor.

22.4 Lighting Design Documentation

The following information shall be provided as a minimum to facilitate the lighting design peer review process:

a) Lighting Design Report (refer section 23.2), including whole of life cost analysis
b) Lighting design drawings (refer section 22.6)
c) Details of the design method used and the values of the light technical parameters obtained, for each of the road elements involved, compared to the limiting values given in AS/NZS 1158
d) Records of any non-compliant design elements and any departures from the design spacing that have been used in the design process
e) A completed Lighting Specification
f) Complete computer analysis information required by AS/NZS 1158
g) Luminaire intensity distribution tables (in North American IES or CIE format as requested) and the origin of this photometric data
h) The name and source of the computer programme used, and a statement of its compliance or otherwise with the requirements of AS/NZS 1158
i) Details of the road surface reflection characteristics assumed in luminance-based design calculations
j) Justification for the maintenance factor used in the calculations and the associated schedule of maintenance to be adopted, e.g. the luminaire cleaning and or lamp replacement intervals, as agreed with the RCA
k) A cross-section drawing showing the proposed type of column, setback, outreach arm, luminaire offset and luminaire

22.5 Control of Non-Conformance

The Lighting Designer shall have a procedure to ensure that design outputs that do not conform to the specified requirements are clearly indicated on the relevant design records, Lighting Design Report and Lighting Design Statement as well as the reasons for the non-compliance. Acceptance of any non-conforming issues shall have RCA's written approval. Such acceptance shall be provided along with lighting design documentation for Peer Reviewers.

22.6 Design Drawings

All engineering drawings shall be legible, clear, readable and complete. They must clearly illustrate the proposal and enable both assessment of compliance with this document and accurate construction.

Engineering design drawings shall include the following:

a) A locality diagram giving the overall layout and location of the works
b) Detailed drawings, longitudinal sections, cross sections and diagrams of the proposed developments and/or construction work required
c) Special details where the standard drawings are not sufficient
d) A north point, preferably pointing above the horizontal (i.e. in the top 180 degrees)

Show the following general information on the drawings:

a) The extent of the works showing existing and proposed roads, and the relationship of the works with adjacent works, services and/or property
b) Proposed and existing property boundaries and street numbers
c) Significant existing vegetation to be removed, any special or protected trees and any areas of heritage significance that may be affected by the works
d) The road lighting layout showing the location and type of each luminaire and proposed and existing significant road features (e.g. kerbs, property boundaries, planting and traffic management devices)
e) Location/warning of existing underground services
f) Lane markings
g) Locations of street furniture, if available
h) Overhead obstructions

Show the following road lighting information on the lighting design drawings:

a) The existing and proposed electrical load of the lighting circuits
b) The lighting design details including: lighting classification and subcategory that the scheme has been designed to meet, mounting height, tilt, maximum spacing and any non-complying portions or exceptions
c) A lighting schedule
d) Carriageway design width (Wk) used in accordance with AS/NZS 1158 clause 3.2.2.2 or Road Reserve width (W).
e) Cable offsets (existing cable locations, records and offsets that are maintained by Electricity Distribution Company)
f) Distribution pole attachment details

Include in the schedule the requirements for each location:

a) Luminaire manufacturer, model, colour and optic used
b) Lamp manufacturer, type, colour temperature and system wattage
c) Outreach bracket (arm) code, outreach length and tilt angle
d) Column type
e) Mounting height to luminaire optical centre
f) Offset or overhang
g) Any other equipment or work required to complete the scheme

Include the following notes:

a) Alternative equipment to that specified in the schedule (columns, outreach brackets (arms), luminaires and lamps) can be provided with the tender or quotation submissions provided all requirements are met and the performance of all alternatives are equal or superior to those indicated on the drawing and the associated documents
b) Requirements for any temporary lighting

See Appendix IV for a sample road lighting drawing.

Drawings must be legible at A3 size and can be drawn to a scale of 1:500 or 1:1000. Electronic drawings must be prepared in an industry standard format suitable for later addition of as-built information and inclusion in the RCA's asset information system. Drawings can be supplied in electronic format as dwg, dxf, pdf or tif files.

23 ACCEPTANCE OF DESIGN

23.1 Documents to be Submitted for RCA Acceptance

Submit the lighting design documentation (section 22.4), design drawings (section 22.6) with the Lighting Design Report (see Appendix II) and Lighting Design Statement (LDS1) - Design (see Appendix III) along with any other relevant information to assist with the design acceptance. Additional information may be required and shall be provided when requested. This information should enable the process to be followed easily and should allow for replication of the results.

23.2 Lighting Design Report

A Design Report (see Appendix II) shall be submitted for acceptance.

The Design Report provides the RCA with specific details relating to the design including any non-compliant design elements. The Design Report shall identify how construction of the project will be managed to ensure the design will be successfully implemented. It shall also describe how communication with stakeholders and other parties to the design has/will be managed.

23.3 Lighting Design Statement (LDS1) - Design

The Lighting Design Statement (LDS1) - Design (see Appendix III) shall be submitted for acceptance. It confirms that the design meets all specifications relating to the project.

The signatory of a Designer on a Lighting Design Statement shall meet the qualifications and experience described above in section 22.2.

23.4 RCA Acceptance

All quality aspects of the investigation, design and construction must comply with the requirements of this document.

When the design documentation and design report meets the requirements of this document, the RCA shall notify the Designer that the design has been accepted. In considering the design and giving its acceptance, the RCA shall act without undue delay.

The "Design Review Certificate" shown in Appendix VI will be used by the RCA (or their representative) in making the final decision to accept the design.

Work **SHALL NOT** commence on site unless and until:

- A resource consent for the work has been granted, except when no such consent is required
- The RCA has given written acceptance
- Any other consent/approval required has been granted
- A Traffic Management Plan has been prepared and approved by the RCA (or their representative)

24 ELECTRICAL RETICULATION

24.1 General

Each column shall be a separate installation in accordance with AS/NZS 3000.

24.2 Underground Services, Construction, Backfill and Bedding

There are various methods of installing underground services. These include open trenching, directional drilling, pipe bursting, vacuum air suction, etc.
Factors that may affect the choice include ground conditions, disruption to traffic, the presence of trees, site safety and the availability of knowledge to location of existing or redundant services.

The Transport Agency National Classification refers to Strategic, Arterial and Collector Roads. The preferred method of trenching across these roads is via a method known as "trenchless" or "thrusting" or "directionally drilled".

The RCA's preferred method of trenching in grass or within new developments is via open trench.

When the intention is to lay a number of utilities in a common trench, ensure the minimum cover and separation distances for each utility in the trench cross-section is maintained.

Bedding materials should comply with the network utility operators requirements. Specify backfill materials individually. The material used must be capable of achieving the backfill compaction required. All surface restoration must match existing surfaces.

The RCA has specific requirements for trench restoration in different locations, for example, on hillsides.

24.3 Points of Supply and Circuiting

Points of supply shall be determined in conjunction with the Electricity Distribution Companies requirements. This shall optimise an efficient, effective and reliable network minimising new works required to connect to the network.

If appropriate, a metered point of supply shall be organised with the Electricity Distribution Company and the preferred Electricity Retailer.

If a three-phase scheme is chosen then luminaires shall be circuited in such a way that the load is evenly balanced across all phases. All luminaires shall be circuited in such a way that adjacent luminaires are not on the same phase. Consideration must also be given to how a three-phase circuit is protected. If using three single pole MCB's, specific warning labelling must also be included, plus a triple pole main switch.

24.4 Cable Type and Terminations

Underground cables shall be single phase or three phase, single core, dual or three core copper conductors with Neutral Screen protection and PVC insulation. The cabling shall be selected by the designer to meet the requirements of AS/NZS 3000.

At every lighting column all conductors shall be terminated within the terminal contacts on a dedicated column switchboard within the base of each column.

To maintain the IP rating of all luminaires all internal cabling from the switchboard protection device to the luminaire shall be either a minimum of 1.5mm^2 circular 3 core TPS cable or a minimum of 1.5mm^2 2C neutral screen cable, continuous throughout the entire length.

If flat 1.5mm^2 2C+E TPS cable is used from the switchboard to the luminaire the termination to the luminaire shall occur within a suitable IP65 (or higher) connector within 300mm of entering the luminaire. The IP rating of the luminaire is not to be compromised in any way.

Flat TPS cable is **NOT** to be used for direct connection into an IP rated luminaire unless an IP66 gland suitable for flat TPS cable is used.

24.5 Qualified Personnel

All work undertaken on the Electricity Distribution Company's network shall be under the direct supervision of a holder of a current Authorisation Holders Certificate (AHC).

24.6 Documentation

The Contractor shall provide design and certification documentation in accordance with the Electricity Safety Regulations.

25 CONTROL AND INSPECTION OF THE WORK

25.1 General

Prior to accepting any newly commissioned lighting installation onto the RCA network, the installation shall be checked by the RCA Asset Manager or his appointed representative. Any remedial work or improvements required to comply with the approved design shall be carried out as identified. This includes any problems, failures or defects that may arise during the stipulated defects liability period, or the guarantee period for individual fittings or fixtures, whichever is greater.

Demonstrate that the following has been undertaken:

- Identify the RCA's key achievement criteria have been met
- Plan how defects will be realised
- Control the work in conformance with the project quality system
- Check, inspect or test the work and verify that it conforms to the specified requirements
- Record the results as documentary evidence of compliance

This section relates to both design and construction works and requires that all processes involved be properly managed.

25.2 Checking, Inspection, Testing and Recording

Check, inspect or test against all key achievement criteria to verify compliance during design and construction and on final completion.

Clearly indicate any "hold" or "witness points" in the Design Report, Specification and Engineer's Report or Contract Quality Plan, where the project requires checking, an inspection and/or approval to proceed (i.e. internally and/or from the RCA).

25.3 Lighting Design Statement (LDS4) – Construction Review

The Lighting Design Statement (LDS4) – Construction Review (see Appendix III) shall be submitted on completion of project.

26 COMPLETION CERTIFICATE

The installation Contractor will be required to send a Completion Certificate to the Lighting Designer (or project manager) on practical completion. The Lighting Designer, after inspecting the work, shall also provide certification of practical completion by submitting a Completion Certificate (see Appendix VII) to the RCA. All other paperwork including audit records, "As-Built Drawings", etc. will be submitted with the Completion Certificate to the RCA.

PART 3 LUMINAIRE REQUIREMENTS

27 LED LUMINAIRE ATTRIBUTES

The following are important LED luminaire attributes and will be used as considerations when assessing new product to be used on any RCA network.

27.1 Reliability

For greater efficiency and less maintenance the reliability of any LED luminaire is important. New luminaires will only be accepted provided they exhibit good characteristics with minimal predicted evidence of premature failure.

ALL components shall be selected to ensure the luminaire has a design life of more than 20 years. These typically include lenses, visor, gaskets, luminaire body, compatible materials, etc. Details on design life of LEDs and drivers and how these lives have been derived shall be provided.

Any supporting data, trial or case study may be helpful in confirming this fact.

27.2 Colour Temperature

All new LED luminaires shall have a nominal colour temperature near 4000˚K such that the values shown in Table 4 for CCT tolerance and Duv and tolerance for a Nominal 4000˚K CCT are achieved.

If the project brief so stipulates a colour temperature in the range 3000 K - 4500 K may be considered noting that:

a) CCT values above 4000˚K will produce more blue light which is generally seen as undesirable in the night time environment and
b) CCT values below 4000˚ K will produce light with a warmer tone but also tend to be less efficient in light output.

The SSL colour rendering index shall exceed Ra 70 in all cases.

Table 4 – Nominal Correlated Colour Temperature and Chromaticity Tolerances

Nominal correlated colour temperature (CCT)	CCT Tolerance (˚K)	Duv and Tolerance
3000˚K	3045 ± 175	0.0001 ± 0.006
3500˚K	3465 ± 245	0.0004 ± 0.006
4000˚K	3985 ± 275	0.0009 ± 0.006
4500˚K	4503 ± 243	0.0014 ± 0.006
5000˚K	5029 ± 283	0.0019 ± 0.006
5700˚K	5667 ± 355	0.0024 ± 0.006

Notes:
1. The preferred value of correlated colour temperature for road lighting is 4000˚K
2. This table is based on ANSI/NEMA/ANSLG C78.377-2008

The approved method of measuring lumen depreciation and expected life shall comply with IESNA LM-80 and TM21.

Initial lumen output is known as L_{100}. Lumen depreciation after 85,000 hours operation must be ≥ L_{90}.

Lumen depreciation in LED luminaires is dependent on ambient operating temperature and driver current. Data for an LED luminaire shall be configured at 25˚C ambient operating temperature. The supplier/manufacturer shall provide the following information with LED lumen depreciation data:

- Driver current
- Initial lumen output
- Chromaticity
- Projected life expectancy TM21
- ISTMT (in situ Temperature Measurement Test)

If additional average ambient operating temperature data is available this should also be provided for consideration.

27.3 Measurement Procedures

LED photometry and measurement procedures are required to be carried out as per IESNA LM79-08 and AS/NZS 1158.

This information includes:

- Total luminous flux
- Minimum power factor of 0.9
- Efficacy (lumens/watt)

Absolute photometry of a completely assembled LED luminaire must be used as opposed to Relative Photometry used via a reference lamp source for traditional HID.

27.4 Maintenance Factors (MF) or Light Loss Factor (LLF)

The basic goal of any lighting design is to meet the light technical parameters over the full life of the installation. One element of that goal is to produce the desired amount of light. However, unless otherwise adjusted, all lighting systems decline in lumen output over time due to reductions in lumen output and changing surface properties of the luminaire or of the environment. Using a LLF less than one typically means the initial light level will be above the recommended target value, but over time this level will decline to the minimum design level.

The Maintenance Factor of an LED luminaire is to be derived from the product of light source lumen depreciation (LLD), luminaire survival factor (LSF) and luminaire maintenance factor (LMF) i.e. MF = LLD x LSF x LMF.

LLD - lumen depreciation factor is information provided by the luminaire supplier (TM-21 report) and taking into account operating temperature, driver current, etc. Use the lumen depreciation value at 85,000 hours operation (20 years).

LSF - lamp survival factor (expected minimum life of 20 years for all componentry). This has been traditionally known as the time period at which 50% of HID lamps fail. Another description of this variable could be "Failure Rate" (F_x) or "Rated Life" (B_x). It is the expected amount of failures after 85,000 hours operation (includes electronic components, drivers, lenses, any premature failure or mechanical failures, etc.). This figure does not include any allowance for lumen depreciation and should be provided by the manufacturer with supporting data. A typical figure for LED is to be higher than 95% at 85,000 hours operation but if no figure (and supporting data) is provided 50% is to be used when calculating overall maintenance factor.

LMF - luminaire maintenance factor is dependent on the ingress protection of the luminaire, pollution category of the street and the cleaning interval of the luminaire. This information can be derived from Appendix within AS/NZS 1158.3.1 or other researched data such as that indicated within BS 5489-1. The RCA will provide the cleaning interval for luminaires within the Design Brief or Principal's Requirements.

Example:
MF = 0.912 (LLD from TM-21 report) x 0.95 (LSF data in this example less than 5% failure rate) x 0.89 (from AS/NZS 1158) = 0.77

Maximum maintenance factors referenced in AS/NZS 1158 are to be adhered to. Note these are maximum values and are **NOT** default values for all luminaires.

27.5 Warranty Period

Manufactures/Suppliers must warrant their luminaires such that they shall perform substantially in accordance with the requirements of this document and applicable standards in force at the time of inclusion to the Accepted Luminaire List (refer section 28) for a period of not less than ten (10) years.

Any breach of this warranty and the Manufacturer's/Supplier's entire liability with respect to any such warranty claim shall either be to collect or bear the cost of shipping the defective Luminaire(s) from the Client's base, and at the Manufacturer's/Supplier's option, provide either a refund at the amount paid by the Client for such luminaire or repair or replacement of the defective luminaire.

Any replacement luminaire will be subject to this Warranty for the longer of the original Warranty period or one hundred (100) days from the receipt of the replacement luminaire to the Client.

The Warranty is void if a luminaire defect has resulted from an accident, improper handling, misuse, abuse, improper installation, vandalism, neglect or negligent accident.

All returns of luminaires that are damaged during shipment from the Manufacturer's/Supplier's New Zealand base will be replaced free of charge but shall have prior agreement from the Manufacturer/Supplier and must occur within 90 days of the original shipping date of the returned luminaires. The luminaires must be returned in their original shipping container/packaging and all shipping charges will be met by the Manufacturer/Supplier.

27.6 Compatibility

It is important that LED luminaires can be installed onto existing columns and outreach brackets. The assessment process will consider:

- Range of spigot sizes
- Capability for both side entry mounting and pole top attachment
- If a spigot adaptor is required
- Tilt adjustment of the luminaire

Typically existing side entry mounts can vary from 32mm to 60mm outside diameter and an existing pole top attachment is typically 60mm or 76mm outside diameter. The preferred side entry mount for new columns and outreach arms is 42mm outside diameter and a new pole top attachment is 76mm outside diameter.

An adjustable tilt is an advantage to allow the luminaire to be used on a number of different situations. An adjustable tilt of +5˚ or -10˚ in incremental steps of 5˚ is desirable.

LED luminaires shall be a standard product that is capable for use via any independent variable lighting system (dimming) and or Central Management System (CMS). The CMS control may be via radio frequency (RF) or power line carrier (PLC) and may utilise a mesh or star network. Refer to Appendix VIII for a diagrammatic description of a Road Lighting Central Management System (CMS). Refer also section 16.

27.7 Compliance

All luminaires must comply with all sections and parts of AS/NZS 1158 series. Refer to the website www.standards.co.nz. Luminaire compliance with IEC 60958.2.3 is required.

All photometric data provided must be supported by an independent test report from a laboratory which is endorsed by IANZ, or carrying the endorsement of an accreditation body which is a signatory to the ILAC MRA for testing.

Every luminaire submitted for consideration must be electrically tested and be fully compliant with the current version of the Electricity (Safety) Regulations. A completed Supplier Declaration of Conformity (SDoC) form available from the Energy Safety website (www.energysafety.govt.nz) is to be provided.

In addition to the above, a Producer Statement (PS) from the luminaire manufacturer with reference to complying standards must be provided. Appendix V shows a sample producer statement.

The following support data must be provided for each specific luminaire:

a) An independent test report from a laboratory which is endorsed by IANZ, or carrying the endorsement of an accreditation body which is a signatory to the ILAC MRA for testing.
b) Declaration of Conformity
c) Producer Statement for Luminaire Manufacture
d) Where a luminaire is specified with a LPC (Light Point Controller), the component manufacturer must have EMC certification for the LPC device(s).

27.8 Labelling

Labelling of all luminaires shall be in accordance with AS/NZS 1158 Part 6 (or future replacement), i.e. "L" for solid-state lighting followed by the system wattage e.g. "L58".

27.9 Protection from Overvoltage

Protection from overvoltage events is necessary to ensure reliability and functionality of LED luminaires shall be in accordance with AS/NZS 1158 Part 6 (or future replacement), i.e. surge protection shall protect **ALL** the electronic componentry of the luminaire. The device(s) shall be able to withstand a number of overvoltage events before needing to be replaced. It shall also have a means of indication that shows when it needs to be replaced.

Protection of overvoltage shall comply with EN 61547 and IEC 61643. The minimum requirement for surge protection in each LED luminaire shall be 10kV/10kA.

27.10 Power System and Power Quality

The overall power installation of any lighting system measured at the point of connection (the electricity meter) must meet certain criteria to ensure the RCA is not charged by the Electricity Distribution Company for poor power quality, poor power factor or bad harmonic emissions. The minimum acceptable power factor is 0.9.

Harmonic distortion and flicker shall be "limited as required by the electricity distribution companies code, and where this does not exist, shall meet the 6100 series joint Australian/NZ EMC Standards".

27.11 Luminaire Attributes

The following luminaire attributes shall be considered when considering an LED luminaire:

a) Technical lighting performance
b) Energy consumption/efficiency
c) Whole of Life Cost
d) Expected life
e) Lumen depreciation
f) IP Rating
g) Warranty period
h) Ease of installation and maintenance
i) Environmental considerations (UWLR, glare and spill light, etc)
j) Recyclability
k) Aesthetics and appearance

New luminaires shall be better than or within 10% of the defined performance indicated in section 21 of this specification.

28 ACCEPTED LUMINAIRES

Before allowing extensive use of a new technology on the lighting network, an RCA needs to be confident that it will **NOT** have a negative impact on long term operating or maintenance costs.

Submissions for acceptance by an RCA of any new luminaire product must comply with the requirements of this document and be supported by full provision of the LED luminaire attributes described in section 27 above.

The review and/or acceptance of new LED product must occur prior to the design of a particular project. RCAs should establish a process for assessing new products.

A list of luminaires assessed in accordance with this specification and accepted for installation on the State highway network is available on the Transport Agency website: www.nzta.govt.nz/consultation/specification-and-guidelines-for-road-lighting-design/index.html

Associated with the acceptance and specification of the above listed luminaires is the minimum requirement for "future proofing" the installation to be incorporated into a Central Management System (CMS) either now or in the future. For example, the minimum specification shall include a variable (dimming)/CMS compatible driver with the ability to add an LPC (Light Point Controller or Luminaire Controller) now or at a later date without requiring expensive wiring modifications.

Should the RCA determine that the qualification testing was flawed, that in-service performance reveals unacceptable issues, or that the luminaire being marketed differs significantly from that which was tested, it shall reserve the right to rescind or modify, at any time, acceptance of any luminaire.

Any of the above luminaires may be used as replacements for a new lighting project upgrade.

Although conventional high pressure sodium luminaires are **NOT** recommended for general use on future RCA projects there may be particular situations where it is advantageous to use HID road lighting luminaires with HPS HO twin arc lamp sources. This must be substantiated via "Whole of Life" calculations.

PART 4 CONSTRUCTION AND INSTALLATION

29 TEMPORARY LIGHTING

If any existing roadway is to be diverted, modified or re-routed to allow the construction of any new works, existing lighting levels must be maintained or improved on during the construction over the diverted or modified route. If existing luminaires are disconnected or removed before adjacent new lighting has been commissioned, then temporary lighting shall be provided. Temporary lighting, including any new luminaires and columns shall be compliant with AS/NZS 1158 for temporary routes unless stated otherwise.

Temporary lighting shall be supplied via a stand-by generator that does not have a detrimental noise effect.

Mobile trailers with low height structures with high output asymmetric floodlights attached are unacceptable for temporary lighting on roads due to their production of high intensity light levels with risk of excessive glare and spill light.

If a Contractor is requesting temporary lighting as part of their construction methodology then it shall form part of their temporary traffic management plan and be approved by the Lighting Designer, Peer Reviewer and the RCA. Existing lighting must not be altered or disconnected until approval has been given and the installation of all temporary lighting is fully operational.

29.1 Construction Activity or Security Lighting

Temporary lighting for construction activities or security lighting for construction sites (excluding road lighting purposes) shall have glare and spill light control compliant with AS 4282. This lighting shall be fully compliant with the requirements of the District Plans for obtrusive light.

In temporary construction sites, spill lighting, glare and “headlight sweep” can cause a detrimental effect. Mitigation of these effects can be controlled with full cut-off luminaires, sunshade screening and buffer zones. Construction and security lighting is usually of a temporary nature and shall be minimised with careful location of site offices and equipment in relation to surrounding properties. It is recommended there be a minimum 10m buffer zone between any equipment or area requiring construction or security lighting and an adjoining property.

30 COLUMN LOCATIONS

Lighting columns shall be determined based on good traffic engineering practice and should be positioned in line with the common side boundary between properties, however these locations do not always coincide with the spacing requirements of the lighting design. If an adjacent property has not been developed and the column cannot be positioned in line with the common boundary, locate the column at least 8m from the boundary to allow for a future vehicle entrance.

Position columns at least one metre away from a vehicle entrance or kerb cut down. Keep columns clear of any tree canopies in the road or in adjacent properties to prevent

shading of the luminaire. Tree trunks in a legal road or other legal road reserves shall be at least 8m away from lighting columns or 5m from the drip line of a mature tree and more clearance may be necessary for some tree species or if the tree is protected. Consider the RCA's requirements for working near existing trees when locating lighting columns.

When installing a column against the building line, ensure that it is installed within the legal road or on RCA land, and not on private property. If the column or outreach bracket has a backward element, be aware of the possibility of aerial trespass.

Where possible, columns should be located (laterally) close to reserve entrances, bus stops and other open spaces to improve safety.

Consider traffic safety when placing lighting columns, especially when they are on or near bends, intersections, threshold treatments, road humps and roundabouts.

Where possible, reduce street hardware by combining traffic lighting and road lighting poles.

Column placement shall be considered by the designer in relation to access and future maintenance. Avoid placing columns in hard to access areas and avoid locating columns within storm water swales.

30.1 Column Placement and Setback from Road or Path

Column setback must be considered as part of the lighting design (refer AS/NZS 1158.1.2).

The preferred location for all passively safe columns is 3m behind kerb line or edge of seal. Alternatively, columns may be located adjacent to property boundary lines. Minimum column setback from the kerb face to front face of column is to be 1.0m for a passively safe column but this can be reduced to a minimum setback of 0.7m for straight sections of road away from intersections and roundabouts.

Columns shall be installed within +/- 100mm of the approved marked location both longitudinally and laterally. Height above finished ground level to ± 50mm of the manufacturer's level. Columns shall also be within 1° of vertical.

If the road is at a different level to where the column is being located, specify columns that will achieve the correct mounting height above the road surface to ensure the installed lighting complies with the design requirements. For each light type the mounting height must be uniform and consistent. If a column is located within a swale the designed mounting height shall be maintained.

If the column is a rigid type (non-frangible) it shall be setback a minimum of 3m from edge of seal for roads with a speed limit not exceeding 70km/h or 6m for roads with a speed limit exceeding 70km/h.

Where columns are to be installed behind guardrails (crash barriers) an absolute minimum clearance of 1.0m between the face of the guardrail and the face of the column is required. Where this clearance cannot be achieved the guardrail shall be strengthened by

an accepted method. Acceptance by the RCA shall be confirmed in writing prior to any installation starting.

No columns shall be installed within 15m of any guardrail end terminal.

30.2 Column Placement and Clearance from Overhead Aerial Conductors

The Installation Contractor is responsible for ensuring all clearances are met and the approval of the Electricity Distribution Company is obtained. Clearance between lighting columns and any overhead distribution lines shall conform to the requirements of NZECP 34.

No installation of new equipment such as a new outreach bracket is permitted where it is required to be done under "live line" (no interruption of supply) conditions.
Electricity Distribution Companies have minimum clearance requirements from columns, poles, outreach arms and luminaires to any overhead electrical conductor that must be maintained at all times. Clearances are measured from the closest part of the lighting installation to the nearest conductor. Clearances shall include an allowance for conductor sway and sag plus the fall distance of a column, outreach arm and luminaire. Fall distance is to be taken in direction of traffic flow.

Minimum clearances also include minimum height clearance with an allowance for the installation of a replacement column.

31 COLUMN INSTALLATION AND FOUNDATIONS

The Transport Agency's preferred column types are indicated in Specification M26. The use of any other type of column must have the RCA's approval prior to ordering materials.

Columns shall be installed as per the manufacturer's recommendations.

Where the longitudinal grade may exceed 1V:6H or the cross fall of a road may exceed 6%, it may not be possible to service the light from an EWPV. In these situations discuss alternative column types with the RCA (e.g. columns that have a ladder rung to allow the light to be serviced via a ladder **OR** a hinged arrangement).

When a special foundation is required provide a producer statement when applying for engineering approval. Include a hold point for construction to allow inspection of the foundation before concrete is poured.

When columns requiring special maintenance visits are specified (e.g. frangible – shear base columns), provide the RCA with a maintenance plan detailing maintenance intervals and work/inspections that need to be carried out.

32 INSTALLATION AND COMMISSIONING

Carry out installation and commissioning in accordance with the RCA's contract requirements.

The Contractor/Designer must have a procedure to ensure that construction work that does not conform to the specified requirements is either:

a) Reworked to meet the specified requirements
b) Accepted with or without repair by concession from the RCA
c) Rejected and replaced

Record all non-conforming work on the relevant construction check sheet. The Contractor shall produce a Non-Conformance Report and send it to the Designer if the construction non-conformance is significant in that it either:

a) Results in the need for written concession
b) Results in delay or interference to the work or to other parties
c) Indicates that the fault has occurred due to the use of incorrect work practices and/or failure of materials and could have been prevented
d) Occurs sufficiently frequently as to indicate a problem in training or procedures
e) Is a safety issue

The report and supporting documentation must clearly indicate the action to be taken to rectify the fault, the timeframe and responsibilities. It must be authorised by the Designer and forwarded to the RCA.

In cases involving concessions, the Designer and the RCA must accept the proposed rectification (the corrective action) of the non-conforming work in writing prior to implementation.

32.1 Testing

Any work required to be tested by the contractor in the presence of the Designer must be pre-tested and proved satisfactory before test witnessing by the Designer and or the RCA is requested.

32.2 CMS Testing and Commissioning

Testing and commissioning shall be completed for the entire installation. Testing following initial installation of hardware and software on site, including commissioning of links with the RAMM database. The CMS and/or Gateway Supplier'(s) shall be on site for the duration of this commissioning.

All specified CMS systems must include 'system redundancy' and 'default operations' for CMS failure i.e. all luminaires should still operate from memory of previous nights on/off cycle and collect and store data from the LPC that may have been missed due to failure of communication to the CMS when fault repaired and CMS restored. "System redundancy" safeguards the speed of communication between Gateways, LPC's and the CMS.

Commissioning shall be deemed to be complete upon the RCA's acceptance of user documentation, the completion of commissioning and any initial training.

33 COMPLETION PROCEDURES AND CERTIFICATION

At the completion of the physical works, the Lighting Designer shall check and then certify that:

a) The project has met all the requirements of the project brief, the standards and specifications
b) All the documentation detailed below has been completed, is correct and has been forwarded to the RCA

At the end of the defects liability period, the Lighting Designer shall carry out an audit and certify that lighting columns are vertical and luminaires have been installed and operate correctly and are at the correct mounting height and at the correct tilt. Illuminance readings are to be taken to verify the installation is achieving within 10% of the design.

The following documentation shall be provided:

a) Electrical Test Certificates for each lighting column
b) Electrical Certificate of Compliance for the complete scheme
c) As-built information in a format suitable to be loaded into the RCA's Road Lighting Asset System
d) Completion Certificate (see Appendix VII)
e) Contractor documentation required by the construction specifications (e.g. construction completion certificate)
f) Any special maintenance requirements (e.g. shear base columns or high mast columns)

Delivery of **ALL** the above documentation **SHALL** occur within one month of livening the installation. If the livening of luminaires is being staged to match other construction works or part of the final installation is being used as temporary lighting for construction works to continue, the above documentation **SHALL** also be staged.

34 COMPETENT CONSTRUCTION PERSONNEL

All construction work is to be undertaken by competent/approved contractors. Any and all Subcontractors, including supervised apprentices employed, must work under the supervision of a competent (approved) person.

Works on or near any Electricity Distribution Company asset can only be carried out by or under the direct supervision of approved personnel.

The contractor is responsible for **ALL** safety procedures throughout the work site(s) and shall use and maintain appropriate safety barriers, warning signs, etc. to protect all workers and the public from all hazards and hazardous situations.

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APPENDICES

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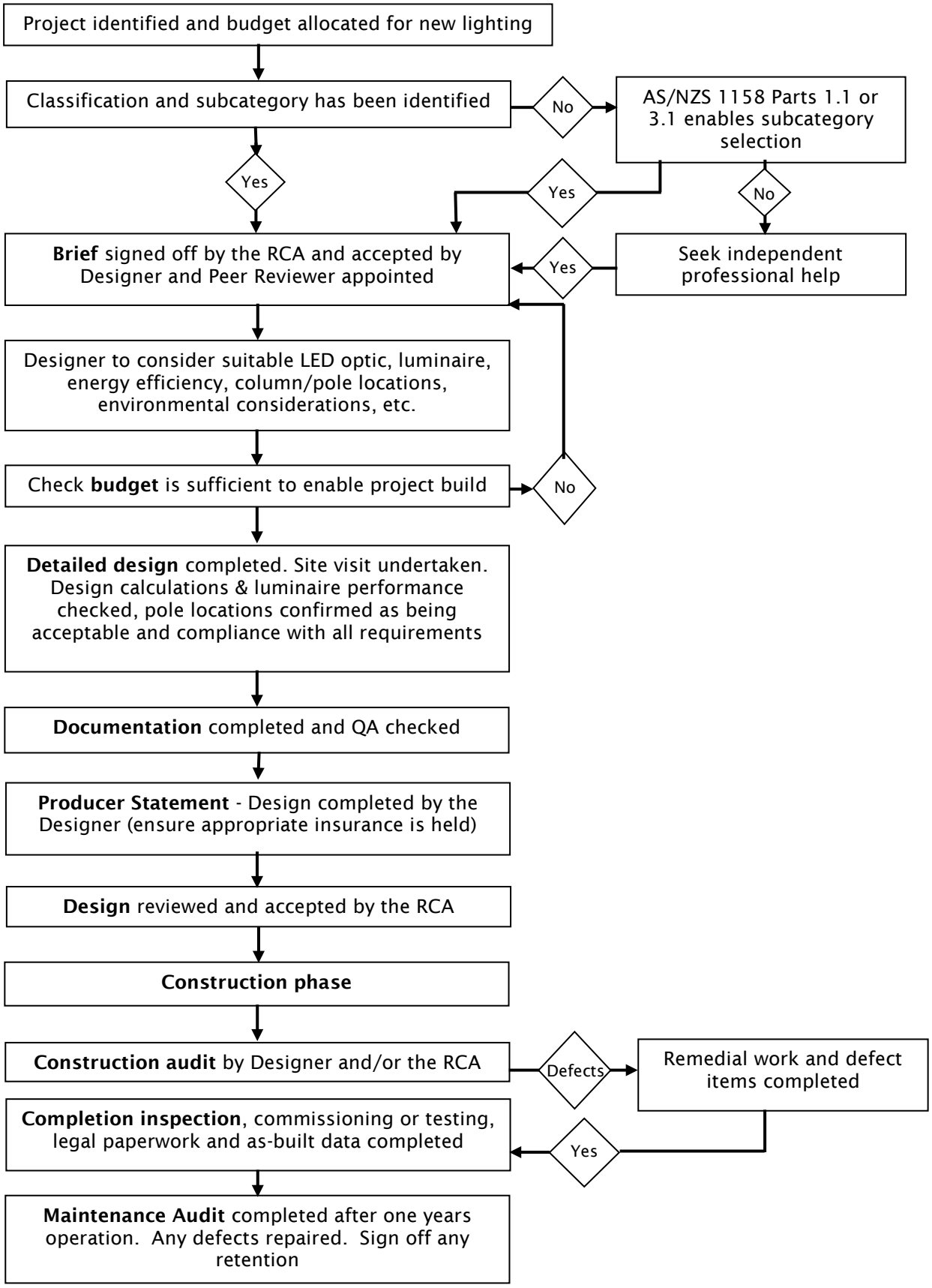
Appendix I - Design and Construction Process Example (informative)



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Appendix II – Lighting Design Report (normative)

_____ *(project name)*

_____ *(project number)*

Drawing Revision: _____ Date of Issue: _____

Project Personnel

Designer:		
Title:	Address:	
Telephone:	Mobile:	Email:

Road Controlling Authority:		
Title:	Address:	
Telephone:	Mobile:	Email:

Design Peer Reviewer:		
Title:	Address:	
Telephone:	Mobile:	Email:

Project Manager:		
Title:	Address:	
Telephone:	Mobile:	Email:

Full Description of Work

Full description of proposed works

Concessions

Identify any work, which does not conform to the specified requirements, which will require a concession from the RCA. The concession(s) proposed will be discussed and must be accepted by the RCA in writing prior to execution.

Design Records

The following design records were produced for this design and are appended where noted: *(e.g. engineering design drawings, specifications, calculations, and material specifications where not detailed elsewhere, column details, photos, etc.)*

Project Management

Detail how construction of the project will be managed to ensure the design will be successfully implemented.

Communication with Stakeholders and Other Parties
Describe how communication with stakeholders and other parties will be managed.

Lighting Design Statement is attached

This Design Report has been:

Prepared by: _____
(Designer) (Name/Signature/Date)

Reviewed by: _____
(Peer Reviewer) (Name/Signature/Date)

Approved by: _____
(Principal Designer) (Name/Signature/Date)

Appendix III - Lighting Design Statement (LDS1) – Design (normative)

Issued by: _____ *(Designer's name)*

To: **RCA**

In respect of: _____ *(Description of design)*

At: _____ *(Location)*

_____ *(Address)*

Lot: _____ **DP:** _____

_____ *(Design Company)* has been engaged by

_____ *(Client)* to provide design services for

_____ in respect of the project requirements

Described above for All ☐ Part only as specified ☐

The design has been prepared in accordance with Transport Agency M30 and AS/NZS 1158 *(category)* and the work is described on _____drawing(s) titled _____ and numbered sheet _____ of _____and the specification plus other documents according to which the construction is proposed to be constructed.

I _____ *(name)* have the necessary qualifications and experience as an independent lighting design professional covered by a current policy of Professional Indemnity Insurance to a minimum value of $_____ and **I BELIEVE ON REASONABLE GROUNDS** that subject to:

(i) The verification of the following design assumptions:_____

_____

_____

and (ii) all proprietary products meeting the performance specification requirements, the drawings, specifications, and other documents according to which the development is proposed to be constructed will result in a compliant design.

_____ Date: _____

(Signature suitably qualified Design Professional on behalf of Design Company)

Qualifications and experience:_____

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Appendix III - Lighting Design Statement (LDS4) – Construction Review & Audit (normative)

Issued by: _____ *(Designer's name)*

To: **RCA**

In respect of: _____ *(Description of design)*

At: _____ *(Location)*

_____ *(Address)*

_____ *(Contractor)* has been contracted to the RCA to carry out and complete certain building works in accordance with contract,
titled _____ (*known as the Contract*).

_____ *(Lighting Design Company)* has been engaged by _____
in accordance with the Contract.

I, ... (*Principal Designer*) a suitably qualified design professional and duly authorised agent of the Contractor's Head Designer confirm that reviews of the Contractor's construction have been carried out with due skill, care and diligence as it relates to:

and I believe on reasonable grounds that these works have been carried out and completed in accordance with the Contract Documents.
I agree that the terms used herein have the same meaning as assigned to them in the Contract.

.....
(Signature of suitably qualified design professional on behalf of Design Company)

..... Date: .....
(Professional Qualifications)

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Appendix IV - Drawing Layout and Format Requirements (normative)

Provide drawings to a minimum standard that complies with AS/NZS 1100.

Where road lighting will be altered, label all affected poles/columns and luminaires as detailed in table below:

- Label poles to be removed with "R"
- Number each affected road luminaire with the related number from the lighting schedule on the drawing. For example L1, L2, L3, etc.
- Label existing poles/columns/luminaires that won't be affected as "E". Show the lighting wattage of all proposed and remaining luminaires
- Refer to section 22.6

Symbols

Symbol	Use	Numbering System
Pxxx	Every pole/column upon which work is to be carried out shall be identified. Existing poles/columns shall have construction material and manufacturer's pole code shown on the drawing	Prefix to be followed with unique identifier either Electricity Distribution Company's pole number or sequential column number for the project
Lxxx	Any alteration to the existing lighting or proposed new installation. Provide separate codes for replacement, new and differing luminaire, lamp, column or outreach arm details	Prefix to be followed with unique identifier
Rxxx	Any lighting equipment to be removed that is not covered by an "L" reference	Prefix to be followed with unique identifier
E	Existing luminaire to remain	Not applicable

Title Blocks

The title block must include the following information:

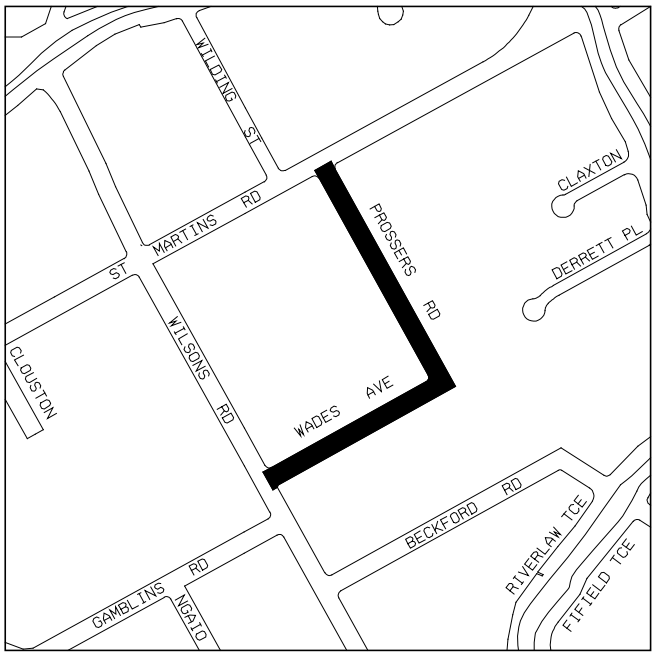
- A project title, including street names
- A unique number or identifier, preferably the consent or project number
- The designer's name, signature and contact details
- The peer reviewer's name and signature
- The stage of work e.g. "acceptance", "tender", "construction", "as-built"
- The date of preparation and of approval
- The scale or scales used
- The original sheet size
- Sheet numbers, including the number in the set
- An amendment box, including brief description of amendment and sign off by designer/peer reviewer

Format
Drawings must be legible at A3 size and can be drawn to a scale of 1:500 or 1:1000.

Prepare electronic drawings in an industry standard format suitable for later addition of as-built information and inclusion in the RCA's asset system. Drawings can be supplied in electronic format as dwg, dxf, pdf or tif files.

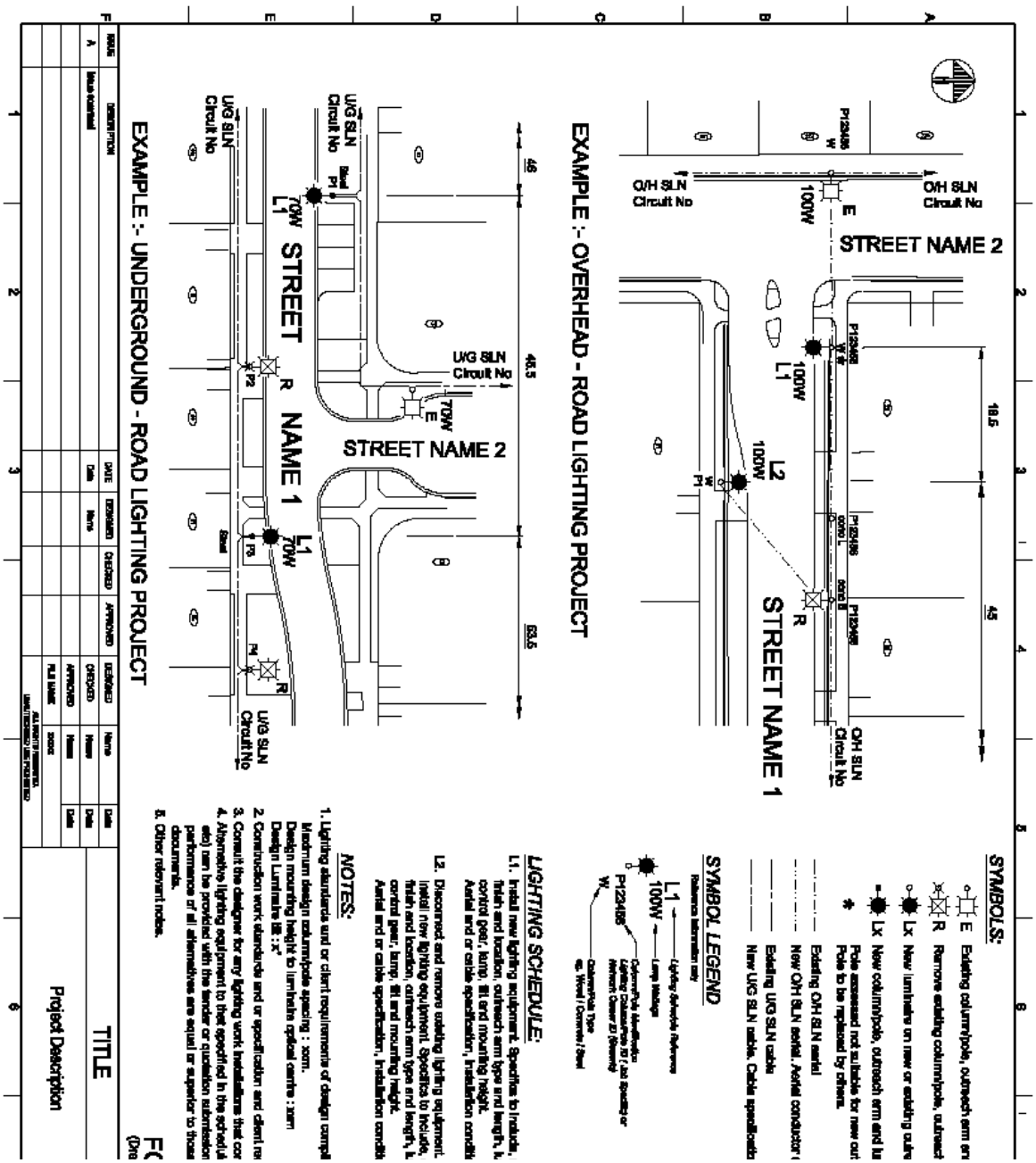
Locality Diagram
Show the road boundaries and street names where considered necessary. Show the limit of the development. Draw the locality diagram true to the map orientation or at the same orientation as the engineering drawing.

Example Locality Diagram:



LOCALITY DIAGRAM

Example Road Lighting Design Drawing:



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Appendix V - Sample Manufacturers Producer Statement (informative)

Company Logo, Letterhead, Name and Address

Sample: Producer Statement for Luminaire Manufacture

Date:

Luminaire Model Reference:

General
Confirmation that the complete luminaire is **FULLY** compliant with AS/NZS 1158.6. Copies of relevant test reports are available on request and include:

- IP Testing
- Wind Testing
- Impact Testing
- Copper content

Quality Control
Documentation to show that the luminaire has been manufactured within a manufacturing environment that conforms to the requirements of AS/NZS/ISO 9001 shall be provided from TELARC SAI (or equivalent organisation).

Luminaire
Confirmation that the LED luminaires performance is documented in accordance with IESNA LM79 and TM21. Appropriate reports shall be provided to confirm that all the following characteristics have been addressed:

- Power Management
  - protection from electrical transients
  - driver current control
- Thermal Management
  - maximize performance, reliability and life expectancy
  - ensure all other component temperatures do not exceed limits
- Optical Management
  - light output is correctly shaped and directed towards the desired area
- Assembly Integrity
  - overall housing provides protection from dust, moisture, vibration and other environmental effects

Optics
Photometric performance (in absolute format) is supported by an independent IANZ or NATA laboratory report. I-Tables are provided in both CIE and IESNA formats.

Materials and components
Identify key material components and applicable standards.

Component	Standard	Manufacturer
Main body - steel		
Main body - aluminium		
LEDs		
LED assembly		
LED lens		
Driver		
Glass visor		
Acrylic visor		
Gasket		
Terminations		
Screw fixings		
Mounting adapter		
Surface finish		
Other		

Quality Assurance
Production factory has the following recognised plant and procedures that are fully utilized during manufacture e.g. ISO 9001.

Electrical Safety
Electrical Safety of the luminaire is compliant with the Electricity (Safety) Regulations 2010 and is supported with a Supplier Declaration of Conformity (SDoC).

Signature:
Name:
Title:

Appendix VI - Lighting Design Peer Review Certificate Template (normative)

Project Description: _____

Client: _____

Asset Owner: _____

Drawing Ref Number: _____ **Drawing Issue:** _____

Review Date: _____

A review of the lighting design information provided has been completed with reference to the following criteria:

1. AS/NZS 1158 sub category _____ This has been confirmed by the asset owner as the design criteria for this application	Yes ☐ No ☐
2. Specific asset owner requirements as identified within the brief or consent application have been met	Yes ☐ No ☐
3. Lighting calculation data provided confirms compliance with AS/NZS 1158 category _____	Yes ☐ No ☐
4. Photometric data provided originated from a certified laboratory and the calculations have been produced from an industry-accepted source	Yes ☐ No ☐
5. Proposed lighting columns, utility poles, outreach brackets (arms) and luminaires, etc. are acceptable for use by the asset owner *Equipment not used previously needs the prior acceptance of the asset owner*	Yes ☐ No ☐
6. Lighting Design Statements (LDS 1) for design, luminaire and column manufacture with reference to complying standards have been provided	Yes ☐ No ☐
7. Landscaping, kerb build-outs and/or traffic management devices that are included in the project area are indicated on the drawings and are to be illuminated to the required level	Yes ☐ No ☐
8. Environment and maintenance issues such as water ingress, column/pole attachments, replacement parts, lamp access, glare and upward waste light, etc. have been considered	Yes ☐ No ☐
9. Effect of the new lighting on adjacent residents, adjoining roads, construction methodology and surrounding area has been considered as part of the overall design	Yes ☐ No ☐

10. Cable design has been reviewed by the Designer ☐ or by Electricity Distribution Company ☐ *Note the lighting designer may not always be responsible for the Network Cable Design*	Yes ☐ No ☐

The following non-compliance issues require action

Comments

A copy of the information reviewed is attached. **Yes** ☐ **No** ☐

After reviewing this lighting design I believe it is acceptable and it **meets / does not meet** (*delete one*) the lighting design requirements of the asset owner referred to above.

Design reviewed by:

Signed: _____ **Date:** _____

Name: _____ **Position:** _____

Company: _____

Appendix VII - Completion Certificate (normative)

To: _____ *(Asset Manager)*

RCA

From: _____ *(Designer's Name)*

_____ *(Designer's Address)*

Lighting installation works at: _____ *(Location)*

The above project has been completed by _____ *(Contractor's Name)*

All work has been carried out in accordance with the contract documentation and approved variations plus any additional requirements specific to this project.

All the tests were successfully completed and the luminaires were livened on _____ *(Date)*

and the maintenance period can commence from this date.

The following documentation is enclosed:

- ☐ Test Certificate for each Lighting Standard
- ☐ Electrical Certificate of Compliance
- ☐ As-Built Information
- ☐ Removed Lighting Equipment List
- ☐ Cable Recording Information

(Signature)

_____

(Print

_____

(Date)

_____

Note:

A completion certificate similar to this can be used by the Contractor to submit to the Designer when construction is completed. This certificate can then be forwarded to the RCA by the Designer with ALL the other completion documentation.

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Appendix VIII - Road Lighting Central Management System (CMS) (informative)