

**Before an Independent Hearing Panel  
Appointed by Wellington City Council**

**In the Matter** of the Resource Management Act  
1991

**And**

**In the Matter** of a Notice of Requirement to  
designate land for Airport Purposes  
known as the Main Site NOR.

**And**

**In the Matter** of a Notice of Requirement to  
designate land for Airport Purposes  
known as the East Side Area NOR.

**Statement of Evidence of  
Andrew Read  
for Wellington International Airport Ltd**

Dated: 05 May 2021

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## **INTRODUCTION**

### **Qualifications and Experience**

1. My name is Andrew Read. I am a Director of Pedersen Read Limited. I hold a Bachelor of Engineering (Electrical and Electronic) with Honours from the University of Canterbury. I am a Chartered Professional Engineer, Fellow and Chartered Member of Engineering New Zealand, am on the register of International Professional Engineers, and am an Associate of Illuminating Engineering Society of Australia and New Zealand.
2. I have been involved with lighting design and the assessment of environmental effects of lighting for over 25 years. I have been involved with submissions on the Christchurch City Plan when the Glare Rules were first introduced in the mid 1990's and have provided lighting advice for multiple outdoor sites since. I have provided advice to Christchurch International Airport for over 20 years on the effects of lighting to airport operations.

### **Code of Conduct Statement**

3. While this is not an Environment Court hearing, I nonetheless confirm that I have read the Code of Conduct for Expert Witnesses issued as part of the Environment Court Practice Notes. I agree to comply with the Code and am satisfied that the matters which I address in my evidence are within my field of expertise. I am not aware of any material facts that I have omitted which might alter or detract from the opinions I express in my evidence. I understand that I have an overriding duty to assist the hearing in an impartial manner and that I am not an advocate for the party which has engaged me.

### **Scope of Evidence**

4. I have been asked by Wellington International Airport Limited (**WIAL**) to provide evidence on the potential Lighting Effects of the Designation Outcomes associated with the Main Site Notice of Requirements (NOR) and East Side Area NOR.
5. In preparing this evidence, I have reviewed the following (in so far as they are relevant to my area of expertise):

- (a) The two NOR and associated Assessment of Environmental Effects (AEE) documents;
  - (b) Further information provided by WIAL in response to requests issued by Council for each NOR;
  - (c) The reports and statements of evidence of all the other witnesses giving evidence on behalf of WIAL;
  - (d) The section 42A report and its relevant appendices;
  - (e) Relevant public Submissions.
6. My evidence includes:
- (a) A review of the existing lighting (both mobile and fixed) in the context of the NORs;
  - (b) A description of the proposed lighting and illuminated signage;
  - (c) Review and comment on submissions and section 42A Report to the NORs;
  - (d) Discussion on the potential effects from the proposed lighting, measured against the existing Wellington District Plan Rules, and AS/NZS 4282: 2019 "*Control of the obtrusive effects of outdoor lighting*".

## **THE NORs**

### **Main Site NOR**

- 7. The Main Site NOR is a designation change that proposes permitted activity standards and thresholds that are generally in accordance with those currently permitted in the Wellington District Plan (WDP). As such, an assessment of environmental effects was not included in the scope of this engagement and has not been undertaken.
- 8. The types and configuration of exterior lighting permitted under the proposed designation are expected to be similar to those permitted under the current Wellington District Plan.

9. Lighting associated with the Main Site NOR is not anticipated to give rise to adverse effects that are different to those that can occur under the presently permitted District Plan provisions. Given this, I do not refer to the Main Site NOR further in this evidence.
10. Wellington District Council are undertaking a full review of the current Wellington City District Plan. It is expected that Rules based around the principles outlined in AS/NZS 4282:2019 "*Control of the obtrusive effects of outdoor lighting*" would be considered.

### **East Side Area NOR**

11. The East Side Area NOR proposes the redevelopment of the existing carparks, car storage, cargo logistics, flight aviation support areas, and part of the golf course to the south east of the existing terminal building, into a limited range of aircraft operations and associated activities.
12. Lighting to the areas to the west of Stewart Duff Drive which are within the East Side Area, presently consists of a variety of luminaire and lamp types and configurations, including luminaires associated with:
  - (a) Pole mounted roadway and carpark area lighting
  - (b) Building mounted area and security lighting.
  - (c) Mobile lighting from vehicle head and tail lights
  - (d) Advertising sign lighting
13. Lighting on the golf course to the east of Stewart Duff Drive is almost non-existent – the only lighting possibly being from an occasional course maintenance vehicle's head and tail lights.
14. Lighting expected as part of the proposed East Side Area designation would include lighting associated with aircraft operations and associated activities, and roadway lighting associated with the relocated Stewart Duff Drive. Generally, the lighting would potentially include:
  - (a) Aircraft Stand and Apron Lighting: Typically, 25 to 30 metre lighting poles with "flat-glass" luminaires mounted on top. Lighting performance parameters would be designed to meet the guidance

provided in the applicable sections of the Civil Aviation Authority of New Zealand's (CAA NZ) Advisory Circular AC139-6.

- (b) Roadway Lighting: Typically, 8 to 12 metre street-lighting poles with "flat-glass" luminaires mounted directly on top, or on outreach arms. Lighting performance parameters would be designed to meet the requirements of applicable sections of the AS/NZS 1158 "*Lighting for roads and public spaces*" suite of standards.
- (c) Navigational Lighting: Taxiway centre line and/or edge lighting, apron guidance lighting, stand lead-in lighting, and illuminated information signs including taxiway, apron warning signs, and nose-in guidance signs.
- (d) Illuminated Signage: Internally illuminated and digital signs for operational and passenger information.
- (e) Vehicle Lighting: Head, tail, and, where required, security beacon lights.
- (f) Aircraft Lighting: Aircraft mounted taxiing and navigational lighting used when aircraft are moving to and from aircraft stands.

## **KEY ISSUES AND ASSESSMENT OF EFFECTS**

### **Basis for Assessment**

- 15. The Wellington District Plan addresses lighting effects in the Airport and Golf Course Recreation Precinct by Rules limiting direct or indirect illumination at the windows of nearby residential areas. Unwanted illumination, referred to as spill light, is measured in lux and reduces in proportion to the inverse square of the distance from the luminaire. As such, spill light is often only an applicable basis for assessment when the light sources are relatively close to potentially affected parties.
- 16. Australian and New Zealand Standard AS/NZS 4282: 2019, "*Control of the obtrusive effects of outdoor lighting*", is a more relevant document to assess the effects against. This document represents good practice and is an update of Australian Standard 4282: 1997. Wellington City Council specifically

requested that the proposed lighting be reviewed from the perspective of this Standard (AS/NZS 4282: 2019).

17. It should be noted that AS/NZS 4282:2019 only considers the effects of outdoor lighting. It does not specifically address the effects of indoor lighting on the external environment i.e. the effects from lighting within the Terminal Building and/or carpark buildings – noting that these will form a background against which the East Side Area outdoor lighting will be seen. Frank Boffa’s report, Visual Effects of Designation Outcomes (paragraphs 6.3 to 6.7), refers to the appearance of the Terminal Building at night and to some of the mitigations that could be put in place to reduce effects.
18. It should also be noted that lighting for aviation safety does not fall with the scope of the Standard. However, the Standard is an appropriate basis for assessing lighting effects.
19. AS/NZS 4282: 2019 uses various Light Technical Parameters (**LTP**) to assess potential lighting effects (some of the more relevant LTPs are included in Appendix A to my evidence). Different limits for the parameters are applied based upon the ambient light conditions. These ambient conditions are set for various environmental zones. The two potentially applicable environmental zones (AS/NZS 4282: 2019 Table 3.1 “Environmental Zones”) for the airport are:
  - (a) **Zone A3**: described as “Medium district brightness” with examples: “Suburban areas in towns and cities”, and
  - (b) **Zone A4**: described as “High district brightness” with examples: “Town and city centres and other commercial areas. Residential areas abutting commercial areas”. (Note: Recreational areas are not considered commercial)
20. AS/NZS 4282: 2019 introduces the concept of lighting curfew periods, during which lower light technical parameters are set. Unless otherwise specified by the controlling authority, the lighting curfew period is taken as between 11:00pm and 06:00am.
21. In addition to the documents above, the Civil Aviation Authority of New Zealand (**CAA NZ**) has requirements for lighting associated with airports. Elements of these requirements assist with the management of lighting effects

whilst ensuring the safety of airport operations. In particular, CAA NZ Advisory Circular AC139-6 Section 5.3 “*Lights*”, Clause 5.3.195 states, “*Apron floodlights should be located so as to provide adequate illumination on all apron service areas, with a **minimum of glare** to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron*”. (my emphasis)

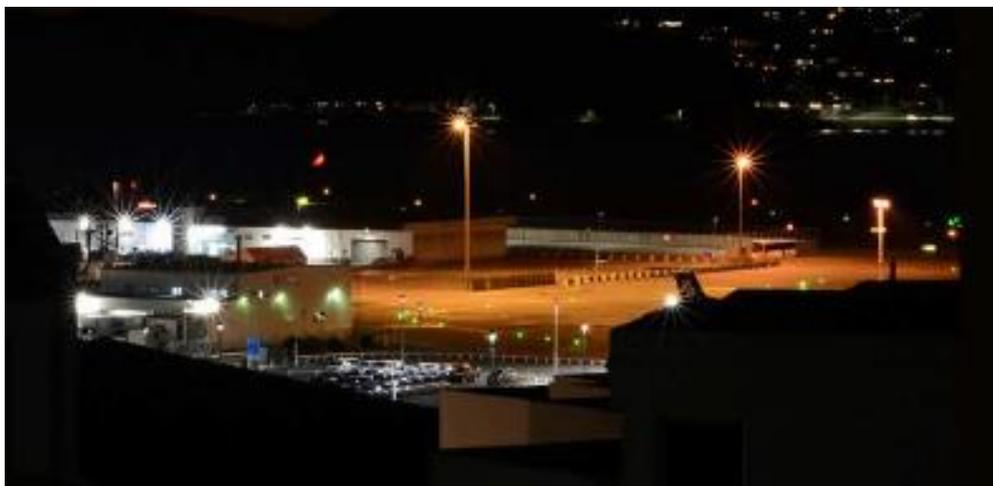
22. The expected lighting installation is therefore assessed against the relevant aspects of all the above documents.
23. The key terms used to describe the lighting effects associated with the NORs are spill light, glare, and sky glow. A copy of the relevant definitions and provisions are **attached** as **Appendix A** to my evidence.

### **East Side Area NOR**

#### **Appearance of Existing Lighting**

24. The existing lighting in the East Side Area is viewable from various residential areas as indicated in the Visual Effects of Designation Outcomes, Additional Material, prepared by Frank Boffa in association with Boffa Miskell Ltd, November 2020.
25. The document includes night-time visualisations of the existing lighting environments.
26. Visualisations N2B and N4B (part included in **Figure 1** and **Figure 2** below) provide examples of the appearance of the existing lighting installation from two locations towards the northeast. The visualisations show the proposed East Side Area in the foreground with the Main Site NOR area in the background.
27. Key features of the existing lighting environment include:
  - (a) Diverse lamp types: high pressure sodium (orange appearance), metal halide (cool white appearance), fluorescent (white appearance), Light emitting diode (LED) (cool white appearance).
  - (b) Point Glare Sources: multiple point glare sources.
  - (c) Illuminated Façades: Building façades washed with light.

- (d) Reflected Light: Light reflected off the ground, vehicles and structures.
- (e) Other: Not seen in the images but regularly present will be point light sources from vehicle head and tail lights, aircraft navigational lights, and airside vehicle warning lights.



28.

Figure 1: Part Visualisation N2B "View from Bunker Way, Strathmore" – Existing View



29.

Figure 2: Part Visualisation N4B "View from Wilberforce St, Seatoun Heights" – Existing View

### Appearance of Proposed Lighting

- 30. The visual appearance of the expected lighting within the East Side Area is depicted within the Visual Effects and Designation Outcomes, Additional Material, prepared by Frank Boffa in association with Boffa Miskell Ltd, November 2020.
- 31. Visualisations N2B and N4B (part included in **Figure 3** and **Figure 4** below) provide examples of the appearance of the proposed lighting installation from two locations towards the northeast. The visualisations show the proposed East Side Area lighting in the foreground against the backdrop of the expanded terminal building - part of the Main Site NOR area.



32.

Figure 3: Part Visualisation N2B "View from Bunker Way, Strathmore" – Proposed View



33.

Figure 4: Part Visualisation N4B "View from Wilberforce St, Seatoun Heights" – Proposed View

34. The proposed apron floodlighting poles are clearly visible (Figure 3 and Figure 4) on the apron side of the terminal building however the luminaire LED lamp sources are not directly visible as the luminaires are at a lower elevation than the viewing location and are mounted with zero upward tilt – i.e., “flat glass”. The effects of the lighting are seen only where the light is reflected off other objects, namely: aircraft, vehicles, the apron, the terminal building, and the lighting towers themselves. On a misty or foggy night, the halo created by the light reflected off the moisture particles in the air would also be visible – appearing as a glow in the air below the luminaire locations. The apron floodlighting poles are modelled at 25m high in the visualisations which could increase to 30m in practice. Such an increase in height is not expected to materially change the effects.

35. Whilst the luminaire's LED lamp sources are not apparent in these visualisations, it is expected that they may be visible from some of the residences in Bunker Way due to the lower elevation of these properties.
36. Whilst the visualisations are good at representing the effects of apron floodlighting, they do not include other lighting effects that will be present, including:
- (a) Lighting to the landside road, Stewart Duff Drive, which follows the outside of the apron's perimeter fence. The luminaires would be mounted with zero upward tilt ("flat glass"), on 8 to 12 metre poles, so that direct view of the LED lamp sources should not be possible from any residential properties. The lighting effect would primarily be contained to the roadway, with possible spill onto the apron and adjacent buffer zone, with a low intensity white lighting effect on the roadway itself.
  - (b) Navigational lighting would present as ground level, variable intensity, coloured individual light sources spaced regularly along the taxiway and apron areas. In several locations there may be low height guidance signs consisting of black writing on a yellow background. These would be positioned so that they are visible to taxiing aircraft.
  - (c) Illuminated signs could be viewable from outside of the site. These could consist of aircraft stand guidance indication mounted on or adjacent to the Terminal building. Similar signage may be used for passenger guidance at apron level. It is not anticipated that advertising signage – whether digital, internally or externally illuminated - would be installed in the East Side Area.
  - (d) Vehicles would be required to use normal head and tail lights as well as amber flashing beacons when moving around the apron.
  - (e) Aircraft anticollision and navigational lighting would appear as bright flashing coloured sources when the aircraft are moving, with taxiway lighting washing the area in front of the aircraft when they are not under tow.
37. In comparing the existing and proposed lighting environments it is apparent that the existing views show multiple, disparate, different coloured, random

lighting effects with many of the luminaire lamp sources clearly visible (exhibiting a star-like effect in the visualisations). In comparison, the proposed views are more uniform in appearance, both in terms of colour and uniformity of lighting effect, with no luminaire lamp sources directly visible.

38. Prominent in the views are the terminal and multi-storey carpark buildings - part of the Main Site NOR area which forms the backdrop to the views. Whilst interior lighting is not normally considered when setting Lighting Rules, and is specifically excluded from AS/NZS 4282: 2019, lighting associated with these buildings could be a prominent component of the lighting environment. The effects of such lighting would depend upon the nature of the interior lighting, location and extent of digital signage, etc and the translucence of the exterior façades. As an example of the potential effects, see **Figure 5** for a night-time view of the existing carpark building cut from visualisation N4B. Whilst no lamp sources are directly apparent within the carpark, illumination of the interior surfaces in the carpark is clearly visible.



39.

Figure 5: Night-time view of existing carpark building

## Assessment of Environmental Effects

### Spill Light

40. WDP Rules 11.1.1.6 (Airport Area) and 11.5.1.5 (Golf Course Recreation Area) limit the amount of spill light (unwanted illumination) to no more than 8 lux (either direct or indirect) at the windows of residential buildings in any nearby Residential Area.

41. AS/NZS 4282: 2019 uses slightly different measurement locations to the WDP, with Clause 3.3.1.3 noting that *“the calculation plane is generally determined at the building line of the potentially affected dwelling/s”*. The standard also considers the concept of lighting curfew and non-curfew periods as previously noted. For the assessed Environmental Zones “A3” and “A4”, the maximum non-curfew limits are 10 lux and 25 lux respectively, and the maximum curfew limits are 1 lux and 5 lux. (Reference: AS/NZS 4282: 2019 Table 3.2)
42. As noted previously, spill light (measured in lux) reduces in proportion to the inverse square of the distance from the luminaire. In the proposed designation site, it is the apron floodlights and the street lights that are most likely to produce the highest illumination values – whilst the other lighting would be visible, it would not be intense enough to create measurable illumination levels at the Residential properties.
43. Given that the apron floodlights and the street lights would be mounted with zero upward tilt, combined with their relative elevations and distance from the residential zoned sites, the spill light requirements of both the WDP and AS/NZS 4282: 2019 would be easily achievable.

## **Glare**

44. In considering the type of lighting proposed as part of the East Side Area with respect to the two primary types of glare, Discomfort and Disability, it is expected that Disability Glare (glare that impairs the visibility of objects without necessarily causing discomfort) would be the most applicable. Potential Glare effects from vehicles and aircraft are considered under separate headings below.
45. The WDP does not include a Rule that specifically manages potential glare effects. However, a note to Rule 11.1.1.6 “Lighting” states that *“In all cases the Council will seek to ensure that the adverse effects of glare from lighting sources are avoided, remedied or mitigated”*.
46. AS/NZS 4282: 2019, for Environmental Zones “A3” and “A4”, recommends maximum luminous intensities per luminaire of 12,500 candela and 25,000 candela respectively (non-curfew) and for both “A3” and “A4”, 2500 candela (curfew) (Reference AS/NZS 4282: 2019 Table 3.3). The luminaires in the

East Side Area which have the potential to produce the greatest luminous intensity are the apron floodlights and the street lighting luminaires. Both types of luminaires would be installed in flat-glass configuration such that the LED light sources would not be visible from any location above the elevation of the luminaire – and hence the limits above would be complied with. The mounting heights would be 25 to 30 m above the apron level for the apron floodlights and 8 to 12 m above the roadway for the streetlights. The only properties that are understood to be below the height of the apron luminaires would be those in Bunker Way. However, sample calculations indicate that the luminous intensity from a typical apron floodlighting luminaire would be well below the lower curfew limits of 2,500 candela in the direction of the Bunker Way properties.

47. **Airfield Navigational Lighting Glare:** Airfield navigational lights vary in their location and intensity, with their primary focus on providing safe guidance to aircraft and other users. As examples, CAA NZ Advisory Circular AC 139-6 requires the following:
- (a) Clause 5.3.164 Characteristics: Taxiway centre line lights to have “*beam dimensions such that the light is visible only from aeroplane on or in the vicinity of the taxiway*”.
  - (b) Clause 5.3.171 Characteristics: Taxiway edge lighting is specified to be “*omnidirectional and show up at least 75° above the horizontal and at all angles in azimuth necessary to provide guidance to a pilot taxiing in either direction*” such that “*the intensity of taxiway edge lights should be at least 2 cd from 0° to 6° vertical, and 0.2 cd at any vertical angle between 6° and 75°.*”
  - (c) Whilst such lights might be viewable from residential properties, the guidance and constraints imposed by the CAA are such that the glare effects should be negligible.
48. **Illuminated Signage and Façade Glare:** With respect to sign lighting, the WDP, Airport and Golf Course Recreation Precinct Area Rules, requires that illuminated signs “*must not flash*”. No definition of what is meant by “flash” is apparent. Other sections of the Plan (for example, Central Area Rule

13.6.4.1.1) also include the constraint that signs “*must not contain moving images, moving text or moving lights*” under certain conditions. No such constraints are provided for the East Side Area in the current WDP Rules. The WDP does not have Rules to manage the brightness of, or glare from, signage. No mention is made in the WDP of illuminated façades.

49. AS/NZS 4282: 2019, Section 3.3.5 “Lit Surfaces”, specifically addresses the production of obtrusive light from “*light emitting and externally illuminated signs,*” and “*building façades*”. Table 3.5 “*Maximum Average Luminance of Surfaces (cd/m<sup>2</sup>)*” specifies maximums of 250 cd/m<sup>2</sup> and 350 cd/m<sup>2</sup>, at all times, for Environmental Zones “A3” and “A4”. Section 3.3.5.4 also provides restrictions on the dynamic content of signs such that, “*Where the graphical content or colours can change, the dwell time of the image shall be 10 seconds or more, and the average luminance shall change by less than 30% on the change of the image*”.
50. The limits imposed by AS/NZS 4282: 2019 provide an acceptable balance between operational function and the needs of adjacent residents. Based upon my understanding of the signs proposed as part of the proposed East Side Area, glare from illuminated signage should be within the limits of AS/NZS 4282: 2019 for both “A3” and “A4” zones. It is not envisaged that any building façades in the East Side Area would be actively illuminated except for security reasons. Any such lighting should be able to comply with the limits in the Standard.
51. **Glare to Motorists on Public Roads:** AS/NZS 4282: 2019 recommends a threshold increment in the vicinity of transport corridors shall be applied to lighting installations as per Table 3.2 of the Standard. The limits for environmental zones “A3” and “A4” are a 20% threshold increment at 1 cd/m<sup>2</sup> and 5 cd/m<sup>2</sup> adaptive level respectively. The only road in close proximity to the East Side Area would be the diverted landside road following the airfields perimeter fence – Stewart Duff Drive. Whilst this would not technically be a public road, it is reasonable to expect that it would be illuminated to the relevant sections of the AS/NZS 1158: “Lighting for roads and public spaces” suite of Standards.
52. The only fixed lighting that would impact this road would be the roadway lighting associated with it. This lighting would be designed to comply with the

requirements of the AS/NZS 1158 suite of standards with the associated controls on threshold increment.

53. Glare from aircraft taxi lighting would need to be modelled to ensure that glare to motorists is not an issue. Solid timber security fencing could be installed in discrete areas if this were found to be an issue.

### **Sky Glow**

54. The applicable aspect of sky glow here is from artificial light sources. Sky glow is caused by lighting radiation that is directly emitted above the horizontal and lighting radiation that is reflected off the earth and other surfaces.
55. Apron floodlighting and street lighting in the East Side Area would be installed in a flat glass orientation such that there would be minimal, if any, direct light emitted above the horizontal. The direct upward light ratio would therefore be less than the maximum limits of 2% and 3% specified in Table 3.2 of AS/NZS 4282: 2019 for zones “A3” and “A4” respectively. Sky glow would therefore not be produced by direct upward light from these luminaires.
56. Reflected light from these lights would produce sky glow in varying amounts depending upon the situation. Light would be reflected from the ground below the luminaires - with greater reflection in wet conditions, with light concrete ground construction, and less reflection with darker asphalt construction. Reflected light into the atmosphere would also occur in misty and foggy conditions – exhibiting as halos of light around the luminaires and between the luminaires and the ground.

### **Airside Vehicle Lighting Effects**

57. Neither the WDP nor AS/NZS 4282: 2019 specifically include the assessment of effects from vehicle lighting.
58. It is understood that vehicles operating airside would be required to operate warning beacons whenever they are mobile. These would consist of roof mounted amber beacons and /or hazard lights. During the hours of darkness, vehicles would also operate with standard head and tail lights.
59. Airside vehicles manoeuvring within the East Side Area should be operating with their main headlights dipped to minimise any potential glare to other

vehicle drivers, pedestrians, and aircraft. Therefore, the effects are expected to be minor.

60. Amber hazard beacons, whilst small light sources, would be visible from reasonable distances as is their intended purpose. Although most of the vehicle movements would be close to and against the backdrop of the expanded terminal building, the effects of such beacons may be seen as obtrusive by some residents who can see them directly.
61. To eliminate effects from aircraft taxiing lighting between 10:00pm and 7:00am, all aircraft would be towed through the East Side Area taxi and apron areas. Tugs towing aircraft would be coming close to the eastern residential areas. The effects of tug head and tail lights are not likely to be significant given that they should be operating with dipped headlights and would be under the nose of towed aircraft. Vehicle amber beacons effects would be close to the eastern residential properties and may be obtrusive to some residents albeit that they would be seen in the context of an aircraft under tow. It is understood that during the 10:00pm to 7:00am curfew period, the airport would minimise the number of aircraft using the East Side Area apron – consequently minimising these potential lighting effects.

### **Aircraft Lighting Effects**

62. Wellington City Council, in its further information request dated 17 July 2020, requested comment on the *“difference in effects of light sweep arising from aircraft on the East Side Area apron, as compared to the current circumstance and any alternatives for aircraft parking”*.
63. Moving aircraft would always operate anticollision (small red flashing light) and navigation lights (green and red lights). After dark and outside of the 10:00pm to 7:00pm curfew period, aircraft may operate their taxiing lights between the runway and the final stand position. It is presumed that the taxi lights are the potential source of light sweep being referred to by the Council. The taxi lights are designed to provide the pilot with visibility of the area they are moving through and can be mounted within the aircraft’s nose landing gear or within the wings. Such lights are less intense than landing lights however they could have beam intensities in the order of 15,000 to 30,000 cd. Whilst AS/NZS 4282: 2019 specifically excludes lighting for aviation, it is useful to consider

the levels of maximum luminous intensities per luminaire (measured in candela (cd)) in Table 3.3 of the Standard with respect to the taxi lights.

64. For environmental zones “A3” and “A4” non-curfew maximums of 12,500 cd and 25,000 cd apply for new installations, with a curfew maximum of 2,500 cd for both zones. This indicates that the taxi light intensity is of a similar order of magnitude to the recommended maximums for a fixed light in the Standard during non-curfew periods.
65. In considering the potential effects to residents, it is noted that the taxi lights are aimed forward and downwards to illuminate the ground in front of the aircraft. They provide a similar function to the dipped headlights on vehicles.
66. Depending upon the mounting location on the aircraft, some taxi lights may be visible to residents when aircraft are moving. Indirect lighting effects would also occur as the light is reflected off the ground in front of the aircraft. The effects of such lights may be seen as obtrusive to some residents with direct visibility of taxiing aircraft.
67. However, it is understood that aircraft under tow by tugs do not operate their taxi lights, to minimise any impact on tug driver vision. Therefore, there would be no effects from these lights during the 10:00pm to 7:00am curfew period thus minimising this potential effect.

### **Construction Lighting Effects**

68. It is understood that civil works construction would be managed under Earthworks and Construction Management Plans, and that the majority of the works would occur during daylight hours (normal business hours). During the winter months it may well be dark at the beginning and end of the working day such that vehicle head and tail lights would be required. It may also be expected that hazard lights and amber warning beacons might be required in the construction area.
69. There may be portions of the work that need to be undertaken after hours to suit airport operational requirements. This could be expected when works occur on or adjacent to operational areas. I understand Wellington Airport is experienced at undertaking such works as part of their regular runway maintenance programme and has procedures for minimising the effects from these works.

70. There may be a requirement for lighting of remote aircraft stands during the construction phases. Temporary lighting would be installed to the same lighting effect control requirements proposed as part of the permanent stands. It is therefore reasonable to expect the effects to be similar.

## SUBMISSIONS

71. I have reviewed an issue-by-issue summary of the East Side Area submissions and have identified only one submission that specifically references lighting as a potential effect - that of George and Andrea Rota, 17 Bunker Way. I have also reviewed the submissions with comments on landscape and/or visual effects and note that none made specific mention of lighting or night-time effects. No submissions were made on lighting effects in relation to the Main Site NoR.
72. The Rota's submission on lighting matters expresses concern that:
- (a) There would be increased levels of light due to the construction and close aircraft operations once completed.
  - (b) There would be loss of aesthetic foreground and background views.
  - (c) The change in land use designation for the Golf Course Recreation would reduce the buffer between airport activities and the outer residential housing in Strathmore Park by 70%, thereby resulting in lighting and visual affects impacts outlined by the respective consultant experts in the full notice of requirement document.
73. In responding to the concerns raised, I accept that there would be increased effects from lighting of the East Side Area which is presently part of the golf course. There would also be a change in the views towards a future terminal building expansion with the introduction of apron floodlighting. In the middle distance, the existing lighting presents as multiple disparate light sources of varying colour, colour temperature, and intensity resulting in multiple glare sources. A redeveloped East Side Area would result in a cool white lighting effect spread uniformly across a similar area to the existing disparate light sources. Glare sources would be significantly reduced due to the flat glass installation method for the apron floodlights. The visual effect would be quite

different to the existing views with the perception of the effects dependent upon the individual viewpoint and viewer.

74. With respect to light effects during construction, my understanding is that construction would occur during daylight hours where practicable. However, it is reasonable to expect that vehicles would operate with head, tail, and amber warning lights during the darker winter hours of the “normal” working day. It is also expected that there would be times when works would be required during the night to avoid aircraft operations – for example when working near operational areas. The effects of such lighting is expected to be typical of a large civil construction site – albeit that the works may occur in stages over time

## COUNCIL REPORT AND RESPONSE

### Officers S.42A Hearing Report

75. Council’s expert urban design advisor, Ms Robin Simpson, referring to the East Side Area, concludes that *“increased ..... light associated with operational activities will diminish the quality of residential amenity and have a negative effect on community resilience”*. (Section 9.4.2 Council’s Expert Urban Design Assessment paragraph 11, (page 39))
76. **Response:** In my opinion, changes within the East Side Area will **change** the quality of the residential amenity with some areas improving and some diminishing. The area presently occupied by the golf course will diminish in quality of residential amenity however the area in the middle field of view, to the west of Stewart Duff Drive, will improve with a reduction in point glare sources and a uniformity of illumination.
77. In Section 9.4.3, Council Lighting Assessment, of the Officers S.42A Hearing Report, Council’s lighting expert, Mr Nayan Swaminarayan, noted that he agreed with most of WIAL’s responses to the Council’s further information request but felt strongly that:
- (a) *“The impact of the lighting on the surrounding area should be looked into against the criteria and limits prescribed in the recently published “Control of the obtrusive effects of outdoor lighting AS/NZS 4282:2019” rather than following the obsolete district plan NZS CP22:1962 and*

*amendments. The reason for that is that the lighting technology has evolved since than from the old gas discharge lamp / High pressure sodium / mercury vapour lamp to current solid State Lighting (SSL) aka LED Luminaire which has its own unique attributes and characteristics that are best captured in the latest AS/NZS 4282:2019 and AS/NZS 1158.3:2020".*

78. Mr Swaminarayan also noted in Section 9.4.3 that, as part of the future design process, Council would like to see detailed lighting design calculations that demonstrate compliance with relevant codes and compliance.
79. **Response:** I support Mr Nayan Swaminarayan's comments with respect to the suitability of the Councils District Plan Rules and confirm that my review has been against the criteria and limits prescribed in AS/NZS 4282:2019 "Control of the obtrusive effects of outdoor lighting" as well as CAA NZ Advisory Circular AC 139-6.
80. I support Mr Nayan Swaminarayan's request that lighting design calculations be provided as part of the future design process to demonstrate compliance with relevant codes and Rules.

**Officers S.42A Hearing Report, Appendices D1 and D2, Urban Design and Landscape Assessment, Sections 7 Streetscape.**

81. Commenting on lighting to the new Airport Road (Stewart Duff Drive), Robin Simpson assesses that "light spill from streetlights can be mitigated to minor level" (Reference: Sections 7.2 and 7.4 "Airport Road", Urban Design and Landscape Assessment, Appendices D2 and D1 of the Officers S.42A Hearing Report).
82. Robin Simpson also recommends:
- (a) Mitigate visual effects of road with tree planting to east side to screen lights.
  - (b) Support existing condition to avoid glare and minimise light spill.
  - (c) Add condition to limit height of any streetlights to 8m.
83. **Response:** I agree with Robin Simpson's assessment that light spill from streetlights can be mitigated to a minor level.

84. I support the intent to avoid glare and light spill, and I propose that the guidance within AS/NZS 4282: 2019 be included within the Conditions.
85. From a lighting performance perspective, I question the limitation on the height of any streetlights and suggest that the criteria within AS/NZS 4282: 2019 are more appropriate than a specific pole height limit.

**Officers S.42A Hearing Report, Appendices D1 and D2, Urban Design and Landscape Assessments, Sections 11.4 Lighting.**

86. With respect to lighting in general, Robin Simpson notes that *“lighting has the potential to negatively impact the quality of residential amenity in the surrounding residential area”*. She identifies the following effects which might diminish resident’s enjoyment and wellbeing:
- (a) *“Hours of site lighting”*,
  - (b) *“Light spill into residential areas”*,
  - (c) *“Glare of moving vehicles within the site”*,
  - (d) *“Hours of operation and movement of vehicles”*,
87. **Response:** Lighting in the area of the existing golf course would change with the additional of in-ground aircraft guidance lighting and periodic aircraft movements. Lighting in the middle field of view would change with the removal of the multiple disparate point glare sources and irregularly illuminated surfaces. The new apron floodlighting would present a uniform white appearance with limited glare points.
88. Robin Simpson recommends limiting the height of luminaires on poles within 20m distance from boundaries to 9m for both the Main and East Side Area.
89. **Response:** I support what I believe is the intent of this Condition, to minimise potential effects, but suggest that there may be situations where this could compromise safety and security of airport operations – for example, the provision of temporary apron floodlighting to a remote aircraft stand location during staging of construction. Such a location might require luminaires mounted at a greater height to ensure operational safety, in a location remote from residential boundaries. I would support using the criteria within AS/NZS

4282: 2019 for managing potential effects rather than a specific limitation on height.

90. Robin Simpson assesses varying levels of effects dependent upon the viewing location and the distance to the lighting.
91. With respect to both the Main and East Side Area, Robin Simpson notes: *“the impact of lighting from midrange views are moderated by distance and assessed as minor. Tall lights would be visible at night in midrange views at e.g., Wilberforce Road and Wexford Place”*.
92. Response: I agree that the impact of lighting in midrange views would be moderated by distance and hence assessed as minor. I believe that the tall lights, presumably the apron floodlighting towers, would not be directly visible at night due to their flat-glass orientation. The indirect reflected light effects, whilst visible, would be less obtrusive than the point glare sources from the existing luminaires.
93. With respect to the East Side Area, Robin Simpson notes, *“the effects at close range are greater in magnitude due to close range.*
  - (a) *“Low- Moderate negative effect closer to residents because; from west is in background of terminal, extends breadth of industrial lighting; from bunker way adds new ancillary buildings in area of no lighting, part obscured by in-between buildings depending on location”*.
  - (b) *“Low- Moderate negative effect from distant views because; extends existing airport lighting, in-between landform and structures obscure majority of hardstand, ancillary buildings visible highlighting need for management of light spill”*.
  - (c) *“Low negative effect of streetlighting from new Airport Access Road from distant views– in-between landform and structures obscures from some locations, in others these are distant”*.
  - (d) *“Low- Moderate negative effect of movement of cars due to proximity – adds moving lights in area of no lighting on golf course, change from dark area to lit surfaces, in area of no lighting, part obscured by in-between buildings depending on location reduces effect.”*

94. Response: As noted elsewhere in my evidence, light spill would not be an applicable effect given the distance of the luminaires from the residential properties. Direct glare effects from the most intense fixed lighting, apron floodlighting and street lighting, should be non-existent from viewing locations above luminaire height. Light reflected off surfaces should be of more uniform appearance than the existing lighting effects. Point source in-ground lighting in the area of the existing golf course will be remotely visible – the effects of which will be dependent upon the viewing location.
95. Robin Simpson's recommendations are:
- (a) Main and East Side Area: *"Accept condition proposed to limit light level to 8lux at residential windows"*.
  - (b) **Response:** I recommend using the limits in AS/NZS 4282: 2019
  - (c) Main and East Side Area: *"Accept condition proposed lighting to extended hardstand to east - to avoid glare and light spill"*.
  - (d) **Response:** I recommend using the criteria in AS/NZS 4282: 2019
  - (e) Main Area: *"Lighting of ancillary buildings at residential edges and South Coast – to be managed through ancillary buildings design guide"*.
  - (f) **Response:** I believe that effects could be appropriately managed using the limits in AS/NZS 4282: 2019.
  - (g) Main Area: *"Luminaires on buildings and poles limited in height to 9m within 20m distance of residential and South Coast boundaries"*.
  - (h) **Response:** As noted previously, I would generally support an effects-based approach for managing potential effects rather than a specific limitation on height. I note that in this particular recommendation, the limitation is proposed with respect to residential and south coast boundaries which would be acceptable.
  - (i) Main Area: *"Streetlighting on new Airport Road – to be limited in height to 9m and meet District Plan requirements"*.

- (j) **Response:** As noted previously, I would support an effects-based approach for managing potential effects rather than a specific limitation on height, i.e. using the criteria in AS/NZS 4282: 2019
- (k) East Side Area: *“Streetlighting on new Airport Road – poles to be limited in height to 8m, avoid glare and meet District Plan expectations, consider temperature”*.
- (l) **Response:** As noted previously, I would support an effects-based approach for managing potential effects rather than a specific limitation on height i.e. the criteria in AS/NZS 4282: 2019. I note that the proposed limiting height is 8m rather than 9m mention elsewhere in the report – I suspect this is a typo. With reference to *“consider temperature”* Robin Simpson does not specify what this relates to however I suspect it might relate to the colour temperature of the LED lamps, with 3000 kelvin (warm white appearance) lamps being considered in suburban environments compared to the more common 4000 kelvin (cool white appearance) lamps. Either lamp would be acceptable however I note that 3000 kelvin lamps produce less light in the blue end of the spectrum which is beneficial to night sky observations. I do not recommend any conditions relating to lamp colour temperature.
- (m) East Side Area: *“Boundary of airside lighting, limit height of luminaires to 9m to reduce light spill”*.
- (n) **Response:** As noted previously, I would support an effects-based approach for managing potential effects rather than a specific limitation on height, , i.e. using the criteria in AS/NZS 4282: 2019

**Officers S.42A Hearing Report, Appendices D1 and D2, Urban Design and Landscape Assessments, Sections 11.5 Signage.**

96. Robin Simpson comments on lighting associated with LED and / or changing signs, noting that *“flashing or fast changing signs are considered alien to the residential environment and unacceptable”* (Main Site).
97. For both the Main Site and the East Side Area Robin Simpson notes that additional conditions are required for:

- (a) LED signs – required to be changeable with a period of adjustment for brightness.
  - (b) Changeable signs – rotational change can command attention like flashing and requires restriction on use.
98. **Response:** I agree with the comment about flashing or fast changing signs and support the recommendations for Condition with respect to LED sign brightness and changeable signs. As noted elsewhere in my evidence, I recommend the criteria and limits within AS/NZS 4282: 2019

## CONCLUSION

### East Side Area NOR

99. The visual effects from the proposed development of the East Side Area would be quite different to the existing views, with the perception of the effects dependent upon the individual viewpoint and viewer.
100. The dark golf course area in the foreground would become permanently illuminated with airfield related lighting and lighting associated with transiting aircraft. The terminal precinct area, which is presently populated with multiple disparate glare sources and irregularly illuminated surfaces, would be replaced by a cool white uniform lighting effect. The lighting would be seen against the backdrop of internally illuminated terminal and carpark buildings and the apron floodlighting for the western apron.
101. The WDP Rules limiting the amount of spill light to residential zoned sites will be easily complied with given the distance between the properties and the lights.
102. Two key lighting effect characteristics are not addressed by the WDP Rules – namely glare and sky glow. These are addressed within AS/NZs 4282: 2019 “*Control of the obtrusive effects of outdoor lighting*” which, whilst excluding airfield lighting, provides a common basis for assessing the likely effects of outdoor lighting.
103. It is expected that lighting within the ESA will comply with the glare limitations specified in AS/NZS 4282: 2019, with the possible exception of the indirect effects from aircraft taxi lights – noting that these are not covered by the

Standard and would not be operating during the curfew period of 10:00pm to 7:00am.

104. Indirect sky glow effects may occur where light is reflected off the ground, other surfaces, and atmospheric particles. The effects would be acceptable – being minimised by using flat-glass luminaire orientation.
105. Changing image signs may be seen as obtrusive however the limits on brightness and image duration in AS/NZS 4282: 2019 should appropriately mitigate potential effects.
106. From a visual perception perspective, Frank Boffa notes (Appendix D, F Boffa Response, Visual Effects of Designation Outcomes Section 6.6) that, “*while the terminal and apron extension lighting will be visible, it will be less visible and obtrusive than the existing airport lighting overall. In terms of mitigation, the use of LED lighting throughout the apron area would contribute to a meaningful reduction in night light effects*”. I support this statement from the perspective of directly viewable lamp sources however, indirect lighting effects (reflection off the apron, aircraft, etc) will be a greater than those which presently exist – albeit more uniform in appearance.
107. The impact the lighting has upon the local environs will depend upon the viewing location and the perspective of the viewer. The limits on spill light, glare, and sky glow within AS/NZS 4282: 2019 would form a reasonable basis for managing potential lighting effects.

## MITIGATION

108. It is recommended that the limits proposed in AS/NZS 4282: 2019 “*Control of the obtrusive effects of outdoor lighting*”, for Environmental Zone A4, would form an appropriate basis for managing lighting effects - balancing the needs of an operational airport with those of adjacent residents.
109. Apron floodlighting and roadway lighting luminaires should be installed with zero upward tilt (flat glass orientation) to minimise the effects of direct glare and sky glow.
110. Aerodrome specific lighting and illuminated signs (i.e. taxiway lighting, stand guidance signage, lead-in lighting, etc) should be excluded from the Rules –

noting that these would be designed to meet the requirements of CAA NZ Advisory Circular AC 139 or other subsequent documents.

111. Any signage should be designed to meet the requirements of AS/NZS 4282: 2019.
112. Any Conditions should not compromise the safe operations of the airport.

A handwritten signature in black ink that reads "A. Read". The signature is written in a cursive style with a large initial 'A' and a stylized 'R'.

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**Andrew Read**

05 May 2021

## APPENDIX A

1. **Definitions:**
2. The key terms used to describe the lighting effects associated with the NORs are spill light, glare, and sky glow.
3. Australian / New Zealand Standard 4282:2019 “*Control of the obtrusive effects of outdoor lighting*” has the following definitions for these terms:
  - (a) Spill Light: “*Light emitted by a lighting installation that falls outside of the design area. Spill light may or may not be obtrusive depending on what it affects*”.
  - (b) Glare: ‘*Condition of vision in which there is a discomfort or a reduction in ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrasts in the field of vision.*
    - (i) *Disability Glare: Glare that impairs the visibility of objects without necessarily causing discomfort*”
    - (ii) *Discomfort Glare: Glare that causes discomfort without necessarily impairing the visibility of objects*”
    - (iii) *Note: Both disability and discomfort glare may be present concurrently.*”
  - (c) Sky Glow: “*The brightening of the night sky that results from radiation (visible and non-visible), scattered from the constituents of the atmosphere (gaseous, molecules, aerosols and particulate matter), in the direction of observation. It comprises two separate components as follows:*
    - (i) *Natural sky glow: That part of the sky glow that is attributable to radiation from celestial sources and luminescent processes in Earth’s upper atmosphere.*
    - (ii) *Artificial sky glow: That part of the sky glow that is attributable to man-made sources of radiation (e.g. outdoor lighting),*

*including radiation that is emitted above the horizontal and radiation that is reflected from the surface of the earth.”*

4. In addition to the above, the following definition is used to measure disability glare:

- (a) Threshold Increment (TI): *“The measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present.*

*Note: Higher values of TI correspond to greater disability glare.”*

5. **Wellington District Plan:**

6. The existing Wellington District Plan, **Airport Precinct Rules** includes the following Rules for Lighting (Rule 11.1.1.6)

- (a) 11.1.1.6.1: *“Any non-aviation activity which requires the lighting of outdoor areas must ensure that direct or indirect illumination does not exceed 8 lux at the windows of residential buildings in any nearby Residential Area.”*, and
- (b) 11.1.1.6.2: *“Subject to rule 11.1.1.6.1 any development which includes pedestrian routes and carparks available for public use during the hours of darkness must be lit at a minimum of 10 lux measured in accordance with [AS/NZS1158.3.1:2005] PC57 and amendments.”*

*[The lighting rules are designed to ensure that areas or sites available for public use are adequately lit to keep people safe, and that where sites on the periphery of the Airport areas are illuminated, the amenities of nearby residents are reasonably protected.]* <sup>PC57</sup>

*In all cases the Council will seek to ensure that the adverse effects of glare from lighting sources are avoided, remedied or mitigated.*

7. The existing Wellington District Plan, **Golf Course Recreation Area Rules** includes the following Rules for Lighting (Rule 11.5.1.5)

- (a) 11.5.1.5.1: *“Any activity which requires the lighting of outdoor areas must ensure that direct or indirect illumination does not exceed 8 lux*

*at the windows of residential buildings in any nearby Residential Area.”, and*

- (b) 11.5.1.5.2: *“Subject to rule 11.5.1.5.1 any development which includes pedestrian routes and carparks available for public use during the hours of darkness must be lit at a minimum of 10 lux measured in accordance with NZS CP22:1962 and amendments.”*

*In all cases the Council will seek to ensure that the adverse effects of glare from lighting sources are avoided, remedied or mitigated.*

8. **AS/NZS 4282: 2019: “Control of the obtrusive effects of outdoor lighting”**
9. In addition to the Wellington District Plan Rules, Wellington City Council requested (in its request for further information dated 17 July 2020) that the proposed lighting be reviewed from the perspective of AS/NZS 4282:2019 “Control of the obtrusive effects of outdoor lighting”.
10. The objective of the Standard is to provide a common basis for assessment of the likely effects of developments that involve the provision of outdoor lighting. The Standard also includes recommendations for the siting and aiming of floodlights.
11. It should be noted that the Standard only considers the effects of outdoor lighting. It does not specifically address the effects of indoor lighting on the external environment i.e. the effects from lighting within the Terminal Building and/or carpark buildings – noting that these will form a background against which the outdoor lighting will be seen. Frank Boffa’s report, Visual Effects of Designation Outcomes (paragraphs 6.3 to 6.7), refers to the appearance of the Terminal Building at night and to some of the mitigations that could be put in place to reduce effects.
12. It should also be noted that lighting for aviation safety does not fall with the scope of the Standard. However, the Standard is an appropriate basis for assessing lighting effects.
13. AS/NZS 4282 2019, Section 2.4.1 “Effects on Residents” outlines the specific effects that need to be considered with respect to residents:

### **“2.4.1 Effects on residents**

*Effects on residents generally involve a perceived reduction of amenity arising from light technical factors such as the following:*

- (a) *The **illumination from spill light being obtrusive**, particularly where the **light enters habitable rooms**. The illuminance on surfaces, particularly vertical surfaces, is an indicator of this effect.*
- (b) *The **direct view of bright luminaires** from normal viewing directions causing annoyance, distraction or even discomfort. The luminous intensity of a luminaire, in a nominated direction, is an indicator of this effect.*
- (c) *Changes in luminance in the peripheral vision due to effects such as **variable content in signage** or trees moving across bright lights.*

*The tolerable levels of each of these light technical parameters will be influenced by the ambient lighting existing in the environment where the light technical parameters are being calculated.”*

*(Note: “**Bolding**” of text added in this document)*

14. Where “obtrusive” light is defined as follows:

#### **“1.4.9 Obtrusive light**

*Light that, because of quantitative, directional or spectral attributes in a given context, gives rise to excessive annoyance, discomfort, distraction or a reduction in the ability to see essential information.”*

15. AS/NZS 4282: 2019 uses various Light Technical Parameters (LTP) to assess potential lighting effects. Different limits for the parameters are applied based upon the ambient light conditions. These ambient conditions are set for various environmental zones. The two potentially applicable environmental zones for the airport and their associated technical parameters are as follows:

- (a) **Environmental Zone A3 and A4:** (AS/NZS 4282: 2019 Table 3.1 “Environmental Zones”)
  - (i) Zone A3 is described as “Medium district brightness” with examples: “Suburban areas in towns and cities”.
  - (ii) Zone 4 is described as “High district brightness” with examples: “Town and city centres and other commercial areas. Residential areas abutting commercial areas”. (Note: Recreational areas are not considered commercial)

- (b) **LTP Vertical Illuminance (Ev):** Illuminance (measured in lux) is the total luminous flux (measured in Lumens) incident on a surface, per unit area. Vertical illuminance relates to a vertical surface. The maximum non-curfew limits are 10 lux (for Zone A3) and 25 lux (for Zone A4) and maximum curfew limits are 5 lux (for Zone A3) and 1 lux (for Zone A4). AS/NZS 4282: 2019 accepts that a higher level of light may be less obtrusive in the early hours of the evening when there is more activity and the majority of people are awake. For later times (in the curfew period) lower limits are applied. Unless otherwise specified by the controlling authority, the curfew period is taken as between 11:00pm and 06:00am.
- (c) **LTP Luminous Intensity (I):** Luminous intensity of a light source is the emitted luminous flux per unit solid angle – stated simply it is its brightness in a given direction.
- (d) **LTP Threshold Increment (TI):** *“The measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare.”* (Definition from AS/NZS 4282: 2019)
- (e) **LTP Upward Light Ratio (ULR):** *“The proportion of flux of a luminaire and / or installation that is emitted, at and above the horizontal, excluding reflected light, when the luminaire(s) is/are mounted in its installed position(s). ULR = upward flux/total flux from the luminaire.”* (Definition from AS/NZS 4282: 2019)

## 16. **Civil Aviation Authority Lighting Requirements**

17. The requirements for lighting within the airfield’s operational areas is defined within the Civil Aviation Authority of New Zealand’s (CAA NZ) Civil Aviation Rules, Part 139 Appendix E3 “*Lights*” and CAA NZ Advisory Circular AC139-6 Section 5.3 “*Lights*”.
18. Generally, the lighting consists of aircraft guidance lights and apron floodlights.
19. The aircraft guidance lights would include:

- (a) Taxiway Lighting: Green centreline or blue edge in-ground lighting for the full length of all taxiways, transitioning to in-ground lead-in lights nearer the aircraft stand locations adjacent to the terminal.
  - (b) Aircraft Movement Signs: Internally illuminated ground mounted signs providing guidance to taxiing aircraft.
  - (c) Stand Docking Guidance Signs: Electronic display signs providing stand docking information to aircraft.
20. The apron floodlighting would be designed to meet various requirements set out in CAA NZ Advisory Circular AC139-6 Section 5.3 “*Lights*”, the following aspects of which are relevant in considering the lighting effects:
- (a) *“5.3.195 Apron floodlights should be located so as to provide adequate illumination on all apron service areas, with a **minimum of glare** to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron.”*
  - (b) *“5.3.196 To minimise direct and indirect glare (see Figure 5-27)—*
    - (a) **direct light above the horizontal plane should be restricted to a minimum***
    - (b) the mounting height of the floodlights should be at least twice the maximum aircraft eye height of pilots of aircraft regularly using the apron area.”*

(Note: “**Bolding**” of text added in this document) (Reference: **Error! Reference source not found.** for Figure 5 -27)

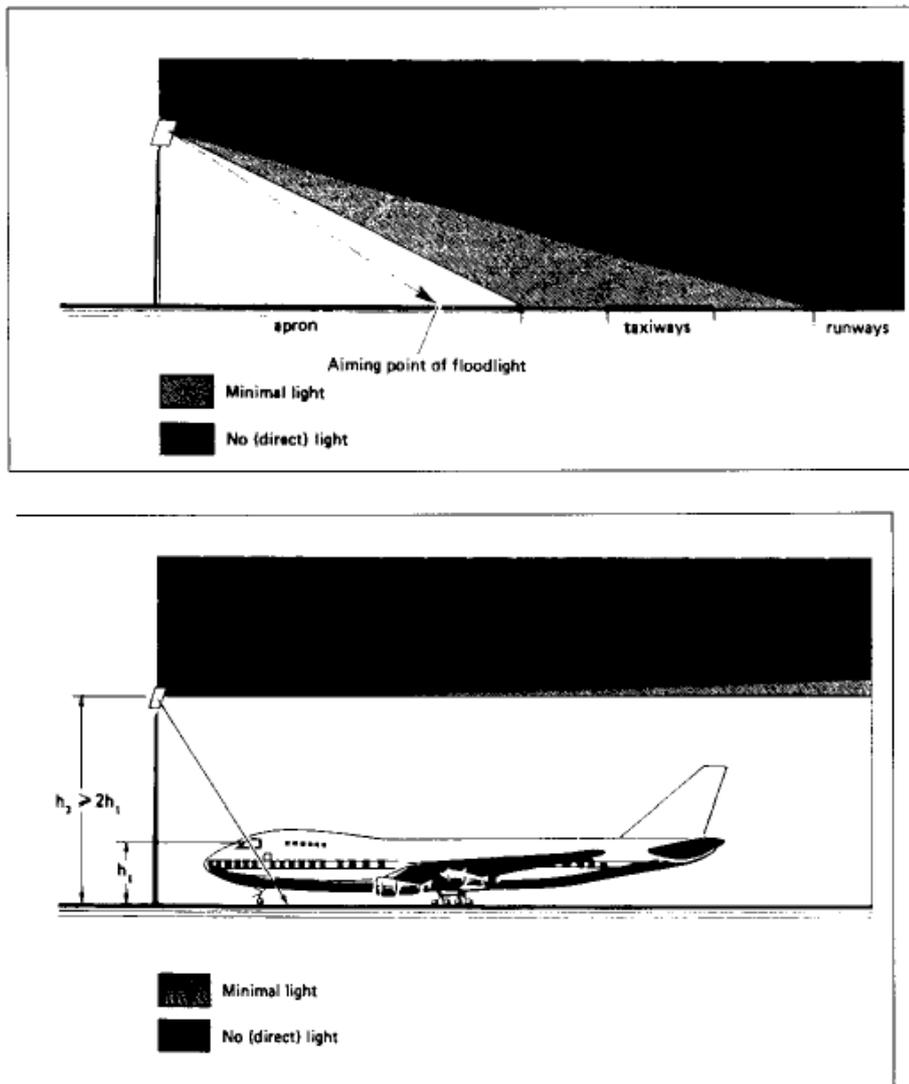


Figure 5-27. Aiming to avoid glare

Figure 6: CAA NZ Advisory Circular AC139-6 Section 5.3 "Lights", Figure 5-27 "Aiming to avoid glare"

21. Whilst **Error! Reference source not found.** shows apron floodlights tilted above the horizontal, current practice for apron lighting design is to have luminaires in a "flat glass" orientation to minimise glare.

**Aircraft Mounted Lighting**

22. Aircraft moving under their own power, would use; taxiing lights (typically bright white lights – not as bright as landing lights – to illuminate taxiways), anticollision lights (small red flashing light), and navigational lights (green and red lights).

23. Aircraft under tow would not use taxiing lights but would still use anticollision and navigational lighting.