Interim Advice Note:

Steps to take to reduce the impact/effect of artificial light on pekapeka (bats): Version 1: 19 August 2025

Understanding is growing about how pekapeka/bats are affected by artificial light at night in Aotearoa New Zealand and overseas. This understanding will help mitigate the effect of old and new lighting systems on bats. Other species, such as coastal seabirds and insects, are also affected by artificial light, so management of light is likely to benefit more species than just bats[1].

This advice note will be updated regularly as knowledge is built.

Light effects on bats: Evidence

Bats are nocturnal mammals. This means they are at active at night and are extremely sensitive to artificial light at night (ALAN)[2]. Historically bats were only exposed to low levels of light, including moonlight, starlight, and low light levels at twilight[3]. The level of light that bats are exposed to from natural sources is lower than artificial light levels, but even at this low light level, bat behaviour and use of an area is affected[4].

Artificial light at night is increasing both in Aotearoa New Zealand and worldwide[5]. Artificial light is known to affect bats. Preferred flight paths, commuting routes and access to profitable foraging (feeding) areas have been severed, and the areas

[1] Cieraad-Farnworth-2023.pdf
[2] doi:10.1016/j.tree.2010.09.007
[3] WEB_EUROBATS_08_ENGL_NVK_19092018.pdf
[4] Page-Corney, 2024
[5] Cieraad-Farnworth-2023.pdf

themselves reduced – all by the addition of artificial light to a once dark place. Roosts, that bats use to shelter in during the day, can be isolated from these areas by light and their use can be reduced or even stopped entirely[6].

Both of Aotearoa New Zealand's pekapeka – long-tailed bats and lesser short-tailed bats – are negatively affected by artificial light [7]. For example, long-tailed bats use lit sites less often than unlit sites and arrive at them later in the night[8]. This means that if artificial light is going to be added to an area where bats are present, then an environmental effect is expected.

Long-tailed bats are detected less often on nights when moonlight levels are high[9] . This means that to avoid an effect of artificial light on bats, light levels would likely need to be lower than average moonlight levels.

There are various ways to measure light but lux is a standardised measure of how much illumination an area receives Long-tailed bats are less likely to be detected when there are more streetlights[10], and when sites receive artificial light of ≥ 0.5 lux[11]. This means that reducing the number of lights, and their spill, and keeping lux to moonlight levels (typical moonlight levels are between 0.05 - 0.1 lux[12]) or less will help reduce the effects of light on long-tailed bats.

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[6] WEB_EUROBATS_08_ENGL_NVK_19092018.pdf
[7] For a summary: long-tailed bats, Cieraad and Farnworth, 2023; lesser short-tailed bats avoid light (unpublished DOC report).
[8] Schamhart et al 2023
[9] Page-Corney, 2024
[10] Dekrout, Clarkson and Parsons 2014
[11] Summarised in Cieraad and Farnworth, 2023.
[12] Kyba et al 2017

Lighting Guidelines

The Australian and New Zealand lighting standards AS/NZS 4282:2023 (Control of the obtrusive effects of outdoor lighting), sets out recommended requirements to control the obtrusive effects of artificial outdoor lighting. These standards state that if an effect of light on wildlife is likely, then reference should be made to the Australian National Light Pollution Guidelines for Wildlife so that additional restrictions can be applied.

The Australian National Light Pollution Guidelines for Wildlife were recently adapted by the Convention on the Conservation of Migratory Species of Wild Animals (CMS) into their own guidelines: Convention on Migratory Species Lighting Guidelines (CMS). New Zealand was involved in the development of both these guidelines.

The CMS is an environmental treaty under the United Nations that aims to conserve migratory species throughout their ranges.

> New Zealand has been a party to the Convention since 2000. The Convention on Migratory Species Lighting guidelines were adopted by CMS Parties (including New Zealand) in 2024. Pages 102-118 of the guidelines deal specifically with bats. Although New Zealand bats are not a migratory species for the purpose of the CMS (i.e., they do not fly out of New Zealand), the guidelines provide recent and comprehensive guidance that is highly relevant to the consideration and control of effects of artificial lighting on New Zealand bats.

Convention on Migratory Species Lighting guidelines provides a framework to:

- Assess and manage the light pollution impacts on protected wildlife
- Details of guidance for how to manage artificial light
- Specific advice on how to protect species including bats (pg 102-118).

Mitigation measures such as those described in the guidance documents should be used and imposed when developing RMA instruments including plans, resource consent conditions and management plans.

There are other bat-specific guidelines available. These will be useful when designing bat-sensitive lighting. The Eurobats guidelines provides additional detail and actions to minimise the impact of lighting on bats.

Principles to follow to reduce the impact/effect of artificial light on pekapeka (bats)

Useful general design principles from are copied below from the Australian National Light Pollution Guidelines for Wildlife page 19 (Table 1).

Table 1. Best practice lighting design principles.

Best practice lighting design incorporates the following design principles.

1. **Start with natural darkness and only add light for specific purposes.**
2. **Use adaptive light controls to manage light timing, intensity and colour.**
3. **Light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill.**
4. **Use the lowest intensity lighting appropriate for the task.**
5. **Use non-reflective, dark-coloured surfaces.**
6. **Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.**

These general principles are outlined in more detail in the table below, which is copied from the CMS' Convention on Migratory Species Lighting guidelines. Pg 114-118.

Table 2. Detailed light management options.

Management Action	Detail
Avoid adding artificial light to previously unlit areas.	Maintaining dark areas is crucial when managing effects on nocturnal species such as bats.
Implement appropriate mitigation where and when bats are likely to be present.	Roosts, commuting routes, foraging areas and water sources are areas used by bats that are most likely to be affected by artificial light. Any direct or indirect artificial light that is visible to a person standing in foraging habitats, commuting corridors or roost habitats will potentially be visible to a bat and should be modified to prevent it being seen.
Turn out lights for as much of the night as possible.	Exterior lights or interior lights which spill light outside should be turned off for as much of the night as possible to prevent negative impacts on bats.
Keep exterior lighting to a minimum.	Only light where necessary and minimise intensity. Stay below legally allowed light levels with outdoor lighting (noting that often these light levels are not legal, but professional society "standards" for example those developed by the IES and CIE in addition to legal prescriptions). Note that good visibility for humans depends on avoiding too high contrasts between max. and min. visible luminance. If visible luminance is reduced, e.g. by shielding or suitable optical design, overall lower illuminance levels can achieve an even better visibility then higher illuminance levels, if the visible luminance is also higher.
Use motion sensors to turn lights on only when needed.	This will mean areas remain dark for longer periods. LEDs have no warm up or cool down limitations so can remain off until needed and provide instant light when required. However, consider whether this will trigger a startle response for bats.
Avoid high intensity light of any colour.	Keeping light intensity as low as possible will reduce impacts on bats.

Management Action	Detail
Use lights with reduced or filtered blue wavelengths.	Bats and their prey are particularly sensitive to short wavelength light. Blue light influences the circadian rhythm of vertebrates and can cause a shift of sleep/activity patterns.
Avoid violet and ultraviolet wavelengths.	While circadian effects are lower with violet than with blue wavelengths, insect attraction can be higher which can have implications for insectivorous bats.
Use LEDs with warmer spectral composition (<<2,700 K).	Even if there is no strict correlation of blue content to CCT, most white light sources with low CCT, i.e. warmer colour temperatures, also have lower blue content. Reviewing the amount of short wavelength light present in each light type using a spectral power curve is important to manage short wavelength light.
Reduce visibility of light sources by minimising radiance, using shielding and lowering luminaire height.	Even distant light sources may attract wildlife because of their high luminance and visibility from a far distance and so actions should be taken to minimise radiance.
Do not illuminate important habitats and features including roosts, roost entrances/exits, caves, hibernacula, swarming sites, associated flightpaths,	These important habitats should be kept dark by avoiding irradiance at these sites. They should not be illuminated with any

Management Action	Detail
commuting habitat, foraging areas (including urban parks, gardens, forest edges, hedgerows) and drinking sites.	spectra (including red light) because any light can have negative effects.
Do not illuminate façades of buildings that are close to important bat habitat e.g. roosts, caves, hibernacula, swarming sites, associated flightpaths, commuting habitat, foraging areas and water sources.	Building façades should not be illuminated in order to reduce light pollution in general, but this is particularly important in areas close to/in bat habitat. Buildings which are known to house roosts should not be illuminated during the whole reproductive season.
Maintain natural light/dark levels (as measured at the new moon) at roost entrances, exits and emergence corridors.	Bats are particularly sensitive in these locations because of the risk of predation and so natural light/dark levels should be maintained.
Do not illuminate flyways between roost entrances/exits and hedgerows, treelines and other commuting routes.	Lighting can disrupt commuting routes leading to increased flight time and energy expenditure. Where feasible natural light/dark levels (new moon) should be maintained.
Avoid illumination at foraging areas such as water bodies (rivers, ponds, canals) and forests, as well as at drinking sites, including small ponds and livestock drinking troughs.	Bats can be deterred from foraging and drinking sites if they are illuminated and so these areas should be maintained with natural light/dark levels (as measured at the new moon).

Management Action	Detail
Discourage visits to caves with bats present, particularly those with nursery/maternity colonies or hibernating bats so that there is no risk of artificial light being introduced e.g. via flashlights / torches, or more permanent lighting.	Some areas are only used by bats seasonally and light management should take this into consideration.
Minimise lighting and its duration in caves. Only use lights when needed and limit them to areas away from bats.	Ideally do not light caves where bats are present. If necessary, only illuminate specific cave formations rather than the whole cave. Switch off lights when not needed.
Seek to separate lights, including streetlights, from important bat habitats by an appropriate distance, and using shielding and other measures to reduce light spill where appropriate.	Distance alone may not be enough. Good optical quality of luminaires is required to prevent spill light to locations away from the street. Shielding and other measures to reduce light spill should be implemented.
Avoid directing light onto vegetation/plants.	Insectivorous bats may forage near vegetation and nectar/fruit feeding bats feed directly from plants and therefore light on vegetation should be avoided.
If lights need to be installed inside buildings with roosts, use low intensity and highly directed light sources away from the bats. Use light only temporarily and when needed.	Light should only illuminate the direct pathways of humans when needed to ensure their safety and should be switched off when not necessary. Automatic timers can be used. Lights should be automatically turned off when it gets dark so that lights are not accidentally left on throughout the night.

Management Action	Detail
Install lights at lower heights so only target areas are illuminated, for example in underpasses or by using bollard lights to light paths.	Lights installed at lower heights will help reduce light spill and unnecessary lighting of dark areas.
Use other materials such as glow in the dark or light-coloured paths.	In some circumstances lighting may not be necessary for human orientation if alternative materials are used to highlight paths or to mark critical objects e.g. curbs or paths.
Create buffer zones between key bat habitat and areas to be lighted.	The key habitat should be maintained with no artificial light, the area next to the key habitat should have strictly limited illuminance, the area next to that should be moderately illuminated with the use of light barriers or screening, and, in the main development area where lighting is deemed most necessary, illuminance levels should be kept as low as possible. See Bat Conservation Trust and ILP (2018) for a useful diagram illustrating this.

Management Action	Detail
Use non-reflective, dark-surfaced buildings, walls, fences, and soft landscaping to block light spill where appropriate. Vegetation may also be used as a buffer.	Though it is preferable to avoid light spill by installing high quality luminaires, if this is not enough, residual spill light can further be reduced by blocking it with walls, fences, soft landscaping or additional shielding. Where vegetation is used as a buffer, ensure that it is not directly illuminated.
Use orientation of light to mitigate negative impacts.	Light should never be directed towards habitats, drinking zones or other critical areas where bats are present. Adapting the orientation of luminaires can help to minimise spill light towards critical/key areas.
Consider placement of footpaths, open space, and number/size of windows in new developments to minimise light spill on to key habitat.	The location of areas and pathways which need to be illuminated should be oriented away from habitats to reduce impacts.
Install dimmable streetlights in areas where roads cross important bat habitats. Dim lights to lowest allowable levels.	Streetlights can be dimmed depending on time of day, to reduce light levels in critical times for bats (e.g. 2 hours after sunset), but can also be dimmed depending on traffic, so that they only turn on if traffic is detected. LED streetlights have no delay to ramp up light levels within seconds.
Only light areas at times when the light is necessary. Ideally, start the dark phase of a lighting scheme within the first two hours after sunset to reduce impacts.	The first two hours after sunset are most critical for disturbance of bats by artificial light because this often overlaps with times bats emerge from their roosts and are most active. Timing of lighting schemes should take this into account and ensure darkness or extreme low light levels during this time.
Use motion sensors and timers to reduce lighting periods to when lighting is necessary.	The trigger threshold should be set high (so that only large objects like humans trigger the sensors) and the trigger duration should be appropriately short (no more than a few minutes). Note that these devices require some degree of attention and maintenance.
Control lighting when bats are present and consider seasonal activities of bats, including migration, mating, and raising dependent young, to make appropriate lighting choices.	For example, in buildings which are used by bats only for a short period of time during the year, external lighting towards these buildings should be completely avoided during the period that bats are present.

In accordance with the principles set out above, appropriate management and mitigation of light effects on pekapeka will likely require more stringent lighting restrictions (for example, lower light levels and warmer colour temperatures) than those that are regularly used or, for example, those outlined in current National Standards (eg. AS/NZS 1158.1.1:2022 Lighting for roads and public spaces) for managing light for humans or along roads or in Regional Infrastructure Technical Specifications (RITS[13]).

For example, the Waikato RITS specifies under its criteria for 'approved luminaries' that 3000K are to be used on both P and V category roads [14]. Using 3000K does not align with international best practice to manage the impact of lighting on bats as outlined in Eurobats 8 or the CMS. More stringent mitigation measures should be provided for where possible, so that the effects of light on native species are appropriately avoided, reduced, minimised, or mitigated.

[13] RITS (Regional Infrastructure Technical Specifications) - Co-Lab
[14] Regional-Infrastructure-Technical-Specification-V1.0.pdf