Toulouse
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Statement of Michael Marc Simpson

Wednesday, 25th March 2026

Contents

Current position

1. My full name is Michael Marc Simpson. I'm referred to in life as Marc Simpson.

2. I am the Managing Director or Toulouse Limited, A lighting design and technology integration company based in Wellington. My expertise is in lighting design, an industry that I have specialised in for over 40 years.

3. I have been requested to support the Sustainable Tarras group to support an on-site lighting trial at the Bendigo-Ophir Gold Project location on the hills of central Otago.

4. Qualification and Experience. My relevant experience includes but is not limited too

   4.1. Expert witness in a logging death court case. In this case, I conducted site trials with tower lights to ascertain the level of illumination that may be required to illuminate a skid site in a forest, where logging sorting and tree processing activities were carried out.

   4.2. Architectural lighting design, museum, gallery and visitor attraction lighting design and implementation in New Zealand, and internationally. Outdoor lighting - I have illuminated large format buildings and theatrical sculptures for large public events and spaces.

   4.3. Theatrical lighting design, this has included design, as well as the physical installation of large and complex lighting systems for large scale productions in both theatre and outdoor environments.

5. I acknowledge that I have read and am familiar with the Environment Court's Code of Conduct for Expert Witnesses, contained in the Environment Court Practice Note 2023, and agree to comply with it.

Preamble

6. This report is structured in three parts.

7. The first part presents the findings of a lighting simulation undertaken to replicate mining operations at the Bendigo–Ophir Gold Project in Central Otago and evaluate their potential effects on the night sky within Outstanding Natural Landscape (ONL).

8. The second part of this report focuses on simulating lighting associated with fixed infrastructure, including buildings and operational plant as well as the suggested temporary tower lights suggested under the Cosgroves Engineering (Lighting) Report.

9. The third part provides an assessment and critique of the Cosgroves Engineering (Lighting) Report.

Lighting trial

10. A two-pronged approach was adopted for the lighting trial.

11. Part one involved simulating active and mobile mining operations using vehicle-mounted lighting. The on-site team installed theatrical lighting fixtures onto four-wheel-drive vehicles to approximate the operational lighting conditions of a large-scale excavator operating on the distant hills.

12. Part two involved the use of lighting towers to simulate illumination from fixed infrastructure, including buildings and operational plant, as well as the temporary tower lighting proposed in the Cosgroves Engineering (Lighting) Report.

13. NOTE: Lighting levels are measured in Lux. Lux (symbol: lx) is a unit that measures how bright light is on a specific surface, known as "illuminance." It tells you how much light is falling on a given area—typically one lumen per square metre. It measures usable light, and is a calculation of illuminance at a distance.

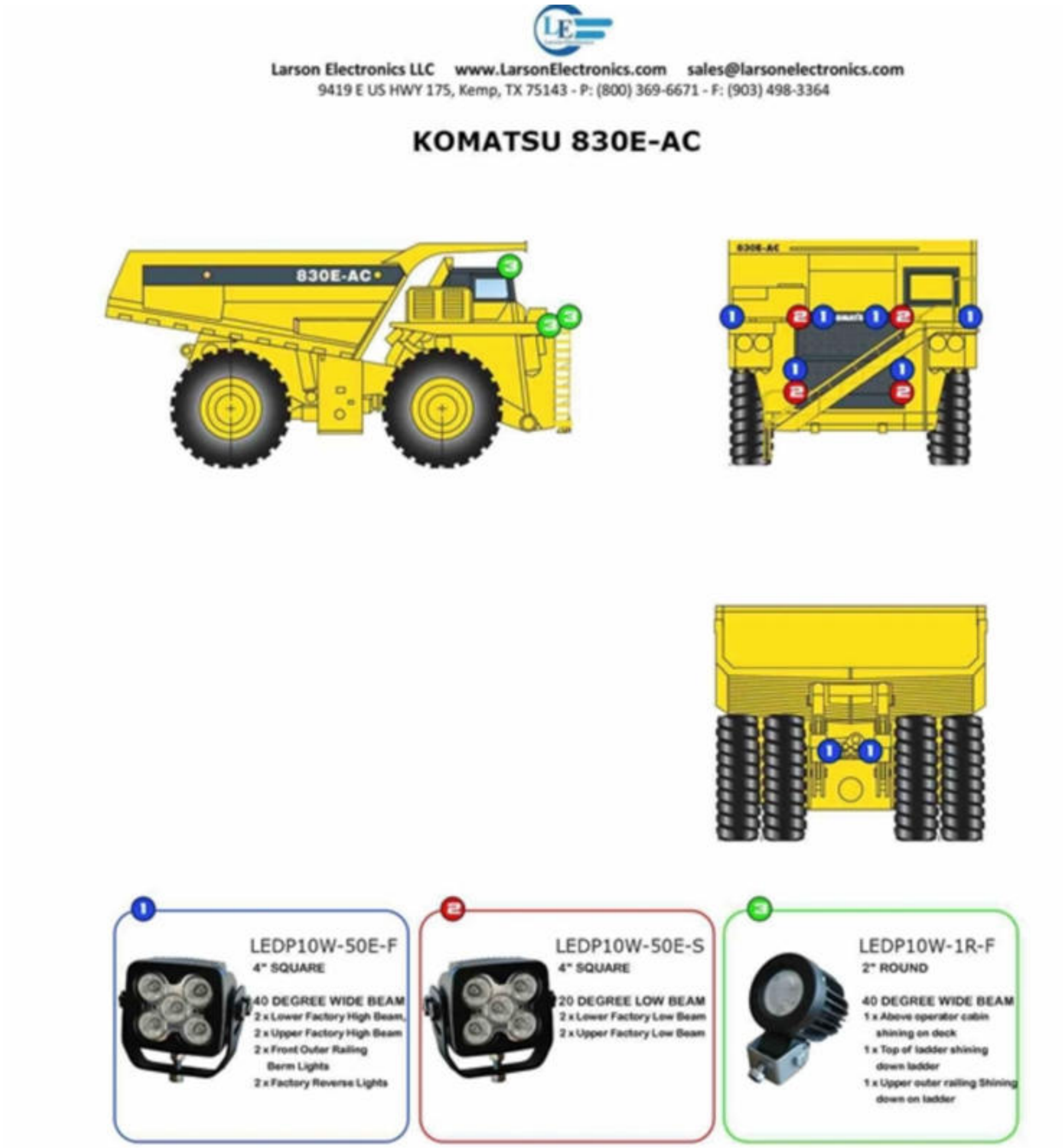
Dump truck lighting

15. The expected lighting output of a large-format dump truck was benchmarked using specifications sourced from Larson Electronics, an international supplier of auxiliary lighting systems for heavy machinery. Their published data provided a sufficient and credible basis to inform and calibrate the physical simulation.

16. Image 1. below shows lights and excavator - Larson Electronics website

17. Suggested placement of lights on the vehicle, as recommended by Larson Electronics, is shown in this visual. There would be six forward-facing wide beam lights and four forward-facing narrow beam lights mounted to the front of the vehicle.

19. Image 2. below showing lights placement on an excavator - Larson Electronics



20. Larson Electronics suggest a light output from each light as follows;
    Flood Beam: Lux @1 meter= 8,950lux @3 meters= 1,225 lux
    Spot Beam: Lux @1 meter= 13,750lux @3 meters= 1,850 lux

21. With six floodlights and four spotlights directed forward from a dump truck, the expected combined illuminance at a distance of three metres is approximately 14,150 lux. These luminaires would typically be arranged to project light in a fan-shaped distribution across the operator's immediate working area. The wide beam fixtures would be focused to illuminate the near working area and the narrow fixtures would be focused into the far distance, almost horizontally, to capture approaching hazards or vehicles.

LED PAR lights

22. Theatrical Par light workshop test = Centre of beam at three metres was recorded at 4790 lux.

23. Note the same light meter was used on site during the trials.

Image 3

Image 4

Image 5

24. The image below shows an ambient light level reading in the testing workshop = 7 lux

Image 6

25. The controlled testing demonstrated that the two LED PAR units per vehicle used in the field simulation produced illuminance levels well under the comparable range to those specified by Larson Electronics for heavy machinery auxiliary lighting, when adjusted for beam type and orientation. With a reasonable level of confidence, we believe that mounting and testing with two

lights off the rear of the vehicles was a substantial underrepresentation of the lighting levels, beam angles and coverage of the forward-facing lighting arrays that are likely to be installed on large-scale excavators in a busy 24/7 mining operation.

26. The lighting used in the simulation was significantly less powerful than the full cluster of lights that may be typically installed on a dump truck. As a result, the trial represented only a small fraction of the lighting levels expected under actual operational conditions. When comparing the calculated output of a dump truck lighting system with the measured output of the theatrical PAR lights used in the trial, it is clear that the PAR units provide substantially lower illuminance. Even after accounting for real-world factors that may reduce dump truck lighting performance—such as dirty or worn lenses, misalignment, dust, and general maintenance degradation—the lighting used in active mining operations would still produce output levels well above those achieved in the simulation.

27. Furthermore, the trial isolated primary forward-facing work area lighting and did not account for supplementary light sources that are commonly present in active mining environments -such as vehicle headlights, rear facing lighting as outlined in the above package or ancillary vehicle lighting. As such, even when considering degradation of all lighting over time, the simulation should be considered conservative in terms of overall cumulative light spill from vehicles.

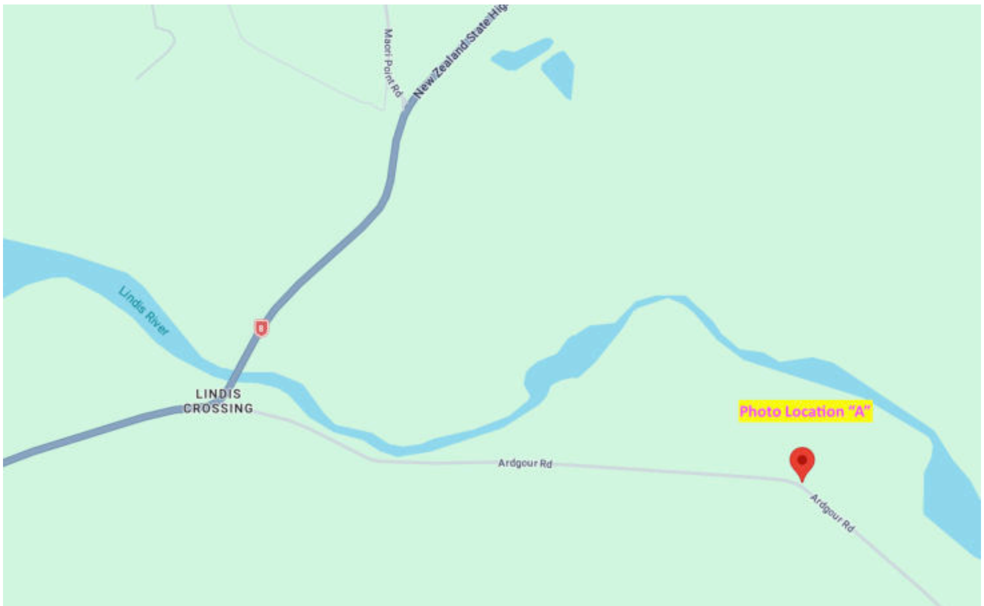
Field testing

28. Observers were stationed at distance of approximately 6.46 kilometres to evaluate the visual impact of these lighting conditions on both the night sky and the broader landscape. The vehicle was then driven around tracks in proximity to the proposed mine location to replicate typical operational movement.

29. Viewing conditions assessed by the naked eye indicated a clear and substantial disruption to both the night sky and the surrounding terrain. Accurately capturing these effects using standard photographic equipment is inherently challenging. Moreover, the human eye and camera sensors respond differently under low-light conditions: the eye adapts through scotopic and mesopic vision, allowing it to perceive subtle variations in low-contrast environments that cameras typically fail to replicate without long exposures or specialised settings. As a result, the level of light pollution observed during field testing can be reliably assessed only in situ by an observer on the ground.

30. Image 7. Below - Google map view showing distance from lights to viewing point - Photo location "A" and testing location "C" a distance of approximately 6.46km

31. Image 8 below is a screen grab from Google maps. Showing the photo location point on Ardgour Road, Lindis crossing – Referred to as photo location “A”



32. Image 9. below is taken from photo location “A” looking towards testing location “C” showing the lighting tower to the left and the dump truck simulation to the right. This image was taken with Canon EOS 1200D camera, Lens EF-S18-55mm, - f/5.6, 20 sec exposure with focal length 55mm.

33. Image 10. below is a zoomed in and cropped section of the above image, showing a close up of the testing location “C”

34. Image 11. Below is a screen grab from Google maps shows testing location “C”

35. These measurements and assumptions underpin the validity of the field observations, providing a quantified basis for assessing the visual and environmental effects recorded by observers during the trial.

36. Image 12. below is of Doug Braithwaite holding a light meter reading Lux levels. The light sensor is facing the light tower at a distance of 10 metres. The tower has been extended to 6 metres in height in a similar manner to photo 17 below. The below reading is 84 Lux, this is from one tower, with all four lights fanned out over a 180’ field.

37. Image 13. below is of Doug Braithwaite holding a Lux meter. The light sensor is facing the lighting tower at a distance of 3 metres. The tower has been extended to 6 metres in height in a similar manner to photo 17 below. The reading is 189 Lux from one tower, with all four lights fanned out over a 180’ field.

38. Image 14. below shows the impact of truck and tower lights in action on the hillside. Viewing from Thompsons George Road, looking towards the simulated dump truck lights that are facing the camera in the centre of frame – Taken adjacent to a light tower.

39. Image 15. below – Taken from a driver in a truck showing impact of tower lights in action on the hillside from Thompsons George Road looking towards the hill summit. Camera - Sony ILCE-7SM2 16-35mm F2.8, exposure 6 sec.

Part Two – Building, plant and temporary construction lighting

40. The second component of the on-site assessment focused on simulating lighting associated with fixed infrastructure including buildings and operational plant, as well as the temporary tower lights suggested in the Cosgroves Engineering (Lighting) Report. To replicate these conditions, two mobile generator-powered lighting towers were deployed on site.

41. The two lighting towers were elevated to a height of approximately six to eight metres to reflect the range of typical installation heights for temporary and semi-permanent site works and industrial lighting.

42. The towers were used to simulate two lighting scenarios

    42.1. Building and yard illumination – ongoing

    42.2. B. Construction works - temporary

Image 16 below - Generac-vt-hybrid lighting towers

43. The hired Generac-vt-hybrid lighting towers operate four LED light heads. The manufacturer's specification suggests four 150 watt LED luminaires are fitted to each tower at an observed colour temperature of between 4000K and 6000K - often referred to as cool white colour temperature.

44. The light heads and tower mast can be oriented in multiple directions, providing operational flexibility and allowing the lighting to be configured according to site requirements. When new, each tower produces an output of approximately 61,000 lumens. In its standard configuration, with all four light heads arranged to provide uniform circular coverage, the system is designed to illuminate an area of approximately 2,500 square metres in a full 360-degree distribution around the tower. This configuration is intended to achieve an average ground-level illuminance of 5 lux.

45. Image 17 below is of a lighting tower with all four lights facing a single direction, at the DOC - Come In Time battery, with DOC sign with Thompson George road. Camera - Sony ILCE-7SM2 16-35mm F2.8 exposure 1/5

46. Image 18 below is a single lighting tower illuminating distant hills, the location is adjacent to the Come In Time battery - looking north west towards Queensbury and Lugget Thompson George road to the left of frame - Camera - Sony ILCE-7SM2 16-35mm F2.8, exposure 4sec

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Building lighting

47. To simulate the potential night-sky effects associated with permanent building-mounted floodlighting, the same lighting towers were deployed in a range of orientations. For reference, each of the four light heads on the tower produces an output comparable to that of a 150-watt commercial or industrial floodlight typically used for industrial building, car parks or yard illumination.

48. Image 19 below showing a light fitting with similar light output as each of the four light heads on the light towers tested

A. Building and yard illumination

49. To simulate the effects of permanent building and yard lighting, the tower-mounted luminaires were oriented toward the hillside to reflect typical illumination practices for storage areas, car parks, and locations where vehicle and pedestrian movement is anticipated. In operational settings, it is common for such areas to be lit using multiple low-cost, commercially available floodlights, similar to the unit referenced above. It's important to note that while the Cosgroves Engineering Report specifies the use of luminaires with a zero Upward Waste Light Ratio (UWLR), such fittings are not generally stocked by standard electrical wholesalers, and are typically significantly more expensive than the widely used 150-watt LED floodlights that are commonly installed in comparable environments. As a result, reliance on UWLR-rated fittings may not represent a realistic or economically practical outcome for the proposed site.

B. Construction works

50. The tower lights were also used to test construction illumination in multiple orientations, as would be utilised during temporary fabrication of the mines mechanical plant systems, e.g., fabrication of the crushing and grinding sites, waste rock and tailings transportation and conveyers systems, treatment plants, dangerous goods storage and delivery facilities and general health and safety, and nighttime security during construction.

51. The tower-based floodlights were tested under two primary orientations:

    51.1. Directed outward toward the valley; and

    51.2. Directed inward toward the adjacent hillside and within the immediate testing area.

52. Observations were again undertaken from near the lights' sources, looking toward the Come In Time Battery on the Thompson George road, at distances of up to approximately 10 kilometres. Under both orientations, a noticeable level of direct and reflected illumination was visible, contributing to discernible changes in both the perceived brightness of the landscape, and to he ambient night sky. It is reasonable to infer that, with the addition of further plant, expanded building infrastructure and increased lighting density, the cumulative effect would result in a proportional increase in skyglow.

53. Image 20 Light tower onsite during testing

Author's Assessment of the Cosgroves Engineering (Lighting) Report

District plan mandatory lighting requirements

54. The September 2025 report, prepared by Cosgroves for Matakanui Gold Ltd (Reference: CQ24020), evaluates the exterior lighting requirements and potential environmental effects for the proposed Bendigo–Ophir Gold Project in Central Otago. Its central conclusion is that the project will comply with the District Plan's only mandatory lighting requirement: spill light must not exceed 10 lux at property boundaries. As the report states: "The current mandatory requirements for compliance with the District Plan relate only to light spill limits, which will be achieved…".

55. The purpose of the report is to support the project's Resource Consent application by assessing lighting impacts and proposing mitigation. The report outlines that lighting is required for safety and operation of mining, processing, and infrastructure areas and that ongoing lighting (building based and mobile towers) will be associated with 24/7 mining operations.

Mitigation

56. Cosgroves have suggested mitigation measures such as

    56.1. Use of luminaires with zero upward waste light ratio (UWLR).

    56.2. Motion sensors and limited night operation in non-24/7 areas.

    56.3. Mobile lighting aimed inward and used only in active work areas.

    56.4. Use of 3000K colour temperature to reduce ecological impacts.

    56.5. Shielding and directional control to reduce sky glow and glare.

Ecological considerations

57. Sensitive areas (e.g., Cushionfields) identified; lighting will be directed away from them.

58. Cosgroves determine this measure aligns with ecological reports on avifauna and invertebrates.

Compliance

59. District Plan spill limits will be met through modelling.

    59.1. Dark Sky Reserve standards are not mandatory but used as guidance "as far as reasonably practicable."

    59.2. AS/NZS 4282:2023 will inform design but is not a compliance requirement.

60. Lighting visibility will change over the mine's life as pits deepen and engineered landforms rise, shielding more light.

Adequacy, completeness, and reliability

61. The author challenges the adequacy, completeness, and reliability of the Cosgroves exterior lighting assessment for the Bendigo–Ophir Gold Project. While the report asserts compliance with District Plan spill-light limits and proposes mitigation measures, it underestimates the scale of lighting effects, overstates the effectiveness of mitigation, and fails to fully assess cumulative, ecological, and landscape impacts. Several conclusions rely on assumptions rather than quantitative evidence, and key uncertainties remain unresolved.

Key issues identified

62. Over-reliance on non-mandatory standards without demonstrating outcomes

    62.1. The report repeatedly references Dark Sky Reserve standards and AS/NZS 4282:2023, but does not demonstrate actual compliance. Instead, it states these will be met "as far as reasonably practicable," which is vague and unenforceable.

63. Lack of Quantitative Modelling

    63.1. The report defers all modelling to future design stages. This means:

    63.2. No spill-light calculations are provided.

    63.3. No sky-glow modelling is included.

    63.4. No cumulative lighting impact assessment is presented.

    63.5. This is a major gap: I consider that information is necessary for a robust assessment of effects, and cannot be deferred to future modelling.

64. Underestimation of mobile lighting impacts

64.1. Mobile lighting towers are among the most obtrusive sources in mining operations. The report acknowledges 10 – 15 towers during construction and 8 – 10 during operations, yet provides:

64.1.1. No photometric modelling

64.1.2. No assessment of tower height, aiming angles, or lumen output, and

64.1.3. No analysis of worst-case scenarios (e.g., fog, snow, reflective surfaces)

65. The claim that mobile lighting will be "aimed inward" is not a mitigation unless supported by enforceable installation standards. It is noted by the author that no lighting towers are available on the market with 3000K warm white light sources, it seems unlikely that towers would be custom manufactured or retrofitted with such luminaires to achieve the above suggested approach to light pollution.

66. Ecological Impacts Are Minimised Without Evidence

66.1. The report states that 3000K lighting will be used "generally," but allows exceptions for operational tasks. These exceptions could be frequent and significant. Sensitive ecological areas (e.g., Cushionfields) are close to mining zones, yet no modelling is provided to show:

66.1.1. Light levels at habitat boundaries

66.1.2. Impacts on nocturnal invertebrates

66.1.3. Effects on avifauna behaviour or migration

66.1.4. The ecological mitigation is conceptual, not demonstrated.

67. Landscape and Visual Effects Are Under-Assessed

67.1. The report relies on a landscape assessment that did not evaluate lighting. Lighting visibility is discussed qualitatively, but:

67.1.1. No night-time simulations are provided

67.1.2. No assessment of glow dome effects

67.1.3. No evaluation of cumulative visibility from multiple pits, haul roads, and plant areas.

67.1.4. Given the project's scale and elevation, night-time visibility is likely to be substantial.

68. Assumption that engineered landforms will shield lighting

68.1. The report claims that landforms (ELF, WELF) will progressively shield lighting. However:

68.1.1. These landforms take years to build.

68.1.2. Lighting impacts occur from day one.

68.1.3. Shielding effectiveness is not modelled.

68.1.4. Early-stage impacts are likely the worst, yet are not assessed.

68.1.5. This is a critical omission.

Alternative conclusions

69. Based on the gaps identified, a more accurate conclusion would be:

69.1. Lighting effects remain uncertain and potentially significant.

69.2. The project cannot yet demonstrate compliance with District Plan spill limits.

69.3. Suitable luminaires and spares are unlikely to be readily available.

69.4. Ecological and landscape effects may be greater than reported.

69.5. Vehicle lighting is not adequately assessed or reported upon.

69.6. Mitigation measures are conceptual and lack enforceable detail.

69.7. Further modelling, night-time simulations, and ecological assessments are required before effects can be properly understood.

Recommendations

70. Provide full photometric modelling for all fixed and mobile lighting.

    70.1. Undertake night-time visual simulations from key viewpoints.

    70.2. Model ecological light exposure for sensitive habitats.

    70.3. Develop enforceable lighting installation standards, not general intentions.

    70.4. Assess cumulative effects across all operational areas and project stages.

    70.5. Re-evaluate compliance once quantitative evidence is available.

Conclusions - from night time lighting trials

71. The findings of this simulation on the hills of Bendigo strongly indicate that mining operations at the proposed site will generate significant, repeated and far-reaching light pollution, even under the very conservative testing conditions carried out. The trial utilised lighting levels well below those expected from actual mining equipment and infrastructure, yet still produced clear and measurable impacts on both the night sky and surrounding landscape viewed from many kilometres away.

72. Given the inherent limitations of working within an undulating hillside environment, downward-directed or horizontally mounted lighting systems cannot realistically achieve complete control of upward light spill. In practice, a combination of direct, stray, and reflected lighting will contribute to elevated skyglow, altering the character of the night environment within and beyond the Outstanding Natural Landscape.

73. When scaled to the lighting outputs of full mining operations - including heavy machinery, construction lighting, fixed plant illumination, and operational safety lighting, the cumulative effects would be considerably greater than those observed during the trial. These impacts are therefore not only predictable but unavoidable.

74. In conclusion, the simulation provides robust evidence that the proposed mining activity will materially affect night-time darkness values and landscape perception. Mitigation measures may reduce but cannot eliminate these effects. Decision-makers should therefore consider the high likelihood of ongoing visual and environmental impacts as an inherent consequence of the project's lighting requirements.

Overall conclusion

75. This report presents the results of an on-site lighting simulation conducted to assess the night-time environmental and visual effects of the proposed Bendigo–Ophir Gold Project. Using vehicle-mounted theatrical lighting and mobile lighting towers, the trial demonstrated that even significantly underpowered lighting—far below actual mining equipment output—produced clear and far-reaching light pollution observable up to 10 km away. The findings show that real mining operations would generate substantially greater skyglow due to unavoidable direct, stray, and reflected light, particularly within the Outstanding Natural Landscape.

76. The report also critically evaluates the Cosgroves Engineering Lighting Report, identifying major gaps including lack of quantitative modelling, underestimation of mobile lighting impacts, unrealistic assumptions about mitigation, and insufficient assessment of ecological and cumulative effects. Overall, the evidence indicates that meaningful night-sky and landscape impacts are inherent and unavoidable, and current assessments do not reliably demonstrate that proposed lighting effects can be adequately mitigated.