WDC District Plan Review - Light

1.1 Introduction

This brief report is a concise presentation of inputs to the LIGHT chapter of the WDC District Plan review, as per the requirements outlined by WDC in their RPS (Deliverable No. 1) of June 2019.

1.2 Draft Chapter

In the NZ regulatory environment the term glare has often been used to generally describe obtrusive outdoor lighting effects, including light spill. However the two are distinctly separate effects, as defined in lighting standards and engineering practice. The chapter title (LIGHT) is therefore more appropriate than the comparable chapter of the operative plan, although OUTDOOR LIGHTING, would be more so.

The introduction to the draft chapter provides the necessary context, but the definitions could be improved to reflect the following.

Glare relates to the discomfort or disability from the brightness of the light source, which is a function of intensity, source area, and view orientation. Whereas light spill is simply light which is emitted beyond the site boundary and may have obtrusive effect on the use of the neighbouring site.

Further input to the development of the draft chapter will be provided at a subsequent stage of the deliverable plan.

1.3 Light Spill

The structures for regulatory control of light spill vary widely amongst local authorities in NZ, as illustrated in Table 2 (Appendix A). The limiting illuminance values don't appear to have an objective basis, and are more likely to be the result of subjective opinion, consensus, and replication.

Generally light spill limits have reduced as district plans have evolved, and the awareness and scrutiny of obtrusive lighting effects has increased. There is also a trend to provide more differentiation between zones which have different levels of sensitivity.

1.3.1 Standards

AS 4282: 'Control of the obtrusive effects of outdoor lighting' was developed in 1995, and formally adopted in 1997. It was a world leading standard, and a major advance in this field of lighting design and application. However it was initially a guidance document, with no regulatory basis in New Zealand, and slow uptake.

As 'light pollution' awareness increased, and early generation district plans began to evolve, reference to the standard began to accelerate. In 2019 it was formally adopted as a joint standard (AS/NZS 4282), incorporating many updates and a shift in emphasis to specific requirements. It is now in common use for exterior lighting design, although it still has no regulatory standing.

While there are other international standards relating to the obtrusive effects of outdoor lighting, they are uncommon in New Zealand. That is probably because of the high standing that AS/NZS 4282 has internationally, and it's strong relevance to New Zealand application.

AS/NZS 4282 is primarily a design standard but it has several features which are particularly relevant to planning control for light spill, as follows;

- Recommended light spill illuminance limits are based upon objective research and analysis.
- The zone recommendations are categorised according to the sensitivity of the background environment.
- The illuminance limits are supported with detailed guidance on assessment, design, and methodology
- The standard is structured to be easily understood, credible, and pragmatic in application

1.3.2 Best practice

In our view the current best practice for the control of obtrusive outdoor lighting effects is selective alignment with AS/NZS 4282, to utilise the features referred above, without direct or comprehensive reference to the standard. That is consistent with the intent of the standard, which is not structured as a regulatory document.

1.3.3 Curfew

A curfew concept enables an association between the management of light spill and the changes in sensitivity that occur during the evening. In particular the concept enables a change in emphasis from supporting outdoor activity in the early evening, to the amenity and sensitivity of the receiving zone in the later evening. Otherwise the control is necessarily more of a compromise.

AS/NZS4282 utilises a curfew structure, and several local authorities have now adopted a similar approach. Of particular note is the inclusion of such a structure in the proposed draft for the SDC plan review.

The default curfew period defined in AS/NZS4282 is 11.00pm to 6.00am, however it is appropriate to align with any other time controlled activity periods (e.g. noise), or representative activity periods.

Our recommendation is to adopt the curfew approach in the WDC plan review, to support the balance between the interests of the activity zone and the receiving zones. The proposed curfew period would be from 10.00pm to 6.00am, which aligns with the SDC proposal.

1.3.4 Recommended Limits

Based upon the rationale above, we propose that the light spill limits be derived from the recommendations of AS/NZS 4282. However those recommendations are design values, and only relate to direct light emission, with no allowance for indirect contribution (i.e. reflected or refracted). They also don't include tolerance for measurement accuracy. Therefore it is appropriate to add a practical margin to those values. The resolved recommendations are therefore as defined in Table 1 below, and related comments and explanations are as follows;

- Non-curfew limits are generally as per AS/NZS 4282 except for the light spill limit for high brightness areas, which has been retained at 20 Lux for consistency with the operative plan, rather than applying the 25 Lux limit from the standard. The rationale being that there was no basis for increased light spill in those areas, when the lower limit is well established.
- An adjustment increase (i.e. from AS/NZS 4282 values) has been applied to the curfew limits, to reflect the greater influence of indirect contribution and measurement tolerance and accuracy.
- The recommended limits are measured within the receiving zone.

- It is significant that the recommendations for most zones align with the Christchurch District Plan limits.

Table 1: Recommended WDC Light Spill Limits

Zone type	Zone Description	Illuminance (Ev) Lux Non-curfew (6.00am – 10pm)	Illuminance (Ev) Lux Curfew (10pm – 6am)
Dark	Relatively uninhabited rural area	2	1
Low district brightness	Sparsely inhabited rural and semi-rural areas	5	2
Medium district brightness	Suburban areas in towns and cities	10	4
High district brightness	Town and city centres and other commercial areas. Residential areas abutting commercial areas	20	10

The zone types and descriptions from Table 1 have been interpreted and applied to the district plan zones in appended Table 2, together with comparison of the limits in other district plans and AS/NZS 4282.

1.3.5 Measurement Methodology

There is wide variance between local authorities on measurement methodology. Some provide no guidance on where the limits would apply, which would provide a maximised measurement. But it could also lead to variance and inconsistency. Other local authorities reference measurement positions at buildings, set-backs, or nominal over boundary offsets (i.e. commonly 2.0m).

AS/NZS 4282 is essentially a design standard which includes various guidelines for assessment, mostly relating to the relativity of buildings to boundaries. That methodology is intended for design calculation purposes, rather than field measurement and would not be appropriate to simply reference for the application of light spill rules.

For the effective application of planning rules, it is important that the assessment of conformity is clear and practical. It is also appropriate to consider the potential development of a receiving property.

In response to the above factors we conclude that it is preferable to use a nominal over boundary offset. That differs from the WDC operational plan (i.e. measured at boundary), but would provide relative consistency with other local authorities, and in particular the Christchurch District Plan. It also reflects the fact that the derivation of the proposed limits is from assessment beyond the boundary, and they are also significantly lower than the present universal limit.

1.3.6 Measurement Plane

Light spill measurement varies according the orientation of the instrument, and is fully quantified when perpendicular to the dominant source direction. Since light spill is usually lateral in nature, and the effect most evident on vertical surfaces, the most relevant standard measurement plane is vertical.

AS/NZS 4282 relies solely upon vertical plane measurement, whereas local authorities often don't define measurement methodology, or reference both horizontal and vertical plane measurement. In some circumstances (e.g. light source close to a boundary) the latter may be more representative than vertical measurement alone.

Although the proposed limits are derived from AS/NZS 4282, and therefore linked to vertical plane measurement, there is no disadvantage to also including horizontal plane measurement. Doing so also retains consistency with both the WDC operational plan and the Christchurch District Plan.

Our recommendation is therefore to reference light spill assessment in both vertical and horizontal planes, and to include clarification that the applicable vertical plane is that directly facing the light source property boundary.

Measurement height is commonly not defined in other district plans. That enables worst case assessment and overcomes complications that could arise from boundary obstructions. Therefore our recommendation is to avoid introducing a prescriptive measurement height.

1.4 Glare

Glare is a relatively complex effect in comparison to light spill. It is a function of source intensity, source area, and view orientation. The associated thresholds of visual disability and discomfort are somewhat subjective, as is the influence on visual amenity.

Objective regulation would therefore be complex in structure, and difficult to effectively administer. For those reasons a more pragmatic approach is universally adopted by local authorities. That approach is limited to requirements for luminaire aim, orientation, and output distribution.

We recommend that the later approach be retained, with the expansion of existing clause 31.10.1.1(b) to include more description around the control of orientation and output distribution. The proposed general form of such conditions could include the following

(a) In all zones, projection light fittings (i.e. without beam diffusion or decorative function) shall be orientated such that the peak output intensity is directed at least 20° below horizontal, and away from adjacent properties and roads.
(b) Reference to design guidance derived from AS/NZS 4282, similar to that provided in Appendix 6.11.13 of the Christchurch Plan

The Christchurch Plan requirement relating to light spill to arterial roadways and associated distraction is not well founded in our view. In the context of common roadway lighting levels for such areas the 2.5 Lux light spill limit would not represent a distraction threshold, and wouldn't provide significant benefit over the proposed general light spill rules. Furthermore, a 2.5 Lux limit implies a level of accuracy and precision of effect that is unrealistic.

1.4.1 Navigation Hazard

In response to the request for comment on a rule regarding the avoidance of lighting hazard to navigation we propose that a suitable provisions would include; reference to 1.4(a) above, and the requirement for the peak output intensity of projection type light fittings to be directed away from established and confined navigation sight lines for sea or air navigation.

1.5 Illuminated Vertical Planes & Signage

From reference to other district plans the regulation covering illuminated vertical planes and signage is summarised in the following observations;

- The lighting of vertical surfaces is typically regulated only in the context of signs.
- Sign illumination and digital signage commonly has little or no reference in the plans for other nearby south island districts. The Christchurch plan is an exception, with a somewhat complex treatment of the issues
- Flashing or intermittent lights are typically excluded from permitted activity.

- Prescriptive limits on the light technical parameters for signage are rare.
- The Christchurch District Plan has a complex structure which includes prescription for associated light spill, and the duration and transition of digital sign images.
- From experience, CCC prescribe sign luminance limits as part of resource consent for discretionary activity, without any reference to the derivation of such limits.
- The Timaru District Plan is an outlier which includes a table of sign luminance limits for varying sizes and locations. It is significant that the associated values are much higher than those recommended in AS/NZS 4282.

AS/NZS4282 collectively addresses the design and conformity of illuminated signs and building facades, with prescription around luminance, image dynamics, and light spill. However that guidance has not been adopted in any plans that we are aware. That may be a reflection of the lack of strong consensus and support, or equally it could reflect the complexity and low level of issues arising.

Illuminated building façades have variables such as texture, colour, area, uniformity of effect. The resulting luminance is also variable according to view orientation and distance. All of which make prescriptive regulation impractical. Unless any obtrusive effect from façade lighting is becoming a significant factor, we recommend that any attempt to prescribe controls is deferred, and more reference or investigation undertaken.

From consideration of the above, our conclusions and recommendations relating to illuminated vertical planes and signage are as follows;

(a) The level of effect relates to the sensitivity of the associated zone and the type of roadway, which should be reflected in the rule structure.

(b) The Christchurch plan offers relevant and useful reference but the structure is complex and difficult to interpret.

(c) Light spill from Illuminated signs is inherently limited by the zone rules, so no additional requirements are necessary.

(d) The obtrusive lighting effect of Illuminated signs (internally or externally illuminated) essentially relates to luminance (i.e. brightness) and associated glare, particularly to road users. As for general glare, a quantitative management approach isn't practical, and nor is an inward aim requirement. But it is appropriate to include policy relating to the avoidance distraction or disability to road users, and for signage in the vicinity of roadways to comply with NZTA regulations and standards.

(e) Apart from the glare and light spill issues above, any control of sign lighting is a matter of balancing the benefit/functionality of such signage with the effect on visual amenity in each zone. Although not essentially a light technical matter, we have consolidated our interpretation of an appropriate rule structure into Appendix A, Table 3. *Illuminated & Digital Signs – proposed Rule structure*. In summary illuminated signage, both internal and external, would be;

- Permitted (i.e. not excluded) in all Business and industrial zones,
- Restricted discretionary in residential zones
- Discretionary in rural and open space zones

That is a little more restrictive than the Christchurch plan, which would generally allow illuminated signage in residential zones.

(f) The issue of off-site signage, and the associated illumination is primarily a planning matter, but our interpretation of a suitable rule structure is also included in Table 3. That structure largely reflects the Christchurch plan.

(g) Intermittent, flashing and rotating sign lighting is commonly not permitted or non-complying, but could be considered a restricted discretionary activity in business and industrial zones for alignment with the Christchurch plan.

(h) Permitted activity rules for digital signs are prescribed in the Christchurch Plan for business and industrial zones depending upon the associated roadway classification. Non-compliant signs are restricted discretionary activities, and such signs in other zones are discretionary activities. Those structures appear to offer an appropriate balance between benefit/functionality and effects, and offer the most substantive and relevant reference. Therefore we have also adopted those concepts in Table 3.

(i) The permitted activity rules for digital signs concentrate on physiological issues associated with attention and distraction, rather than the obtrusive visual effects addressed in the scope of our input. However suitable rules could be developed from reference to the Christchurch Plan, with consideration also given to the longer image dwell time (i.e. 10 seconds) and rate of illuminance change (<30%) defined in AS/NZS 4282.

1.6 Sky Glow

The aesthetic value of the view to the night sky is gaining increasing appreciation and awareness amongst the general public. The quality of that view is also particularly important to the Oxford Observatory and astronomers.

Sky glow is the effect of brightening of the night sky from the scatter of artificial lighting, and it has a degrading effect on the natural view. The effect is cumulative and of a wide area nature, but there are various measures that can reasonably be taken to mitigate the effect while balancing the benefits and necessity for artificial lighting.

In response to the factors outlined above, we recommend that it would be appropriate to include specific policy, objective, and rules relating to the mitigation of sky glow contribution as part of the plan review. Such inclusion would include specific provisions relating to the Oxford Observatory which has the leading interest in this area.

General provisions for sky glow mitigation should concentrate on luminaire type, orientation, distribution, and control. Special provisions could be included in relation to the Oxford Observatory, and the spectral characteristics of roadway lighting. The latter two issues will be further developed in subsequently reporting deliverables.

1.7 Appendices

Appendix A:

Table 2 – Light Spill Limits Comparison

Table 3 – Illuminated & Digital Signs proposed Rule Structure

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Appendix A

Table 2 - Light Spill Limits Comparison

(Illuminance values in Lux)

Zone	WDC	WDC (proposed)		AS/NZS 4282		CCC	SDC	HDC	MDC	TDC		ADC
		STD	Curfew	STD	Curfew					STD	Curfew	
General rural zone	20	5	2	5	1	10	3	8	2.5	20	-	3
Rural lifestyle zone	20	5	2	5	1	10	3	8	2.5	5	-	3
General residential zone	20	10	4	10	2	4	3	8	2.5	20	10	3
Large lot residential zone	20	10	4	10	2	4	3	8	2.5	20	10	3
Settlement zone	20	10	4	10	2	4	3	8	2.5	20	10	3
Special purpose zone – Tuahiwi	20	10	4	10	2	4	3	8	2.5	20	10	3
Medium density residential zone	20	10	4	10	2	4	3	8	2.5	20	10	3
Town centre zone	20	20	10	25	5	10	10	8	10/2.5	20	10	10
Large format retail zone	20	20	10	25	5	10	10	8	10/2.5	20	10	10
Local centre zone	20	20	10	25	5	10	10	8	10/2.5	20	10	10
Neighbourhood centre zone	20	20	10	25	5	10	10	8	10/2.5	20	10	10
Light industrial zone	20	20	10	25	5	10	10	8	10/2.5	20/10	10/1	10
General industrial zone	20	20	10	25	5	10	10	8	10/2.5	20/10	10/1	10
Heavy industrial zone	20	20	10	25	5	20	10	8	10/2.5	20/10	10/1	10
Special purpose zone – Kaiapoi regeneration	20	20	10	25	5	10	10	8	10/2.5	20	10	10
Special purpose zone – Museum and conference centre	20	20	10	25	5	10	10	8	10/2.5	20	10	10
Special purpose zone – hospital	20	20	10	25	5	10	10	8	10/2.5	20	10	10
Open space zone	20	10	4	10	2	10	3	8	2.5	20	10	2.5
Sport and active recreation zone	20	10	4	25/10	5/2	10	3	8	10/2.5	20/10	10/1	10
Natural open space zone	20	2	1	2	0.1	4	3	8	2.5	20/10	10/1	2.5

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Appendix A

Table 3 - Illuminated & Digital Signs Proposed Rule Structure

Zone	On-site Illuminated signs (int & ext.)	Off-site illuminated signs (int & ext)	Intermittent sign lighting.	Digital
General rural zone	**D**	**D**	**NC**	**D**
Rural lifestyle zone	**D**	**D**	**NC**	**D**
General residential zone	**RD**	**RD**	**NC**	**D**
Large lot residential zone	**RD**	**RD**	**NC**	**D**
Settlement zone	**RD**	**RD**	**NC**	**D**
Special purpose zone – Tuahiwi	**RD**	**RD**	**NC**	**D**
Medium density residential zone	**RD**	**RD**	**NC**	**D**
Town centre zone	**P**	**RD**	**RD**	**PC/RD[1]**
Large format retail zone	**P**	**RD**	**RD**	**PC/RD[1]**
Local centre zone	**P**	**RD**	**RD**	**PC/RD[1]**
Neighbourhood centre zone	**P**	**RD**	**RD**	**PC/RD[1]**
Light industrial zone	**P**	**RD**	**RD**	**PC/RD[1]**
General industrial zone	**P**	**RD**	**RD**	**PC/RD[1]**
Heavy industrial zone	**P**	**RD**	**RD**	**PC/RD[1]**
Special purpose zone – Kaiapoi regeneration	**P**	**RD**	**RD**	**PC/RD[1]**
Special purpose zone – Museum and conference centre	**P**	**RD**	**RD**	**PC/RD[1]**
Special purpose zone – hospital	**P**	**RD**	**RD**	**PC/RD[1]**
Open space zone	**D**	**D**	**NC**	**D**
Sport and active recreation zone	**D**	**D**	**NC**	**D**
Natural open space zone	**D**	**D**	**NC**	**D**

Clarifications
P= Permitted (default)
PC= Permitted/conditional
NC= Non complying activity
RD= Restricted discretionary activity
D= Discretionary activity

Notes
1. PC or RD depending upon roadway type

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Appendix B – Oxford Observatory

The following is a brief review of the submission from the Oxford Area School Observatory committee in relation to the Waimakariri District Plan review.

Analysis;

1. The intent of the submission (i.e. to conserve the quality of view to the night sky) is consistent with a general objective of mitigating detrimental effect to wildlife and human health, and also with common perceptions of visual amenity.

2. The submission overstates the quality of the night sky at the Oxford Observatory site, when describing it as equivalent to that at the Mt John observatory site. The referenced satellite data indicates significantly higher radiance and brightness than at Mt John observatory, but confirms somewhat better conditions (i.e. lower radiance and brightness) than at the West Melton site.

3. CIE 126 - 1997 (Guidelines for Minimizing Sky Glow) defines a zonal system for the classification of night sky environments and the relative astronomic activities and outdoor lighting requirements. From that reference the Oxford observatory site has a similar classification to the West Melton observatory, and both have lower classification than the Mt John observatory.

4. The CIE guidelines emphasise the elimination of unnecessary lighting, which particularly relates to the control of distribution, orientation, and time of use. They also include more onerous mitigation options relating to the spectral characteristics of light sources, in the most demanding circumstances. Any applicable controls therefore need to reflect the balance between the protection benefit, and the interests of those affected.

5. The proposed conditions within a 2km zone are essentially those adopted by the McKenzie District Council (MDC) for their wide area of outdoor lighting restriction, but with a more onerous curfew (i.e. 9pm vs 11pm), and no accommodation for legacy installations. Those conditions include requirements for the spectral characteristics of light sources, as per the CIE guidelines.

6. The proposed plan conditions for an outer zone are essentially those of the Selwyn District Council (SDC) for the West Melton Observatory zone, except that the zone is larger (i.e. 10km vs 5km), and the curfew period longer(i.e. 9pm vs 10pm).

7. Alignment with the MDC conditions doesn't appear to be justified considering the lower status of the observatory, and the implications to residents and businesses. It is also relevant that the Oxford Observatory has been established in an existing urban environment which inherently constrains the quality of the night sky environment.

8. The size of the West Melton Observatory zone (i.e. 5km radius) is greater than the CIE 126 recommendation of 2km radius. That may be to ensure that the nearby township is fully included within the zone. The Oxford Observatory submission states that the West Melton zone isn't sufficiently effective, but doesn't consider other influences such as the proximity to the high district brightness of Christchurch city, or the effectiveness of the zone conditions. The submission also doesn't provide any basis for the proposed zone size.

Conclusions

1. The proposed zones and conditions would benefit the Oxford Observatory by minimising the future degradation of the present environment for astronomic observation. However that benefit would be very minor, unless large scale local area development was to occur.

2. The submission overstates the present quality of the night sky environment and the status of the site in relation to reference provisions.

3. The proposed zones and conditions are demanding in relation to the status of the observatory. In particular the inner zone conditions would have major implications to future lighting installations in Oxford township, and differ considerably from those existing.

4. If a special zone is considered to be justified, then the most objective prescription of area and conditions would be from CIE 126. That would result in a zone of 2km radius, and conditions to minimise unnecessary lighting (e.g. control of distribution, orientation, and time of use). More onerous conditions relating of spectral characteristics of the light sources wouldn't be justified in that context.

5. The most relevant local planning reference is the SDC provisions for the West Melton observatory, but the size of that zone (i.e. 5km) doesn't appear to have objective basis.

6. The intent of the submission could be addressed to some extent, by enhancing the present general provisions for conserving the night sky environment. That would also be consistent with a general objective of mitigating detrimental effect to wildlife and human health, and also with common perceptions of visual amenity. Such provisions could include design guidance and rules relating to luminaire type, orientation, and distribution, and operation. Such an approach would have broad benefit to the environment of natural open space areas, and also to Oxford Observatory.

7. The proposed general provisions relating light spill and glare include controls with indirect benefit to the conservation of the night sky environment. Those provisions are substantially aligned with the conditions proposed by the Oxford Observatory for an outer zone.

8. The colour temperature of roadway lighting is related to light emission in the blue part of the spectrum, which is significant to both biology and sky glow contribution, and therefore also relevant to the Observatory. This issue is the subject of separate analysis and review, which may also contribute to the submission response.