

Before an Independent Hearings Panel, Selwyn Proposed District Plan

**STATEMENT OF PRIMARY EVIDENCE OF STEPHEN (STEVE) JAMES MUIR
ON BEHALF OF SELWYN DISTRICT COUNCIL**

LIGHT CHAPTER

Dated: October 2021

1. INTRODUCTION

- 1.1 My full name is Stephen James Muir. I am a Director of ELC – Essential Lighting Consultancy Ltd, an independent lighting consultancy business offering Lighting Advisory Services.
- 1.2 My qualifications include NZ Certificate Electrical Engineering (NZCE), Illumination Engineering Certificate, current Member of The Illumination Engineering Society (MIES), and a Registered Lighting Practitioner (RLP).
- 1.3 For the past four and half years I have worked as a director of ELC where I have been involved with many exterior lighting projects, including assessments of obtrusive lighting effects. Previous projects include assisting NZ Cricket to prepare a resource consent application to Regenerate Christchurch for floodlighting within Hagley Oval to ICC and International Broadcasting requirements, and assisting NZTA with their submission and evidence in relation to the Signs and Lighting Chapters of the Whangarei Proposed District Plan.
- 1.4 Previously I worked for Connetics Ltd for 15 years as their Lighting Design Manager responsible for many roading and exterior lighting projects, including: the Christchurch Southern Motorway; various sports floodlighting; lighting of new subdivisions; inner city precinct areas and exterior feature lighting projects such as Christchurch Cathedral and Victoria Street bridge. I co-authored the NZ Transport Agency's M30 specification¹ and a Christchurch City Council LED Billboard research project².
- 1.5 I have attended many international lighting conferences and manufacturing facilities throughout the world and presented a paper on the obtrusive effects of new LED streetlight technology at the 2012 Starlight Conference in Tekapo.
- 1.6 I confirm that I have the qualifications and experience relevant to the Light Chapter and that I have been engaged by Selwyn District Council to provide evidence in relation to my qualifications and experience.
- 1.7 My evidence should be read alongside of the s42a report of Vicki Barker.

2. CODE OF CONDUCT

- 2.1 I confirm that I have read the Environment Court's Code of Conduct for Expert Witnesses, and I agree to comply with it. My qualifications as an expert are set out

¹ <https://www.nzta.govt.nz/assets/resources/specification-and-guidelines-for-road-lighting-design/docs/m30-road-lighting-design.pdf>

² <https://ccc.govt.nz/assets/Documents/Consents-and-Licences/resource-consents/PN-03-2021-Billboard-practice-note.pdf>

above. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed. I understand that the Code of Conduct requires me to assist the Hearings Panel impartially on matters within my expertise, and not to advocate for Selwyn District Council.

2.2 The key documents I have used, or referenced in preparing this brief of evidence are:

- a) The Selwyn Proposed District Plan (PDP) – Light Chapter.
- b) AS/NZS4282:2019 Control of the obtrusive effects of outdoor lighting.
- c) Selwyn District Council Engineering Code of Practice, Part 11 - Lighting.
- d) NZTA M30 Specifications and guidelines for road lighting design.

3. SCOPE OF EVIDENCE

3.1 My evidence addresses the following matters:

- a) Spill Light, Glare and Sky Glow
- b) AS/ZS 4282:2019 Control of the obtrusive effects of outdoor lighting
- c) The submissions that Selwyn District Council requested I provide technical lighting evidence in response to (in part), include:
- d) DPR-0068 MetroPort Christchurch.
- e) DPR-0358 Rolleston West Residential Limited (RWRL), DPR-0363 Iport Rolleston Holdings Limited (IRHL), Rolleston Industrial Developments Ltd (RIDL), DPR-0374 Rolleston Industrial Holdings Limited (RIHL), DPR-0384 Rolleston Industrial Developments Ltd (RIDL)) (which are almost identical submissions)
- f) DPR-0453 Midland Port, Lyttleton Port Company Ltd.
- g) DPR-0375 NZ Transport Agency Waka Kotahi
- h) DPR-0442 Castle Hill Community Association
- i) DPR-0422 Federated Farmers

4. SPILL LIGHT, GLARE AND SKY GLOW

- 4.1 **Spill light** is the illuminance falling onto an adjoining property or area that is not intended to be illuminated by a resultant light source. The permitted levels of spill light within any city can range between 1 – 25 lux depending on what environmental zone and what time the lighting installation is being used. It is also important to differentiate between specific light trespass (spill light) into surrounding areas and the addition to general light pollution within cities (sky glow).
- 4.2 At night (or low light levels) the eye compensates for lower light levels by becoming more sensitive to light; it is more easily distracted, dazzled, and even disabled by an overly luminous object than the daytime eye is. It is, therefore, important to set limits for the brightness of signs for dusk and night-time to avoid adverse effects.
- 4.3 **Glare** is a reduction in the ability to see and is the result of excessive amounts of luminance in the human field of view or excessive and uncontrolled brightness (luminance).
- 4.4 There are two types of glare.
- (i) **Disability glare** impairs the visibility of objects without necessarily causing discomfort (reduction in visibility). Threshold Increment is a measure of disability glare expressed as a percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. The higher the percentage of Threshold Increment the greater the value of disability glare. Table 3.2 AS/NZS4282:2019 limits Threshold Increment for the various Environmental Zones.
 - (ii) **Discomfort glare** causes discomfort without necessarily impairing the visibility of objects.
- 4.5 Sky Glow is caused by artificial lighting that increases the night sky brightness and is a human-made source. It is light that is either emitted directly upward by luminaires or reflected from the ground that is scattered by dust and gas molecules in the atmosphere, producing a luminous background. It has the effect of reducing one's ability to view the night sky. Sky glow is highly variable depending on immediate weather conditions, quantity of dust and gas in the atmosphere, amount of light directed skyward, and the direction from which it is viewed. In poor weather conditions, more particles are present in the atmosphere to scatter the upward light, so sky glow becomes a visible effect of wasted light and wasted energy. While it is difficult to accurately model sky glow, at this

point it is presumed that the most important factors are light output and lamp spectral characteristics, light distribution from the luminaire, reflected light from the ground, and aerosol particle distribution in the atmosphere. If the quantity of light going into the sky is reduced, then sky glow is reduced. Thus, current practice is to reduce sky glow by 1) using full cut off luminaires to minimize the amount of light emitted upward directly from the luminaire; 2) reducing outdoor light levels; 3) turning off unneeded lights; 4) limiting lighted hours of outdoor areas, parking areas, and signs around important observing sights; and 5) limiting lighting installations.

5. AS/NZS 4282:2019

- 5.1 AS/NZS4282:2019 is a design guide to limit the obtrusive effects of outdoor lighting. The objective of this standard is to provide a common basis for assessment of the possible effects of outdoor lighting and it is intended to assist in assessing the potential obtrusiveness of outdoor lighting. Several aspects of obtrusiveness are considered such as light spilling onto surrounding properties (spill light), the amount of upward light distribution, the brightness of luminaires in the field of view and glare towards transportation users. In general, this standard does not apply to lighting provided for the purposes of safety and security on public roads, cycle paths, and pedestrian areas but provides a measure where the local authority considers that obtrusive light should be considered. The impact of public lighting is assessed independently of other lighting.
- 5.2 Intent of AS/NZS4282:2019 is not only to control the obtrusive effects of spill light into neighbouring properties but is an attempt to control all obtrusive effects of outdoor lighting. AS/NZS4282:2019 replaces AS4282:1995 upon which the Operative District Plan Light rules are based.
- 5.3 Industry Research, best practice guidelines, level of lighting existing in an area and consultation feedback went into the writing of AS/NZS4282:2019. It is my opinion that it will be adopted by most territorial authorities in New Zealand in the future.
- 5.4 Outdoor lighting, whilst intended for a specific purpose, can influence the environment and surrounding area in which it is installed. These specific effects can be influenced by: the area abutting or in proximity; the topography height or direction of view; physical features such as trees or buildings; existing ambient lighting levels; or the location of a proposed development relative to a cultural, historical, scientific, transportation, community, or astronomical facility. The effects will have an impact on residents, transportation users, signalling systems and astronomical observation sites hence Environmental Zones are identified in Table 3.1 AS/NZS4282:2019. These

Environmental Zones have been reviewed and matched with the most appropriate PDP zones and are the basis for the lux levels specified in LIGHT **TABLE 1** applicable to each PDP zone. The Environmental Zones can be described as:

- (i) *Intrinsically dark* with examples being major astronomical observatories with no road lighting,
- (ii) *Dark* areas that are relatively uninhabited rural areas with no road lighting,
- (iii) *Low district brightness* areas that are sparsely inhabited rural or semi-rural areas,
- (iv) *Medium district brightness* areas that are suburban areas in towns or cities and
- (v) *High district brightness* areas that are town or city centres, commercial areas or residential areas abutting commercial areas.

5.5 Comparison table between AS/NZS4282:2019 & PDP Table 1..

| AS/NZS4282:2019 Zones | 2200 – 0600 (lux) | Hours of darkness from 0600 – 2200 (lux) | PDP Zone |
|----------------------------------|------------------------------|---|--------------------------------------|
| Intrinsically Dark A0 | 0 | See note 1 | |
| Dark A1 | 0.1 | 2 | |
| Low District Brightness A2 | 1 | 5 | |
| | 1 | 5 | GRUZ / Castle Hill |
| Medium District Brightness A3 | 2 | 10 | |
| | 2 | 10 | RESZ, MPZ, GRAZ, TEZ, LCZ |
| | 3 | 5 | GRUZ adjoining DPZ or PORTZ, SKIZ |
| High District Brightness A4 | 5 | 25 | |
| | 5 | 25 | CMUZ, GIZ, PORTZ, KNOZ |

Notes

1. As close to zero as practicable without impacting on safety.

5.6 Two sets of values are specified in LIGHT TABLE 1 based on the times that the proposed lighting system is to operate. The higher value of light indicated is likely to be less obtrusive because this corresponds to the early hours of the evening when there is likely to be more activity and most people are awake (i.e. hours of darkness from 0600 to 2200). For later times when more people are likely to be asleep (i.e. 2200 to 0600), and hence the possibility of more obtrusion, lower limits have been applied. This lower level

also applies to environmentally sensitive areas. These time periods also coincide with other time periods in the PDP (e.g. noise control).

6. SUBMISSIONS

DPR-0384 MetroPort

- 6.1 LIGHT-REQ1 LIGHT-Table 1 states that 5 lux applies between 2200 to 0600 and 25 lux between 0600 to 2200 in the CMUZ, GIZ, PORTZ and KNOZ. The submitter opposes the 5 lux level between 2200 to 0600 and wants this increased to 10 lux based on the Operative Plan rule.
- 6.2 The Operative District Plan 10 lux level was established from reference to AS4282:1995 and or research around this time approximately 25-30 years ago.
- 6.3 Since 1995, lighting technology has changed significantly with improved luminaire and optic design, increased lighting knowledge, and the widespread uptake of LED technology. Also, during this time artificial lighting design has become more aware of the obtrusive effects on the environment. In establishing the maximum spill light level in LIGHT-TABLE1 of 5 lux during 2200 to 0600, the Council referred to the latest updated standard AS/NZS4282:2019 Control of obtrusive effects of outdoor lighting and associated research.
- 6.4 A level of 5 lux is consistent with an area of high district brightness adjoining town and city centres or other commercial/industrial areas operating all night as specified in Table 3.1 and Table 3.2 within AS/NZS 4282:2019 and as shown in the table at paragraph 5.5.
- 6.5 LED technology has enabled designers to select lighting products specifically designed to deliver results only to those areas where it is required, hence I believe the 5-lux level over the operating times of 2200 to 0600 is not onerous or restrictive.

DPR-0384 Rolleston Industrial Developments Ltd (RIDL), DPR-0358 Rolleston West Residential Limited (RWRL) and DPR-0363 Iport Rolleston Holdings Ltd (IRHL)

- 6.6 Like Metroport, these submitters are also seeking increased lux levels, which I disagree with for the same reasons outlined in paragraphs 6.1 to 6.5.
- 6.7 With respect to Light REQ1 the submitter would like the rules to apply “*at the notional boundary or a point 20m from the side of any building used for a ‘sensitive activity’*”.

- 6.8 I disagree with this modification because the designer when calculating the effects of a proposed lighting scheme would need to know the use and activities of the adjoining building, which is not always possible.
- 6.9 In addition, Clause 3.3.1.3 and Figure 3.1 within AS/NZS4282:2019 describes where and when the calculation plane to assess spill light is to be taken. This is typically 10m from the boundary or on the building line if the building is located closer than 10m from the boundary. 'Notional boundary' is defined in the PDP as: "means a line 20 metres from any side of a residential unit or other building used for a noise sensitive activity, or the legal boundary where this is closer to such a building." Applying measurement at the notional boundary would therefore be more lenient than and inconsistent with AS/NZS 4282:2019.

DPR-00453 Midland Port, Lyttelton Port Company Ltd.

- 6.10 The submitter requests that LIGHT -Table 1 column one heading be amended as follows "Zone of the adjoining site receiving light spill (unless otherwise stated)". I disagree with this request because there is no reason given for this addition and I don't believe it is necessary because all areas are included within the current Table description.
- 6.11 The submitter is also requesting that in the GRUZ adjoining DPZ or PORTZ, SKIZ that the levels be measured at the notional boundary of any rural dwelling in the GRUZ. I disagree with this submission point for the same reasons set out in paragraphs 6.6 to 6.9.
- 6.12 The submitter also considers that measuring light spill at the interface with the Rural Zone is overly restrictive, does not relate to the actual adverse effect on residential amenity, and would undermine safe and efficient Port operations. On site measurement to confirm conformance is not intended because of the relatively low values and the uncontrolled influences of ambient conditions such as cloud cover, weather and moonlight. Conformance will be demonstrated by the results of calculations and design methods with respect to the requirements set.
- 6.13 The submitters are also concerned that the lux levels that apply in GRUZ are too low. I consider that designers can select lighting products specifically designed to deliver results only to those areas where it is required. Furthermore, I note that a level of 3-lux is higher than the recommended 2-lux level permitted within an area of medium district brightness adjoining suburban areas in towns and cities operating all night as specified in Table 3.1 and Table 3.2 within AS/NZS 4282:2019. I understand from the Council Officer's s42a report that these more generous limits have been applied in the GRUZ

adjoining the Dairy Processing Zone (DPZ), PORTZ and SKIZ only in recognition of the established nature of the facilities within these zones, and to provide greater development flexibility in relation to these zones which include important infrastructure. Overall, I consider the 3-lux and 5-lux levels over the operating times of 2200 to 0600 is not onerous or restrictive.

6.14 As alternative relief the submitter is seeking to increase the lux levels in both the GRUZ and the CMUZ, GIZ, PORTZ and KNOZ. They are seeking to:

(i) In the GRUZ adjoining DPZ or PORTZ, SKIZ. - Amend the 3-lux value to 10 lux between 2200 to 0600, and from 5 lux to 25 lux between hours of darkness from 0600 to 2200: and

(ii) In the CMUZ, GIZ, PORTZ, KNOZ - Amend the 5-lux value between 2200 to 0600 to 25 lux.

6.15 As already mentioned, in establishing the maximum light spill levels in LIGHT-Table 1, a level of 5 lux during 2200 to 0600 is based on the latest updated standard AS/NZS4282:2019. This 5 lux level is consistent with an area of high district brightness adjoining town and city centres or other commercial/industrial areas. LED technology has enabled designers to select lighting products specifically designed to deliver results only to those areas to where it is required, hence I believe the 5 lux level over the operating times of 2200 to 0600 is not onerous or restrictive.

6.16 A spill light level of 25 lux between 2200 to 0600 for CUMZ, GIZ, PORTZ & KNOZ is considered excessive because they are operating spill light levels permitted for sports venues illuminated for TV coverage during hours of darkness 0600 to 2200 that would typically be 1400 to 1900 lux at 100 to 200 meters from the playing area as per Table 3.4 AS/NZS4282:2019.

6.17 I believe there is a need to have a difference in illumination levels in GRUZ compared to GIZ (3 lux and 5 lux 2200 to 0600) and this is consistent with AS/NZS4282:2019 and the Environmental Zones having medium district brightness and high district brightness.

6.18 As already mentioned, the values of 3 lux and 5 lux in GRUZ adjoining DPZ or PORTZ, SKIZ and GIZ between 2200 and 0600 are already less onerous than those listed in Table 3.2 AS/NZS4282:2019 namely 1 lux and 5 lux between 2200 and 0600.

Submission DPR-0375 from NZTA Waka Kotahi

- 6.19 With respect to LIGHT-R3 Artificial Outdoor Lighting – Public Sports Courts and Grounds, I agree with the submitter wishing to add: “LIGHT-REQ 2 Glare” to the activity status because that will ensure spill lighting from Public Sports Courts and Grounds are subject to the management of the glare requirements onto the transportation network. This is achieved via the Threshold Increment referenced in Table 3.2 AS/NZS4282:2019.
- 6.20 The submitter wishes to add “LIGHT-REQ 2 Glare” to the activity status of LIGHT-R5 Artificial Outdoor Lighting – Temporary Activity. I agree with the need to reference LIGHT-REQ 2 Glare in this situation because glare should be controlled for all activities in situations to manage safety.
- 6.21 The submitter would like clarification within LIGHT-REQ 1 rule on controlling light spill onto roads from artificial outdoor lighting and spill light from road lighting.
- 6.22 LIGHT-REQ1 sets the maximum spill light levels and sets the levels that apply on an adjoining site, “excluding roads”. I consider that spill light levels onto an adjoining site should also include the light spill levels **onto** roads because the users of any transportation network should not be subjected to undue risk from excessive glare or spill light from lighting installations proposed on adjoining sites if they are not controlled via levels indicated within LIGHT TABLE 1 and or Tables 3.2, 3.3 & 3.4 within AS/NZS4282:2019.
- 6.23 However light spill from road lighting should not be subject to the spill light levels in LIGHT-REQ1 because the light levels of road lighting is managed by the AS/NZS1158 series of standards which ensures light spill from public lighting installations facilitates the safe, effective, and efficient operation of roads and public spaces. Therefore, road lighting does not need to be subject to LIGHT-REQ1 given it is already managed by AS/NZS 1158.
- 6.24 LIGHT-REQ2 Glare. I agree with the deletion of the word “~~fixed~~” because the effect of glare applies to all artificial outdoor lighting not just fixed installations.

DPR-0442 Castle Hill Community Association Inc.

- 6.25 The submitter requests that light spill within Castle Hill Village be restricted further by adding Castle Hill Village to LIGHT-REQ1 Table 1 with the same maximum light spill level as GRUZ which is 1 lux from 2200 to 0600 and 5 lux from 0600 to 2200. Currently Castle Hill is zoned both RESZ and LCZ which is 2 lux /10 lux. Therefore, more stringent limits are being requested.

6.26 I can support this request as Castle Hill is in a proposed Outstanding Natural Landscape (ONL) Overlay which corresponds with the Environmental Zone in AS/NZS 4282:2019 of Low District Brightness which corresponds to 1 lux between 2200-0600 and 5 lux during the hours of darkness from 0600 to 2200. I also consider that small commercial activity of the nature anticipated in Castle Hill Village in the LCZ would be able to operate at these lux levels.

DPR-0422 Federated Farmers

6.27 The submitter requests that the definition of “Artificial outdoor lighting” is amended to “Any electrically-powered exterior lighting and/or sign that emits directly into the outdoor environment.” I disagree with the rewording by the submitter because how a light fitting is powered can have little or no effect on how the light fixture performs or emits light. Solar, wind, generator or mini hydro, and other power generation methods can all be used to provide an energy source to produce light. It is the obtrusive lighting effects from all outdoor lighting that the council want to manage via the district plan.

7. CONCLUSION

7.1 I will be attending the hearing on this matter, and I would be happy to answer any questions on my evidence.