

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the hearing of a submission and further submission lodged by the **OUT OF HOME MEDIA ASSOCIATION OF AOTEAROA** in respect of the 'Signs' Chapter of the **PROPOSED LOWER HUTT DISTRICT PLAN 2025**

**STATEMENT OF EVIDENCE OF RUSS KERN FOR
OUT OF HOME MEDIA ASSOCIATION OF AOTEAROA ON THE
PROPOSED LOWER HUTT DISTRICT PLAN – HEARING 7**

LIGHTING

29 SEPTEMBER 2026

1. INTRODUCTION

1.1 My name is Russ Kern.

Qualifications and relevant experience

1.2 I am a lighting engineer at Kern Consultants Limited.

1.3 I hold the following academic and professional qualifications:

- (a) NZ Certificate in Engineering (Electrical) from AUT (43/1982);
- (b) An Engineering Associates Registration Certificate (EARB 4320) since 1986; and
- (c) A Certificate in Illumination Engineering from Auckland Institute of Technology (1996).
- (d) Member of the Illuminating Engineering Society of Australia and New Zealand IESANZ (MIES 455) since 1993.

1.4 I have over 40 years' experience in the electrical and lighting industry, including 15 years' experience in assessing the environmental lighting effects of digital billboards and completing verification testing after installation. I specialise in lighting design and assessment including outdoor lighting for commercial, industrial and residential projects.

1.5 I have been a member of the Illuminating Engineering Society of Australia and New Zealand Limited (MIES 455) since 1993 and I am currently serving on the New Zealand Lighting Society Chapter Management Membership Committee.

1.6 Examples of my experience that are relevant are:

- (a) I participated in a 2012 trial of a digital billboard to determine operating characteristics during daytime and nighttime conditions (dwell times, image transition methods and times, and luminance levels) which was temporarily installed at 1 Beaumont Street in Auckland. This trial was also attended by various experts from, and consultants representing, Auckland

Council, Auckland Transport, and industry representatives. These trials were undertaken prior to the establishment of a digital billboard industry in New Zealand and have helpfully informed the establishment of a set of industry operational standards that have since been widely applied throughout New Zealand.

- (b) I have prepared lighting assessments for numerous resource consent applications for developments which include signs and, in particular, LED billboard lighting in various cities and towns throughout New Zealand including Whangarei, Auckland, Tauranga, Hamilton, Napier, Hastings, Gisborne, New Plymouth, Masterton, Porirua, Wellington, Lower Hutt, Blenheim, Timaru, Rangiora and Christchurch dating back to 2011 and an earlier digital billboard in 2007.
- (c) I have experience testing luminance levels at over 110 digital billboards throughout New Zealand and have prepared lighting assessments for over 150 digital billboard applications for installation in Australia and New Zealand.

Expert Witness Code of Conduct

- 1.7 I confirm I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and I agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise, except where I state I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Purpose and scope of evidence

- 1.8 My evidence has been prepared in support of OOHMAA's primary submission (Submission 413) on the Signs provisions of the Proposed Lower Hutt District Plan (Proposed Plan).
- 1.9 Specifically, my evidence will address submission point 413.12, which relates to Rule SIGN-R3.1(d)(iii).

1.10 I have read:

- (a) The Council's s 42A Report (**s 42A Report**) prepared by Mr Sean Bellamy;
- (b) The Technical Assessment prepared by Mr Mike Smith of Stantec (Appendix 4 of the s 42A Report); and
- (c) Relevant submissions and further submissions.

2. EXECUTIVE SUMMARY

- 2.1 OOHMAA opposed Rule SIGN-R3.1(d)(iii) on the basis that restricting luminance changes between successive images is unworkable and impractical for digital billboard operators. I agree and recommend that SIGN-R3.1(d)(iii) be deleted.
- 2.2 The likely genesis of this rule was Section 3.3.5.4 of AS/NZS 4282: 2019 which contained a requirement that luminance levels from one image to another be restricted to a 30% change. This requirement was deleted after a committee review and revision of the 2019 standard and the current version of AS/NZS 4282 (2023) does not include that requirement. Compliance for internally lit and light emitting surfaces is now measured against a full white screen benchmark (Section 3.3.3.3.1) rather than the step-wise 30% change.
- 2.3 There is no lighting reason why successive image luminance should be limited to 30%, particularly when the maximum nighttime limit is set to limit glare, so it is not obtrusive. A motorist in daytime experiences far brighter variances between a digital billboard image limited to 5,000 cd/m² and an adjacent light coloured painted building surface lit by sunlight potentially being 15,000 cd/m² or more.
- 2.4 Use of the term "average luminance" relating to lit surfaces should be replaced in the District Plan by "maximum luminance".
- 2.5 The advice of Mr. Michael Smith (Stantec) supporting the retention of the rule is flawed because it focuses on road-surface illuminance (lux)

from AI generated models rather than the surface luminance rule which is the subject of OOHMAA's submission.

3. LIGHTING 101

- 3.1 In order to fully understand my evidence, this section provides some introductory remarks in relation to the key issues that need to be considered in assessing lighting effects from digital billboards.

Luminance

- 3.2 Luminance refers to a photometric measure of the luminous intensity per unit area of light travelling in a given direction. It describes the amount of light that passes through, is emitted from or reflected from a particular area, and falls within a given solid angle.
- 3.3 The rationale for measuring digital billboard luminance is to provide an empirical value that can be reliably compared between different colours and hues because brightness effects would otherwise differ depending on who is viewing the image. It also provides a comparison of brightness based on empirical luminance values measured from different surfaces.
- 3.4 In accordance with the International System of Units (SI), the appropriate unit of measurement¹ for a digital visual display billboard and other signage that is internally lit, e.g., fast food signs with fluorescent tubes or LED strips inside, is by luminance values in candela per square metre (cd/m²).
- 3.5 Luminance is measured using a specialist luminance meter that has a very narrow, one degree, viewing beam that can accurately isolate the brightest portions of a multicoloured image.
- 3.6 I have undertaken nighttime tests of digital billboards to monitor compliance with consent conditions, and the results of this monitoring have been presented to various council officers in the past to confirm luminance limits are being met.

¹

Section 4.8 and 12.18 of the IESNA Lighting Handbook.

- 3.7 When used for visual displays, 1.0 cd/m^2 is also known by the non-SI unit² as 1.0 Nit when referring to manufacturer's data. Digital billboards are typically capable of up to $7,000 \text{ cd/m}^2$ or $10,000 \text{ cd/m}^2$ depending on the manufacturer.

Illuminance

- 3.8 Illuminance is not the same as luminance. 'Illuminance' is the term used to refer to the amount of luminous flux, i.e., brightness, falling on a surface, per unit area; for example, to describe a surface lit by a floodlight. It is measured in lux which is equal to one lumen per square metre. A lumen is the SI measurement for luminous flux. Illuminance was formerly often referred to as 'brightness', but this leads to confusion with luminance and glare.
- 3.9 It is possible to measure both luminance and illuminance on a traditional floodlit billboard surface; however, it is only possible to measure luminance from a digital billboard and internally lit billboards due to the direction of light emanating from within the billboard. Illuminance, however, is measured to determine any spill light from all types of billboards.

4. RULE SIGN-R3.1(d)(iii)

- 4.1 Rule SIGN-R3 of the Proposed Plan relates to digital signs. Digital signs are provided for in a range of zones, which are subject to several sub-rules.
- 4.2 OOHMAA opposed Rule SIGN-R3.1(d)(iii) on the basis that restricting luminance changes between successive images is unworkable and impractical for digital billboard operators and requested that the clause be deleted. I support that relief and my evidence focuses on that rule.
- 4.3 The full rule as proposed states:

d. Illumination of the sign:

i. Automatically adjusts to allow for ambient light levels,

² Units that are not defined as part of the International System of Units (SI) but are otherwise mentioned in the SI Brochure.

ii. Does not alter during the display of any image,

~~iii. Does not alter the average luminance of any two successive images by more than 30%.~~

The likely genesis of Rule SIGN-R3.1(d)(iii)

- 4.4 To assist with an understanding of the likely source for Rule SIGN-R3.1 (d)(iii) relating to average luminance of any two successive images displayed on a digital billboard, I draw attention to lighting standard AS/NZS 4282 "Control of the obtrusive effects of outdoor lighting" and its development relating to lit surfaces.
- 4.5 The above lighting Standard was first released as AS 4282 in 1997 and there was no reference to lit surfaces except for a statement in its Foreword and also in Scope Section 1.1 (b) and (c) that read;
- "This Standard does not apply to internally illuminated advertising signs; and the obtrusive effects of brightly lit surfaces, e.g. floodlit buildings, and externally lit advertising signs".
- 4.6 The second release was AS/NZS 4282: 2019. This was the first version of the lighting standard to introduce Section 3.3.5 relating to a Lit Surface where it specifically referred to surfaces that may produce obtrusive light either by emitted or reflected light. Section 3.3.5.4 stated:
- "Where the graphical content or colours can change... the average luminance shall change by less than 30% on the change of the image".
- 4.7 It is important to understand that the above lighting standard relates only to nighttime obtrusive lighting effects. Daytime luminance values from sunlight cannot be controlled by the same method.
- 4.8 The third, and current, version of AS/NZS 4282 was released in 2023. In this version, Section 3.3.5.4 was deleted and replaced by Section 3.3.3.3.1 to apply to internally lit and light emitting surfaces. (i.e. digital billboards, displays, and internally illuminated signage).
- 4.9 The lighting standard described average luminance for internally lit and light emitting surfaces based on the maximum average luminance produced when displaying a full white screen/image at night with

maximum average limits provided by Table 3.4 for various environmental zones.

- 4.10 Importantly, the 2023 version omits any requirement restricting luminance variance between successive creative images to 30%. Compliance should now be measured against absolute maximum limits (via Table 3.4, as opposed to maximum average) rather than controlling creative content step changes between advertisers.
- 4.11 The removal of any reference to average luminance on successive images appears to be in recognition that maximum luminance limits determine safe “brightness” or glare values to control obtrusive effects when viewed against a background environment. At night, the background environment is typically a night sky or building façade lit by available ambient light.

Analysis

- 4.12 It is the brightest portion of an image that has potential to create glare and should be the focus of nighttime luminance limits. Provided the brightest colour on a digital sign or billboard is controlled to a maximum luminance level, it will not result in unsafe lighting levels or glare, regardless of what image came before or what image it will transition to next. Luminance (brightness) is not relative.
- 4.13 The maximum luminance limits in Standard SIGN-S9.1 are generally consistent with typical district plan standards for the luminance of digital signs and billboards and will appropriately control luminance levels of digital signs at night. One significant difference with most other district plans however is that reference is made to “average” luminance values instead of maximum luminance.
- 4.14 Relying on an average value across an image will only dilute the maximum luminance value and potentially create a bright image.
- 4.15 My opinion is that SIGN-S9.1 and LIGHT TABLE 3 should be amended to read “maximum” luminance to ensure glare from bright signage is minimised instead of the potentially brighter “average” luminance standard as stated.

Flaws in Mr. Smith's analysis

- 4.16 I observe that the thrust of comments made by Mr. Michael Smith of Stantec, at paragraphs 66 to 73 of his advice to Hutt City Council regarding submissions on SIGN-R3.1(d) Luminance Levels is based around spill light and road surface illuminance comparisons from a series of images generated by Artificial Intelligence (AI), not real-world lighting-based experience.
- 4.17 The images produced by Mr. Smith apparently represent two billboards, one displaying a dark image and the other a light image, with the brighter image supposedly 'set to' 5 lux. I consider that these are misleading and are inapt to the consideration of SIGN-R3.1(d)(iii), because:
- (a) Lux is a measurement of light spill. It is the intensity of light that falls on a specific surface area. An internally illuminated sign (such as a digital billboard) cannot be 'set to' a lux level. It is possible to design and control a digital sign or billboard to ensure it does not result in more than a determined lux at a specific point, which is relative to the distance of that point from the sign or billboard. I therefore do not know what is meant by the images apparently representing a billboard at 5 lux.
 - (b) The SIGN rule being reviewed does not relate to spill light and road surface illuminance at all; rather, it relates to luminance (brightness) of successive images.
 - (c) The images are not representative of real-world experience of digital signs and billboards. The 'dark' billboard image is unnaturally dark to the point that the black colouring is indistinguishable from the night sky in the background, which is not likely in any well illuminated area such as a highway (as appears to be represented) where the billboard structure itself would be visible from light spill from other sources.
- 4.18 I note that Mr. Smith states "I defer the assessment of luminance levels to HCC lighting expert". There is therefore no analysis by a lighting expert included with the S42A Report. In my opinion, the analysis by

Mr. Smith is not technically correct, and is not supported by relevant technical standards or by qualified experts.

- 4.19 The crux of Mr. Smith's analysis appears to be his statement that:

"A sudden change from dark content to light content will give the appearance of a brighter sign."

- 4.20 As I have set out above, the luminance of an image displayed on a digital sign or billboard is not relative to the image that preceded it. Provided the luminance of the image is at or below the absolute maximum, it will not result in glare or unacceptable lighting effects. The key concern should be to limit maximum image brightness, so it does not appear glary to observers during the day and at night.

- 4.21 Further, successive images are programmed to have a soft transition so it does not appear to an observer as a flick or flash that would otherwise draw attention and potentially create a distraction. I note that Rule SIGN-R3.1(b) requires this transition.

Section 42A Officer's Report

- 4.22 Paragraphs 155-158 in the S42A Officer's Report focus on the ability of a sign/billboard operator to control image content and colouring and does not address glare or general lighting effects.
- 4.23 From my experience working with a range of billboard operators, it is challenging to accurately model what the average luminance will be for any given advertisement before it is displayed on the digital sign / billboard. The software that manages digital billboards will typically set a maximum luminance level from the display, based on a white colour.
- 4.24 It has been standard to have conditions on digital billboard resource consents requiring post-implementation monitoring and verification of luminance levels. This is not undertaken by software modelling luminance output of an image. Rather, I undertake 'field' monitoring using handheld equipment that measures the luminance of the single brightest 'spot' within an image, to determine that the brightest spot complies with the maximum luminance limit. To my knowledge, there is no technology that is capable of reading a whole image and calculating an average luminance from that image.

- 4.25 If I was tasked with monitoring an operating digital billboard to confirm if a maximum 30% average luminance variance was being complied with, I would have to:
- (a) Observe 'Image A', and divide the displayed image into even portions (I estimate at least 20 portions to ensure a fine resolution).
 - (b) Take individual readings of each portion.
 - (c) Record each reading.
 - (d) Calculate the average of all of those readings to determine the average luminance of Image A.
 - (e) Then do the same again for the Image B.
 - (f) Then compare the average luminance of Image A and Image B and determine whether the variance is more or less than 30%.
 - (g) All of the above within the short duration that each image is displayed (typically 8 seconds).
 - (h) And continue with Image C, Image D, and so on, for an undefined length of time as the number, type and sequence of images displayed on a billboard will change frequently.
- 4.26 This is also further complicated if this monitoring were to be undertaken in daylight, when the luminance of a digital sign or billboard is automatically adjusted to respond to changes in ambient light. Rule SIGN-R3.1(d)(iii) could not be implemented during the day due to sunlight effects on adjacent surfaces.
- 4.27 Given luminance monitoring is undertaken in real time, and there are significant, practically insurmountable challenges to undertaking monitoring of this rule, it is my opinion that Rule SIGN-R3.1(d)(iii) would be unenforceable.
- 4.28 In summary, a correctly commissioned digital billboard changing from a darker image to a lighter image has a soft transition between each

image so it is not a distraction and is not glary because of other preset limits programmed into the billboard software to limit luminance and are controlled by other conditions routinely imposed on digital billboard resource consents.

5. CONCLUSION

- 5.1 I support the relief sought by OOHMAA to delete SIGN-R3.1(d)(iii) that relates to average luminance of any two successive images.
- 5.2 It is assumed that the source of Mr. Smith's reference to a limitation of luminance between successive images, was AS/NZS 4282:2019 but the control he was referring to has now been deleted and is not contained in the current AS/NZS 4282: 2023 version.
- 5.3 The short point is that a potential change in average appearance between successive images is not relevant to maximum luminance requirements in any event.
- 5.4 Reference to average luminance is likely to be unenforceable, particularly since daytime sunlight cannot be controlled and other sign rules correctly relate to maximum luminance values during the day and at night.

Russ Kern

29 September 2026