



Department of Corrections

Waikeria Prison Development

Assessment of Environmental Effects – Lighting

Summary Report



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1. Introduction

The Department of Corrections (the Department) has identified the development of a new facility at Waikeria Prison, between Te Awamutu and Otorohanga, as an appropriate response to meet the rising demand for prisoner places in New Zealand. The Department therefore intends to give notice of requirement to Otorohanga District Council to amend the designation for the Waikeria Prison site to allow up to 3,000 prisoners to be accommodated on the site. The increase in capacity will enable a new facility for 2,000 male prisoners to be built, the operation of existing facilities and provide for future demand if needed.

The current prison facilities on the site can accommodate approximately 650 prisoners while the current designation for Waikeria Prison allows for up to 1,250 prisoners to be accommodated on the site. If the amendment to the designation is confirmed, the Department proposes to construct all new prison facilities on the site within an identified “Proposed Building Zone”. Refer to the Figures Volume = Figure 3: Local Context Plan (external to this report) for definition of the Proposed Building Zone.

To support the application to increase the designated capacity of Waikeria to 3,000 prisoners, the Department requires an assessment of lighting effects associated with the new facility to accommodate 2,000 prisoners. This assessment also considers the lighting of the lower jail as this existing facility is located within the Proposed Building Zone.

2. Site Description

Waikeria Prison is located on a 1,276-hectare site on Waikeria Road, with an emergency access point off Wharepuhunga Road. The site is 8km from State Highway 3 and approximately 17km south of Te Awamutu and north east of Otorohanga.

The site is designated under the Otorohanga District Plan 2014 (Designation D55) for the operation of Waikeria Prison and associated activities (subject to conditions). The Designation for the site allows for up to 1,250 prisoner places. The underlying zoning is described as ‘Rural Effects Area’ by the District Plan.

The prison site is surrounded by a mix of rural lifestyle and farming activities. The landscape is generally open and is characterised by low-lying areas interspersed with rolling hills and small ridges. Most the prison site is used for dairy farming operations and other dry stock purposes run by the Department.

Existing prison facilities form several small “nodes” within the site, separated by large areas of farmland. The existing prison buildings are one to two storeys in height and at the closest point are located approximately 400 metres from the site boundary. The closest residential building is located approximately 850m away from the Proposed Building Zone within which all new prison facilities will be located. The existing lower jail located in the Proposed Building Zone has exterior lighting comprising of pole mounted floodlights mounted approximately 12m above ground level in the corner of each prison hut unit. There are up to four existing floodlights on each pole.

3. The Proposal

The proposal is to amend the designation to enable the Department to construct, operate and maintain prison facilities accommodation up to 3,000 prisoners at Waikeria Prison.

In parallel to the designation process, the Department will run a procurement process for the design, construction, finance and maintenance of a new facility accommodating 2,000 prisoners. This will be formalised and delivered by way of a public private partnership (PPP) which will be finalised in April 2018. The final design of the new facility will not be known until the contract with the private partner is signed in April 2018. For the purposes of assessing the lighting effects of the new facility as well as any future facilities on the environment, and providing the community with information about the proposal, design parameters have been developed by the Department.

The design parameters that are of relevance to this lighting assessment are:

- All new prison facilities for the overnight accommodation of prisoners will be located within the Proposed Building Zone.
- The maximum height of the secure perimeter is 6m (The secure perimeter includes the primary physical barrier, fences outside the primary physical barrier, an access road around the outside of the fences and a surveillance strip outside the access road). Exterior lighting will be installed both inside and outside the secure perimeter.
- Lighting will comply with applicable relevant district, national and international standards

4. Prison Lighting Requirements

Lighting is required to enable prison staff to complete their duties, provide security and assist in the detection of attempted intruders and escapees. Lighting enables any movement in the zones between buildings and fences to be clearly discerned from the cameras. Exterior security and perimeter fence lighting is essential to provide public safety.

Based on information gathered from other prison sites in New Zealand, the general exterior lighting areas and components required for functional lighting of prisons generally include the following:

- Lighting on the inside of the secure perimeter
- Lighting on the outside of the secure perimeter
- Secure compound lighting
- Building security lighting
- Staff and visitor carpark lighting
- Access road lighting

5. Methodology

The remainder of this report has been compiled based on the following assessment methodology

- Review of statutory provisions and standards,
- Consultation and analytical study of the existing lighting environment for the lower jail,
- Assessment of potential adverse lighting effects:
 - Lighting technical requirements for proposed development,
 - Review of potential effects, and
 - Design approach to mitigate effects.
- Conclusions.

6. Statutory Provision and Standards

Lighting has been identified as having potential effects relevant to the Resource Management Act 1991. This report has been prepared to assess these effects and, where any such effects are potentially significant, to recommend measures that could be implemented to avoid, remedy, or mitigate such effects. The relevant statutory provisions and standards are listed below as these provide lighting assessment criteria appropriate to the surrounding receiving environments.

There are two sets of statutory provisions that are relevant to this assessment. These are:

1. The lighting and glare provisions of the Otorohanga District Plan 2014; and
2. The lighting and glare conditions of the existing designation for Waikeria.

While not statutory or mandatory in New Zealand, the following standard is one of the more prominent and credible standards and has increasingly been adopted as an international reference:

3. Australian Standard AS 4282 – 1997 (Control of the Obtrusive Effects of Outdoor Lighting).

Another relevant standard used in lighting is:

4. AS/NZS1158 Lighting for Roads and Public Spaces (All Parts)

These are each discussed below and have been used to inform this assessment.

6.1. Otorohanga District Plan 2014 - Lighting and Glare

The Otorohanga District Plan 2014 includes objectives, policies, standards and rules relating to artificial lighting and its effects of the physical environment. Those relevant to Waikeria Prison are:

District Plan – Relevant Objectives, Policies, Standards and Rules

Issues / Objectives / Policies

Issue 3 – Rural Character

3.2 Objectives

- 3.2.1 *To retain the rural character and amenity values of an area through managing land use and development and controlling subdivision.*

3.3 Policies

- 3.3.7 *In the Rural Effects Area, avoid, remedy or mitigate against the adverse effects, including cumulative effects, on rural character associated with:*

(l) glare and light spillage.

Issue 8 – safety of road users

8.2 objectives

- 8.2.2 *To ensure that the safety and function of the transport network is not adversely affected or compromised by:*

(d) glare or light spillage from artificial lighting;

8.3 policies

- 8.3.5 *The safety of users of the transport network should not be adversely affected by:*
 (e) *the intensity, design, orientation and nature of lighting, including illuminated signs, where it is likely to cause distraction to driver vision;*

Land Use Chapter

18 Outside Lighting / Reflective Building Materials

While sunlight is usually a positive light source, other sources of light such as artificial lighting or glare can create a nuisance for neighbouring property owners or a hazard for road users.

Standards

- 18A *Light emissions from a site shall not exceed a measurement of 10 lux (lumens per square meter) measured at 1.5 meters above ground level at the boundary of the site.*
- 18B *No structure shall be finished in a manner which could create glare nuisance to road users or neighbouring properties.*

Rules

- 18.1 *Any activity which complies with standards 18A and 18B is a permitted activity.*
- 18.2 *Any activity which does not comply standard 18A or 18B is a discretionary activity. The Council will restrict its discretion to:*
- a. *nuisance effects associated with glare and light spillage;*
 - b. *effects on private amenity values and neighbourhood character*
 - c. *hours and/or duration of operation; and*
 - d. *effects on safety of the road and railway network users.*

6.2. District Plan – Waikeria Prison Designation Conditions

The conditions contained within Designation D55 that relate to lighting are:

Condition 4.

Light levels from fixed lighting at the prison site measured at a height of 1.5m above ground level at or beyond the site boundary of the designated site shall not exceed 10-lux.

Condition 5.

Except for emergency and security incident lighting, all new exterior lighting installations shall be designed and constructed to the following obtrusive light limitations

<i>Sky Glow</i>	<i>Light Spillage</i>	<i>Glare Source Intensity I</i>	<i>Building Luminance</i>
<i>UWLR (Max %)</i>	<i>Ev (Lux)</i>	<i>(kcd)</i>	<i>L(cd/m2)</i>
5	5	50	5

Note UWLR (Upward Waste Light Ratio) = Maximum permitted percentage of luminaire flux that goes directly into the sky

I = Light intensity in Candelas

L = Luminance in Candelas per square meter

Glare Source Intensity - This applies to each source in the potentially obtrusive direction, outside of the area lit. The figures given are for general guidance only and for some medium to large sports lighting applications with limited mounting heights may be difficult to achieve. However, if the aforementioned recommendations are followed then it should be possible to lower these figures to under 10kcd (kilocandela).

Building Luminance – This should be limited to avoid over lighting, relate to the general district brightness.

6.3. Australian Standard AS 4282 – 1997 (Control of the Obtrusive Effects of Outdoor Lighting)

There are no specific standards applicable to external lighting for New Zealand prisons or corrections facilities. However, Australian Standard AS 4282 – 1997 (Control of the Obtrusive Effects of Outdoor Lighting) is accepted as providing the most appropriate guidance on the control of external lighting.

Several aspects of potential obtrusive external lighting effects are considered by AS 4282 – 1997, including light falling on surrounding properties, brightness of light fittings in view of nearby residents, glare to users of adjacent transport systems and the effects on astronomical observations.

For the control of these potential obtrusive external lighting effects, technical parameters are recommended in Tables 2.1 and 2.2 of Australian Standard AS 4282 – 1997 (refer Appendix A). Further AS 4282 defines the strategy adopted for developing controlling values of spill light based on the following:

- a. The level of lighting existing in the area.
- b. The time that the proposed lighting is to operate (curfew).
- c. The type of lighting technology available to light the area/activity.
- d. The use of readily available and easily understood technical data on the lighting installations which can easily be verified at the design and assessment stages.

Note Compliance with Australian Standards AS 4282 – 1997 is not required to meet District Plan Rules however, it is a useful guide to limit detrimental effects from exterior luminaires and is considered appropriate for assessing prison lighting.

6.4. AS/NZS1158 (Lighting for Roads and Public Spaces)

AS/NZS 1158 ensures safe vehicle and pedestrian movement and the timely identification of objects and pedestrians by the motorist's eye, while travelling at speed during the hours of darkness.

7. Summary of Consultation Feedback on Lighting

Commencing in late 2016 the Department consulted with site neighbours and members of the local community. Light pollution from the existing prison site was raised as a concern during the public open days and at two residents' meetings. One meeting was attended by residents on Wharepuhunga Road and the other by residents on Waikeria Road, Walker Road and Adams Road. Department representatives also met with site neighbours on a one-on-one basis and light pollution was raised as a concern by a number of residents.

While light pollution in general was raised as an issue of concern, the following specific comments were made:

- As light pollution was more noticeable in winter due to the deciduous trees no longer screening the prison from view, could more trees be planted?;
- There is a haze from the existing floodlights;
- A neighbour who looks straight down on the lights does not want to see an increase in the 'glow';
- A neighbour was interested in understanding what the possible solution to the light pollution would look like;
- Changing the existing lighting levels is a good idea.

Feedback from some residents was also obtained as part of the Analytical Study and is contained in Appendix B.

8. Site Visit / Analytical Study

In November 2016, an analytical study was carried out with regard to the existing lighting at lower jail which is within the Proposed Building Zone. Night time measurements were undertaken and the extent of views from neighbouring residential properties and roadside vantage points captured. The results of the analytical study are included in Appendix B and key points noted below:

1. The existing pole mounted floodlights around lower jail are visible from the surrounding local road network. Due to the separation distance the floodlights are not considered to be a distraction to motorists. The existing pole mounted floodlights are also visible from neighbouring residential properties. The Department proposes that this aspect of the existing installation be reviewed, and upgraded to lessen the obtrusive lighting impact of both the Upwards Waste Light Ratio (UWLR) and Glare Source Intensity.
2. All new prison facilities will be located within the Proposed Building Zone. The Proposed Building Zone can be viewed from several neighbouring residences and roadside vantage points with concern being raised about the effect of additional light pollution at night from development within the Proposed Building Zone.
3. Based on the measurements taken, the existing installation was observed to generally comply with the requirements of the District Plan and the Designation conditions. The aiming of some existing luminaires contributes to Upwards Waste Light Ratio but this was subjectively considered to be below the 5% threshold however will require confirmation by detailed calculation/modelling. Due to the separation distance from the site boundaries, the spill lighting effects were observed to be well below the specified 5 lux limit. Glare source intensity and building luminance are considered compliant based on the luminaires installed and the building construction materials/colour respectively. The aiming of luminaires contributes to more subjective glare effects which are of nuisance/annoyance value to a static observer in the rural area. Further, based on the feedback of neighbouring residents during the consultation, this remains an area of concern.

9. Assessment of Potential Adverse Lighting Effects

There are three main obtrusive lighting effects that have the potential for varying degrees of impact on neighbouring residents, vehicles and users of public spaces. They are spill lighting, glare and sky glow. These lighting effects are defined in Appendix C to assist the reader to better understand the technical parameters, plus benchmark lighting levels have been included that provide further context on the typical exterior environment.

The following section considers the lighting design technical requirements for the new facility and retrofitting of lower jail and provides commentary on how these effects may be appropriately mitigated.

9.1. Lighting Technical Requirements

While a design for the new facility will not be finalised until April 2018 when the PPP procurement process concludes, it is expected that exterior lighting for the new facility will include some, or all of the following:

- Pole mounted lighting for the access road and car parks.
- Building or pole mounted security lighting within the secure compound.
- Wall or pole mounted lighting for Perimeter wall/fence and secure perimeter zone.
- Luminaires equipped with the most appropriate lamp technology to meet requirements of the prison facility whilst also maximising energy efficiency.
- All luminaires will be equipped with full cut-off optics (designed with lamps recessed into the body) to control the light spill.
- Pole height will be dependent upon the purpose and function with luminaire and lamp wattage selection, plus luminaire aiming to ensure correct distribution of light and minimize light spill, glare and sky glow.
- Automatic controls to turn on at early dusk and off at late dawn each day, plus low level and high “Alert” level controls for the secure perimeter zone integrated with the detection systems.
- All cabling to be underground, or concealed within structures or building cladding.

9.2. Potential Effects

9.2.1. Spill Lighting

Most nearby residentially occupied buildings are partially screened by existing trees and the land contour between the residential buildings and proposed Building Zone.

Any residential properties that do have a direct view into the site are located a significant distance from and above the height of the proposed Building Zone therefore, on the basis that all new luminaires are cut-off type and aimed appropriately, will not be subjected to spill lighting effects.

The maximum illuminance from perimeter luminaires will generally be the highest directly adjacent to the installation position. This will generally decrease rapidly at the distance increases from the pole, especially with the use of cut-off optics, thereby mitigating spill lighting effects.

Illuminance measurements are required at the site boundaries in respect of Spill lighting. The existing installation currently complies with the District Plan Standards and existing Designation Conditions. However, The Department is focussed on both further reducing the impacts of the existing installation and setting performance limits for the proposed new facility such that the outcome achieved is exemplary when considered against the District Plan or Designation. i.e. all parameters can be assessed or measured to be well below the defined limits.

9.2.2. *Glare*

Luminance calculations (glare) and numerical evaluation is not a direct requirement of the District Plan. However, Designation D55 refers to a maximum building luminance of 5 cd/m². The intent of Section 18 of the Land Use Chapter within the District Plan is to limit glare for both motorists and residents to an acceptable level. Referencing standard AS 4282, clause 2.4 (c) (ii) states that consideration should be given to:

- The direct view of bright luminaries
- A reduction in the ability of transport users to see essential details of the route ahead, including signalling systems, due to glare from bright luminaries
- Changes to night sky viewing conditions from 'sky glow'

One of the primary concerns for glare is short-term road users approaching the site along Wharepuhunga Road and Waikeria Road. The second consideration is for residents that overlook the site from surrounding farms and rural properties and have a direct view of the site.

Tables 2.1 and 2.2 from AS 4282-1997 were established for assessment of residential glare and are based on 'long term' or continuous views of luminaries. Road users and pedestrians experience momentary or short-term viewing and as such, evaluation of glare can be established by relatively simple analysis of property boundaries, luminaire locations and control of the direction of intensity in candelas (cd).

The use of luminaires with full cut-off optics and appropriate aiming below the horizontal will ensure that glare effects are prevented or reduced to an acceptable level at and beyond the site boundary.

Building luminance will be kept to a minimum to ensure the general appearance of the site is as unobtrusive as possible when viewed from neighbouring properties. This will be achieved by materiality choices and colour selection used as part of the building construction and be within the limits of the Designation.

9.2.3. *Sky Glow Effects*

Sky Glow effects and the Upwards Waste Light Ratio (UWLR), are impacted predominantly by both luminaire selection and aiming. The existing Designation sets a maximum limit for UWLR of 5% which is representative of values that have been historically achieved via the use of semi cut-off luminaires on either road lighting or flood lighting installations.

Using full cut-off luminaires, together with appropriate positioning and aiming allows UWLR to be reduced to values approaching 0%.

Sky glow effects are potentially more pronounced on a misty or wet night due to the increased reflection or refraction from atmospheric particles. On a clear and low humidity night, the effects are more subtle.

Via appropriate material choices and colour selections for the building construction, low reflectance values of the ground and building facades will ensure that the lighting effects in to a dark sky will be low. Coupled with the appropriate positioning and aiming of luminaires, only reflected light from the ground or buildings will be able to affect the surrounding environment rather than direct upward light from the luminaires. Any reflected light will generally be low in intensity and will have a less than minor effect on road users or neighbourhood residents.

9.3. Summary of Effects

9.3.1. Surrounding Residential Properties

The immediate surrounding properties are rural in nature and, in accordance with Issue 3 of the District Plan, the Policy states that adverse effects associated with glare and light spillage must be avoided, remedied or mitigated.

Exterior lighting will be designed to reduce the effects on the environment by implementing best practice techniques. Adverse lighting effects will be avoided or mitigated by: -

- Using full cut-off and/or asymmetric optics in all external luminaires as appropriate to technical design requirements
- Mounting luminaires at an appropriate height to reduce number of poles and aiming towards the ground to control glare and spill light
- Adequate separation of luminaires from site boundaries

9.3.2. Road Users

Staff and visitor carpark lighting will be located some distance from the closest public roads being SH3, Whangapuhunga Road, Waikeria Road and Walker Road. There will not be any direct light on to adjacent roads due to the use of full cut-off luminaires and the separation distances involved (i.e. the nearest boundary/road is more than 400m away from the Proposed Building Zone).

The number of vehicles accessing / egressing the site will increase due to the significant uplift in staff numbers and associated visitors. While the effect of individual car headlights is no worse, it will be much more frequent. Landscape planting or screening can be undertaken to soften the environment and reduce effects from the fixed lighting installed on access roads and to prevent moving vehicles from being visible from remote vantage points at neighbourhood properties.

9.3.3. Construction Effects

Construction lighting can be a source of nuisance as often there is no specific design or assessment applied to this type of temporary lighting.

Temporary lighting may be required during the construction period for security purposes. Most construction activity will be undertaken during daylight hours however external lighting may be needed for early morning or early evening works. Through appropriate luminaire selection and aiming, its effects will be negligible.

To ensure that the effects of construction and associated security lighting are avoided, or mitigated, it is recommended that a construction lighting management plan be developed and submitted by the contractor for review prior to commencement of the construction phase. The construction lighting, albeit temporary, will be designed to comply with the designation conditions and in turn minimise any obtrusive lighting effects.

9.3.4. Other Effects

In the context of the Waikeria prison site, other potential effects include:

9.3.4.1. Effect on Aircraft Navigation

Waikeria prison is located approximately 30km South and outside of the approach path of Hamilton International Airport. There are no other significant airfields located in close proximity so any aircraft passing over the site is expected to be of sufficient altitude such that it does not experience any detrimental effects due to the prison lighting installation.

9.4. Design Approach to Mitigate Effects

The lighting installation will be designed such that luminaire selection, mounting and aiming will meet operational requirements for maintained light levels. It is expected that luminaire selections for external lighting for the new facility will include the following:

- Building mounted luminaires with full cut-off optics to limit localised glare to within acceptable levels.
- Lighting design to incorporate Type C Luminaires (Asymmetrical or cut-off floodlights), as defined in Appendix D / Figure D1 of AS 4282 (refer to Appendix C).
- Luminaires generally aimed in a downward direction with all light directed below the horizontal, so that both glare and spill lighting are minimised or even eliminated.
- Lamp selection will be made to optimize efficiency, pole height and spacing, while meeting operational requirements.

Calculations for the levels of illuminance required to meet security levels will be finalised by the designer of the lighting for the new facility. By employing the principles outlined above, and following the technical principles of AS 4282 – 1997, any potentially adverse lighting effects in relation to spill lighting, glare and sky glow can be minimised. Whilst the procurement specification for the new Waikeria facility is largely performance based, the Works Requirement section on lighting states that, in addition to defining the operational criteria for the new facility, the outdoor lighting installation must perform within the requirements of the District Plan or Designation Conditions and in accordance with the recommendations of AS 4282.

Further, the Department is also focussed on improving the rural character of the existing environment by undertaking a detailed review and upgrade of the existing exterior lighting installation at the lower jail. This will result in a reduced impact of spill lighting, glare and sky glow. Based on the results of the Analytical Study, it is noted that the existing installation does comply with the requirements of the District Plan and Designation D55, however aiming of some existing luminaires currently allows the lamp source to be visible from outside of the site, creating a perception of glare and contributing to sky glow.

The review and upgrade of the exterior lighting installation at the lower jail is scheduled to be undertaken prior to the completion of the proposed new facility.

10. Conclusions

- A. The Department intends to amend the existing Designation to increase capacity at Waikeria Prison up to 3,000 prisoners. Exterior lighting will be designed to limit illuminance levels to those required for specific working purposes and for security in the special circumstance of the proposed new facility.
- B. The Department is seeking to mitigate any adverse lighting effects through the implementation of appropriate “best practice” design and controls solution for the exterior lighting to the proposed new facility such that security and safety of staff, community and prisoners is assured.
- C. A specific and detailed design for exterior lighting has not been prepared but will be developed as part of the subsequent outline plan of works process by the successful PPP consortium. Key technical requirements and design principles have been defined for the purposes of this report and will be used as inputs to the delivery brief and works requirements. The final exterior lighting plans will show and describe the location, type and illuminance of external lighting for the proposed new facility.
- D. Exterior lighting will be designed to minimise, as much as practicable, illuminance levels to those required for the security and functioning of the proposed prison facility, and to minimise glare and light spill beyond the boundary.
- E. Overall, by employing the principles outlined in this report, including the requirements contained in AS4282, the site exterior lighting for the new facility can be designed to comply with, and indeed achieve performance limits that are well within the relevant District Plan rules and Designation conditions and thereby minimise any potential adverse effects on neighbouring properties, roads and other public spaces.
- F. The detailed review and upgrade to be undertaken on the existing lighting installation at the lower jail will be focussed on reducing any existing obtrusive lighting effects. The Department’s aim is to achieve levels that are well below the limits of the District Plan and Designation, thereby improving the rural character of the local area in time for the completion of the proposed new facility.



Appendix A

Tables 2.1 & 2.2 from AS 4282 – 1997

TABLE 2.1
RECOMMENDED MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS
FOR THE CONTROL OF OBTRUSIVE LIGHT
 (See Clause 2.7)

1	2	3	4	5
Light technical parameter	Application or calculation conditions (see also Figure 2.1 and Section 5)	Recommended maximum values		
		In commercial areas or at boundary of commercial and residential areas*	Residential areas	
			Light surrounds [†]	Dark surrounds [‡]
Illuminance in vertical plane (E_v)	<i>Pre-curfew:</i> Limits apply at relevant boundaries of nearby residential properties, in a vertical plane parallel to the relevant boundary, to a height commensurate with the height of the potentially affected dwellings. Values given are for the direct component of illuminance	25 lx	10 lx	10 lx
	<i>Curfewed hours:</i> Limits apply in the plane of the windows of habitable rooms of dwellings on nearby residential properties. In the absence of development (i.e. vacant allotment), the limits apply on the potentially affected property, in a vertical plane parallel to the relevant boundary, at the minimum setback permitted for a dwelling, to a height commensurate with land use zoning provisions. Values given are for the direct component of illuminance	4 lx	2 lx	1 lx
Luminous intensity emitted by luminaires (I)	<i>Pre-curfew:</i> Limits apply to each luminaire (irrespective of the number on a head frame) in the principal plane, for all angles at and above the control direction, when aimed in accordance with the installation design	Limits as determined from Table 2.2. Alternatively, the limits and method of assessment associated with curfewed hours may be applied, at the discretion of the designer (see Clauses 2.7.1 and 2.7.2)		
	<i>Curfewed hours:</i> Limits apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents, from positions where such views are likely to be maintained, i.e. not where momentary or short-term viewing is involved	2 500 cd	1 000 cd	500 cd
Threshold increment (TI)	Limits apply at all times where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and viewing directions in the path of travel	20% based on adaptation luminance (L) of 10 cd/m ²	20% based on adaptation luminance (L) of 1 cd/m ²	20% based on adaptation luminance (L) of 0.1 cd/m ²

* Applies to residential accommodation in commercial areas or at the boundary between commercial and residential areas. The term 'commercial' is used as a generic description for zoning which provides for urban uses other than residential.

† Where the affected property abuts roads that are lit to Category V5 or higher in accordance with AS/NZS 1158.1.1.

‡ Where the affected property abuts roads that are lit to Category B1 or lower in accordance with AS 1158.1, or where there is no lighting.

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TABLE 2.2
MAXIMUM LUMINOUS INTENSITY PER LUMINAIRE
FOR PRE-CURFEW OPERATING TIMES
 (See Table 2.1)

1	2	3	4
Area description		Maximum luminous intensity from each luminaire*	
Size of area	Controlling dimension (Figure 5.1)	Level 1 control (Note 1)	Level 2 control (Note 2)
Large	>75 m	7 500 cd	100 000 cd
Medium	≥25 m ≤75 m	7 500 cd	50 000 cd
Small	<25 m	2 500 cd	25 000 cd

* Limits apply to each luminaire (irrespective of the number on a head frame) in the principle plane, for all angles at and above the control direction, when aimed in accordance with the installation design (see Clause 5.3.2.1).

NOTES:

- 1 Level 1 control is appropriate for development control of environmentally sensitive areas, i.e. where the existing environment is of high quality, where abutting properties are close to the installation, where they are residential in nature, where the existing ambient light levels are low and where the community requires the best available environmental safeguards to be applied.

As the use of Type C cut-off luminaires† is likely to be necessary for Level 1 control, the implementation of this level of control will normally be possible only for lighting applications that require relatively high illuminances over areas that are small to medium in size, e.g. lighting for tennis courts or hockey fields. However, Level 1 control may also be suitable for larger areas where lower illuminances are appropriate, e.g. for car parks and outdoor storage areas.

- 2 Level 2 control will permit the use of a wide range of currently used lighting techniques but will limit intensities in the control direction to what might reasonably be expected by careful attention to design and the selection and aiming of luminaires, especially for applications involving Type A luminaires†.



Appendix B

Site Visits / Analytical Study

Site Visits – On-Site Assessment 24 November 2016

TIME	ADDRESS	RESIDENTS COMMENTS	ADDITIONAL COMMENTS
8.00pm	XX Walker Road	The residents described their concerns around lighting having lived there for the past 20 years. They are aware that lighting is required for security purposes and are reasonably happy with existing lights following complaints 15 years ago.	This property is higher up the hill across a valley from the site. Existing lights are clearly visible below the horizon and appear acceptable (but bright) on a clear night. They would be less visible when fog settles in the river. When revisited at 9.20pm, there was a bit of an area glow from a fine mist in the area. Maximum luminance was 95 cd/m ² .
	XX Wharepuhunga Road	These residents have lived here for 10 years and do see two lights from youth prison site and can see two thirds of existing lights, but only from the deck.	Existing lights appear to be acceptable from this property. Maximum luminance measured was 15.4 cd/m ² .
	Wharepuhunga Road		Roadside view from entrance to Wharepuhunga Road properties. Existing facility and expansion area to the west is visible and existing floodlights can be seen clearly but not distracting for motorists.
8.45pm	XX Wharepuhunga Road	The occupants commented they have their curtains drawn at night. They have observed a haze from existing floodlights.	There is a view towards the north side of the existing facility but the rest is largely screened by intervening houses and trees. Potential views towards expansion. Existing lights can be seen at night but are acceptable. Maximum luminance was 12.5cd/m ² .
	XX Wharepuhunga Road		Not visited. View towards existing facility. Potential views towards expansion.



Appendix C

Definition of Lighting Effects

a) Forms of Potential Adverse Lighting Effects

There are three main lighting effects that have the potential for varying degrees of intrusiveness to both residential site neighbours and road users. They are:

Light spill

If luminaires are not correctly selected for the appropriate light distribution and not properly angled, light will be received at a location beyond the application area, particularly a property boundary. The effect can be mitigated through the optical control features of light fittings, mounting height and tilt angle.

Glare

Glare is related to light source intensity, background brightness and the location relative to the viewing position. Glare can cause visual impairment, discomfort or reduced amenity from the brightness contrast of a light source against the surrounding background.

Sky glow

Sky glow is the increased brightness of the night sky, and associated loss of visual amenity from the upward light (i.e. direct and indirect) reflected off atmospheric particles. Mitigation can be provided by the appropriate orientation and optical control of light fittings, efficiency of design. The reflective properties of surfaces such as paved areas are also relevant.

It should be noted that these effects are subject to the variable influence of weather conditions. In particular, atmospheric water vapour content (i.e. mist and cloud) accentuates sky glow appearance and has a diffusing effect on glare.

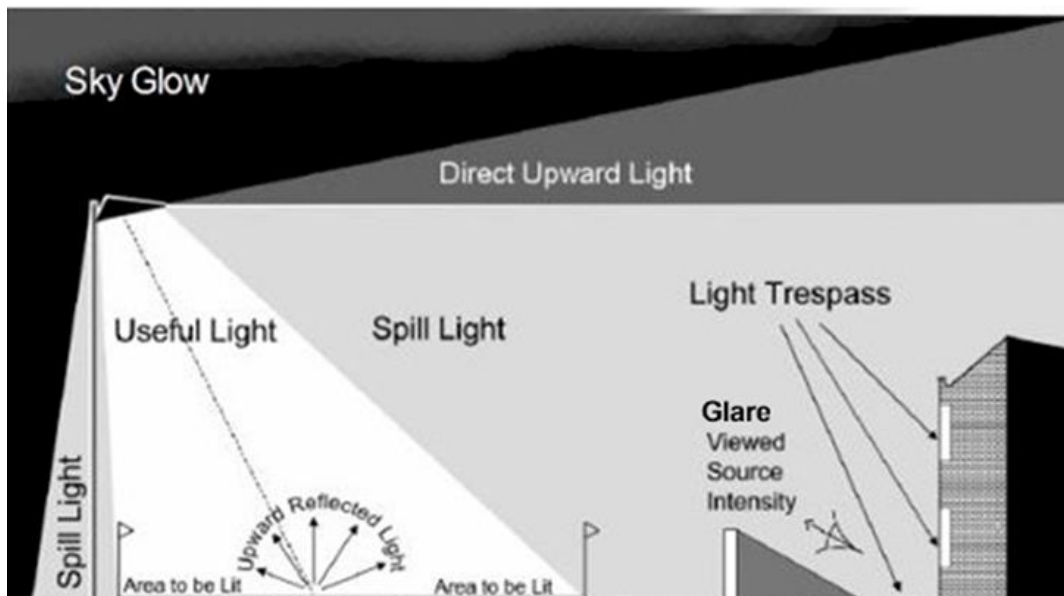


Figure 1: Illustration of obstructive lighting effects

b) Benchmark Illuminance Levels

To assist in the understanding of illumination values described in this report, the following summary lists typical values from general situations:

- Open area on a sunny day - 100,000 lux
- In the shade of a leafy tree - 10,000 lux
- Inside a building close to a window during daylight - 2,500 lux
- General office with artificial lighting – 500 lux
- Residential living area - 100 to 150 lux
- Street lighting - 5 to 30 lux
- Moonlight - 0.5 to 1 lux

c) Luminaire Specification Types

The following except from AS4282 defines typical luminaire specification types.

APPENDIX D
ILLUSTRATION OF FLOODLIGHT CLASSIFICATIONS
(Informative)

Two systems for classifying floodlights are described in AS 2560.1, namely—

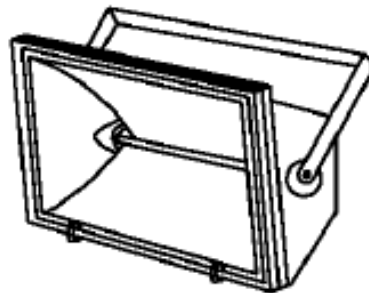
- (a) a classification system based on the general shape of the light beam provided, designated Type A, B or C; and
- (b) a classification system based on the degree of divergence of the light beam, separately evaluated in both horizontal and vertical planes through the floodlight, designated Class NN, N, 1, 6 or 7.

Reference should be made to AS 2560.1 for the details of these systems.

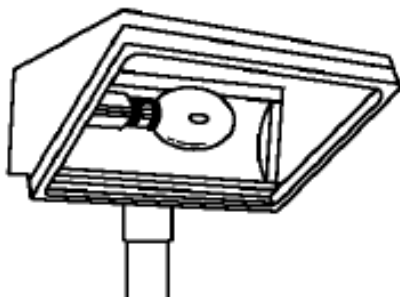
For the purpose of this Standard, Figures D1 and D2 illustrate the classification system described in Item (a).



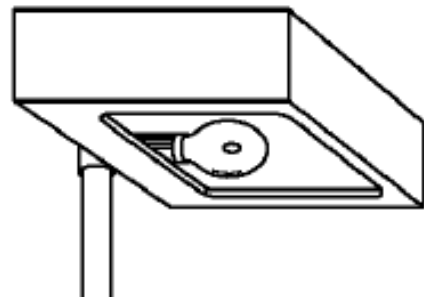
(a) Type A floodlight giving a symmetrical beam



(b) Type B floodlight giving a fan-shaped beam



(c) Type C floodlight giving a fan-shaped beam with asymmetric distribution in the vertical plane



(d) Type C cut-off floodlight (see Note)

NOTE: Reference is made in this Standard to Type C cut-off floodlights which are not described in AS 2560.1. Such floodlights are designed to be mounted with the light-emitting face horizontal, or near horizontal, and are sometimes referred to as ‘environmental’ type floodlights.

FIGURE D1 GENERAL TYPES OF FLOODLIGHTS



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