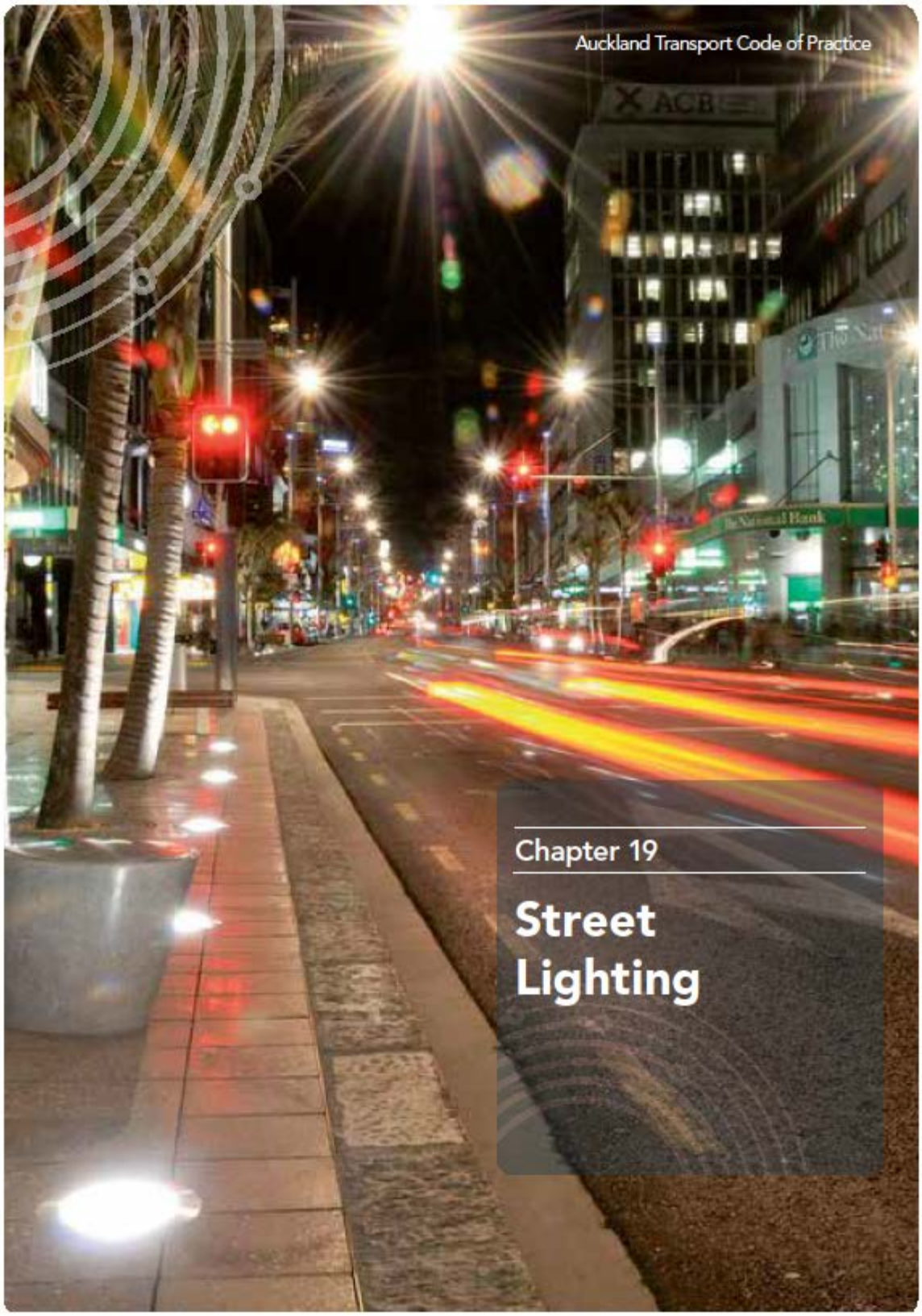

Auckland Transport
An Auckland Council Organisation

19 Street Lighting

19.1 Street Lighting Guidelines

It is essential that AT's Street Lighting Guidelines (PDF 115KB) are read before reading the rest of this chapter.

19.2 Introduction

This document provides a guide to those who become involved in the management and design of public lighting installations. The underlying standards provide the detail required to achieve the standard of street light installation Auckland Transport expect on the network.

Auckland Transports objective is to ensure that the public lighting network is attractive, of good quality, easy to maintain, and cost effective. The purpose of public lighting is to provide a safe environment for pedestrians and vehicles and to discourage illegal acts. In achieving these objectives care must be taken to minimise spill light onto neighbouring properties and upward light, sky glow.

This guide includes but is not limited to:-

- Roads.
- Pedestrian Crossings.
- Pedestrian and Cycle Paths.
- Public Precincts (e.g. Shopping Precincts)
- Outdoor Car parks.
- Steps, Stairs, Ramps, Subways and Footbridges.

It excludes:

- Building Interiors.
- Building Facades.
- Signs.
- Indoor car parks
- Sports fields

Where clauses differ from existing standards, the requirements of this document shall apply.

It should also be noted that:

- Lighting other than street lighting in a designated public road may require Resource and Building Consents.
- Street lighting shall be designed in accordance with all applicable New Zealand Standards including but not restricted to the current version of AS/NZS 1158 Lighting for Roads and Public Spaces series of standards.

This document will be subject to periodic review.

19.2.1 Codes, Regulations and Standards

The codes, regulations and standards referenced in this document shall be the latest version complete with all amendments.

All works are to be carried out in accordance with all relevant statutes, bylaws and regulations and in particular:

a) The Electricity Act 1992, Electricity Regulations 2010, the relevant Electrical Codes of Practice (ECP) referred to in this, and relevant Standards referenced in ECP3.
b) New Zealand Radio Interference Notices 1958 and 1985 and Radio (Television) Interference Notice 1961.
c) Health and Safety Employment Act 1992.
d) Health and Safety Amendment Act 2001 and regulations
e) Relevant Statutory Acts, Regulations and Bylaws.
f) The requirements of Network Supplier's Health and Safety Standards (NHSS)
g) AS/NZS3000 – Australia/New Zealand Wiring Rules
h) AS/NZS1158 – Road Lighting
i) AS/NZS 7000 - 2010 Overhead Line Design.

19.3 Lighting Classifications

The classifications shall be determined and set (specified) by Auckland Transport who reserves the right to change a road's lighting hierarchy classification.

The "Right Light Guide" is found on the following web site *http://www.rightlight.govt.nz/road-lighting/category-selection*. This should be used to establish the lighting classification of a road when no other information is available. The lighting classification must be agreed by Auckland Transport before design begins.

There is a guide for categorising 'P' roads to support the Standards. This can be found on the internet under Auckland Transport.

The following Table provides an informative guide to determine the road hierarchy classification. However, it should not be considered in isolation, but shall be read in conjunction with the AS/NZS 1158.1.1 and AS/NZS1158.3.1 Standards in order to determine the appropriate lighting classification and sub category:

Table 70: Categories

Road/Area Type	Traffic counts VPD	Category
Major/Minor Roads	>20,000	V1
	15,000 to 20,000	V2
	5,000 to 15,000	V3
	3,500 to 5,000	V4
	750 to 3,500	P3
	<750	P4
Cycleway	N/A	P3
Accessway	N/A	*

Public Activity	N/A	P6,P7,P8

*Accessways must be lit to the appropriate P Category as set out in the current version AS/NZS1158 3.1 which classifies accessways as Pathways (including Cycleways). Table 2.2 defines the criteria for determining the lighting subcategory. The Auckland Transport P Category Calculator Tool shall be used to assist with the classification. LED luminaires must be used in all accessways and must be pole top mounted to allow access from a ladder.

Where Accessways are bordered by wooden fencing, being the residential property boundary, careful consideration must be given to Spill Light over these adjoining residential properties. Where this is determined to be an issue, Bollard style Luminaires (maximum height to the height of the adjoining fences) may be used to minimise obtrusive light and obstruction to residents view shafts. Utilisation of Bollard style Luminaires should be at a maximum spacing of 25m which will provide a good level of guidance lighting. Auckland Transport accepts that in these circumstances compliance with the current version AS/NZS1158 3.1 is unlikely to be achieved.

Check with Auckland Transport that the lighting classification road is correctly determined and agreed before proceeding with lighting designs.

Other spaces (e.g. public precincts, transport terminals, etc.) shall be classified in accordance with the current version of AS/NZS 1158.part 3.1.

19.4 Lighting Columns

19.4.1 Compliance

All street light columns must comply with the *"Street Lighting Column Specification and Assessment Methodology"* Appendix C

19.4.2 Numbering of Columns.

Each column shall be individually numbered at time of manufacture together with the month and year of manufacture. In addition to the unique column number there shall be a QR code attached for easy on site data availability. The labels will be attached 2.0 metres above ground level.

19.5 Roadway Lighting Column Locations

The minimum column set back from kerb face to face of column should be at least 700mm, in accordance with the current version of AS/NZS 1158 unless otherwise agreed with Auckland Transport.

However, common sense should be used to avoid lighting columns being positioned on footpaths in a way that obstructs pedestrians. For this reason, the preferred position of street lighting poles is clear of footpaths and where this is not possible - towards the back edge of footpaths. A clear 1.5m minimum footpath space should be allowed.

19.6 Luminaires

19.6.1 General

Luminaires must be manufactured & tested in accordance with and comply with the current version of AS/NZS 1158. Part 6.

A Certificate of Compliance from an accredited, independent testing laboratory shall be made available on request for each luminaire.

All luminaires must comply with Auckland Transport (AT) HID (Appendix A) and LED (Appendix B) Road Lighting Specification respectively and be included on the Approved List.

In-ground up-lights shall also meet the following minimum requirements:

- AS/NZS 60598.1: 2003;
- In trafficable areas, the luminaire shall not present a tripping or slip hazard.
- Impact resistance of IK10.
- Ingress protection of IP 68.
- Anti-glare attachments to be positioned to limit the upward light to passing traffic.

19.6.2 Fluorescent Lamp Efficacy

All fluorescent lamps of length 550 mm or greater shall comply with NZHB 4782.2. In particular, they shall meet the requirements of Class R in relation to lamp efficacy.

19.6.3 Labelling

Labelling shall be in accordance with the current version of AS/NZS 1158.Part 6.

19.6.4 Bollard Luminaires

Bollards are not preferred and will only be permitted if approved in writing by Auckland Transport. A recognised possible application would be for narrow walkways between residential boundaries where the spill light limits can't be achieved using column mounted luminaires.

- Construction & finishes to be consistent with the requirements for Columns and luminaries.
- The maximum luminous intensity in any normal viewing direction shall not exceed 500 cd/m^2.

19.6.5 Luminaires currently in use

All new public lighting designs must use luminaires from the appropriate Approved List. Where "in fill" luminaires are required it is acceptable to use luminaires of a similar type, provided the lighting design scheme meets the respective requirements of either AS/NZS1158.1.1 or AS/NZS1158.3.1 as appropriate.

Generally "in fill" lighting shall be restricted to a maximum of 3 luminaires along a section of road.

Approved Luminaires.

All new luminaires must be included on the Approved List of luminaires before they can be utilised on Auckland Transport network. The approval process is set out Appendix A for HID Luminaires and Appendix B for LED Luminaires.

19.6.6 Lighting Design

The lighting design shall comply with requirements set out in this Code of Practice and the current version of:-

- AS/NZS 1158.1.1 - For roads where the needs of vehicular traffic dominate (Category V) lighting.
- AS/NZS 1158.3.1 – For roads where the needs of pedestrian traffic dominate (Category P) lighting.
- AS 4282 – For control of the obtrusive effects of lighting.

19.7 Luminaire Spacing and Column Height

The lighting design must maximise the spacing between luminaire positions optimising the mounting height, luminaire type and lamp output.

19.7.1 Spill Lighting and Glare Control (Obtrusive light)

The lighting design must minimise the impact on the neighbouring properties and environment with regard to glare and spill light.

Requirements aimed at minimizing the obtrusive effects of Public Lighting are addressed in the current version of AS/NZS 1158 Lighting for Roads and Public Spaces covering Vehicular Traffic (Category V) and Pedestrian Area (Category P) Lighting.

Further guidance is provided in AS 4282 – Control of the obtrusive effects of lighting.

In addition the following criteria apply:

1. The maximum tilt for a luminaire should be 5 degrees from the horizontal, tilts up to 10 degrees from the horizontal may be used in exceptional cases.
2. The Threshold Increment (TI) along the road shall be no greater than 10% with the pedestrian traffic lights included in the calculation as well as the adjacent street lights.

Note: External screens are not to be used.

19.8 Trees and Road Lighting Luminaires

19.8.1 Where trees are existing

- For mature tree-lined roads, if single sided, poles should be located on the road side opposite the trees. If there are trees on both road sides, lighting columns on each side may be required located midway between trees, having long outreach arms to reach out under the canopy. Careful pruning will be necessary to allow the light to pass under the tree canopy to the road. Consultation with the power and telecommunications utilities is required if there is overhead reticulation.
- Where there are existing overhead power lines the luminaires will require long outreach brackets from the existing power poles with lighting columns supplementing the road light from the other side of the road.
- Lighting Columns should be located at least 5m from the drip-line of any tree (based on the mature tree expected growth). Care should be taken to place street light columns where the tree root structure can't interfere with underground cabling or other underground services unless tree pits are used to confine the root structure.

19.8.2 For new roading installations

- Where there are areas of new planting proposed, consideration should be given to the potential impact of shadows from road lighting when the trees are mature. Care should be exercised when selecting the species of trees and positioning them in relation to street lights.
- In new subdivisions and developments lighting column positions must be located to provide the correct lighting levels in accordance with AS/NZS 1158 and this Code of Practice. Only then should trees be located to create the future daytime aesthetics and shall not be within 5m of any Lighting Column. This measurement is taken from the drip-line of the canopy of the mature trees species proposed to be planted.

There is no simple single solution applicable for all roads or streets, which already have existing trees, but there should be a high level of coordination between the trees and the placement of lighting columns to provide an acceptable urban landscape.

19.9 Lamps

Lamps must meet the minimum light outputs for each standard lamp size specified in the HID Road Lighting Luminaire Specification and Assessment Methodology - Appendix 19A, and comply with the relevant International Standard Specifications.

19.9.1 White light.

The international trend in recent years has been to light public places in city centres and places of interest with 'white light'. The main advantages are:-

- Imparts natural appearance due to better colour rendition and generates a general feeling of security and wellbeing.
- Makes city centres and places of interest appear more natural and attractive, and thereby attract more people.
- Research indicates that 'white light' reduces an observer's reaction time and increases safety.

The disadvantage has been the high running cost of Metal Halide (MH) lamps and the high percentage of mercury contained within the lamp. This has now changed with the introduction of LED technology.

Locations where white light shall be used instead of High Pressure Sodium Lamps are:-

- All Category V Roundabout intersection.
- All Category V Traffic Light Controlled Intersections
- All Category V Intersections that are not either of the above configurations
- All Category P lighting design schemes – LED Luminaires Only
- City centres and other main centres
- Commercial areas where there is heavy pedestrian use at night
- Areas of significant tourist, historical, amusement and entertainment interest.
- Public transport facilities
- Areas that are monitored by security cameras
- Major intersections
- High risk pedestrian routes that are actively used at night.

19.9.2 High Pressure Sodium Lamps

High Pressure Sodium Lamps (Golden Yellow light) shall be used in all other locations where colour rendering is not important.

19.9.3 LED Technology

LED Luminaires included in the LED Road Lighting Luminaire Specification and Assessment Methodology Appendix ‘B shall be used for Category P lighting design schemes

19.9.4 Lamp replacements

Lamp replacements must utilise the minimum rated lumens defined in Appendix 19A: HID Road Lighting Luminaire Specification and Assessment Methodology be of the highest quality.

19.10 Road Lighting in Rural Areas

Road lighting in Rural Areas is addressed in AS/NZS 1158. Since the ambient light and sky glow in Rural Areas is significantly less than that in built-up areas, the impact of obtrusive light is much more pronounced.

AS 4282-1997 (Control of the Obtrusive Effects of Outdoor Lighting) will be used as a guide in these areas.

The following design guidelines apply:

- Keep road lighting to the minimum applicable standard at intersections and road terminations.
- Minimize lighting beyond these areas (intersections and terminations). Only provide sufficient lights such that a pedestrian walking along the road always has a light in view, for orientation and guidance.
- Priority shall be given to roads that are designated for traffic detours from main highways.

19.11 Safety and Security Lighting

Following the principles of Crime Prevention through Environmental Design (CPTED), lighting is considered one of a number of measures to be taken to reduce the risk of crime, improving safety levels on local roads and public spaces. Particular attention shall be given to the current version of AS/NZS 1158.Part 3.

19.12 Pedestrian Crossing Lighting

Pedestrian Crossings shall be lit in accordance with the current version of AS/NZS 1158.Part 4.

Luminaires with specifically designed photometric distributions must be used.

At an un-signalised pedestrian crossing AS/NZS allows the use of a Belisha disc or a flashing Belisha beacon. Auckland Transport will specify which is appropriate for the specific crossing.

19.12.1 Pedestrian Crossings (Traffic Signal Controlled intersections)

Where there are defined Pedestrian Crossing Routes at Traffic Signal Controlled intersections the following lighting design criteria shall apply in addition to those of AS/NZS11581.1 (Category V) and AS/NZS1558.3.1 (Category P):

Lighting Classification – Category V1 and V2 – Minimum 20 Lux Horizontal Point Illuminance

Category V3 and V4 – Minimum 10 Lux Horizontal Point Illuminance

Lighting Classification – Category P - Minimum 10 Lux Horizontal Point Illuminance

19.12.2 Local Area Traffic Management Devices (including roundabouts)

Devices intended to slow traffic.

(Category P roads only. Slows traffic and regulates its flow.)

3.5 lux horizontal point illuminance white light. Note this is not additional to road lighting.

Devices intended to deter traffic.

(Category P roads only. Devices intended to slow and deter through traffic.)

- **Reflective devices.** Installed in accordance with the Manual of "Traffic Signs and Markings"

Auckland Transport shall determine whether Local Area Traffic Management Devices are "slowing" or ''deterring" traffic and should be agreed before design begins.

19.13 Adjacent Access Routes

Where the primary area to be lit is accessed by a road, path or similar that is also required to be lit, the access way shall be lit to the same standard with lighting systems of similar appearance and quality as those in the primary area.

19.14 Design Solutions Based on Alternative Standards

Road lighting design solutions utilising computer calculations based upon CIE standards are acceptable provided that clear correlation is supplied to prove equivalence with the current version of AS/NZS 1158 requirements for the specific project parameters.

19.15 Equipment & Components

Electrical equipment and components shall be manufactured to comply with the applicable New Zealand or International Standards and shall be readily available as spare parts. These components shall be incorporated into the luminaire or column, be protected against the ingress of dust and moisture to the appropriate Ingress Protection (IP) level and be easily accessible for repair or replacement. Warranties on these components shall be the manufacturers' standard warranty, but no less than 12 months, and be applicable from the date of hand-over of the installation to Auckland Transport.

19.16 Energy Efficiency

The installation shall be designed for economic use of energy, applying the following principles:

- Electronic control ballasts shall be used for all luminaires up to and including 150w
- Power Factor ≥ 0.95 lagging/leading
- High efficacy lamps.

19.16.1 Ballasts.

- New luminaires with HID lamps, 150 watts and less shall have electronic ballasts fitted.
- In some areas within the region Auckland Transport will install dimmable ballasts. Auckland Transport will include this within the appropriate lighting design brief. The electronic ballasts in these areas will be fitted with a control interface of either DALI or 1-10 volts DC.
- All LED luminaire power supply drivers shall be fitted with a control interface of either DALI or 1-10 volts DC.

Note Electronic ballasts are more efficient than magnetic ballasts and prolong the life of the lamp by regulating the lamp voltage to within close tolerances.

19.16.2 Dimmable lamps.

Auckland Transport will be installing adaptive lighting in selected areas through the region. The principle of installing adaptive lighting (lighting that is adapted to the changing road utilisation conditions) has the advantage of further reducing spill light (obtrusive light), sky glow and reduces energy consumption at time of reduced traffic volumes. This shall be achieved in one of two ways:-

- **Programmable photocell**. These photocells have a fixed dimming profile programmed into the photocell. The profile can't be changed on site. For example the lights may be dimmed to the next category down at say 11.00 PM and then brought back to normal levels at 6.00 AM ready for commuters. Note some ballasts in the market now offer the fixed dimming profile capability but still require a photocell to detect night and day.
- **A transceiver RTU** which allows two way communications to a central computer. This allows differing profiles to be selected for each light or group of lights, depending on the lighting requirements on the night. Example the lighting requirement around Eden Park is quite different on event nights from non-event nights when it is a residential suburb. Non-event profiles also change.

The interactive communication system can be further extended through traffic counters to be fully interactive adjusting the light levels; In addition allowance can be made for weather conditions example wet or foggy conditions.

19.17 Electrical

19.17.1 Installation

Each street light position is an Installation as defined in AS/NZS3000.

All work shall be carried out in accordance with the Electricity Regulations 2010, AS/NZS3000 and the applicable Electrical Codes of Practice. The most recent amendments must be used.

19.17.2 Connection to network.

Each street light shall be connected directly to the Vector network providing continuous supply (24/7) into the street light column. In some sections of road it may be more cost effective to connect more than one light to a single feed from the LV network connection. The number of lights connected to a single connection should be limited to three in any one direction from the supply point. Where there is more than one light fed from a single vector connection the cable shall be looped in and out of each column. The cable shall be 10mm2 N/S single core. Breach joints are not recommended and must be approved by Vector Networks and Auckland Transport before use.

Vector Networks will supply and own all cables from the network to the connection point in the base of the street light column. Vector must install these cables.

19.17.3 Electrical connections and isolation

At the base of each pole between 600 mm and 900 mm above ground level a switchboard shall be installed inside the pole to meet the requirements of AS/NZS 3000 with a neutral bar, earth bar and fuse/MCB protection for the lamp. Refer to Standard Engineering Drawings. *Note the Lucy Titan 2 HRC fuse and disconnector unit is approved.*

19.17.4 Luminaires on Vector poles

In areas where Vector's network is overhead and AT has installed luminaires on Vector poles, each luminaire will be connected directly to the Vector supply using an HRC fuse in the live conductor. The fuse carrier to be a 30 Amp Michaud K223 cross-arm mounted. The HRC fuse link shall be 6 amps fusing characteristic gG 120 kA. Each alternate luminaire shall be connected to alternate phases to keep the load balanced on the LV network.

19.17.5 Luminaire Control.

Each luminaire shall be controlled individually. The options are a photocell, a programmable photocell, a transceiver RTU to provide two way communications to a central control terminal.

19.17.6 Internal wiring in column.

The cable from the fuse board at the base of the column to the luminaire shall be 2 core 2.5mm2 N/S. The screen shall be earthed. Refer to Standard Engineering Drawing (SED) – Street Lighting Electrical Connections.

19.17.7 Earthing.

Each pole shall be earthed by means of 10 mm2 copper insulated wire exothermically welded to a 16 mm copper bonded steel earth rod 300 mm from the pole base. Sherlok connectors are approved for burying. The connector shall be buried 300 mm below the pavement surface. AS/NZS 3000. Refer to Standard Engineering Drawing (SED) – Street Lighting Earthing Details.

19.17.8 Connection of street lights at traffic control cabinets

Refer to Standard Engineering Drawing (SED) – Traffic Signal / Street Light Combination Electrical Schematic.

19.17.9 Safe working distances.

Maintaining safe distance from electric lines and cables at all times is mandatory. EPC 34 sets out Electrical Safety Distances.

Safety Manual – Electrical Industry (SM-EI) part 2 and 3 sets out the minimum approach distances for approved qualified staff with current work competencies.

19.17.10 Personal Protective Equipment (PPE)

All personnel working on the public lighting network must wear the PPE equipment on all sites.

19.18 Approvals

All proposed changes or additions to the public lighting network must be approved prior to construction. The following information is required to allow the evaluation/peer review of the design:-

- Electronic copy of the lighting design plan showing luminaire positions. Documentation in accordance with the relevant AS/NZS1158 part and the current version of AS/NZS1158.1.2 to show compliance.
- Lighting sub category used in the design. E.g. V2, P4 etc. These must be recorded on each lighting plan.
- Category V roads - Luminance calculations from Perfectlite together with illuminance diagrams from AGI32 - illustrating relevant contours for the lighting sub-category with illuminance and point illuminance values necessary to demonstrate compliance.
- Category P roads - Illuminance diagrams from AGI32 illustrating relevant contours for the lighting sub-category with illuminance and point illuminance values necessary to demonstrate compliance.
- The following Tables – V Category Roads and P Category Roads – defines the Lighting Technical Parameters that shall be provided.

Table 71: V Category Roads

Parameter	Symbol	Notes
Average Carriageway Luminance	L	Straight sections
Overall Uniformity	U_o	Straight sections
Longitudinal Uniformity	U_L	Straight sections
Threshold Increment %	TI	Straight sections
Surround (verge) Illumination Ratio	E_s	Straight sections
Point Illuminance	E_{ph}	Intersections only
Illuminance (Horizontal) Uniformity	U_{E1}	Intersections only

Table 72: P Category Lighting

Parameter	Symbol	Notes
Average Horizontal Illuminance	E_h	
Point Horizontal Illuminance	E_{ph}	
Illuminance (Horizontal) Uniformity	U_{E2}	
Point Vertical Illuminance	E_{pv}	

19.19 Checklist

The following checklist must be completed when submitting a proposed lighting design for approval.

1. Initial Considerations

    a. A holistic approach to the lighting design has been considered. ☐

    b. A night site visit (where applicable) has been completed identifying features such as CCTV cameras and trees. ☐

2. Area Classification

    a. An appropriate lighting sub category classification has been agreed with Auckland Transport for all roads with the design scheme. ☐

The lighting classification/sub category for each road is:

3. Light Source

Define which Light Source has been utilised in the design - LED, Ceramic Metal Halide or High Pressure Sodium ☐

Light Source for each road is:

4. Luminaire Selection

Only luminaires included on the Auckland Transport (AT) HID (Appendix 19A) and LED (Appendix 19B) Road Lighting Specification Approved Lists shall be used in the design scheme.

Alternative luminaires may be submitted for consideration on a specific project, however these will have to be assessed against the respective criteria in Appendix 19A and Appendix 19B and must be approved by Auckland Transport before design begins. ☐

5. Lighting Column

Only Lighting Columns on the Auckland Transport (AT) Lighting Column (Appendix 19C) Specification Approved List shall be used in the design ☐

Alternative Lighting Columns may be submitted for consideration on a specific project, however these will have to be assessed against the respective criteria in Appendix C and must be approved by Auckland Transport before design begins.

6. Electrical Considerations

Electrical reticulation has been specified (where applicable).

Prepared By: _____ Date: _____

Checked by: _____ Date: _____

19.20 Differences between the AT Code of Practice (CoP) and the Standards

- The maximum tilt for a luminaire should be a maximum of 5 degrees from the horizontal, but in exceptional cases a maximum of 10 degrees may be used. Refer to *ATCOP Section 19.7.1*
- The Threshold Increment % (TI) along the road must not be greater than 10%. Refer to *ATCOP Section 19.7.1*
- Pedestrian Crossing Routes at Traffic Signal Controlled intersections have additional requirements to those of AS/NZS1158 for the illumination of intersections. Refer to *ATCOP Section 19.12.1*
- Local Area Traffic Management Devices (including roundabouts) intended to slow traffic and regulate its flow must utilise white light. Refer to *ATCOP Section 19.12.2*
- Category P roads - Illuminance diagrams from AGI32 illustrating relevant contours for the lighting sub-category with illuminance and point illuminance values necessary to demonstrate compliance. Refer to *ATCOP Section 19.18*

Appendix 19A - HID Road Lighting Luminaire Specification and Assessment Methodology December 2012

1 Overview

This specification outlines the requirements that a Road Lighting Luminaire shall meet for inclusion Auckland Transport – HID Approved Luminaire List (AT-HALL). The approval criteria of new Luminaires onto AT-HALL comprises of three parts:

- Compliance with the most up-to-date version of the Australia/New Zealand Standard for the Lighting of Roads and Public Spaces – AS/NZS1158, Part 6
- Additional criteria specific to Auckland Transport listed below in Sections 2 and 3.
- Achieving a “Pass” mark from the new Road Lighting Evaluation Form (Appendix 18A).

Manufacturers/suppliers of the HID Road Lighting Luminaire under consideration, shall pay Auckland Transport a fee of NZ$1000 to undertake the assessment.

2 Auckland Transport Approved HID Luminaire Requirements

2.1 Luminaire Compliance and Design Features

The current version AS/NZS1158 Part 6 outlines the requirements for design, construction, performance and testing of road lighting Luminaires. Luminaires that are to be used by Auckland Transport shall be compliant with this standard and with this specification document and have an expected design life of 20 years minimum.

All approved Luminaires shall utilise Flat Glass (FG) or Curved Tempered Glass (CTG). No “bowl” style luminaires will be considered for standard road lighting projects.

For special projects, Luminaires will be considered on a case by case basis. However compliance with AS/NZS1158, Part 6 will be a minimum requirement.

Luminaires will be reviewed against each item listed on this specification and if determined to be non-compliant, they will not be considered for inclusion on AT-HALL.

2.1.1 Material

The material of the luminaire housing shall be in accordance with the current version of AS/NZS 1158 Part 6. It is preferred that luminaires utilize an aluminium alloy having a copper content of not greater than 0.1%.

Testing in accordance with ISO9227 where additional surface treatments have been applied, shall be provided to demonstrate compliance with that standard.

Saline mist testing shall be for a minimum of 1000 hours.

2.1.2 Tool-less Entry

Tool-less entry is required for the luminaire electrical compartment for maintenance purposes. Additionally for ease of maintenance, a “quick disconnect control gear assembly”.

2.1.3 Internal Tilt Mechanism

The luminaire shall have an internal tilt mechanism so that the luminaire can be adjusted between 0° and -15° (minimum). No external bracket or adaptors shall be required to provide a 0° (zero) tilt

of the Luminaire in relation to the road surface. This allows the luminaire to be installed on existing road lighting columns that have a tilt angle to the bracket arm.

2.1.4 Ingress Protection (IP)

The luminaire shall be exposed to weather conditions and as such should be have an IP66 rating, for both the optical and control gear compartments.

2.1.5 Remote Luminaire Control - Telemetry

The luminaire shall have room to incorporate telemetry control components within the luminaire body or bracket arm without compromising the IP66 rating.

2.1.6 Photocell Compatibility

Road lighting luminaires shall be capable of incorporating photocells without compromising the IP66 rating. The Auckland Transport current approved photocell is the Zodian SS12A and variants thereof .

2.1.7 Upgrade

The luminaire shall be designed to enable the light engine to be replaced and/or upgraded. The IP66 rating of the complete luminaire shall not be compromised as a result of either replacement of upgrade of the luminaire components.

2.1.8 Warranty

A minimum ten (10) year warranty from the date of on-site installation shall be offered by the Luminaire supplier for the housing/glass/seal and reflector of the Luminaire and a five (5) year warranty for all Electronic Control Gear/Ballast/Driver.

2.2 Quality Assurance and Electrical Safety

2.2.1 Luminaire Supplier Declaration of Conformity (SDoC)

A Suppliers Declaration of Conformity is a statement from the supplier that the luminaire is electrically safe and that the supplier takes responsibility for the safety of the product. It is a requirement that all luminaires have a SDoC.

2.2.2 ISO 9001 Registered

The International Organization for Standardization 9000 Family of standards refer to quality management systems, ISO 9001 lists the requirements to meet the standard. Over one million organizations are registered with ISO 9001 and it is requirement that all luminaire manufactures are independently verified.

2.3 Sustainability

2.3.1 Restriction of Hazardous Substances (RoHS)

The luminaire shall comply with the RoHS Directive which sets restrictions on the use of six hazardous substances in electric equipment. The restricted substances are; Lead, Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls & Polybrominated diphenyl ether.

2.3.2 International Dark-Sky Association (IDA)

The luminaire shall be IDA accredited or be able to demonstrate that it complies with the principles of IDA which is the limitation of light pollution from outdoor luminaires in respect to glare, sky glow (light directed above the horizontal into the sky) and light trespass (illuminating unwanted areas like private property).

3 Approved Luminaire Assessment Methodology

HID Road Lighting Luminaire manufacturers and suppliers shall supply supporting documentation and IES/CIE files identifying their best performing road lighting Luminaires.

Optical performance will be assessed in accordance with the most up-to-date versions of AS/NZS 1158 1.1 and 3.1 respectively for Category V and P roads – Table 73.

Table 73: Summary of AS/NZS 1158 Light Techncial Parameters, Lighting Categories V and P

Summary of AS/NZS 1158 Design Categories as @ November 2011				
Vehicle Category Roads				
	Average Carriageway Luminance (cd/m²)	**Average Illuminance (lux)**	**Overall Uniformity (min/avg)**	**Longitudinal Uniformity (min/avg)**
V1	1.5	15	0.33	0.3
V2	1.0	10	0.33	0.3
V3	0.75	7.5	0.33	0.3
V4	0.5	5	0.33	0.3
Pedestrian Category Roads				
	Average Illuminance (lux)	**Point Horizontal Illuminance (lux)**	**Horizontal Uniformity (max/avg)**	
P3NZ	1.3	0.22	10	
P4	0.85	0.14	10	

Each Luminaire will be reviewed against the criteria within this specification and be compliant with all requirements in order to be considered for inclusion on the AT-HALL.

Once the Luminaire has been placed on the AT-HALL, it may be subjected to random product testing at Auckland Transport discretion. Failure to meet and maintain the requirements laid out in this specification and assessment methodology document may result in the Luminaire being removed from the AT-HALL.

3.1 Performance and Acceptance Testing

All road lighting Luminaires for consideration will be assessed based on its optical performance on the “test road” and its performance against Luminaires already on the Approved Luminaire List. The test road sets out a typical roadway topology for Category V and P roads.

Road Lighting Category V

- Overall Carriageway width (Kerb to Kerb) = 12m
- Number of Lanes: 2 (one in each direction)
- 2m Footpath and 1.5m Grass Berm
- Road Luminaire mounting height - 12m, complete with 2m Outreach Arm
- Setback: Luminaire suppliers choice
- Road lighting Column Arrangement: Luminaire suppliers' choice between Single Sided, Staggered and Opposite.
- Luminaire Tilt Angle = 0 Deg
- Maintenance Factor (MF): High Pressure Sodium = 0.75, Metal Halide – 0.75 and Cosmopolis – 0.8

Road Lighting Category P3NZ and P4

- Overall Carriageway width (back of footpath to back of footpath) = 20m
- Number of Lanes: 2 (one in each direction)
- 1.5m Footpath and 2m Grass Berm
- Road Luminaire mounting height - 8m, complete with 2m Outreach Arm
- Setback: Luminaire suppliers choice
- Road lighting Column Arrangement: Luminaire supplier's choice between Single Sided, Staggered and Opposite.
- Luminaire Tilt Angle = 0 Deg
- Maintenance Factor (MF): High Pressure Sodium = 0.78, Ceramic Metal Halide – 0.67 and Cosmopolis – 0.7

The following "Minimum Rated Lamp Lumens" shall be used for all street lighting designs utilising HID Luminaires.

Table 74: Table of Minimum Rated Lamp Lumens

Lamp Source / Watts		Minimum Lumen Output	Comments
High Pressure Sodium	50	4400	
	70	6600	
	100	10700	
	150	17500	
	250	33200	
	400	56500	
	600	90000	
Metal Halide	35	3200	GE Streetwise lamp
	50	5000	GE Streetwise lamp
	70	7640	GE Streetwise lamp
	100	10900	GE Streetwise lamp
	150	16300	GE Streetwise lamp
	250	25000	GE TT
	400	41000	GE TT
CosmoPolis	45	4725	
	60	6800	
	90	10450	
	140	16500	
Elite	210	24150	Colour Temp = 3000K
	315	38700	Colour Temp = 3000K

4 Road Lighting Auckland Transport - HID Approved List (AT-HALL)

Table 75: Category V

Manufacturer	Model Name/Number	NZ Supplier	Date Approved
AEC	KAOS1	Tech Light	31/10/2011
AEC	KAOS2	Tech Light	31/10/2011
Schréder	Ambar2	Betacom	31/10/2011
Schréder	Ambar3	Betacom	31/10/2011

Table 76: Category P

Manufacturer	Model Name/Number	NZ Supplier	Date Approved
AEC	KAOS1	Tech Light	31/10/2011
Schréder	Ambar2	Betacom	31/10/2011
Schréder	Nano	Betacom	31/10/2011

Table 77: Pedestrian Crossing (Zebra)

Manufacturer	Model Name/Number	NZ Supplier	Date Approved
AEC	KAOS 1 OPSX/OPDX	Tech Light	31/10/2011

Appendix 19B - LED Road Lighting Luminaire Specification and Assessment Methodology December 2012

1 Overview

The luminaires will be assessed by consideration of five main criteria;

1. LED Attributes
2. Luminaire Optics
3. Driver and Electrical Properties
4. Luminaire Compliance and Design Features
5. Sustainability

Appendix 19B1 outlines the standard requirements that LED Road Lighting Luminaires must satisfy before they can be considered for a more detailed evaluation of the luminaires optical performance. All questions must be answered "YES" at the initial evaluation stage.

Appendix 19B2 outlines the detailed luminaire assessment methodology covering the optical performance against a group of standard road geometric configurations. It must also verify all the data supplied by the Luminaire distributer in response to the questions set out in Appendix 19A. This detailed assessment shall be undertaken by an independent consultant selected by Auckland Transport.

Appendix 19B3 is the Auckland Transport LED Approved Luminaire List (AT-LALL).

2 LED Chip Characteristics

The quality and characteristics of the LED chip is paramount to the performance and quality of the luminaire. As such selection of the correct LED chip is one of the most important steps in designing a high quality luminaire.

2.1 LED Chip Manufacturer

There are currently four LED chip manufacturers that are recognized as world leaders in LED technology and as such it is required that the LED chip for streetlight luminaires shall be manufactured by Cree, Philips, Orem or Nichia.

2.2 Correlated Colour Temperature (CCT)

Auckland Transport requires the CCT to be in the range of 4000 ± 300°K; the LM-79-08 report will detail the luminaires CCT.

2.3 Lumen Depreciation

An LED lumen output deteriorates over time and the rate of decay should be measured in accordance with the methodology outlined in IESNA LM-80-08, this involves measuring the initial output of the LED and taking periodic measurements over time.

As LEDs have extremely long life it is not practical to test the LED for 100,000+ hours. IES TM-21-11 is an American standard which outlines the procedure on how to extrapolate the data from IESNA LM-80-08 Report and accurately predict the lumen depreciation. For comparison of luminaires the initial lumen output is required as well as the percentage of the initial output after 25,000 hours, 50,000 hours and 100,000 hours at an ambient temperature of 15 °C and the driver

current set at/or above the rated current. The minimum required maintenance factor for 100,000 hours is .75.

2.4 Colour Maintenance

Through life the lumen output of the LED decreases the colour of the LED can also shift. The initial colour of the LED should be compared to the colour after 6,000 hours and the colour shift should not be more than 1 Macadam Ellipse.

On a chromaticity diagram a macadam ellipse is an area where the colours contained cannot be distinguished from each other by the human eye.

The Colour Rendering Index (CRI) shall be ≥ 70.

2.5 Photobiological Safety

LED chips are capable of emitting highly concentrated light waves that have the potential to be harmful to the human eye and skin. There are two standards that measure the risk from LED light sources; IEC/EN62471 & ANSI/IESNA RP-27. LED light sources are split into four risk groups; Exempt Group (no risk), Group 1 (low risk), Group 2 (moderate risk) & Group 3 (high risk).

2.6 LED Chip Warranty

Auckland Transport requires a 5 year warranty on the LED Chip used within the luminaire.

3 Luminaire Optics

The optical performance of the luminaire is determined by a combination of both the LEDs and the optic distribution. The 'Illuminating Engineering Society of North America' (IESNA) report 'IES LM-79-08: IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products' details guidelines for testing LED luminaires and a LM-79-08 report must be verified from an independent test laboratory that is accredited by National Association of Testing Authorities, Australia (NATA) or International Accreditation New Zealand (IANZ) or an overseas laboratory that is accredited under a mutual recognition agreement with either of these bodies.

3.1 Total luminous Flux

The total luminous flux is the total lumen output of the luminaire taking into account losses from the optical lens or diffuser. This value will vary depending on what traditional luminaire the LED street light is designed to replace. The total lumen output of the luminaire is measured in accordance with LM79-08 and is used to calculate the luminaire efficiency.

3.2 Photometric Distribution

Streetlight luminaires are installed onto a wide variety of geometric street configurations and as such it is a requirement to have different optical distributions so that a streetlight designer can choose the one that best suits the road geometry.

It is preferred that LED streetlights shall have a minimum of THREE different optical distributions.

3.3 LED Configuration

The luminaires LEDs should not be mounted in clusters. All LEDs shall be mounted at 0° to the horizontal and use optical refractor/lens to distribute the light from each LED over the target area. "Overlay" technology is the preferred methodology to achieve this rather than "directional".

3.4 LED Module Array Configuration

With utilization of existing lamp technology a luminaires output could be controlled by the selection of the appropriate lamp wattage. LED luminaires also need to be scalable for different roading applications and this is achieved by having different LED Modular Array Configurations. For ease of use, the LED Module Array Configuration should not increase by more than 20 LEDs per incremental step.

3.5 Electronic Photometry File

The test laboratory which produces the LM-79-08 report should supply results in electronic format in both an IES file and CIE convention together with a full print report. The IES and CIE files can then be used by lighting designers in various photometric analysis software programs to model the luminaire on roads and assess its performance in particular applications.

It should be noted that scaled photometry for luminaires with expandable LED modular arrays are acceptable in LM79-08 provided thermal differences are accounted for in the prescribed method.

4 Driver and Electrical Properties

The driver supplies the constant current source to the LED chips to run and as such it must operate effectively and efficiently. The key considerations for the driver are detailed below.

4.1 Luminaire Supply Voltage

Streetlights are integrated with the local electrical distribution network and as such must have an input voltage of 230V ±6% at a frequency of 50 Hz.

4.2 Driver Current

Increasing the supply current to an LED increases both the light output, as well as the LED junction temperature. This increase in junction temperature increases the rate of lumen depreciation and consequently a reduction in life.

It is advantageous to have a range of driver currents available for the luminaire, however the maximum driver current shall not exceed 1000mA.

4.3 Electrical Components

The driver shall have a service life of 20 years.

4.4 Dimming Interface

To provide adaptive lighting and to maximize energy savings from the LED luminaire, The Driver shall have either a 1-10V or DALI interface that can be connected directly to a RF receiver.

4.5 Luminaire Efficiency

The luminaire efficiency should be expressed as a ratio of the ‘measured lumen output’ against the ‘total circuit wattage’ (LED + Driver) and achieve a minimum efficiency of 70 lm/w. The efficiency of a luminaire is a component of the LM-79-08 report.

4.6 Power Factor

The power factor is the ratio of real power, used by the load, to apparent power, drawn by the load. The lower the power factor the more current is drawn by the load to do the same amount of work.

The effect of a low power factor is that cable sizes may have to be increased to match the extra currents. The minimum power factor for LED Luminaires should be 0.9 (90%).

4.7 Harmonic Distortion

Non-linear loads like capacitors and inductors cause a distortion of the current waveform. Harmonic distortion can lead to significantly reduced life for electronic equipment and increase cost of supply cables so that they can handle the extra heat generated by the distorted waveforms. The maximum allowable Total Harmonic Distortion (THD) is 20%.

4.8 Protection Against Transient Voltages

As streetlights are connected to the local electrical distribution system there is the potential for transient voltages from lighting strikes and other faults on the overhead lines. The luminaire shall have built in protection from voltage surges for 10 KV and 5000 A and tested in accordance with IEEE/ANSI 62.41.

4.9 Driver Warranty

Auckland Transport requires a 5 year warranty on the LED Driver used in the luminaire.

5 Luminaire Compliance and Design Features

The current version AS/NZS 1158 Part 6 outlines the requirements for design, construction, performance and testing of road lighting luminaires. Streetlight luminaires to be use in Auckland Transport must comply completely with this standard and have an expected design life time of a minimum 20 years.

Furthermore the luminaire shall also comply with the following additional requirements.

5.1 Material

The material of the luminaire housing shall be in accordance with the current version of AS/NZS 1158 Part 6. It is preferred that luminaires utilize an aluminium alloy having a copper content of not greater than 0.1%.

Testing in accordance with ISO9227 where additional surface treatments have been applied, shall be provided to demonstrate compliance with that standard.

Saline mist testing shall be for a minimum of 1000 hours.

5.2 Tool-less Entry

Tool-less entry is preferred for the luminaire electrical compartment for maintenance purpose. Additionally for ease of maintenance, a “quick disconnect harness” for both the LED module and Driver electrical connections shall be provided.

5.3 Internal Tilt Mechanism

The luminaire shall have an internal tilt mechanism so that the luminaire can be installed between ±5° (minimum). This allows the luminaire to be installed on existing street lighting poles that have the luminaire tilted at the mounting point.

5.4 Ingress Protection (IP)

The luminaire shall be exposed to weather conditions and as such should be have an IP66 rating.

5.5 Remote Luminaire Control - Telemetry

The luminaire shall have room to incorporate telemetry control components within the luminaire body or bracket arm without compromising the IP66 rating.

5.6 Photocell Compatibility

Streetlight luminaires shall be capable of incorporating photocells without compromising the IP66 rating. Auckland Transports current approved photocell is the Zodian SS12A and variants there off.

5.7 Upgrade

The luminaire shall be designed to enable the light engine to be replaced and/or upgraded. The IP66 rating of the complete luminaire shall not be compromised as a result of either replacement of upgrade of the luminaire components.

5.8 Housing Warranty

Auckland Transport requires a 10 year warranty on the housing of the luminaire.

6 Quality Assurance and Electrical Safety

6.1 Luminaire Supplier Declaration of Conformity (SDoC)

A Suppliers Declaration of Conformity is a statement from the supplier that the luminaire is electrically safe and that the supplier takes responsibility for the safety of the product. It is a requirement that all luminaires have a SDoC.

6.2 ISO 9001 Registered

The International Organization for Standardization 9000 Family of standards refer to quality management systems, ISO 9001 lists the requirements to meet the standard. Over one million organizations are registered with ISO 9001 and it is requirement that all luminaire manufactures are independently verified.

7 Sustainability

7.1 Restriction of Hazardous Substances (RoHS)

The luminaire shall comply with the RoHS Directive which sets restrictions on the use of six hazardous substances in electric and election equipment. The restricted substances are; Lead, Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls & Polybrominated biphenyl ether.

7.2 International Dark-Sky Association (IDA)

The luminaire shall be IDA accredited or be able to demonstrate that it complies with the principles of IDA which is the limitation of light pollution from outdoor luminaires in respect to glare, sky glow (light directed above the horizontal into the sky) and light trespass (illuminating unwanted areas like private property).

8 Appendices to Appendix 19B

'Appendix 19B1 – LED Road Lighting Luminaire Evaluation Methodology Part B1: Initial = Evaluation Checklist' lists the essential criteria for this assessment that must be met.

Luminaires that satisfy ALL the requirements of 'Part B1' may then be considered for a detailed assessment carried out by an independent consultant of Auckland Transports selection. 'Appendix 19B2 – LED Luminaire Evaluation Methodology Part B2: Detailed Independent Assessment' is the results table for the luminaires optical performance assessed on a group of standard road geometric configurations and the maximum design spacing that complies with AS/NZS 1158 for four different road lighting categories (P3NZ, P4, V3, V4). 'Part B2' must verify that 'Part B1' is accurate and that the luminaire has no major design issues in relation to the specification outlined above.

If the luminaire passes 'Part B2' then it shall be placed on the 'Approved List' at the discretion of Auckland Transport. It is recommended that the supplier of the LED road Luminaire under evaluation of Part B3 pays Auckland Transport a fee of $1500 to undertake the evaluation. This will demonstrate the commitment of the supplier to the quality, performance and support of the product.

Appendix 19B3 is the current Auckland Transport – LED Approved Luminaire List (AT-LALL)

Appendix 19B1

LED Road Lighting Luminaire Evaluation Methodology Part B1: Initial Evaluation Checklist

Luminaire Manufacturer	
Model Name/Number	
Cost Per Unit	

	Initial Evaluation Checklist	Yes	No
1	**LED Chip Manufacture** The LED chip must be manufactured by Cree, Philips, Osram or Nichia.	☐	☐
2	**IESNA LM-79-08 Report and IES/CIE Photometry Files** Supply a LM-79 report from a certified independent laboratory as well as the IES and CIE files based upon absolute photometry.	☐	☐
3	**Correlated Colour Temperature (CCT)** CCT within the range of 4000±300°K.	☐	☐
4	**Lumen Depreciation in accordance with IESNA LM-80-08 and IES TM-21-11** Supply initial lumen and output after 25,000 hours, 50,000 hours and 100,000	☐	☐

	hours at an ambient temperature of 15°C. Maintenance factor after 100,000 shall be ≥ .75.		
5	**Colour Maintenance** The LED colour shift after 6,000 hours must be ± 1 Macadam Ellipse	☐	☐
6	**LED Configuration** Horizontal mounting, LEDs not in clusters and utilizing overlay photometry.	☐	☐
7	**LED Modular Array Configuration** Increase in array size by maximum of 20 LEDs	☐	☐
8	**Photometric Distribution** Ideally a minimum of three optical distribution settings.	☐	☐
9	**Driver Current + Dimming Capability** The supply current does not exceed 1000mA, and dimming either 1-10V or DALI.	☐	☐
10	**Ingress Protection** The luminaire must be at least IP66	☐	☐
11	**Warranties** The luminaire shall have a warranty of 5 years for the LED Chip/Driver combination and 10 years for the housing/external protective treatment.	☐	☐
12	**Sample Luminaire** A sample luminaire must be available in New Zealand for inspection.	☐	☐
13	**Luminaire manufacturer ISO 9001 Registered** Luminaire manufacturer is independently verified that they comply with ISO 9001.	☐	☐
14	**Luminaire Supplier Declaration of Conformity (SDoC)** Supply a copy of the luminaires SDoC.	☐	☐

New Zealand Distributer;

Company Name: _____

Contact Name: _____ **Position:** _____

Phone Number: _____ **Email Address:** _____

Signature: _____ **Date:** _____

Appendix 19B2

LED Road Lighting Luminaire Evaluation Methodology Part B2: Detailed Independent Assessment

Luminaire Manufacturer	
Model Name/Number	

Optical Performance							
	Geometric Road Configuration			**AS/NZS 1158 Road Lighting Category Maximum Design Spacing (m)**			
	Carriageway Width (m)	**Boundary to Curb (m)**	**Total Width (m)**	**P3NZ**	**P4**	**V3**	**V4**
Road Design 1	**8**	**4**	**16**				
Road Design 2	**10**	**4**	**18**				
Road Design 3	**10**	**5**	**20**				

Summary of AS/NZS 1158 Design Categories				
Vehicle Category Roads				
	Average Carriageway Luminance (cd/m²)	**Average Illuminance (lux)**	**Overall Uniformity (min/avg)**	**Longitudinal Uniformity (min/avg)**
V3	.75	7.5	0.33	0.3
V4	.5	5	0.33	0.3

Pedestrian Category Roads			
	Average Illuminance (lux)	**Point Horizontal Illuminance (lux)**	**Horizontal Uniformity (max/avg)**
P3NZ	1.3	0.22	10
P4	0.85	0.14	10

Verification of Initial Evaluation Checklist and		
1	**LED Chip Manufacture**	**Pass / Fail**
2	**IESNA LM-79-08 Report and IES/CIE Photometry Files**	**Pass / Fail**
3	**Correlated Colour Temperature (CCT)**	**Pass / Fail**

4	Lumen Depreciation in accordance with IESNA LM-80-08 and IES TM-21-11	Pass / Fail
5	Colour Maintenance	Pass / Fail
6	LED Configuration	Pass / Fail
7	LED Modular Array Configuration	Pass / Fail
8	Photometric Distribution	Pass / Fail
9	Driver Current + Dimming Capability	Pass / Fail
10	Ingress Protection	Pass / Fail
11	Warranties	Pass / Fail
12	Sample Luminaire	Pass / Fail
13	ISO 9001 Registered	Pass / Fail
14	Supplier Declaration of Conformity	Pass / Fail
Identify any issues with Luminaire		
Recommend Luminaire for Auckland Transport LED Approved Luminaire List (AT-LLAL)		Yes / No

Assessment Completed By;

Company: _____

Contact Name: _____ **Position:** _____

Phone Number: _____ **Email Address:** _____

Signature: _____ **Date:** _____

Appendix 19B3

Auckland Transport LED Approved Luminaire List (AT-LALL)

Manufacturer	Model Name/Number	NZ Supplier	Date Approved
CREE Lighting	LEDway	Advanced Lighting Technologies	31/10/2011
CREE Lighting	Edge Round	Advanced Lighting Technologies	31/10/2011
CREE Lighting	Edge Square	Advanced Lighting Technologies	31/10/2011
CREE Lighting	SLM	Advanced Lighting Technologies	1/01/2013
AEC	LEDin	Tech Light	31/10/2011
AEC	A2	Tech Light	1/01/2013
Schreder	Teceo	Betacom	1/01/2013

9 References to Standards

1 *Illuminating Engineering Society of North America - IES LM-79-08: IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products. (2008)*

2 *Illuminating Engineering Society of North America - IES LM-80-08: IES Approved Method for Measuring Lumen Maintenance of LED Sources. (2008)*

3 *Illuminating Engineering Society of North America – IES TM-21-11: Lumen Depreciation Lifetime Estimation Method for LED Light Sources. (2011)*

4 *AS/NZS 1158: Lighting for roads and public spaces. (2005-2010).*

5 *IEE/ANSI 62.41: IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits. (1995)*

6 *IEC/EN 62471: Photobiological safety of lamps and lamp systems. (2006)*

7 *ANSI/IESNA RP-27: Recommended Practice for Photobiological Safety from Lamps. (2007)*

8 *Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Regulations 2008. (2008)*

Appendix 19C - Street Lighting Column Specification and Assessment Methodology December 2012

1. Overview

This document specifies the minimum requirements for the standard design of street lighting columns intended for use in Auckland Council region under the guidance of Auckland Transport.

This document should be read in conjunction with the current version of the Auckland Transport Code of Practice (ATCOP) and the current issues of the Auckland Transport HID and LED Road Lighting Luminaire Specification and Assessment Methodologies.

1.2 Typical Column Terminology

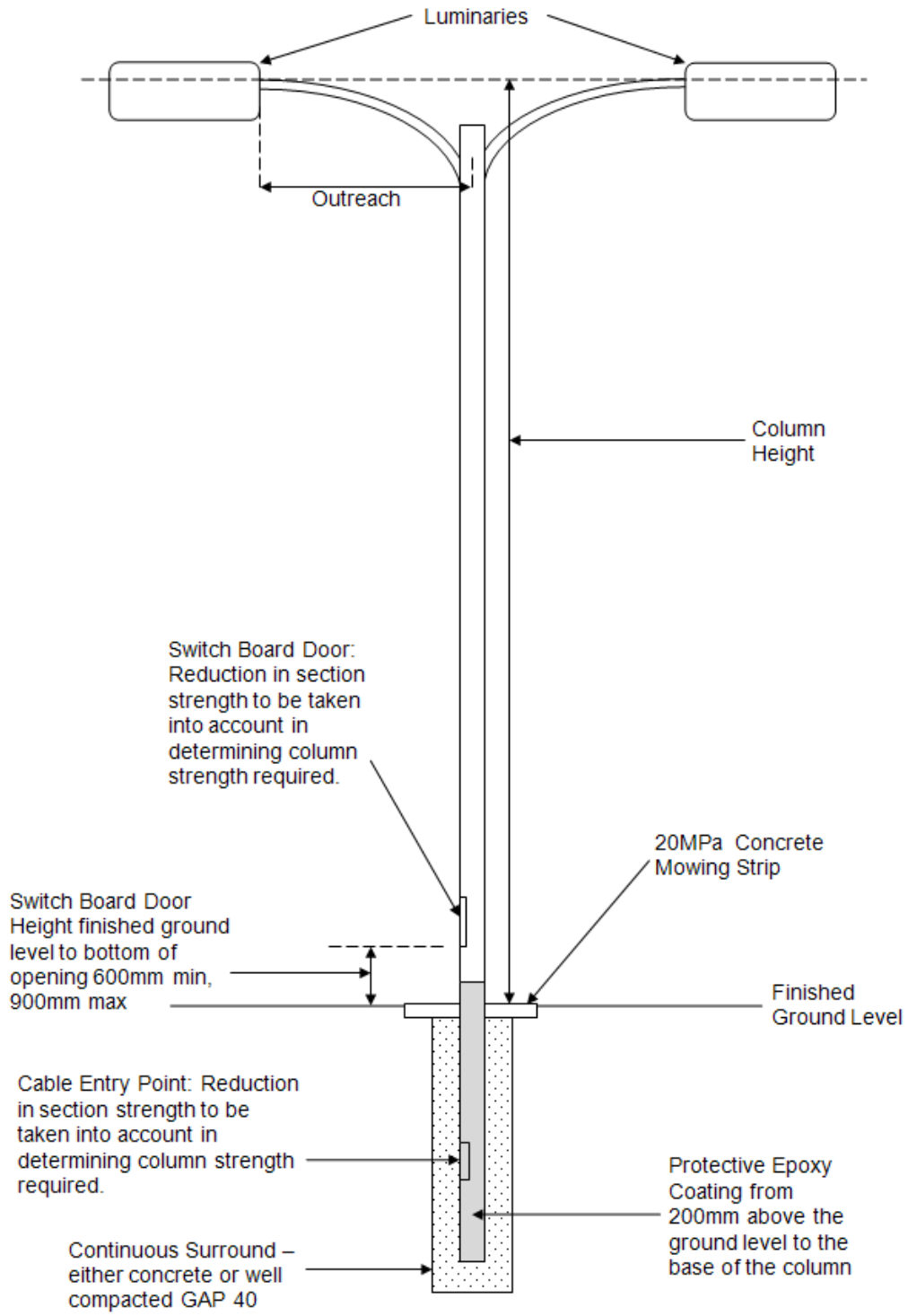

Figure 103: Terminology – Not to Scale

2 Column Design

All lighting columns must have a minimum 50 year design life and shall be manufactured by Auckland Transport approved suppliers. See Appendix 19C for the current list of approved suppliers.

2.1 Introduction

The design requirements for columns shall be in accordance with the Australian/New Zealand Standard AS/NZS 4676 “Structural design requirements for utility services poles” and AS/NZS 4677 “Steel Utility Service Poles”.

Design of components for strength will be subject to specific design by the suppliers.

All construction is to comply with the New Zealand Building Code and the appropriate New Zealand Standards.

2.2 Standard Columns

All lighting columns shall be constructed to a standard length of 6.0m, 8.0m, 10.0m, 12.0m or 14.0m from ground to the tip of the bracket arm and have a maximum bracket arm outreach length as specified inTable 78unless otherwise approved by Auckland Transport.

Each column shall be designed to take the load of a standard luminaire as outlined in Table 78 below:

Table 78: Table of Standard Column Heights and Associated Bracket Arm Lengths, Mass and Sail Areas

Nominal Column Height (m)	Maximum Bracket Arm Outreach (m)	Luminaire Mass (kg)	Luminaire Sail Area (m^2)
14.0*	4.0	15.0	0.15
12.0	4.0	15.0	0.15
10.0	3.0	10.0	0.12
8.0	2.0	9.0	0.10
6.0*	1.0	8.0	0.10

*Appropriate for single outreach only.

Standard Columns shall have a Curved Outreach Bracket Arm with a 5° upward tilt.

The minimum spigot diameter shall be 42mm.

The minimum thickness of steel plate used in any structural column element shall not be less than 2.0mm. Special requirements from AS/NZS 4676 apply if the thickness of steel used in any structural elements of the column is less than 3.0mm.

2.3 Approved Columns

A list of the current approved columns can be found in Appendix 19C. Auckland Transport will consider alternative columns for specific areas/special projects on a case by case basis.

2.4 Wind Loadings

The column shall be designed to an Importance Level of 2 with 50 years Design Life and safely sustain the appropriate loads as set out in the current version of AS/NZS 1170.2 “Structural design actions - Wind actions”. Refer to Table 79 below.

Wind loadings are assumed to be non-directional, i.e. the worst orientation of the light column is considered. Specific design considering wind direction, with respect to the orientation of the lighting column, may be warranted in special cases, but this is considered not generally necessary.

Wind pressures are based on design wind speeds for each wind zone as per Section 5 of AS/NZS 3604 “wind bracing demand” and are calculated in accordance with AS/NZS 1170.2.

The minimum drag coefficient is taken as for a smooth round shape (C_D = 1.2). Other shapes will require modification with the appropriate modification factor in accordance with Table E4 of AS/NZS 4676.

The frontal area of luminaires shall be taken from the orientation that results in the greatest wind exposed surface and the force on these is assumed to act at the top of the column. The frontal area shall include all other attachments, motifs etc., which are not part of the main lighting column structure.

Allowance shall also be made for the additional forces due to wind on a 1.0m^2 fixed sign or, for a single outreach, one 0.9m x 1.8m banner, and for a double outreach, two 0.9m x 1.8m banners, mounted 2.5m above ground level. Columns may be fitted with either a sign or banner(s) but not both.

2.4.1 Auckland Transport Region – Wind Speed Design Factors

$$V_{sit,\beta} = V_R \; M_d \; (M_{z,cat} \; M_s \; M_t)$$

Table 79: Factors to Determine Site Wind Speed

Description	Factors	AS/NZS 1170.2:2002 Reference Clauses
Regional Gust Wind Speed, V_R	45 m/s (Design Life 50 years, Region A)	Table 3.1 – Regional Wind Speeds
Wind Directional Multipliers, M_d	1.0 (Any direction)	Table 3.2 – Wind Direction Multiplier
Terrain/Height Multiplier, $M_{z,cat}$	Terrain Category 2, Site elevation 0m; $M_{z,cat}$	Clause 4.2 – Terrain/Height Multiplier
Shielding Multiplier, M_s	1.0	Clause 4.3 – Shielding Multiplier
Topographic Multiplier, M_t	1.0	Clause 4.4 – Topographical Multiplier

2.5 Minimum Column Strengths

Steel Column Strengths are based on the requirements of AS/NZS 3404 “Steel Structures Standard” and AS/NZS 4600 “Cold-Formed Steel Structures”.

Steel sections strength requirements apply to the base of the column (at the top of the concrete footing) i.e., not necessarily at the ground surface.

Minimum section modulus requirements must take into account any service opening near the critical location at the base. Locations of openings other than at the base should also be considered.

2.6 Deflection and Vibration

The complete assembly (e.g. column, outreach and luminaire) must be designed to minimise deflection and vibration.

To account for fatigue, the lateral liner deflection of the column must not exceed $h_p/15$, where h_p is the height of a column above ground level.

2.7 Dynamic Response Check

2.7.1 Translational Response

Dynamic response of a light column may subject the structure and fixtures to excessive acceleration and forces. Where structures have natural frequencies less than 1Hz, Section 6 of AS/NZS 1170.2 requires dynamic analysis to be carried out.

The dynamic response of a light standard may be in a number of vibrational modes, including fundamental translational (lateral) cross wind and along and response as well as torsional response, particularly where the fixtures are eccentric and have high mass.

The dynamic analysis of a wind sensitive structure is outside the scope of this document and specialist design will be required where the structure is deemed to be wind sensitive.

2.7.2 Torsional Response

The torsional response may be combined with the translational response.

As with the translational response, Section 6 of AS/NZS 1170.2 requires dynamic analysis to be carried out for structures with natural frequencies less than 1Hz.

2.8 Switchboard – Door Cavity Opening

The door cavity opening shall be positioned to permit safe access for maintenance, i.e.:

- Not facing the street.
- Not facing the property boundary behind the column.
- Fixings shall be vandal and child resistant and shall require a specialised tool to open.

The door cavity opening shall be a standard size of 300mm x 150mm and the base of the door cavity opening shall be located between 600mm and 900mm above finished ground level to provide safe and easy access for maintenance.

The door cavity opening shall be prevented from being opened by unauthorised persons, by the use of fasteners requiring a specific tool to gain access to the switchboard.

2.9 Shear Base Columns

Shear base columns are only to be installed in speed zones of 70km/h or greater. All other speed zones shall utilize flange base or ground planted columns.

All shear base type columns must incorporate IP68 plug and socket connections to ensure that the pole does not become live in the event of vehicle impact or similar event (Transnet Amerace 65U or equivalent).

3 Foundation Design

Footings for lighting columns may be classified into two broad groups, namely direct planted footings and pad footings.

Direct planted footings are simply an extension of the pole, which relies primarily on varying the length of the extension (i.e. the embedment depth) and its projected area to engage the required resistance of the foundation to overturning and sliding. This type is widely used for foundations with a bearing strength between 100kPa and 240kPa.

Pad footings are usually constructed from concrete and rely primarily on their mass and the distribution of this mass to provide the required stability. For this type of footing, the embedment depth is not as critical a factor in the overturning resistance of the pole but may be a major consideration in generating resistance to sliding.

3.1 Material Properties

The design properties of the footing and foundation materials must be determined in accordance to Section 6 of AS/NZS 467 “footings and foundations”.

3.2 Embedment Depth (Direct Planted Footings)

The embedment depth of directly planted poles must be calculated in accordance AS/NZS 4676, taking due account of the mechanical properties of the particular foundation materials.

The embedment depth should not be less than 0.5m in any soil.

The top 0.5m of any pile foundation shall be ignored when determining capacity.

3.3 Concrete Footings

Concrete footings may be used as an alternative to direct-planted footings where drilling is impracticable due to either extreme hardness or softness of the foundation material or the inaccessibility of the site, or some combination of these.

Base fixing bolts shall be designed in accordance with AS/NZS 4676 and shall be arranged so that cable access through the baseplate hole is not impaired.

4 Fabrication and Installation

This section details the requirements for finishes and their application, as solutions considered satisfactory by Auckland Transport. Alternative products and processes may be submitted for approval for specific projects and/or for future incorporation in this document.

Surface preparations, coatings and repairs shall be in accordance with AS/NZS 2312 “Guide to the Protection of Structural Steel against Atmospheric Corrosion by the use of Protective

Coatings" and be performed by one of the companies approved for that system to meet the minimum warranty period.

Final coating is optional. However, all columns, complete with mitred and curved outreach arms, shall be finished, both internally and externally, in one of the following forms:

- Hot dipped galvanised mild steel – painted or unpainted
- Stainless steel (316 grade) – painted or unpainted
- Contact Auckland Transport regarding other clear acrylic coatings

Surface finishes shall be smooth and free from obvious blemishes.

4.1 Standards

The following standards are applicable to this section

AS/NZS 2312 Guide to the Protection of Structural Steel against Atmospheric Corrosion by the Use of Protective Coatings.
AS/NZS 4680 Hot-Dip Galvanised (Zinc) Coatings on Fabricated Ferrous Articles.
AS/NZS 3750.9 Paints for steel structures - Organic zinc-rich primer.
AS/NZS 3750.15 Paints for steel structures - Inorganic zinc silicate paint.
AS/NZS 1554.1 Structural Steel Welding - Part 1: Welding of Steel Structures.

4.2 Repair of Damage to Surfaces

Corrosion protection which has been damaged by welding, erection or other causes shall be rectified before the column is put into use.

The damaged area shall be prepared and must be dry and clean, free from dirt, grease, loose or heavy scale of rust, before the corrosion protection is applied. The corrosion protection shall be applied as soon as practicable and before noticeable oxidation of cleaned surfaces occurs. Damaged zinc coating shall be resorted by application of an equivalent thickness of a suitable zinc paint conforming to AS/NZS 4680, AS/NZS 3750.9 or AS/NZS 3750.15 or with thermal zinc spray.

4.3 In-Ground Section of all Columns

Structural steel sections should not make direct contact with ground. All sections must be embedded in, or bear on, concrete, or be otherwise protected. Concrete poured around steel structures must be continuous and not cast in sections.

All lighting columns shall, on top of the all-over galvanisation, be covered in an extra epoxy protective coating from 200mm above the ground level to the base of the column.

Bare, untreated metal is not acceptable.

4.4 Alternatives

Where alternative materials or paint finishes are required to those described above the applicant shall submit full details of the proposed process and materials for review with the submission.

4.5 Warranty

Providing the coating applicator has been certified by the paint supplier as an approved provider of the proposed coating system, a copy of the coating applicator's certification that the galvanising and/or paint has been applied in accordance with the coating manufacturer's specification shall be provided before installation of the columns.

If the applicator does not possess the necessary "certified applicator" status, then the paint supplier shall monitor the work and provide the required certification.

Materials and paint finishes of columns, and luminaire bodies shall be unconditionally guaranteed against fair wear and tear for a minimum of 10 years, commencing from the date of hand-over of the installation to Auckland Transport.

4.6 Quality Control

All welds and welding processes must comply with the current standards outlined in AS/NZS 1554.

Auckland Transport may nominate an inspector to insure the quality of the lighting column including, but not limited to; the quality of steel, welds, and protective coating. Upon request by Auckland Transport the manufacturer shall supply Auckland Transport with any certificates to insure the quality of the column.

4.7 Protection

Structural members must be adequately protected during handling and transport to minimise damage to the corrosion protection. The columns shall be individually wrapped in heavy duty polythene, or similar method of protection, to protect the equipment from damage. The protective wrapping shall not remain in place for any extended period of time, e.g. during site storage, as damage to the paint finish is likely to occur.

Components which are transported in nested bundles should be separable without damage to other components or their coatings. Consideration should be given to the use of lifting beams with appropriately spaced lifting points and slings, or to lifting with properly spaced fork-lift tines.

The column wrapping shall be applied whilst the column is installed and stood upright in the excavation, and the wrapping shall be removed. Upon completion of installation

Any damage caused prior to the hand-over to Auckland Transport must be repaired as new with all warranties remaining intact. Where the damage is considered too severe the contractor shall, upon written instruction from Auckland Transport, or their representative, replace the damaged equipment with new at no cost to Auckland Transport.

4.8 Excavation and Backfill

All excavation and backfilling must be carried out in accordance with the contract specification.

4.9 Mowing Strip

A smooth concrete mowing strip must be provided around the base of lighting columns where appropriate. The concrete shall be 25MPa strength with a minimum width of 200mm on all sides and depth of 150mm. The concrete shall be boxed, finish level with the surrounding ground level and have a smooth trowel finish, slightly graded away from the column to eliminate water collecting next to the column.

5 Appendix

“Appendix 19A1: Lighting Column Evaluation Methodology Part A: Initial Evaluation Checklist” lists the essential criteria for this assessment that must be met for each new column design submitted to Auckland Transport.

Lighting Columns that satisfy ALL the requirements of “Part A” may then be considered for a detailed assessment carried out by an independent consultant of Auckland Transports selection.

“Appendix 19B1 – Lighting Column Evaluation Methodology Part B: Detailed Independent Assessment” is the results table for the columns structural performance. ”Part B” shall verify that “Part A” is accurate and that the column has no major design issues in relation to the specification outlined above.

If the lighting column passes “Part B“ then it shall be placed on the “Approved List“ at the discretion of Auckland Transport. It is recommended that the supplier of the lighting column, under evaluation of Part B, pays Auckland Transport a fee of $1000 to undertake the evaluation. This will demonstrate the commitment of the supplier to the quality, performance and support of the product.

Appendix 19C1 is the current Auckland Transport –Approved Lighting Column List (AT-ALCL)

5.1 Appendix 19A1

Lighting Column Evaluation Methodology Part A: Initial Evaluation Checklist

Column Manufacturer	
Model Name/Number	
Cost Per Unit	

	Initial Evaluation Checklist	Yes	No
1	**Height and Outreach Length** The column must have a nominal height and a maximum outreach arm as outlined in Table 78 of this specification.	☐	☐
2	**Tilt Angle** The outreach arm must have an upward tilt angle of 5°.	☐	☐
3	**Permanent Design Load** The column must be designed to take the load of a standard luminaire as outlined in Table 1 of this specification.	☐	☐
4	**Wind Design Load** The column design must comply with the latest standards set out in AS/NZS 1170.2 and must be designed to take the load on a 1.0m^2 sign attached 2.5m above ground level.	☐	☐
5	**Structural Steel Thickness** The minimum steel thickness for the in ground section of the column with a nominal height greater than 10.0m must not be less than 3.0mm. Other structural elements of the column must not be less than 2.0mm.	☐	☐
6	**Steel Properties** All structural steel used to manufacture the column must comply with the standards set out in NZS 3404.	☐	☐
7	**Deflections** The column must be designed to have a maximum deflection of no more than ±3.0°.	☐	☐
8	**Dynamic Response** The dynamic response of the column must comply with Section 6 of AS/NZS 1170.2	☐	☐
9	**Switchboard Door Cavity Opening** The base of the switchboard door cavity opening must be located between 600mm and 900mm above finished ground level and must require a special tool to open.	☐	☐
10	**Protective coating** The entire column, both internally and externally, must be galvanized or otherwise protected by an Auckland Transport approved coating system.	☐	☐
11	**Base Section** The base section of the column must, on top of the overall galvanisation, have an approved extra protective coating from 200mm above ground level to the base of the column.	☐	☐

12	**Welding** All welding on the column must comply with AS/NZS 1544.	☐	☐
13	**Design Life** The column must have a minimum design life of 50 years.	☐	☐

Note: If any column submitted does not comply fully with the above points please provide all the necessary information (i.e. design calculations or manufactures warranty) for alternative design consideration.

New Zealand Distributer;

Company Name: _____

Contact Name: _____

Position: _____

Phone Number: _____

Email Address: _____

Signature: _____

Date: _____

5.2 Appendix 19B1

Lighting Column Evaluation Methodology Part B: Detailed Independent Assessment

Verification of Initial Evaluation Checklist		
1	Height and Outreach Length	Pass/Fail
2	Tilt Angle	Pass/Fail
3	Permanent Design Load	Pass/Fail
4	Wind Design Load	Pass/Fail
5	Structural Steel Thickness	Pass/Fail
6	Steel Properties	Pass/Fail
7	Deflections	Pass/Fail
8	Dynamic Response	Pass/Fail
9	Switchboard Door Cavity Opening	Pass/Fail
10	Protective coating	Pass/Fail
11	Base Section	Pass/Fail
12	Welding	Pass/Fail
13	Design Life	Pass/Fail
Identify any issues with Column		
Recommend Column for Auckland Transport Approved Column List		Yes / No

Assessment Completed By;

Company: _____

Contact Name: _____

Position: _____

Phone Number: _____

Email Address: _____

Signature: _____

Date: _____

5.3 Appendix 19C1

Auckland Transport – Lighting Column Approved List (AT - LCAL)

Manufacturer	Model Name/Number	Supplier	Date Approved
CSP Pacific Ltd	Oclyte™ octagonal tapered steel columns supplied in sections	CSP Pacific Ltd	*
CSP Pacific Ltd	Tamaki Drive cylindrical pole	CSP Pacific Ltd	*
CSP Pacific Ltd	Auckland CBD CSP Multi Function Pole	CSP Pacific Ltd	*
Steelgal	Oclyte	Steelgal	*
Spunlite	Oclyte	Spunlite	*
GESS	Tamaki Drive cylindrical pole	GESS	*

*** Inclusion on the Approved List is valid until 30th June 2013**