

RESEARCH REPORT



DNB311

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Phase 1

Introduction

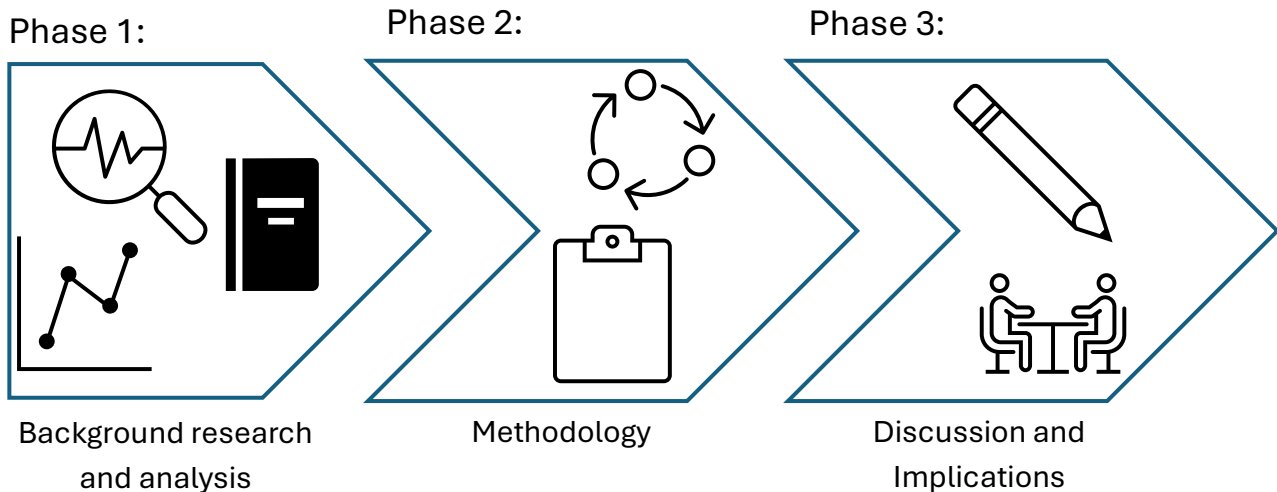
Artificial light at night plays a vital role in modern infrastructure, improving visibility, safety, and accessibility for pedestrians. On bridges, in particular, lighting reduces the risk of accidents, supports wayfinding, and helps users feel more secure. However, there is a growing body of evidence showing that artificial lighting also has unintended ecological consequences. From insects to mammals, experience disruption to their natural rhythms, foraging behaviours, and reproduction because of exposure to artificial light. Where pedestrian infrastructure intersects with bushland and waterways, this creates an important design challenge of how to keep people safe at night while minimising harm to local ecosystems.

This issue matters because poorly considered lighting can simultaneously reduce biodiversity and waste energy, undermining sustainability goals. Conversely, thoughtful design has the potential to balance human needs with environmental responsibility. By investigating how people use pedestrian bridges at night and integrating ecological research on ALAN, new design approaches can be developed that support both community safety and wildlife conservation.

Aim

The aim of this project is to explore how artificial lighting on pedestrian bridges influences both human use and local wildlife, and to propose design strategies that enhance safety, comfort, and accessibility while minimising ecological disruption.

Project Structure



Background

Artificial light at night has become an essential part of urban infrastructure, improving visibility, safety, and accessibility for pedestrians (Mushtaha, E 2022). However, growing evidence shows that poorly designed lighting can have unintended negative impacts on both people and wildlife. For pedestrian bridges in natural or semi-natural settings, this presents a design challenge of how can lighting balance user safety and comfort while also minimising ecological disruption?

Research across multiple disciplines has shown the wide range of effects of artificial light on animals. At the functional level, ALAN disrupts circadian rhythms and hormone regulation, particularly melatonin production, which is essential for synchronising sleep and reproduction (Gaston, K. J., Davies, T. W., Nedelec, S. L., & Holt, L. A. 2017). Birds exposed to urban lighting wake earlier, reduce sleep, and experience changes to seasonal timing of breeding (Dominoni, D., Quetting, M., & Partecke, J. 2013). And (Raap, T 2015). Small mammals such as rodents adjust their space use and social interactions under artificial illumination, with potential consequences for territory and reproduction (Bonnell et al., 2019).

Invertebrates are especially vulnerable. Many insects, including moths and fireflies, rely on darkness for orientation and mating signals. (Gomes, E., Lemaître, J. F., Rodriguez-Rada, V., Débias, F., Desouhant, E., & Amat, I. 2024), highlight how attraction to artificial lights increases mortality while reducing reproductive success. More recently, (Willmott, N. J., Black, J. R., McNamara, K. B., Wong, B. B., & Jones, T. M. (2024), found that juvenile spiders exposed to light pollution developed smaller visual brain regions, suggesting neurodevelopmental impacts. These disruptions cascade across ecosystems. (Grubisic, M., & van Grunsven, R. H. (2021), show that ALAN modifies predator prey dynamics and causes trophic imbalances, leading to measurable shifts in invertebrate populations.

Recognising these risks, current best practice in lighting design includes strategies that mitigate ecological impact while maintaining human safety. (Straka, T. M., Greif, S., Schultz, S., Goerlitz, H. R., & Voigt, C. C. (2020), demonstrated that red-spectrum streetlights reduce disruption to bat activity compared to white lights. Warm-coloured LEDs are now recommended by the International Dark-Sky Association, while turtle conservation areas employ amber lights to protect nesting behaviours (Council, 2015). Adaptive technologies, such as motion activated or dimmable LEDs, are increasingly used in Europe and Australia to reduce unnecessary illumination. Alternative approaches, including glow-in-the-dark path materials and reflective wayfinding systems, further reduce reliance on constant electric lighting.

This clearly shows that ALAN has profound impacts on wildlife physiology, behaviour, and ecosystems, yet emerging design solutions can minimise these effects without compromising human safety. For pedestrian bridges in ecologically sensitive areas, integrating wildlife-friendly lighting principles such as spectrum control, shielding, and adaptive systems can present an opportunity to design infrastructure that serves both people and the environment. This project seeks to build on this knowledge by combining observation of nighttime user behaviour with industrial design strategies informed by ecological research.



A hatchling sea turtle turns inland following human-made lights instead of seaward toward safety. (Photo credit: Blair Witherington) (Brigagliano, 2025)

Benchmarking

Benchmarking involves analysing existing products, devices, and design solutions to identify strengths, limitations, and gaps in the market. For this project, benchmarking focuses on current lighting technologies and pedestrian bridge designs that aim to improve safety while minimising environmental impacts. Reviewing these products provides insight into what has been achieved and highlights opportunities for innovative industrial design.

Existing Products and Competitor Solutions

01: LED Street and Pathway

LEDs are the standard for urban lighting due to energy efficiency and long lifespans, shown in figure 1. Warm-spectrum LEDs are increasingly used to minimise ecological impacts (Brigagliano, 2025).



Figure 1: LED Street and Pathway Lighting (Brigagliano, 2025)

02: Wildlife Sensitive Lighting:

In Lille's Parc de la Citadelle, a nocturnal corridor has been created to preserve biodiversity. Each luminaire in the corridor has different colour temperatures: amber, 2,200K and 2,700K. They also have motion detection sensors to distinguish the arrival of pedestrians, cyclists and cars



Figure 2: Wildlife Sensitive Lighting

03: Non-Electric Alternatives:

Glow-in-the-dark path materials (such as glow path materials (Harrington, 2025) and reflective paints offer low-light visibility without powered fixtures, shown in figure 3. While innovative, these approaches may not provide sufficient illumination for safety on bridges, limiting adoption.



Figure 2: Non-Electric Alternatives (Harrington, 2025)

04: Smart and Adaptive Lighting:

Motion activated, dimmable, and sensor-based lighting systems allow illumination to adjust based on activity levels. Selux and Schreder, for example, offer "smart city" lighting with remote monitoring and adaptive brightness, shown in figure 4. While effective for energy reduction, these systems are not always designed for wildlife. (Schreder, 2025)



Figure 1: Smart and Adaptive Lighting (Schreder, 2025)

Opportunities and Gaps

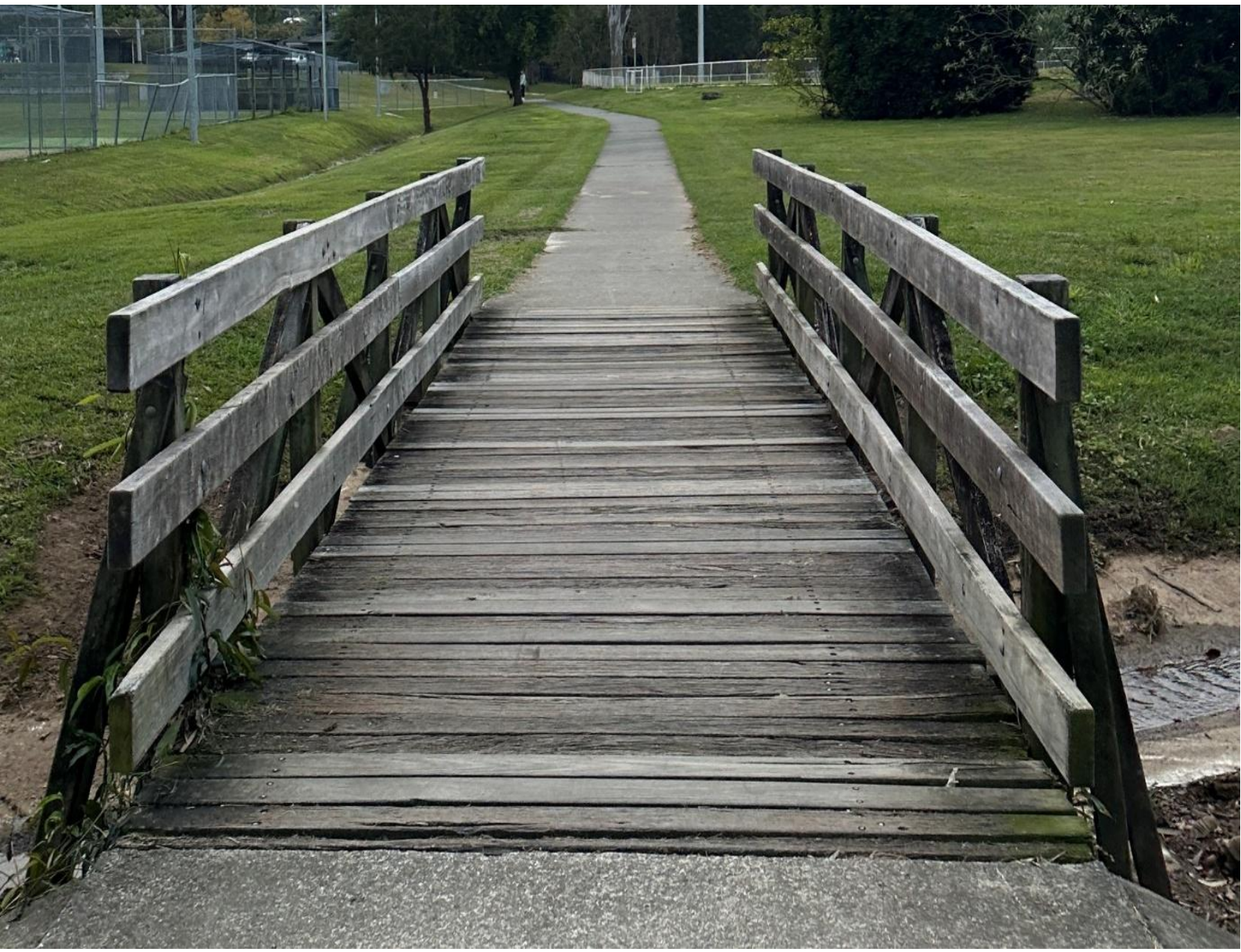
Although existing products show progress toward sustainable and wildlife-sensitive solutions, gaps remain:

Lack of Integration: Most lighting products address either human safety or environmental protection, but few integrate both. For example, amber lights protect wildlife but may reduce human perceptions of safety if visibility feels inadequate.

Design Aesthetics: Few products consider industrial design appeal. Many wildlife-friendly solutions are utilitarian, missing opportunities to enhance user experience and blend into the natural environment.

Over-Reliance on Brightness: Safety in bridge design is often equated with more light, rather than smarter placement, shielding, or complementary design features (e.g., reflective rails, surface materials, or low-level guide lighting).

Underutilisation of Sensor Technology: While adaptive systems exist, they are rarely combined with ecological data. For example, lights could be programmed to dim during peak bat activity hours or avoid illumination during certain seasons.



Benchmarking Matrix

PRODUCT / CATEGORY	KEY FEATURES	STRENGTHS	WEAKNESSES	OPPORTUNITIES / GAPS
LED STREET & PATHWAY LIGHTING	Standard LEDs, warm-spectrum options, energy-efficient	Long lifespan, cost-effective, widely available, sustainable retrofit potential	Can cause light pollution, ecological disruption if colour temp is too high	Adapt for smaller pedestrian contexts, integrate wildlife-friendly spectrum
WILDLIFE-SENSITIVE LIGHTING	Amber/red spectrum lights (e.g., turtle/bat-friendly)	Minimises ecological disruption, already trialled in sensitive zones	Reduced human perception of safety (dim, unusual colour), limited availability	Combine with user-centred design and aesthetics; adapt to suburban bridges
SMART & ADAPTIVE LIGHTING	Motion-activated, dimmable, remote-controlled systems	Reduces energy waste, responsive to activity levels, integrates into smart cities	High installation cost, rarely programmed with ecological data	Incorporate wildlife activity cycles; tailor for smaller-scale infrastructure
NON-ELECTRIC ALTERNATIVES	Photoluminescent paths, reflective paints, surface treatments	Low energy, low cost, minimal ecological impact	Limited illumination for safety, weathering reduces performance	Combine with low-level targeted lights; use as supplementary rather than sole solution
DESIGN-AESTHETIC CONCEPTS	Architectural lighting, concealed fixtures, integrated rails	Enhances user experience, blends with natural or built environment	Often prioritises form over ecological impact	Merge aesthetics with wildlife-sensitive approaches for dual benefit

Benchmarking highlights that while energy efficient and wildlife sensitive lighting solutions are emerging; current products are not fully optimised for suburban pedestrian bridges. The market shows a strong emphasis on safety and sustainability, but opportunities exist for integrated solutions that combine adaptive technologies, ecological sensitivity, and thoughtful industrial design. This project seeks to fill those gaps by proposing lighting and bridge concepts tailored to both human users and the surrounding environment.

Phase 2:

Research

To design pedestrian bridge lighting that balances user safety with ecological sensitivity, it is important to understand both how people interact with bridges at night and how artificial light at night impacts local wildlife. This research project combines user-focused observation with survey data and a review of secondary literature to inform industrial design outcomes. The purpose of this section is to outline the methodology and methods used, and to explain how the data was gathered, analysed, and applied.

Methodology

This project adopts a mixed-methods approach, drawing on both primary research (surveys and observations) and secondary research (literature review and benchmarking). Mixed methods are appropriate because the research problem spans two interconnected domains: human experience (social science focus) and environmental impact (biological and ecological focus). Using both allows for a holistic understanding of the issue.

The methodology is guided by three principles:

1. User-Centred Design (UCD): Understanding how people currently use pedestrian bridge at night, with attention to safety, comfort, and accessibility.
2. Evidence-Based Design (EBD): Drawing on scientific studies about artificial lighting's effect on animals to ensure the design is ecologically responsible.
3. Benchmarking & Market Review: Comparing existing products and identifying gaps to position the project within real-world design opportunities.

Methods

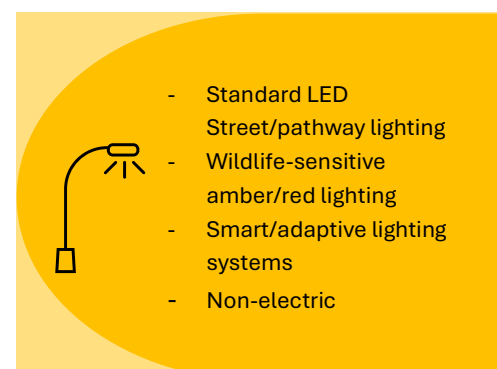
1. Secondary Research (Literature Review)

A targeted review of peer-reviewed studies and reputable reports was conducted to gather insights on ALAN and wildlife impacts. For example, (Gaston, K. J., Davies, T. W., Nedelec, S. L., & Holt, L. A. 2017), demonstrated that light pollution alters insect behaviour and reduces biodiversity, while Straka, T. M., Greif, S., Schultz, S., Goerlitz, H. R., & Voigt, C. C. (2020), noted disruptions to bat foraging patterns caused by white LED lighting. Reports from conservation agencies were also reviewed to understand best practices in wildlife-sensitive lighting (e.g., use of amber and red spectrums).

2. Benchmarking Analysis

A market scan of existing lighting products was carried out, focusing on:

This method allowed identification of strengths, weaknesses, and opportunities in the current market, which in turn helped shape the design direction for a bridge-specific solution.



3. Observational Research

Direct field observations were conducted at pedestrian bridge over three nights. Variables recorded included: number of people using the bridge, type of use (walking, cycling, social gathering), duration of stay, group sizes, and visible challenges (e.g., hesitancy when entering darker areas). Notes were also taken on lighting conditions, visibility of the surrounding environment, and the perceived safety of the crossing. This method was chosen because it provides authentic, real-time insights into how users behave in the environment without requiring direct intervention. This site was chosen as it has three bridges in close distance that can't be used at night time.

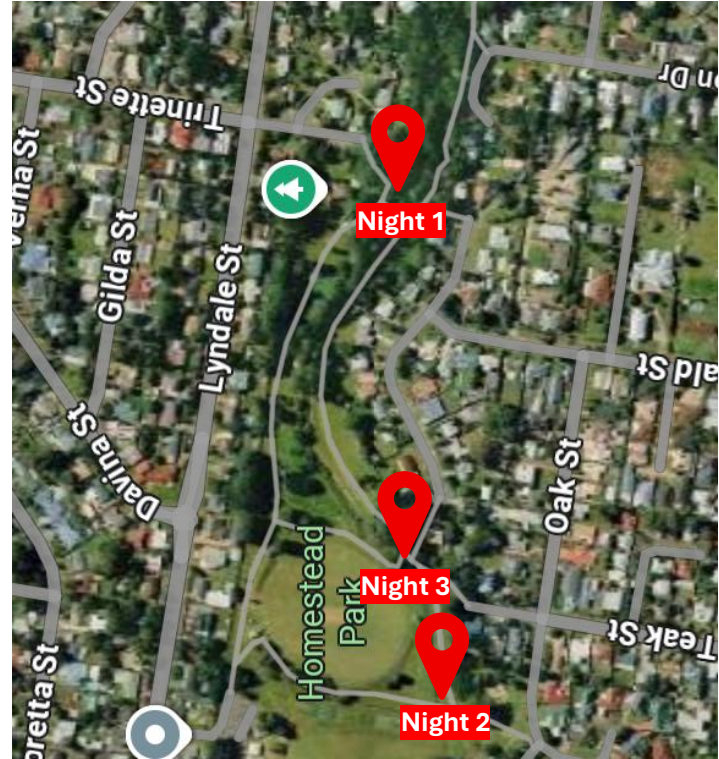


Figure 3: Site Map



Figure 4: Bridge 1 During Day Time



Figure 76: Bridge 2 During Day Time



Figure 87: Bridge 3 During Day Time



Figure 5: Bridge 1 During Night Time



Figure 10: Bridge 2 During Night Time



Figure 11: Bridge 3 During Night Time

4. Surveys

A short survey was distributed to local community members who regularly use pedestrian bridge. The survey included both closed and open-ended questions.

Surveys were chosen because they allow collection of broader perspectives and quantitative data that can be compared across different groups of users. The responses were analysed to identify common concerns, patterns in perceptions of safety, and preferred design solutions.



- "How safe do you feel using the bridge at night?" (scale rating)
- "What lighting features would make your experience more comfortable?"
- "Do you avoid using the bridge after dark, and if so, why?"

Why These Methods Were Chosen

These methods were selected because they balance practical, site-specific insights (from surveys and observations) with scientific rigor (through literature review) and market relevance (via benchmarking). Observational research ensures that the design responds to actual user behaviours, surveys capture user perceptions and needs, while the literature review ensures ecological considerations are evidence-based. Benchmarking ties the project to existing solutions, preventing redundancy and identifying innovation opportunities.

The research process combined observations, surveys, literature review, and benchmarking. This triangulated approach ensures that the final design recommendations will be credible, practical, and innovative, addressing both human and environmental needs. By grounding the project in lived experiences, community feedback, and scientific evidence, the research establishes a robust foundation for developing lighting solutions that improve safety and comfort for pedestrians while minimising ecological disruption.



Analysis & Findings

Introduction

The purpose of this section is to analyse the data collected through surveys, observations, and secondary research. The analysis focused on identifying key patterns in user behaviour, perceptions of safety, and environmental considerations relevant to lighting design. By integrating both quantitative and qualitative insights, this section highlights findings that directly inform the design opportunities for improving the Shailer Park pedestrian bridge at night.

Data Analysis Approach

The data was analysed using a combination of descriptive statistics (for survey results) and thematic analysis (for open ended survey responses and observation notes). Percentages and frequency counts were used to summarise quantitative data, while qualitative data was coded into themes such as safety, comfort, visibility, and wildlife awareness. Observational notes were cross-checked with survey responses to identify consistencies and contrasts between how people reported feeling and how they behaved in practice.

Results

Survey Findings:

A total of 18 survey responses were collected from local community members who use or have previously used pedestrian bridge at night.

Table 1: Key Survey Results

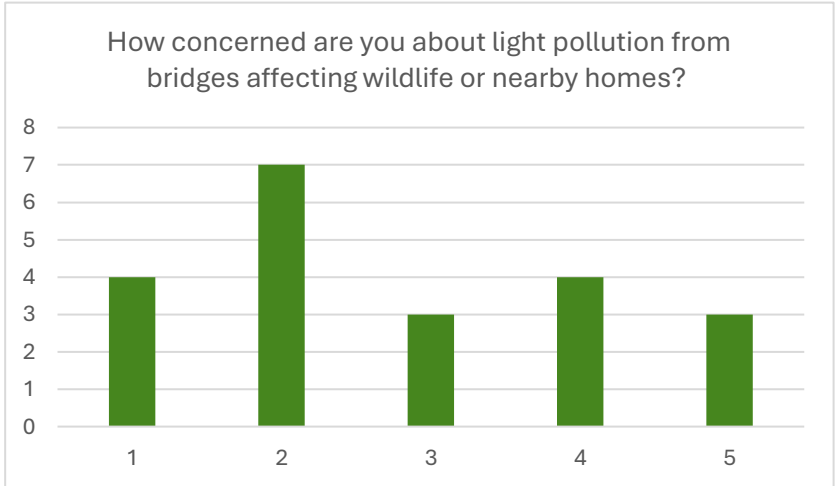
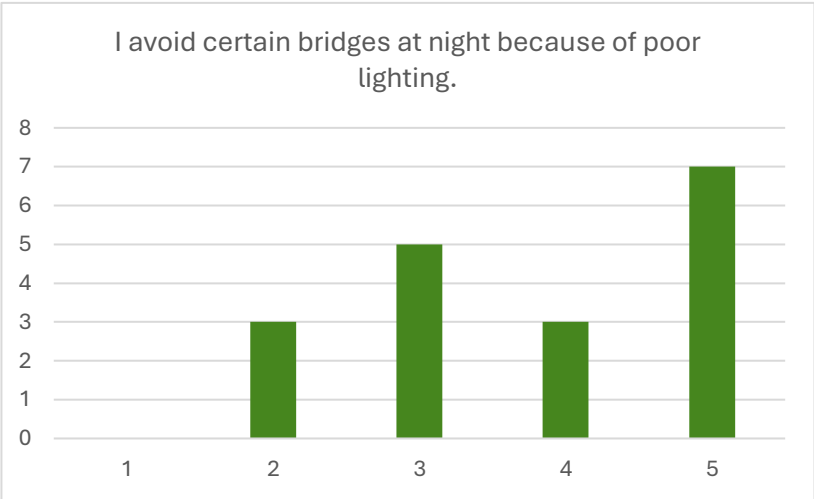
Key Insights:

- Majority of users feel unsafe, confirming need for improved lighting.
- Poor lighting significantly reduces bridge usage at night.
- Users’ preference for softer lighting that aligns with wildlife-friendly design.
- Strong support for energy-efficient, user-responsive solutions.

3

Main Themes

1. Desire for better visibility of steps and path edges.
2. Requests for wildlife-sensitive design, as many respondents expressed awareness of bats and possums in the area.
3. Interest in aesthetic improvements (e.g., lights that make the bridge feel more inviting, not just functional).



Observational Findings

Across three suburban evenings of observation, the bridge recorded low but steady use before sunset, followed by a sharp decline afterwards.



- Overall numbers: A total of 83 people crossed across the three nights, with most use concentrated before 7:00pm. After-dark activity was minimal, with fewer than 10 people observed in total across all nights.
- Cyclists' vs pedestrians: The majority of users were pedestrians (85–90%), often walking dogs or in pairs. Cyclists (10–15%) were few and generally crossed quickly without hesitation.
- Group vs solo use: In daylight, solo walkers and commuters were common. After sunset, most users travelled in pairs or small groups, with almost no solo crossings recorded.
- Lighting and hesitation: Multiple instances were observed of people pausing at the entrance before crossing or slowing in darker central sections. This behaviour was more common after sunset and among women.
- Atmosphere shift: Before sunset, the bridge felt social and communal, with families, recreational walkers, and dog owners. After dark, it became quiet, isolated, and cautious, with fewer users and shorter, more purposeful crossings.

Secondary Research Links

The survey and observational findings align with published studies on night-time bridge use and lighting impacts. For example, research by Mattsson, P., Johansson, M., Almén, M., Laike, T., Marcheschi, E., & Ståhl, A. (2020), found that poor lighting reduces pedestrian willingness to use infrastructure after dark, while Straka, T. M., Greif, S., Schultz, S., Goerlitz, H. R., & Voigt, C. C. (2020), emphasised that blue-rich white LEDs disrupt nocturnal species such as bats and insects. The community's preference for warm/amber lighting supports these ecological recommendations, suggesting a solution that benefits both people and wildlife.

Relevant Findings to Discuss

From the analysis, several key findings emerge:

- Safety and comfort are primary concerns: over 60% feel unsafe at night, directly discouraging bridge use.
- Lighting colour matters: community preference for amber aligns with ecological best practice, presenting a dual benefit.
- Adaptive lighting is strongly supported: the majority want dynamic, energy-saving systems that respond to presence.
- Individual vulnerability: people crossing alone often feel hesitant, highlighting a psychological as well as physical barrier.
- Usage patterns show underutilisation: the bridge is significantly less used after dark, limiting its value as community infrastructure.

Summary

The analysis demonstrates that current lighting conditions on pedestrian bridge reduce both actual usage and perceived safety at night. Surveys reveal a strong demand for warmer, wildlife-sensitive lighting and openness to adaptive smart systems, while observations confirm that poor visibility deters individuals from using the bridge alone. These findings form the foundation for targeted design solutions that enhance human experience while minimising ecological disruption.

Phase 3:

Discussion

The findings from this project reveal significant insights into how lighting design affects both human behaviour and wildlife around pedestrian infrastructure. The combination of survey and observational data confirms that lighting plays a critical role in determining whether individuals feel safe enough to use the space at night. Over 83.3% of survey respondents reported feeling unsafe on the bridge after dark, and observations showed sharp declines in usage after sunset, especially by individuals walking alone. These results closely align with existing literature, which emphasises that poorly lit environments reduce pedestrian mobility and discourage independent use of public spaces at night (Mattsson, P., Johansson, M., Almén, M., Laike, T., Marcheschi, E., & Ståhl, A. 2020).

An important theme emerging from this research is the preference for warmer, amber-toned lighting over bright white or blue-rich LEDs. This finding not only echoes ecological studies that show amber lighting reduces disruption to nocturnal species (Straka, T. M., Greif, S., Schultz, S., Goerlitz, H. R., & Voigt, C. C. (2020), but also challenges the prevailing assumption in some infrastructure projects that brighter equals safer. In fact, community responses highlight that visibility does not need to come at the expense of comfort or environmental sensitivity. This adds nuance to the existing body of research, which has primarily considered safety and ecology as competing priorities, by suggesting that they can be addressed simultaneously through thoughtful design.

The findings also reinforce the potential of adaptive, smart lighting systems. With 50% of respondents supportive of dynamic lighting that responds to presence, the data suggests that users are open to innovative technologies that not only improve safety but also conserve energy. This extends the literature on urban lighting by introducing a user-centred perspective, while much existing research highlights the environmental and energy benefits of adaptive systems. This study shows that communities themselves see value in responsive lighting as a solution to both safety concerns and ecological impact.

The combination of locally focused primary research and perspectives from secondary sources, this project helps fill the identified research gap around community informed, wildlife-sensitive bridge lighting. Previous studies have examined lighting impacts in either ecological or urban design contexts, but few have combined both with direct input from users of a specific site. Therefore contributes to a broader understanding of how lighting can be designed to balance human needs with ecological considerations.

Overall, the research highlights that effective lighting is not only about visibility but about creating a sense of comfort, inclusivity, and environmental responsibility. These insights will inform design recommendations that move beyond conventional solutions towards adaptive, community responsive, and ecologically sensitive lighting systems.

Design Implications

The research has shown clear implications for the design of lighting systems on pedestrian bridges. While traditional infrastructure projects often prioritise functional lighting for visibility, this research highlights that design must also address perceptions of safety, user comfort, and ecological responsibility. With existing solution that only maximises brightness, instead a lighting systems need to respond holistically to human and environmental needs.

Balancing Human and Ecological Needs

01

Overall, the community preference for warmer amber lighting over harsh white LEDs highlights an opportunity to adopt wildlife sensitive lighting without compromising on user comfort. Current products, such as low colour temperature LEDs already exist, but they are not widely integrated into public infrastructure. This suggests a design opportunity to normalise amber toned lighting in bridges and walkways where both people and nocturnal species are active. By using spectral tuning, designers can ensure that lighting supports pedestrian safety while minimising disruption to wildlife, addressing two key issues simultaneously.

Adaptive and Smart Lighting Systems

02

The high levels of user support for adaptive, motion-activated lighting create a strong design direction for future infrastructure. Traditional static lighting often results in energy inefficiency and unnecessary light spill into natural habitats. In contrast, responsive systems that brighten when a pedestrian or cyclist is detected can enhance perceptions of personal safety while also reducing overall energy use. Importantly, the research shows that people are not resistant to these innovations, rather they perceive them as modern and effective solutions. Designers should therefore prioritise integrating sensor based and programmable lighting systems into new projects, ensuring they remain flexible to different contexts.

Enhancing User Comfort and Wayfinding

03

The observational data revealed that many pedestrians avoid using the bridge after dark, often due to a perceived lack of safety. Design responses should therefore go beyond illumination levels and consider the psychological aspects of lighting. Consistent spacing of lights, reduced shadowed areas, and even distribution of illumination all contributes to a sense of security. In addition, integrating subtle wayfinding cues through lighting design, such as slightly brighter entry and exit points, or edge strip lighting to define pathways can improve navigational clarity and reduce anxiety for users crossing at night.

Summary

In summary, the research findings point towards three key design opportunities, wildlife-sensitive lighting using amber tones and spectral tuning, adaptive smart systems that enhance safety while conserving energy and human-centred lighting design that reduces shadows, improves wayfinding, and fosters comfort.

Together, these implications suggest that future bridge lighting systems should be dynamic, ecologically aware, and user informed. By adopting these principles, designers can transform bridges from underutilised, unsafe-feeling spaces at night into welcoming and sustainable parts of the urban environment.

Conclusion

This research project examined the use of pedestrian bridges at night, focusing on how lighting design influences safety, comfort, and environmental sustainability. Through surveys and observations, combined with a review of existing literature, the study identified key challenges, limited perceptions of safety, uneven lighting distribution, and potential ecological impacts on local wildlife. These findings aligned with current research showing that excessive artificial lighting can disrupt nocturnal species while also shaping human behaviour and sense of security.

Benchmarking of existing products revealed that while many technologies exist such as LED floodlights, solar bollards, and motion-activated systems most fail to balance human and ecological needs in a cohesive way. The analysis demonstrated a clear gap in the market for adaptive, wildlife sensitive lighting systems designed specifically for community infrastructure like pedestrian bridges.

The project's findings carry important design implications. Users strongly preferred amber toned lighting and adaptive systems that respond to human presence, while also valuing even distribution to reduce shadows and improve wayfinding. These insights suggest future lighting solutions should prioritise wildlife friendly spectral design, adaptive smart systems, and human-centred safety features.

In summary, this research contributes to the growing conversation on sustainable urban lighting by demonstrating that well designed bridge lighting can simultaneously improve user safety, reduce ecological harm, and foster community engagement. By applying these insights, designers can transform underutilised pedestrian bridges at night into safe, inviting, and ecologically responsible public spaces.



References

- Brigagliano, J. (2025, April 03). *DarkSky Approved products*. Retrieved from Dark Sky: <https://darksky.org/what-we-do/darksky-approved/darksky-approved-luminaires-program/luminaires/>
- Council, B. R. (2015). Retrieved from Reducing urban glow: <https://www.bundaberg.qld.gov.au/Environment/Reducing-urban-glow>
- Dominoni, D., Quetting, M., & Partecke, J. (2013). Artificial light at night advances avian reproductive physiology. *Proceedings of the Royal Society B: Biological Sciences*, 280(1756), 20123017.
- Gaston, K. J., Davies, T. W., Nedelec, S. L., & Holt, L. A. (2017). Impacts of artificial light at night on biological timings. *Annual Review of Ecology, Evolution, and Systematics*, 48(1), 49-68.
- Gomes, E., Lemaître, J. F., Rodriguez-Rada, V., Débias, F., Desouhant, E., & Amat, I. (2024). Foraging at night under artificial light: impacts on senescence and lifetime reproductive success for a diurnal insect. *Animal Behaviour*, 210, 85-98.
- Grubisic, M., & van Grunsven, R. H. (2021). Artificial light at night disrupts species interactions and changes insect communities. *Current Opinion in Insect Science*, 47, 136-141.
- Harrington, K. (2025). *Glow Path*. Retrieved from About Glow Path Technology: <https://glowpathtechology.com/about/>
- Mattsson, P., Johansson, M., Almén, M., Laike, T., Marcheschi, E., & Ståhl, A. (2020). Improved usability of pedestrian environments after dark for people with vision impairment: An intervention study. *Sustainability*, 12(3), 1096.
- Mushtaha, E., Hussien, A. A., Arar, M., Salleh, S. A., Mohammad, A., Masoud, W., ... & Almubyedh, H. (2022). Artificial lighting systems and the perception of safety in underpass tunnels. *Tunnelling and Underground Space Technology*, 122, 104376.
- Raap, T., Pinxten, R., & Eens, M. (2015). Light pollution disrupts sleep in free-living animals. *Scientific reports*, 5(1), 13557.
- Schreder. (2025). *What we do*. Retrieved from Schreder: <https://au.schreder.com/en/what-we-do>
- Straka, T. M., Greif, S., Schultz, S., Goerlitz, H. R., & Voigt, C. C. (2020). The effect of cave illumination on bats. *Global Ecology and Conservation*, 21, e00808.
- Willmott, N. J., Black, J. R., McNamara, K. B., Wong, B. B., & Jones, T. M. (2024). The effects of artificial light at night on spider brains. *Biology Letters*, 20(9), 20240202.

Appendix A: Observations

Observation Night 1 (5:00–9:00pm)

Conditions: Clear evening, mild temperature. Sunset approx. 5:30pm.

5:00 - 6:00pm

- 18 people crossed.
- Cyclists 15%, pedestrians 85%.
- Mix of commuters and a few joggers.
- Atmosphere relaxed, no hesitation observed.
- One cyclists

6:00 - 7:00pm

- 10 people.
- Some pedestrians paused briefly to talk or check phones.
- Lighting began to make darker sections more obvious.
- 3 people walking dogs

7:00 - 8:00pm

- 2 people.
- 60% pairs/groups, 40% solo.
- Two pedestrians paused at entrance before committing to cross.

8:00 - 9:00pm

- Very quiet: 0 people total.

Observation Night 2 (4:00–8:00pm)

Conditions: Overcast evening, cooler. Sunset approx. 5:20pm.

4:00 - 5:00pm

- 14 people.
- Walking with dog 40%, No Dog 60%.
- Mainly commuters, plus a family with children.
- Social atmosphere while still light.

5:00 – 6:00

- 10 people.
- Walking with dog 50%, No Dog 50%.
- Several walkers slowed to chat or take photos before sunset.
- Atmosphere calm, communal.
- One cyclist

6:00–7:00pm

- 7 people.
- 70% pairs/groups, 30% solo.
- Pedestrians slowed in unlit centre, one stopped briefly before continuing.

7:00 – 8:00

- 4 people.
- All in groups or pairs, no solo walkers.
- 2 walking dogs
- One pair paused at entry, glancing back before crossing.
- Bridge felt isolated and quiet.

Observation Night 3 (4:00–7:00pm)

Conditions: Cooler night with light wind. Sunset approx. 5:30pm.

4:00-5:00

- 10 people.
- Without Dogs 30%, With Dogs 70%.
- Quiet but steady flow.

5:00–6:00pm

- 13 people.
- Without Dogs 40%, With Dogs 60%.
- Some recreational walkers taking photos at sunset.
- Bridge felt social and active.
- One cyclists

6:00–7:00pm

- 6 people.
- 70% groups, 30% solo.
- 2 people with dogs
- Two women hesitated at entrance, one waited until joined by another.
- Pedestrians slowed in darker sections

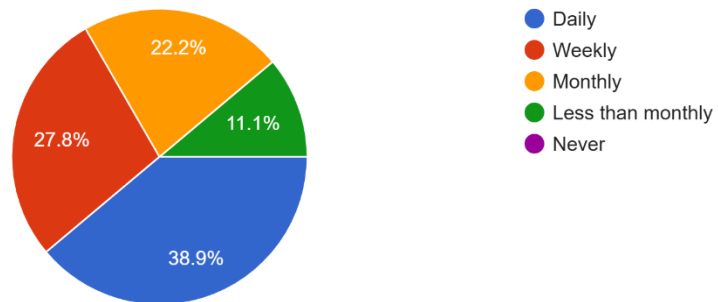
7:00–8:00pm

- 3 people.
- Two in a pair, one solo
- Pedestrians cautious, walking quickly and looking around.
- Strong sense of isolation, little ambient activity.

Appendix B: Survey

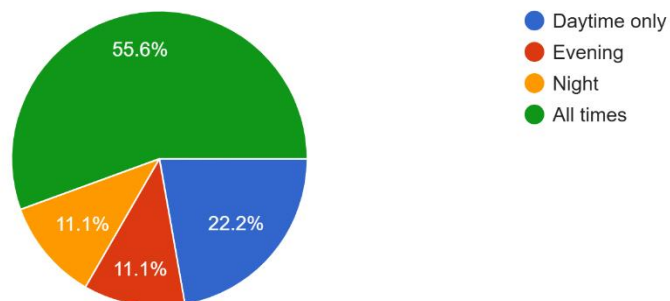
How often do you use pedestrian bridges?

18 responses



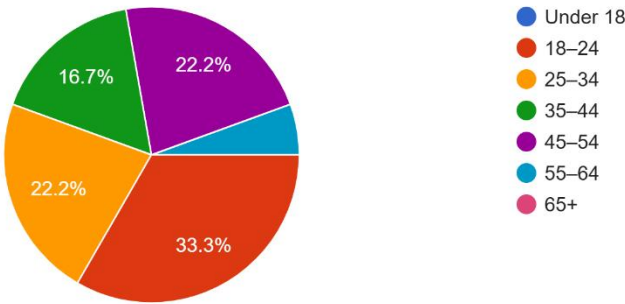
At what times do you usually cross pedestrian bridges?

18 responses



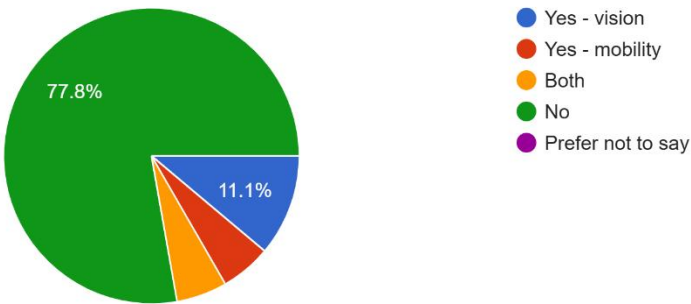
What is your age group?

18 responses



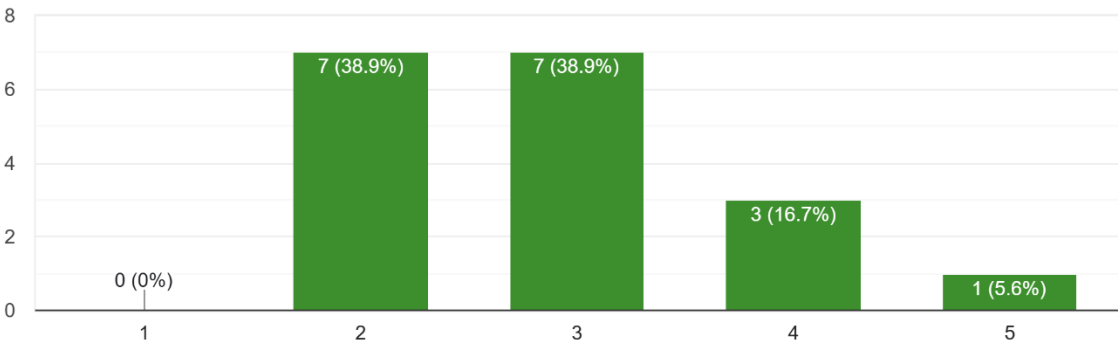
Do you have any vision or mobility impairments that affect your use of bridges?

18 responses



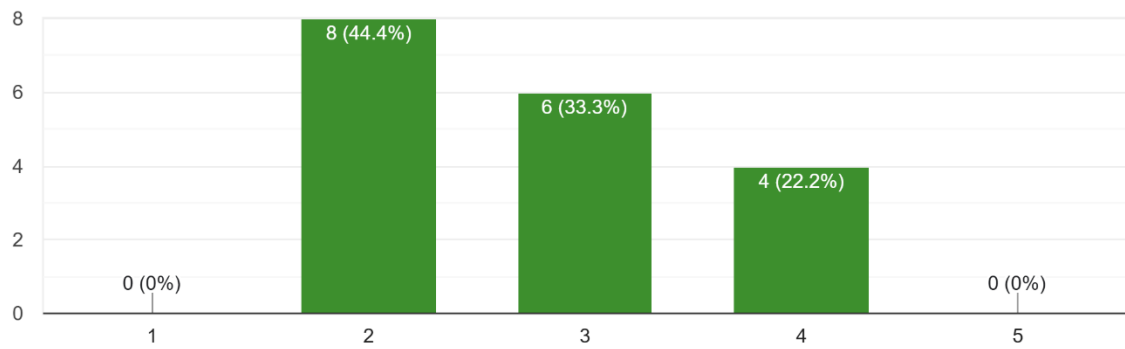
The lighting on pedestrian bridges I use is bright enough to see clearly at night.

18 responses



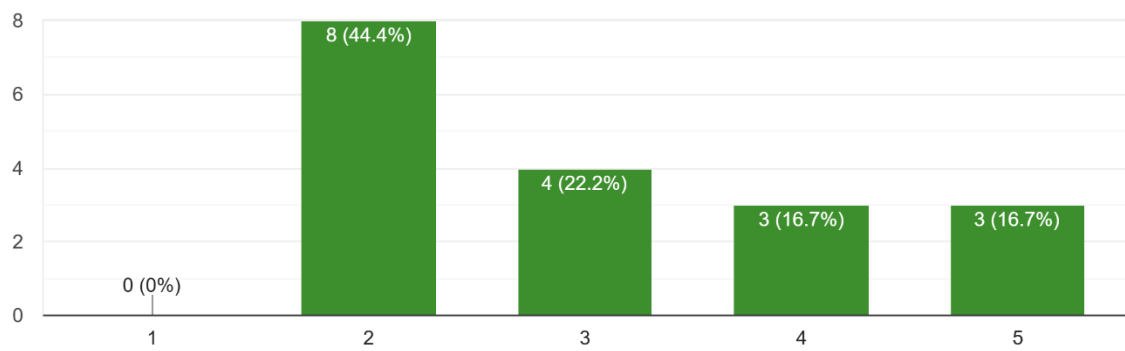
The lighting makes me feel safe from crime when crossing.

18 responses



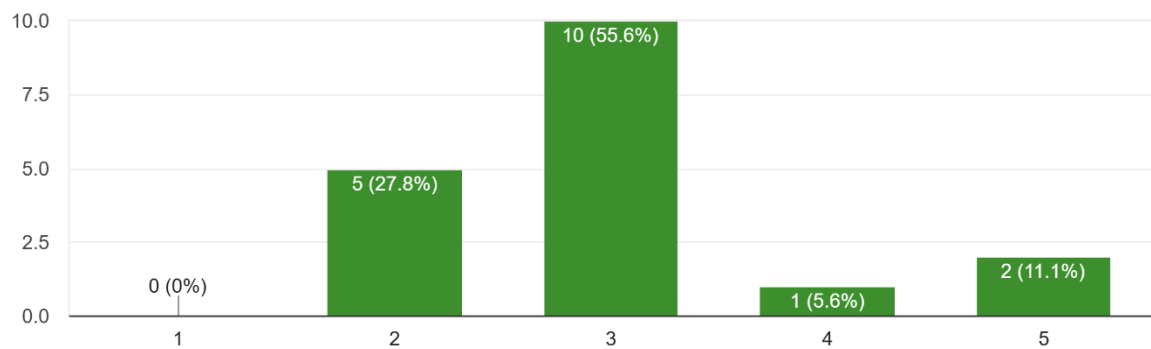
The lighting makes me feel safe from tripping or falling hazards.

18 responses



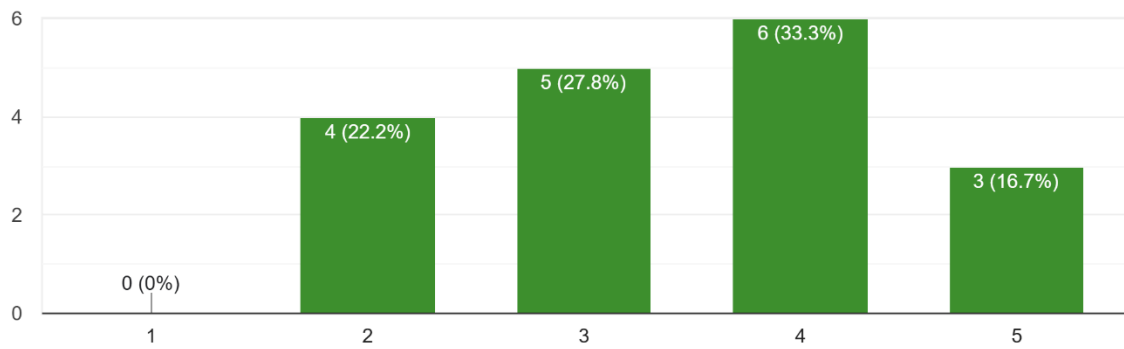
Lighting is evenly distributed along the bridge (no overly dark or overly bright spots).

18 responses



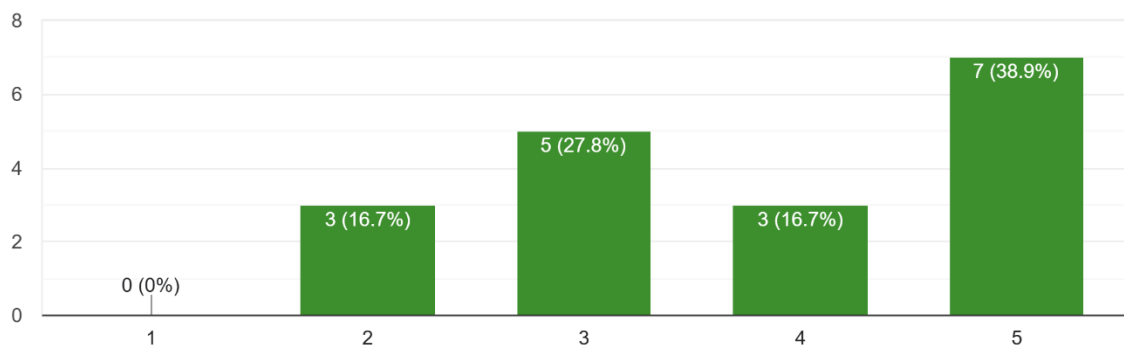
The lighting is comfortable for my eyes (not glaring or blinding).

18 responses



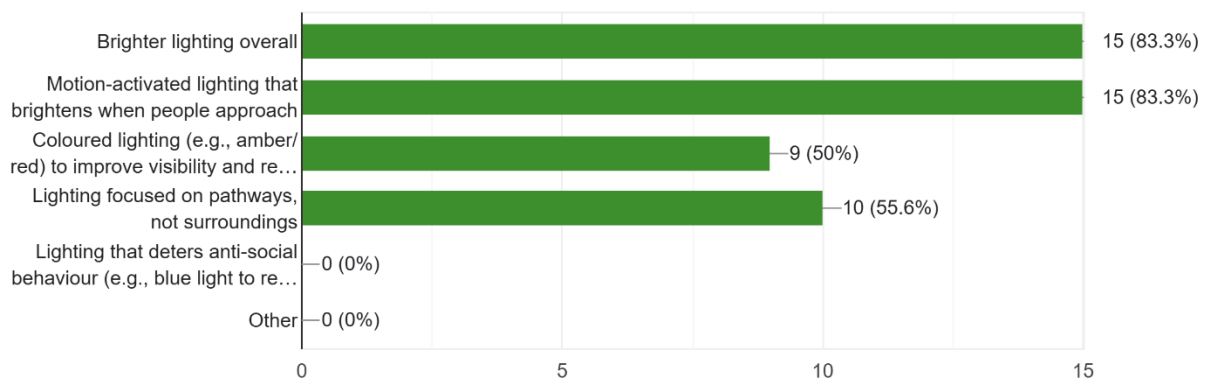
I avoid certain bridges at night because of poor lighting.

18 responses



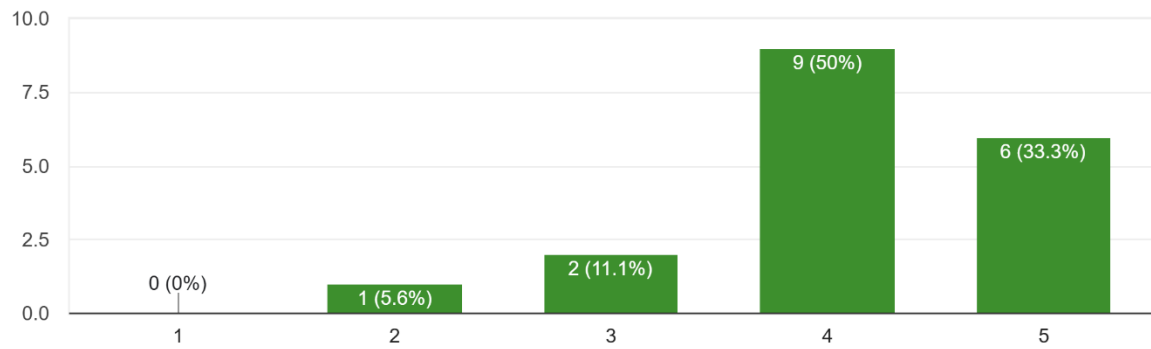
Which lighting features would make you feel safer? (Select up to 3)

18 responses



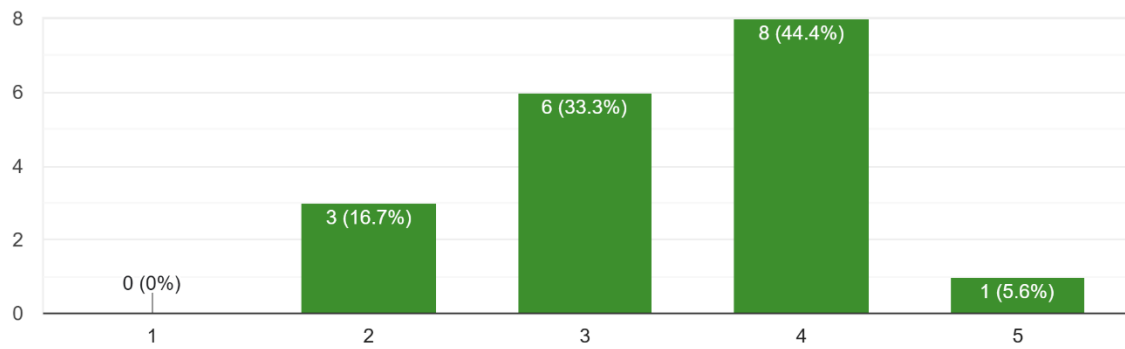
How important is lighting in your decision to use a bridge at night?

18 responses



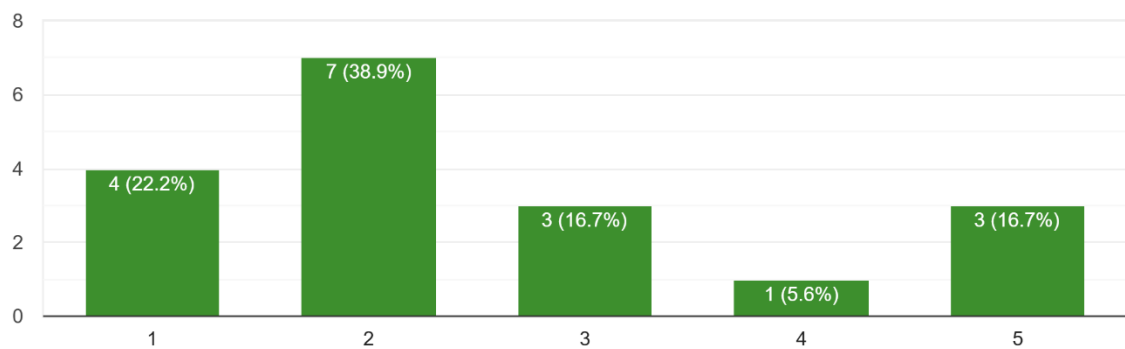
I would benefit from lighting that changes brightness or colour based on conditions (e.g., fog, rain)

18 responses



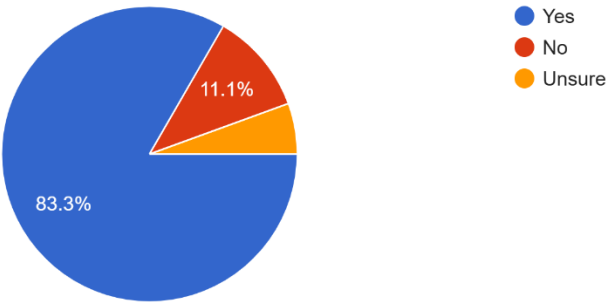
How concerned are you about light pollution from bridges affecting wildlife or nearby homes?

18 responses



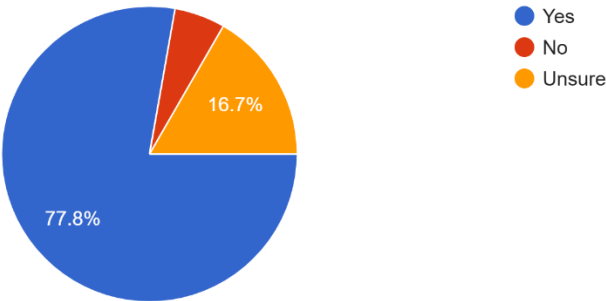
Would you support smart lighting systems that adjust brightness automatically based on pedestrian presence?

18 responses



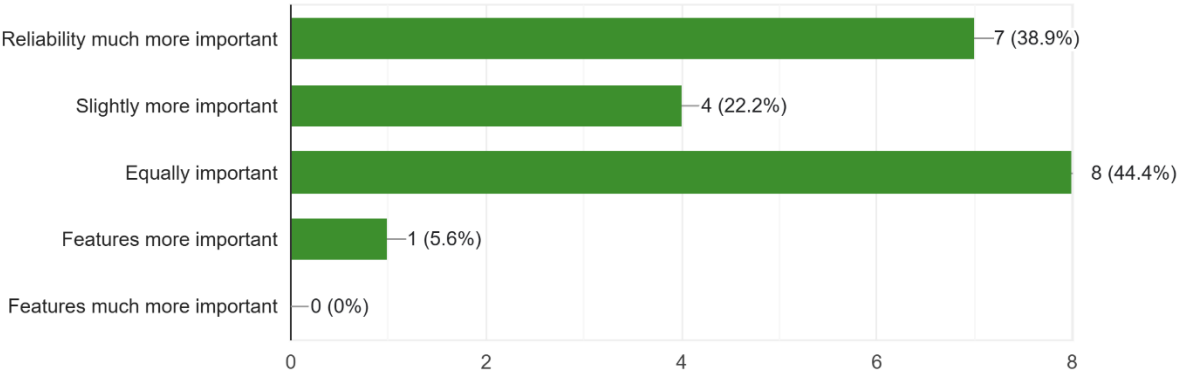
Would you feel more comfortable knowing lighting is linked to security cameras or emergency systems?

18 responses



How important is reliability (lights always working) compared to advanced features (e.g., colour-changing, sensors)?

18 responses



What's one improvement you'd like to see in bridge lighting?

11 responses

- Not sure
- Lights
- Able to see the bridge at night
- More light
- More light - able to see where bridge starts and ends
- Wild life design
- Better and more leading up to and moving away from the bridge so the entry and exit points
- ash
- Lights working during night time

Any other comments or suggestions about bridge lighting?

10 responses

- NA
- N/A
- Na
- No
- A light in the middle of the bridge?
- Aesthetic
- Love the aesthetic needs to be more practical
- ash