CONCEPT DESIGN FOR TRACK LIGHTING

at

WTR GREENFIELDS RACECOURSE DEVELOPMENT

Client

Waikato Thoroughbred Racing
Te Rapa 3241
New Zealand

Lighting Consultant

Dr Richard Dluzniak
Dr Richard Dluzniak Consulting Pty Ltd
537 High Street, Kew. Vic 3101 Australia

October 2026

Dr Richard Consulting Pty Ltd
537 High Street, Kew. Victoria 3101 Australia
[redacted]

TABLE OF CONTENTS

Section	Description	Page
1	Introduction	3
2	Track Lighting Design Parameters	3
3	Lighting Proposals	5
4	Public Lighting	8
5	Summary	9
Appendix A	Typical Mast, Floodlight and Control Cubicle details	10

Drawings

TL01	Site Plan and Proposed Track Lighting Layouts
TL02	Main Gallops Training Tracks Lighting Layout
TL03	Harness Track Lighting Layout
TL04	Backtrack Lighting Layout
TL05	Obtrusive Light Abatement
TL06	Track Lighting Mast Details
TL07	Track Lighting Floodlight and Control Cubicle Details

LIST OF REFERENCES

Standards Aust	AS/NZS 4282:2023 Control of the obtrusive effects of outdoor lighting (referred to as the Obtrusive Light Code)
Standards Aust	AS 2560.2.2021 Sports Lighting : Part 2 Specific Applications
Standards Aust	AS/NZS 1158.1.1 Category V Lighting (Streetlighting)
Standards Aust	AS/NZS 1158.3.1 Category P Lighting (Public lighting)

Dr Richard Dluzniak Consulting Pty Ltd
537 High Street, Kew Victoria 3101 Australia
[redacted]

1 INTRODUCTION

This Report presents a concept plan (and preliminary design) for the lighting of various racing and training tracks at the WTR Greenfields site.

The concept scope includes the lighting of the following tracks:

Main Gallops Training Tracks

No 2 grass track	Lighting for early morning training
Synthetic track	Lighting for early morning training
No 1 sand track	Lighting for early morning training
No 1 plough track	Lighting for early morning training

Harness Track

Main track	Lighting for CTV broadcast night races

Backtrack Training Tracks

No 3 grass track	Lighting for early morning training
No 2 sand track	Lighting for early morning training
No 2 plough track	Lighting for early morning training

The concept submission will discuss the following principal track lighting parameters:

- Proposed track illuminance levels and related lighting parameters
- Proposed lighting layout for the main gallops training tracks
- Proposed lighting layout for the harness track
- Proposed lighting layout for backtrack training tracks
- Obtrusive light assessment for the complete site
- Proposed track lighting masts
- Proposed track lighting floodlights control gear cubicles

2 TRACK LIGHTING DESIGN PARAMETERS

Although there is no Australian or International standard for the lighting of horse tracks, there are numerous examples of lit track in Australia (and overseas) where lighting levels and lighting parameters can be obtained, compared and adopted.

The set of lighting and installation parameters adopted for the various tracks at the new WTR Greenfield racing development are summarized below:

a Lighting levels

Main Gallops training tracks

Illuminance on all grass, sand, synthetic & plough tracks at track level	20 lux

Harness night racing track

Front straight

Illuminance at track level	1000 lux
Illuminance towards CTV camera	1200 lux
Illuminance at the finish line	2000 lux

Back straight and turns

Illuminance at track level	800 lux
Illuminance towards CTV camera	1000 lux

Harness Training track

Illuminance at track level	20 lux

Note – Lighting Definitions

Horizontal illuminance This is the lighting level in lux at ground level which corresponds to the lighting on a horizontal plane on the track. This is the "brightness" of the track as seen by the jockeys, trainers and racecourse patrons.

Camera illuminance This is the lighting level in lux in the direction of the main CTV camera which corresponds to the lighting on the vertical sides of the jockeys and horses. This is the most important illuminance which governs the quality of CTV pictures.

Finish line illuminance This is the lighting level in lux, across a narrow band across the finish line, in the direction of the photo finish camera. A very high level of illuminance is required to obtain high contrast, clear photo finish images.

b Lighting Masts, Floodlights and Control Gear Cubicles

Lighting Masts

Mast type	Galvanized steel, base plate mounted
Mast headframe type	Custom fabricated curved headframe
Minimum mast height	18m
Maximum mast height	22m
Mast mounting	Mounted on bored pier concrete footings

Floodlights

Floodlight type	High power LED technology
Control gear	Electronic drivers
LED floodlight power	1500 Watt
LED floodlight lumens	220,000 lumens
Lamp life	> 50,000 hours

Lighting Control

LED controller (driver)	Electronic controller with 0-100% dimming capability
Lighting control	Dali control system

Lighting Control Gear Cubicles

Cubicle type	Weatherproof aluminium clad switchboard
Cubicle location	Cubicle mounted on concrete slab adjacent to each mast
Cubicle gear	Cubicle houses lamp circuit protection switchgear, LED drivers and power & communications circuits

Note: All galvanised steel masts, mast headframes and aluminium lighting control gear cubicles to be painted the same visually regressive colour (to be selected) to be less obtrusive and blend in with the surroundings.

c Obtrusive Light

The obtrusive light (spill light and glare) emanating from the track lighting at the racecourse has to comply with the Australian and New Zealand standard AS/NZS 4282:2023 – Control of the obtrusive effects of outdoor lighting.

The values of the spill light and glare attributable by the training tracks and harness night racing track have to be included in the detailed lighting designs for the tracks and assessed for full compliance with the obtrusive code.

This concept proposal gives all the obtrusive light parameters at the racecourse property boundary only. The evaluation of these parameters, relative to residential properties, will be made at the design stage of the project.

3 LIGHTING PROPOSALS

The salient features of the lighting for each of the lit tracks are summarised on the drawings accompanying this report.

Site Plan and Lighting Layouts : Drawing TL01
This drawing shows the Greenfield site plan with the proposed lighting layouts for the lit tracks.

The proposed lighting design parameters (lighting levels and lighting uniformities) are also shown for each track as well as the principal floodlight aiming directions from the masts.

Note that only the harness track is to be used for night time televised racing, hence the inclusion of additional lighting design parameters for the track lighting, compared to the non-televised training tracks.

Gallops Training Tracks Lighting : Drawing TL02
This drawing shows the lighting layout for the main gallops training tracks.

The lighting design is based on a high mast system using 22m steel masts. The lighting system employs 12 masts set 20m from the inside track and 140m apart. Because the light throws are very long (typically 150m), the masts have to be high so that the floodlights have an acceptable aiming angle well below the horizontal. This is essential to reduce discomfort and disability glare at the tracks.

The lighting level of 20 lux on all the training tracks is considered adequate for gallops early morning training and is consistent with lighting levels at major training tracks in Australia.

The track training lighting is turned on at 4.30am and turned off at sunrise.

Harness Track Lighting : Drawing TL03

This drawing shows the lighting layout for the harness track.

The lighting design is based on a medium high mast system using 18m and 22m steel masts. The lighting system employs 17 off 18m masts in the infield and 7 off 22m mast in the front straight. The front straight masts are located 33m from the outside fence which will allow acceptable sight lines to the track from the grandstand.

A total of 180 LED floodlights are required to produce the lighting levels on the track as stated in Section 2. The front straight is lit to a higher level than the back straight and turns (common at many harness tracks) to enhance the front straight action.

Because the harness races will be broadcast, both horizontal and camera levels are required to be designed to produce good quality CTV pictures. Additional lighting to a level of 2000 lux (2000 lux) is also required at the finish line for sharp and clear photo finish camera images.

The track lighting will be turned off at 10pm after the last race is run at 9.30pm.
The harness training track is turned on at 5am and turned off at sunrise.

Note: Lighting of the inner harness training track is an option where no additional lighting is required to be installed. One of the harness track floodlights on each mast would be switched on (using the DALI lighting control system) to achieve 20 lux on the training track.

Back Track Lighting : Drawing TL04

This drawing shows the lighting layout for the backtrack training tracks.

The lighting design is based on a high mast system using 22m steel masts. The lighting system employs 12 masts set 18m from the inside track and 140m apart. Because the light throws are very long (typically 150m), the masts have to be high so that the floodlights have an acceptable aiming angle well below the horizontal.

As for the main training tracks, the lighting level of 20 lux on these tracks is considered relatively high for gallops early morning training and is consistent with lighting levels at major training tracks in Australia.

The back track lighting is turned on at 4.30am and turned off at sunrise.

Obtrusive Light : Drawing TL05

This drawing shows the obtrusive light assessment boundary around the racecourse. In this concept proposal the worst-case scenario is considered where the obtrusive boundary is the racecourse property boundary. In the detailed design of the track lighting the actual residential property boundaries will be used.

The obtrusive light parameters which determine compliance with the Code are composed of both physical (measurable) quantities and theoretical (non-measurable) quantities.

The following gives the definition of each of the parameters and their impact on the neighbourhood.

a Environmental Zones

The impact of obtrusive light on a neighbourhood will depend not only on the magnitude of the light spill and glare but also on the “brightness” of the surroundings.

The Obtrusive Light Code classifies the brightness of a surrounding by defining 5 zones: Zones A0 to A4 and zone TV. The following Zones are applicable for the lighting at the site:

For a sports lighting installation with CTV coverage, **Zone TV** is the appropriate classification

For non-televised outdoor lighting (training track lighting), **Zone A3** is the appropriate classification.

b Spill Light (Ev)

Spill light is the defined as the light falling on a property boundary (or dwelling). It is defined as the vertical component of the total light normal to the property boundary measured at a height of 1.5m above ground level.

Spill light is a physical quantity which can be measured with a light meter. The unit of spill light is lux (lumens/m2).

Spill light manifests itself by lighting up residential properties (buildings, windows, fences, front yards, etc) at night as a result of light "spilling over" from a lighting installation.

c Luminous Intensity (I)

The luminous intensity is the intensity of a floodlight in a given direction. In non-technical terms is can be interpreted as how "glary" a floodlight appears.

Luminous intensity cannot be measured on site but is determined in a lighting laboratory using a goniometer. The unit of luminous intensity is the candela (cd).

Luminous intensity manifests itself as discomfort glare to an observer. The maximum luminous intensity that is acceptable in the Code is labelled Imax. Floodlights which are aimed correctly and/or have louvres or shields fitted appear less "glary" than floodlights without these features.

d Threshold Increment (TI)

The threshold increment is a theoretical parameter which describes the disability glare a motorist experiences when driving in a field of glare sources (the floodlights).

The threshold increment cannot be measured on site, or in the laboratory, because it is a theoretical parameter. The threshold increment is a dimensionless parameter expressed as a % value.

This parameter manifests itself as a disability glare which impedes the vision of a motorist while driving in a field of glare sources (the floodlights).

e Sky Glow (Upward Waste Light Ratio)

The sky glow cannot be practically measured on site but can be predicted from the floodlight photometrics and lighting design aiming directions. The sky glow is defined by the Upward Waste Light Ratio (UWLR) and is quoted as a decimal fraction.

High values of UWLR cause light pollution in the sky which severely effects professional astronomical research and amateur astronomy work. Generally, sky glow does not directly affect local residents.

f Obtrusive Light Mitigation

To achieve the required obtrusive light parameters to comply with the obtrusive light code the following measures are proposed to be taken:

- Computer aided analysis of the obtrusive light enabling mast heights and spacings, floodlight types and beam distributions, and floodlight aiming directions to be determined to achieve the obtrusive parameters

- The employment of externally fitted metal louvres and shields to the floodlights in order to physically cut-off light at obtrusive angles

- The use of state-of-the-art polymer optical lenses installed over the floodlight LED 's to produce a glare shield for obtrusive light control.

The adoption of some, or all, of the above measures will guarantee the obtrusive light - spill light, glare and light intensity – will be reduced to levels stipulated by the obtrusive code.

g Natural Environments

The pekapeka-tou-roa (NZ long-tailed bat) has been acknowledged as a taonga species and spill light limits on the existing trees and habitats located in the infield area of the training tracks will be imposed.

Since all the floodlights lighting the thoroughbred backtracks are facing outwards from the infield area the light spill on the kahikatea trees will be low. Spill levels less than 4 lux will be imposed on the perimeter of these trees.

h Lighting Control

Programmable digital controllers will turn on and off all the various lights as detailed below:

- Harness track lights will turn off at 10.00pm on race nights. (approx. 40 per year)
- Harness training lights will turn on at 5.00am and turn off at sunrise
- Thoroughbred training lights will turn on at 4.30am and turn off at sunrise.

Lighting Masts and Headframes : Drawing TL06

This drawing shows the different masts and mast headframes proposed for the track lighting.

All the masts are fixed, tapered galvanized steel masts, baseplate mounted on concrete footings. All mast headframes are custom fabricated curved arm crossarms designed to accommodate the specific LED floodlights to be used for the lighting.

All masts have an extension spigot fitted on top of the mast for aesthetic reasons.

Floodlights and Control Cubicles : Drawing TL07

This drawing gives details of the proposed floodlights and control gear cubicles to be used for the track lighting.

All the proposed floodlights are 1500 W, 220,000 lumen LED lights controlled by electronic drivers. Both asymmetric and symmetric floodlights are required. Asymmetric types are required for the harness track while symmetric "projector" types are required for the training tracks.

All the LED floodlights shall be suitable for light dimming using the Dali protocol.

The drawing also gives details of the control gear cubicles which accommodate the LED drivers and the electrical protection and switchgear for the lights. The cubicles are essentially free standing, weatherproof aluminium clad switchboards mounted on concrete pads adjacent to the masts.

4 PUBLIC LIGHTING

Public lighting at the site will be required for personal safety and safety of movement of people being at the site for the various training sessions and publicly accessible spaces during evening and night time events.

Public lighting will be designed for the following areas:

Internal roads and footpaths
Public car parks
Horse float car parks
Access tunnel to main training tracks
Horse stables
Events/Function Centre

Lighting will be designed to comply with the following Australian and New Zealand standards:

AS/NZS 1158 - Cat V for streetlighting and Cat P for public lighting.
AS/NZS 4282: 2023 – Control of the obtrusive effects of outdoor lighting

5 SUMMARY

This concept design presents a comprehensive technical summary of the proposed lighting to be installed for the race and training tracks at the new racecourse site.

The new lighting is based on state-of-the-art LED technology integrated with Dali protocol switching and dimming features. The lighting levels proposed are consistent with lighting at other gallops training and harness racing tracks located in metro areas.

One of the main concerns with any sports lighting installation is the obtrusive light emanating from the lighting system into the local neighbourhood. In this report a comprehensive summary of the obtrusive light parameters has been presented and measures to be taken to mitigate this effect.

The obtrusive light – spill light, glare and light intensity – will completely comply with the requirements of the Australian and New Zealand obtrusive light code.

END OF REPORT

Dr Richard Dluzniak
Consulting Engineer
PhD, MIE Aust, MIES, CPEng

October 2026

APPENDIX A

TYPICAL MAST, FLOODLIGHT & CONTROL CUBICLE DETAILS



Typical 22 m steel masts with 16 x 1500W LED floodlights. Control gear cubicle (housing LED drivers) shown at base of each mast

Note: Masts shown unpainted. Masts proposed to be painted to approved colour



Typical custom built curved headframe to support 16 x 1500W LED floodlights.

Note: Mast and headframe shown unpainted. Masts proposed to be painted to approved colour



Free standing, weatherproof aluminium control gear cubicle mounted adjacent to mast on concrete pad. Cubicle houses the LED drivers to control the lights.
Typical dimensions :2000 long x 1700 high x 400 wide

Note : Cubicle shown unpainted. Cubicles proposed to be painted to approved colour.



1500W, 220,000 lumen high power LED floodlight, dimmable.

Dimensions of floodlight:
600 wide x 650 high x 120 thick



Close-up: Polymer optical lenses integrated in a metal louvre frame that is installed over the LED 's to produce a glare shield for obtrusive light mitigation.