

Royal Berkshire NHS Foundation Trust ERF – External Lighting Statement

PROJECT TITLE	Royal Berkshire NHS Foundation Trust ERF
PROJECT NO.	P.019694
PREPARED BY	Leon Green
DATE	10/03/2023
DOCUMENT CLASSIFICATION	☒ Public ☐ Internal ☐ Restricted ☐ Confidential

The Royal Berkshire NHS Foundation Trust are proposing to demolish an existing pre-fabricated building and replace with a new build clinical space on the southern end of the site. The external lighting will be designed in accordance with Approved Document L 2021, the NHS HTM & HBN standards, British Standards and CIBSE Guidance.

The external lighting will be designed to ensure the scheme is as unobtrusive as possible, complies with guidelines for the reduction of light pollution and satisfies local planning requirements.

The external lighting scheme will be designed to create a safe external environment by providing artificial lighting in the hours of darkness, only whilst motion is detected, and ensuring the lighting is unobtrusive to the environment and neighbouring properties.

A desktop study utilising Relux software, a professionally recognised computer-generated lighting calculation software application, has been completed to assess the proposed lighting scheme conformity with recognised guideline requirements.

Definitions

Lux (lx) is the unit in which light is measured on a surface from a source. Unit used to define illumination. 1 lux is equal to 1 lumen falling on an area of 1 square meter.

Average Lux (Eav) is the maintained average illuminance.

Minimum Lux (Emin) is the maintained minimum illuminance.

Maximum Lux (Emax) is the maintained maximum illuminance.

Upward Light Ratio (ULR) is the maximum permitted percentage of luminaire flux that goes directly into the sky.

Sky Glow is the illumination of the night sky caused by artificial light.

Obtrusive light is the existing spilling of light beyond the boundary of the area being lit.

Spill light – For the purpose of this document, spill light can be defined as the illumination that is produced by a light source or light sources at a point or surface on which the light is not intended or desirable.

Glare – The discomfort or impairment of vision experienced when the image is excessively bright compared to the general surroundings.

Environmental Zones are a permitted classification for the environment in which lighting can be designed to recommended levels.

BREEAM Compliance

The Trust are targeting a BREEAM accreditation of 'excellent'. The external lighting scheme will be designed to achieve the 'Hea01 Visual Comfort, external lighting', 'Ene03, external lighting' and 'Pol04, reduction of night time light pollution' credits.

The requirements set out in the BREEAM assessment matrix for external lighting states that *"All external lighting located within the construction zone is designed to provide illuminance levels that enable users to perform outdoor visual tasks efficiently and accurately, especially during the night. To demonstrate this, external lighting provided is specified in accordance with BS EN 13201 series Road Lighting and BS EN 12464-2:2014 Light and lighting - Lighting of workplaces - Part 2: Outdoor workplace"*.

Design Guides & Industry Standards

The proposed external lighting scheme has been designed in accordance with good practice guidance documents and National & international Industry Standards, incorporating the following:

- BS EN 12464-2: Lighting of Workplaces – Outdoor Works Places
- BS EN 13201-2: Road Lighting – Performance Requirements
- Institute of Lighting Professionals (ILP) – Guidance Notes for the Reduction of Obtrusive Light
- CIE 126 Guidelines for Minimising Sky Glow
- CIE 150 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations

The Institute of Lighting Professionals 'Guidance Notes for the Reduction of Obtrusive Light' provides the basis for the comparative analysis when defining whether an installation will be obtrusive to the environment and neighbouring properties. It assists in quantifying and providing acceptable maximum threshold recommendations for light spill, sky glow and glare. Good lighting design also includes luminaires that have been selected to minimise light intrusion and glare to pedestrians and drivers. This is the primary document used by most local councils and planning departments to categorise the provision of external lighting, in accordance with best practice.

Methodology

Desk based information

A desktop review of the site and surrounding area has been undertaken to identify potential light sensitive receptors and to establish the appropriate Environmental Zone classification for the site as defined by the International Commission on Illumination Guidance Notes for Obtrusive Light.

Modelling was undertaken using Relux software, an independent lighting model that can calculate daylight and artificial lighting scenes in interior and exterior scenarios. The model incorporates BS EN 12464-2 calculation methodologies and is commonly used for lighting impact assessment.

Institute of Lighting Professionals Environmental Zone Classification

CIE 150 tables Environmental Zones for exterior lighting based on the existing external ambient lighting levels in the area. The guidance note classifies environmental zones into five categories.

The CIE Environmental Zone classification for the site and its surroundings has been determined based on professional judgement but is subject to consultation and agreement with the local planning authority.

Predictive modelling has been undertaken to study, identify and reduce potential light pollution from the site to achieve compliance with CIE 150 Guidance notes for the Reduction of Obtrusive Light.

Zone	Lighting Environment	Examples
E0	Intrinsically dark	UNESCO Starlight Reserves, IDA Dark Sky Parks, Major optical observatories
E1	Dark	Relatively uninhabited rural areas
E2	Low district brightness	Sparsely inhabited rural areas
E3	Medium district brightness	Well inhabited rural and urban settlements
E4	High district brightness	Town and city centres and other commercial areas

Figure 1 – Environmental Zone Classification (Source CIE 150)

A category Environmental Zone E3 is defined in EN 12464-2 Clause 4.5 (Table 2) as ‘medium district brightness areas, such as industrial or residential suburbs’ and in CIE 150 as ‘medium district brightness areas such as well inhabited rural and urban settlements. This site would comply with both the definitions provided for a category E3 scheme.

The CIE Environmental Zone classification determines the appropriate exterior lighting limitations for that area. The specification of the limitations for each Environmental Zone are set out in the below figure extracted from CIE 150.

Light Technical Parameter	Application Conditions	Environmental Zones				
		E0	E1	E2	E3	E4
Illuminance in vertical plane (E_v)	Pre-curfew	n/a	2 lx	5 lx	10 lx	25 lx
	Post-curfew	n/a	< 0,1 lx*	1 lx	2 lx	5 lx

* If the installation is for public (road) lighting then this value may be up to 1 lx.

Figure 2 – Maximum values of vertical illuminance on properties (Source CIE 150)

Light Technical Parameter	Environmental Zones				
	E0	E1	E2	E3	E4
Upward light ratio (ULR) / %	0	0	2,5	5	15

Figure 3 – Maximum values of upward light ratio of luminaires (Source CIE 150)

In accordance with Environmental Zone classification E3, medium district guidance, is to have a maximum sky glow (URL) limit of 5%, maximum light trespass of between 10 to 2 lux (pre and post curfew). As the proposed site is for a healthcare facility that will operate 24/7, the ‘pre-curfew’ values noted in CIE figure 2 have been ignored. The more onerous ‘post-curfew’ value of 2 Lux is to be applied to the design methodology (maximum trespass / spill lighting).

Road Lighting

There is no construction of roads included within the project scope and hence, the design of such is excluded.

Lighting Assessment

Light pollution is a recognised statutory nuisance. Obtrusive light from floodlighting within the site boundary onto adjacent roads and adjacent south block building glazing will be minimised by taking into consideration (a) sky glow (b) light trespass, over illumination and (c) glare.

The qualitative assessment considers:

- The change in views as a result of the introduction of external lighting at night-time.
- The effects of obtrusive light on sensitive receptors such as the ward glazing in the main south block.

The following three components of artificial light in open spaces contribute to the potential for obtrusive light as shown in figure 4:

Sky glow – this is the general illumination of the night sky above conurbations and any areas where there are large amounts of artificial light. It comprises aspects of reflected light from illuminated surfaces, direct upward light from lighting installations and intrusion light, which is light which falls outside the specific area to be lit.

Light Intrusion (or ‘trespass’) – this is light which affects areas beyond those which are supposed to be lit by a particular source and which, depending on the nature of the receptor affected, has the potential to cause nuisance and disturbance.

Glare – this is the brightness of a light source when viewed against a dark background. Most often experienced when the light source itself (i.e., the bulb or tube) is directly visible and is not covered by a shield, cowl or directed by a suitable lens/reflector arrangement.

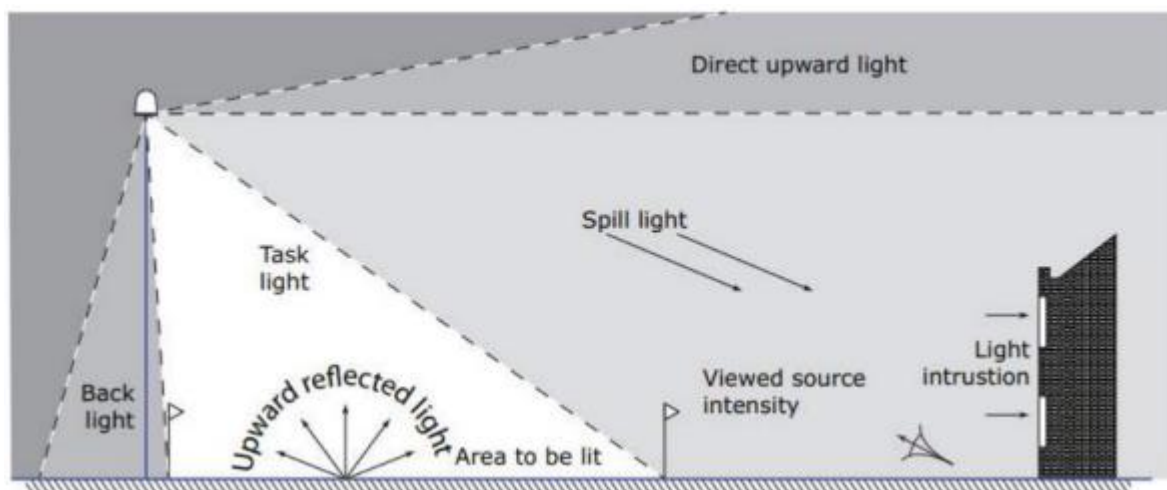


Figure 4- Types of Obtrusive Light (Source ILP Guidance Notes GN01/21)

A lighting model was developed to represent the proposed external lighting scheme and to enable the obtrusive light to be calculated & evaluated. Lighting level requirements within the site were designed to ensure sufficient illumination to carry out relevant tasks safely and allow safe access and egress for employees and visitors.

The design of the lighting has been undertaken in a manner such as to address two potentially conflicting needs, the provision of a safe environment for the movement of pedestrians, vehicles, motorcycles and bicycles when the natural lighting levels fall and, to meet the light obtrusion limitations stated within the relevant standards and guidance in order to avoid any detriment to local amenity.

The following stages have therefore been undertaken in order to produce a suitable external lighting design for the purposes of this assessment and assess potential impacts:

- Qualitative assessment of potential lighting impacts at light-sensitive receptors bordering the proposed development site, based on the proposed external lighting design and,
- Formulation of appropriate mitigation measures, where necessary, in order to minimise the potentially detrimental impacts of the lighting scheme.

The use of high efficiency, low energy LED lighting is one of the key elements to assist with “Energy Performance in New Buildings”.

The model has been used to calculate the predicted Upward Lighting Ratio (ULR) of the proposed external lighting scheme. The ULR of luminaires would be assessed to ensure the ratio of light emitted at and above the horizontal to the total light emitted is within the guidelines in the environmental zone’s classification. The proposed scheme is to have a ULR value of 0% (no upward light / sky glow). This falls within the commended 5% for an E3 zone, 2.5% for an E2 Zone as well as 0% for E1. Model outputs predict a sky glow figure (ULR) of 0% and is therefore not considered to result in impacts on the dark sky landscape.

The external lighting scheme of the site is illustrated with supported design calculations results in Appendix A.

Best Practice Design

As well as meeting the statutory design standards outlined in the above section, the external lighting design has sought to meet a number of criteria to ensure that the environmental effects of artificial lighting are managed to a high standard. These criteria are:

- All luminaires will be mounted at 0° tilt to minimise upward light
- The area will be lit in accordance with the minimum requirements set out in EN 12464-2
- Light intrusion has been reduced as far as possible into the surrounding areas
- Efficient LED light sources have been selected throughout to minimise energy consumption
- All new luminaires will be fitted with flat glass to aid 0% upward light discharge
- The external lighting control philosophy during “post curfew” hours will be controlled by motion detectors; therefore, lighting will only be required when motion is detected

Conclusion

The external light fixtures proposed for the scheme are of the energy-efficient LED type that have been chosen due to their high optical efficiency and within 70 luminaire lumens per circuit watt.

In accordance with Environmental Zone classification E3, the maximum sky glow / upward light ratio (URL) limit of 5% has not been exceeded. The lighting calculation demonstrates that the proposed external lighting scheme achieves 0%. This indicates that no upward lighting / sky glow will occur as all light fixtures have been modelled to be mounted at zero degrees.

The proposed external lighting scheme has been specifically designed to reflect the worst-case scenario. Where possible, the recommended limitations on obtrusive light stipulated in the outlined guidance notes & design standards have been adhered to. It is important to note that the lighting model is only able to accurately represent the effects of solid structures such as buildings and walls on light obtrusion. Non-solid barriers such as fences, trees, berms, and hedges cannot be accurately modelled.

The Lighting Design prepared for external areas of the proposed site seeks to be efficient; ensure safety and security for people moving in and around the site; meets where possible the recognised design standards and guidance; whilst ensuring that light intrusion onto adjacent areas is minimised or avoided where possible.

Appendix A – External Lighting Relux Report

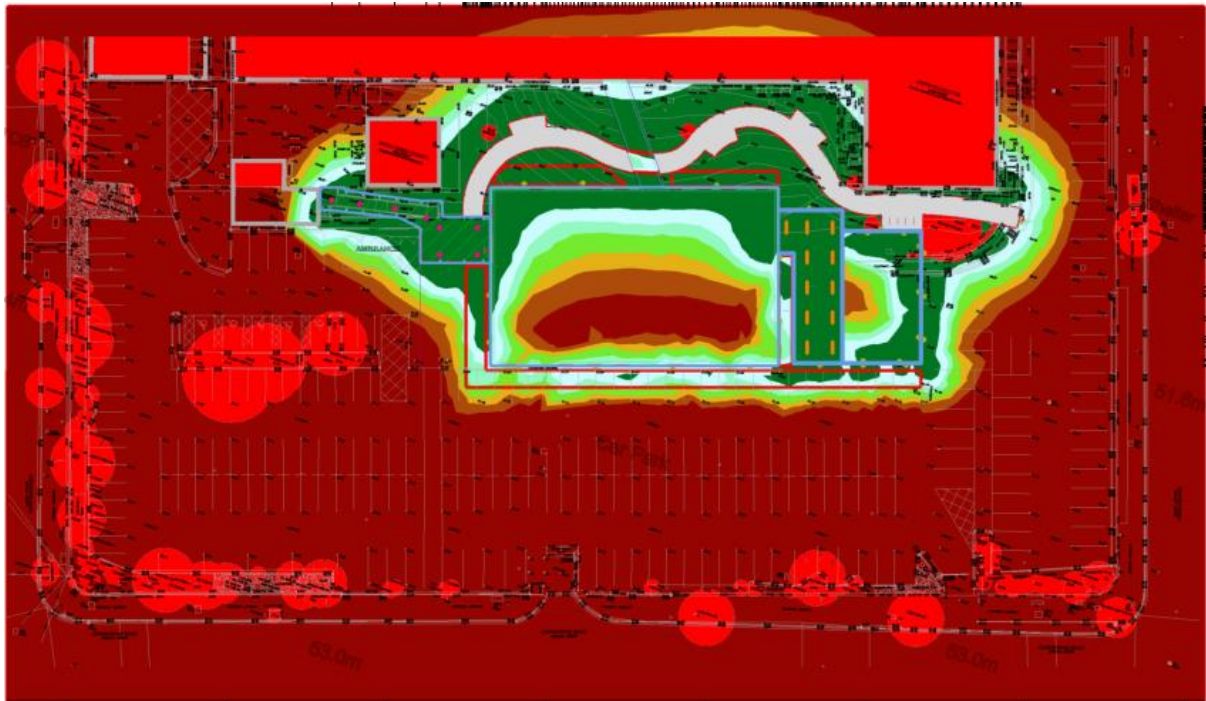


Figure 5- Extract from Relux lighting calculation software

RBH ERF

Installation : External Lighting

Project number : P.019694

Customer : NHS

Processed by : Yousuf JAnabi

Date : 08.03.2023

Project description:

The following values are based on exact calculations on calibrated lamps, luminaires and their arrangement. In practice, gradual divergences can occur.

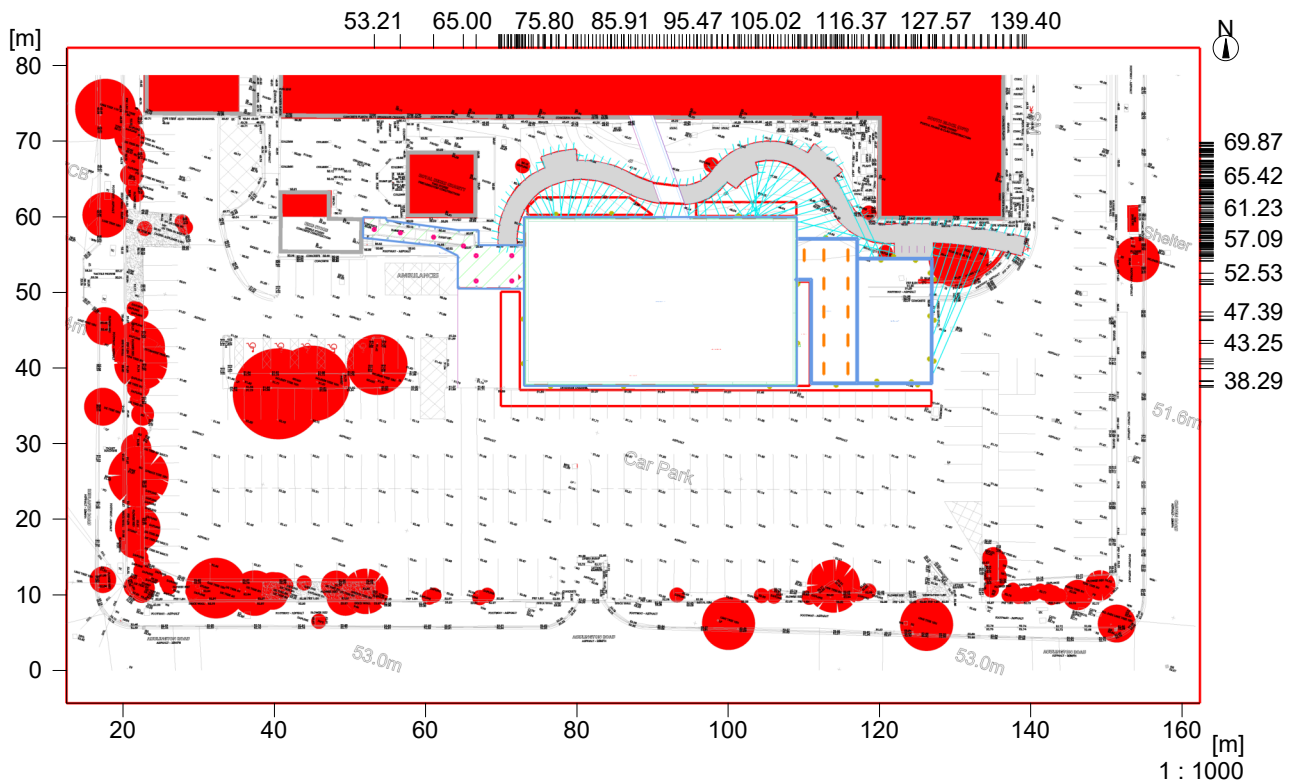
Guarantee claims for luminaire data are excluded.

Relux and the luminaire manufacturers accept no liability for consequential damage and damage which is occasioned to the user or to third parties.

2 Exterior 1

2.1 Description, Exterior 1

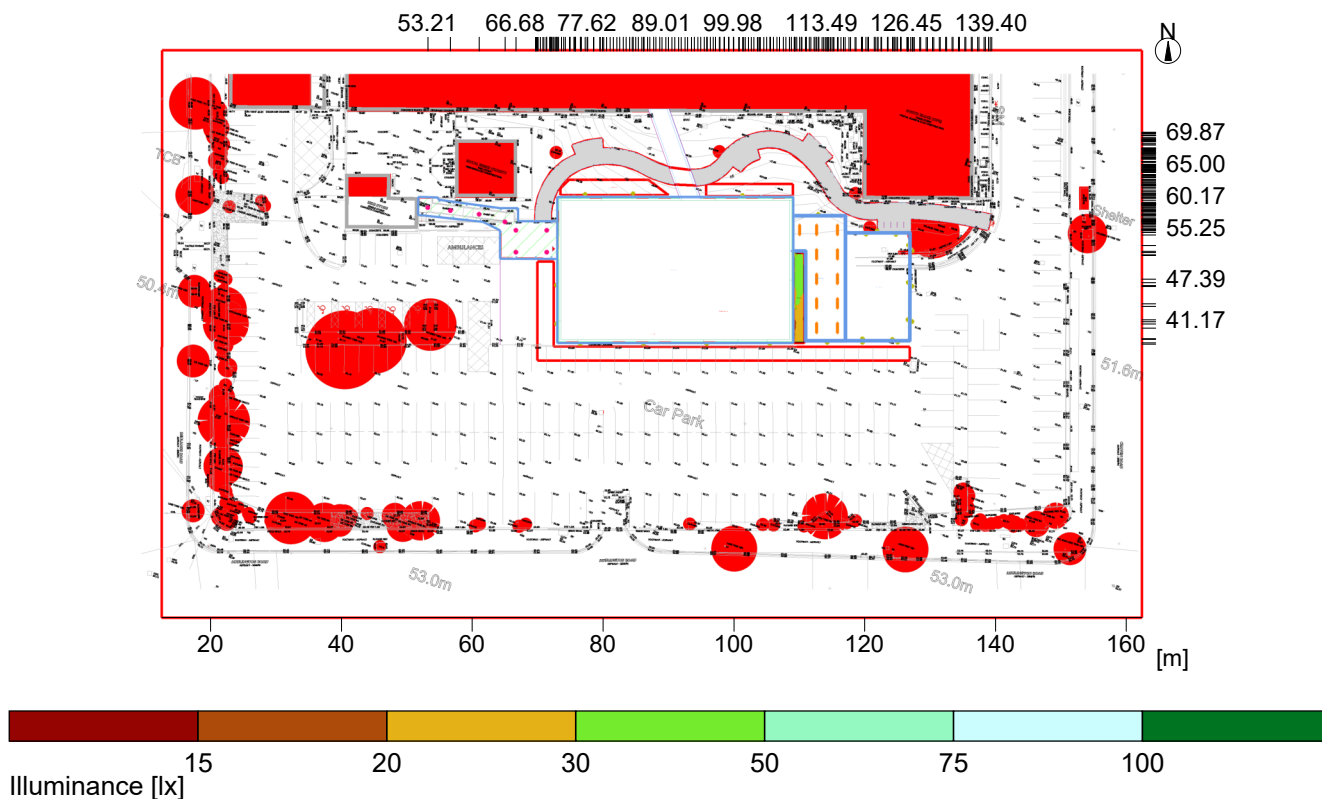
2.1.1 Floor plan



2 Exterior 1

2.2 Summary, Exterior 1

2.2.1 Result overview, Escape Route



General

Calculation algorithm used	Average indirect fraction
Height of evaluation surface	0.00 m
Maintenance factor	0.80
Total luminous flux of all lamps	333435 lm
Total power	2834.6 W
Total power per area (12972.10 m ²)	0.22 W/m ²
Upward light ratio (ULR)	0.32

Illuminance

Average illuminance	Eav	28.6 lx
Minimum illuminance	Emin	16.5 lx
Maximum illuminance	Emax	46.1 lx
Uniformity Uo	Emin/Em	1:1.73 (0.58)
Diversity Ud	Emin/Emax	1:2.79 (0.36)

Type No. Make

Thorlux Lighting

The ULR value has been calculated without obstruction by other objects.

2 Exterior 1

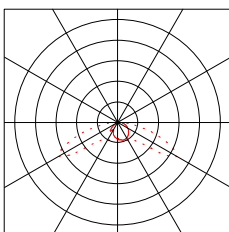
2.2 Summary, Exterior 1

2.2.1 Result overview, Escape Route

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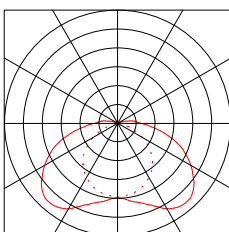
Order No. : ERL19069
 Luminaire name : Realta
 Equipment : 1 x 8 W / 1320 lm



3 11



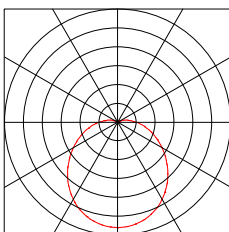
Order No. : EAL20230
 Luminaire name : A-Line - Ligature-Resistant
 Equipment : 1 x 41 W / 8145 lm



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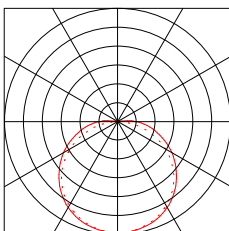
Order No. : TAN19209
 Luminaire name : Arcadian
 Equipment : 1 x 27 W / 3565 lm



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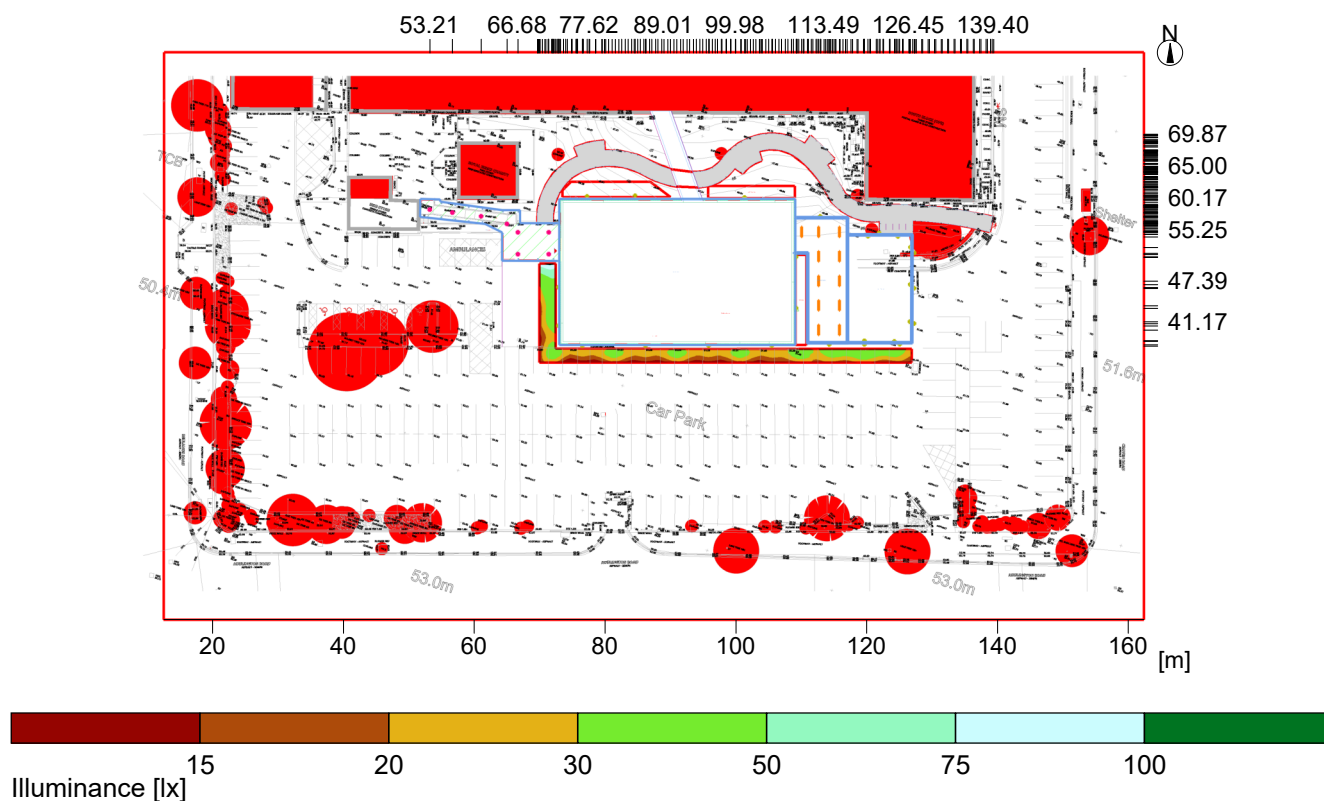


PROLED
 Order No. : L625804HL/L625804HL
 Luminaire name : PROLED FLEX STRIP IP68 300 HE+ MONO
 Equipment : 1 x LED 9.6 W / 1000 lm



2.2 Summary, Exterior 1

2.2.2 Result overview, South & West Boundary



General

Calculation algorithm used	Average indirect fraction
Height of evaluation surface	0.00 m
Maintenance factor	0.80
Total luminous flux of all lamps	333435 lm
Total power	2834.6 W
Total power per area (12972.10 m ²)	0.22 W/m ²
Upward light ratio (ULR)	0.32

Illuminance

Average illuminance	Eav	27.5 lx
Minimum illuminance	Emin	11.2 lx
Maximum illuminance	Emax	96 lx
Uniformity Uo	Emin/Em	1:2.46 (0.41)
Diversity Ud	Emin/Emax	1:8.59 (0.12)

Type No. Make

Thorlux Lighting

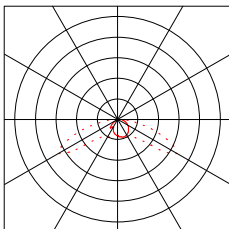
2.2 Summary, Exterior 1

2.2.2 Result overview, South & West Boundary

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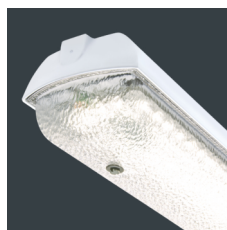
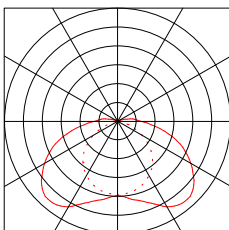
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 Luminaire name : Realta
 Equipment : 1 x 8 W / 1320 lm



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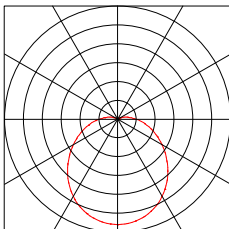
Order No. : EAL20230
 Luminaire name : A-Line - Ligature-Resistant
 Equipment : 1 x 41 W / 8145 lm



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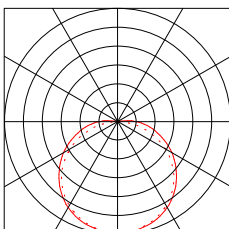
Order No. : TAN19209
 Luminaire name : Arcadian
 Equipment : 1 x 27 W / 3565 lm



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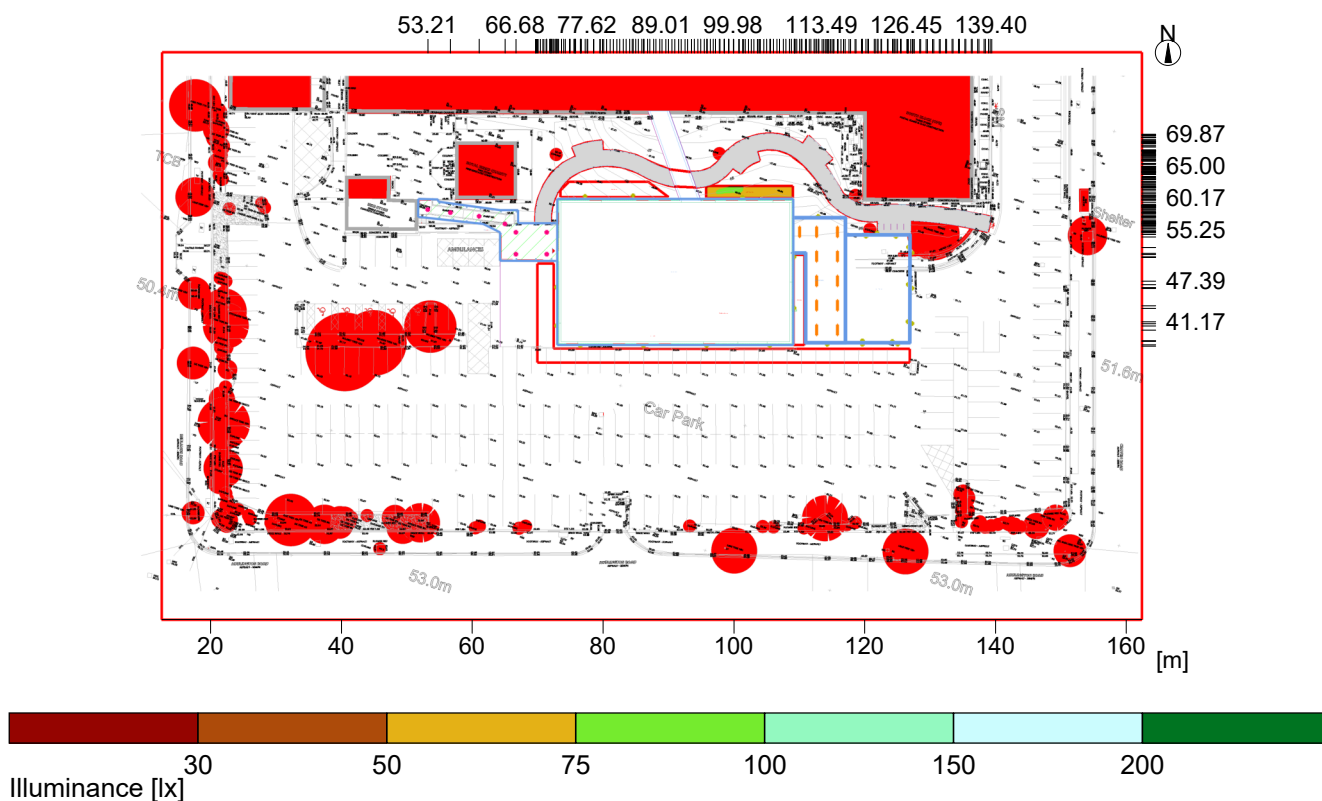


PROLED
 Order No. : L625804HL/L625804HL
 Luminaire name : PROLED FLEX STRIP IP68 300 HE+ MONO
 Equipment : 1 x LED 9.6 W / 1000 lm



2.2 Summary, Exterior 1

2.2.3 Result overview, North West Boundary



General

Calculation algorithm used	Average indirect fraction
Height of evaluation surface	0.00 m
Maintenance factor	0.80
Total luminous flux of all lamps	333435 lm
Total power	2834.6 W
Total power per area (12972.10 m ²)	0.22 W/m ²
Upward light ratio (ULR)	0.32

Illuminance

Average illuminance	Eav	63.7 lx
Minimum illuminance	Emin	43.3 lx
Maximum illuminance	Emax	73.8 lx
Uniformity Uo	Emin/Em	1:1.47 (0.68)
Diversity Ud	Emin/Emax	1:1.7 (0.59)

Type No. Make

Thorlux Lighting

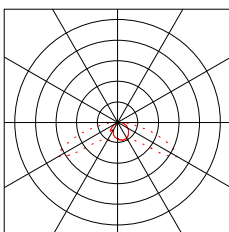
2.2 Summary, Exterior 1

2.2.3 Result overview, North West Boundary

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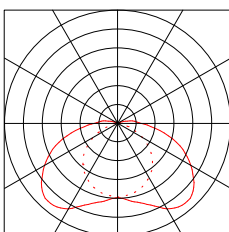
Order No. : ERL19069
 Luminaire name : Realta
 Equipment : 1 x 8 W / 1320 lm



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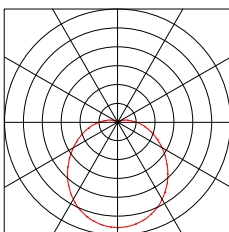
Order No. : EAL20230
 Luminaire name : A-Line - Ligature-Resistant
 Equipment : 1 x 41 W / 8145 lm



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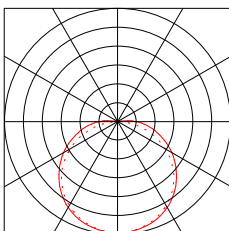
Order No. : TAN19209
 Luminaire name : Arcadian
 Equipment : 1 x 27 W / 3565 lm



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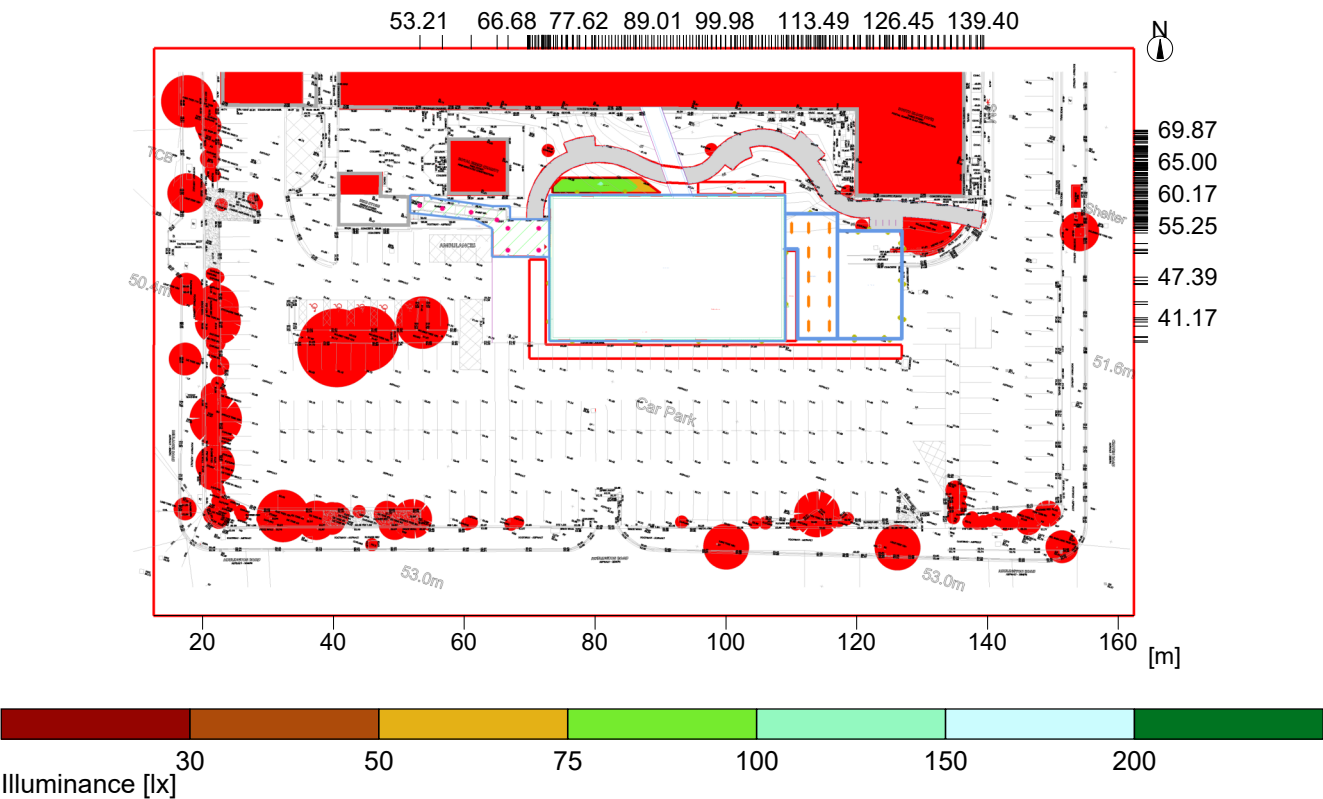


PROLED
 Order No. : L625804HL/L625804HL
 Luminaire name : PROLED FLEX STRIP IP68 300 HE+ MONO
 Equipment : 1 x LED 9.6 W / 1000 lm



2.2 Summary, Exterior 1

2.2.4 Result overview, North Boundary



General

Calculation algorithm used	Average indirect fraction
Height of evaluation surface	0.00 m
Maintenance factor	0.80
Total luminous flux of all lamps	333435 lm
Total power	2834.6 W
Total power per area (12972.10 m²)	0.22 W/m²
Upward light ratio (ULR)	0.32

Illuminance

Average illuminance	Eav	80.2 lx
Minimum illuminance	Emin	51 lx
Maximum illuminance	Emax	96.8 lx
Uniformity Uo	Emin/Em	1:1.57 (0.64)
Diversity Ud	Emin/Emax	1:1.9 (0.53)

Type No. Make

Thorlux Lighting

The ULR value has been calculated without obstruction by other objects.

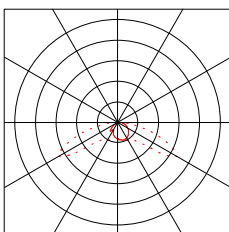
2.2 Summary, Exterior 1

2.2.4 Result overview, North Boundary

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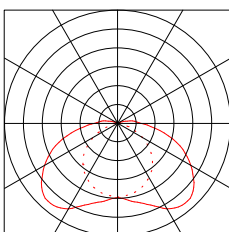
Order No. : ERL19069
 Luminaire name : Realta
 Equipment : 1 x 8 W / 1320 lm



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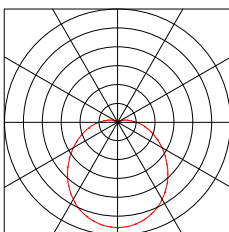
Order No. : EAL20230
 Luminaire name : A-Line - Ligature-Resistant
 Equipment : 1 x 41 W / 8145 lm



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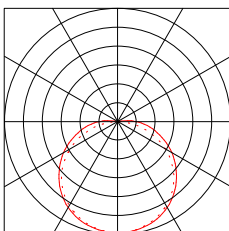
Order No. : TAN19209
 Luminaire name : Arcadian
 Equipment : 1 x 27 W / 3565 lm



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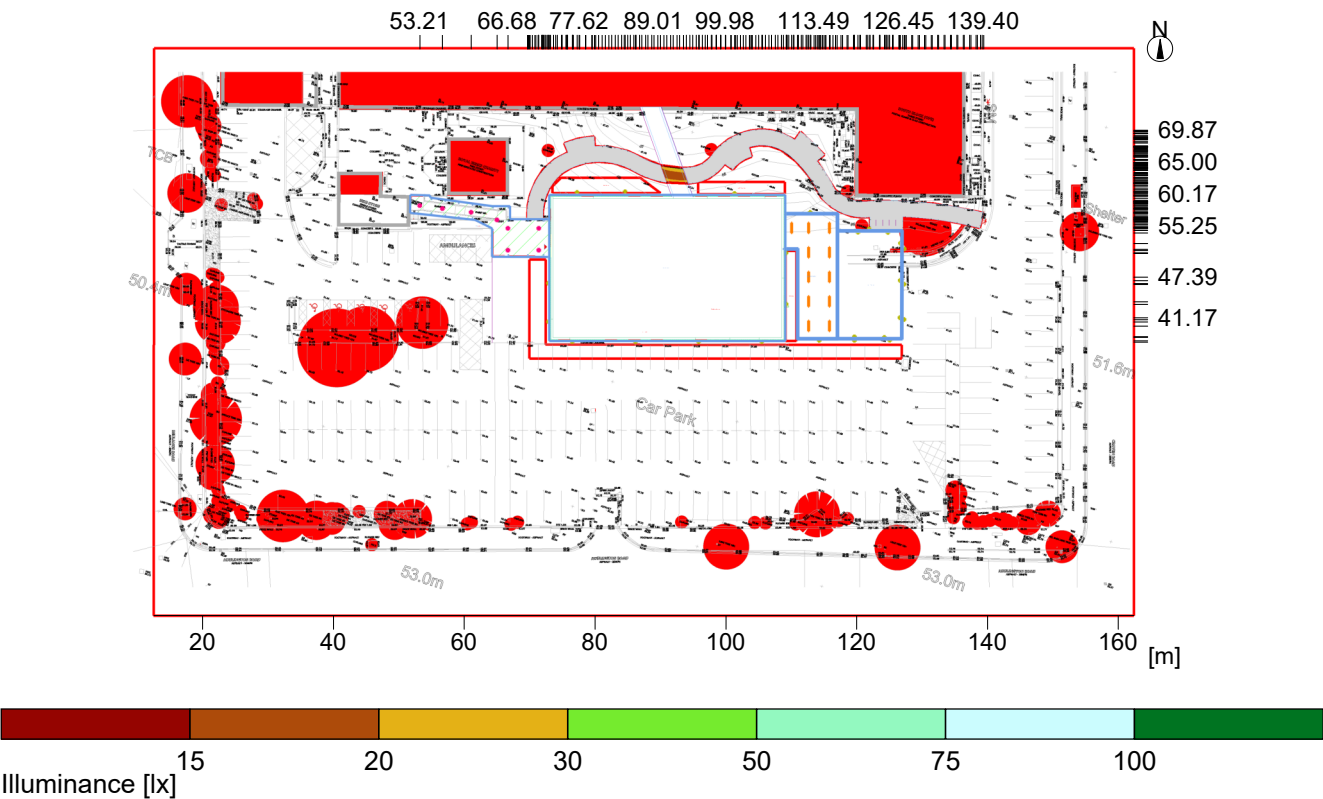


PROLED
 Order No. : L625804HL/L625804HL
 Luminaire name : PROLED FLEX STRIP IP68 300 HE+ MONO
 Equipment : 1 x LED 9.6 W / 1000 lm



2.2 Summary, Exterior 1

2.2.5 Result overview, Walkway



General

Calculation algorithm used	Average indirect fraction
Height of evaluation surface	-0.00 m
Maintenance factor	0.80
Total luminous flux of all lamps	333435 lm
Total power	2834.6 W
Total power per area (12972.10 m²)	0.22 W/m²
Upward light ratio (ULR)	0.32

Illuminance

Average illuminance	Eav	26.3 lx
Minimum illuminance	Emin	2.7 lx
Maximum illuminance	Emax	98.3 lx
Uniformity Uo	Emin/Em	1:9.69 (0.1)
Diversity Ud	Emin/Emax	1:36.2 (0.03)

Type No.Make

Thorlux Lighting

The ULR value has been calculated without obstruction by other objects.

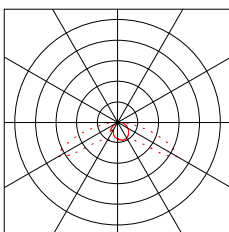
2.2 Summary, Exterior 1

2.2.5 Result overview, Walkway

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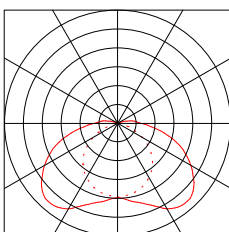
Order No. : ERL19069
 Luminaire name : Realta
 Equipment : 1 x 8 W / 1320 lm



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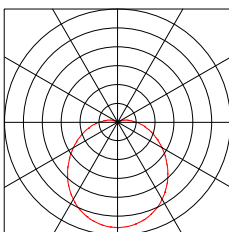
Order No. : EAL20230
 Luminaire name : A-Line - Ligature-Resistant
 Equipment : 1 x 41 W / 8145 lm



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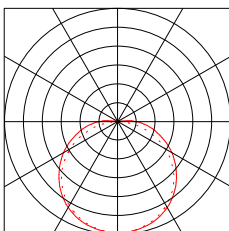
Order No. : TAN19209
 Luminaire name : Arcadian
 Equipment : 1 x 27 W / 3565 lm



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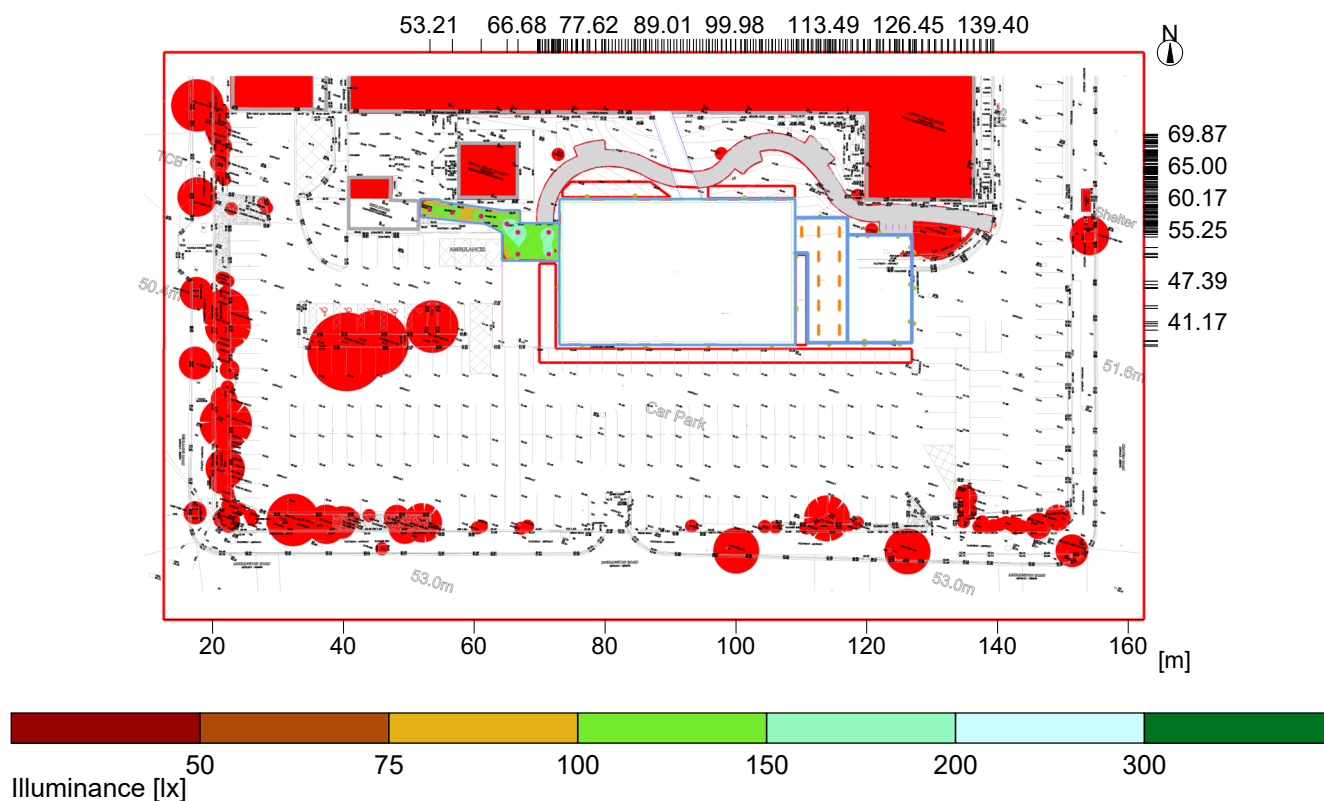


PROLED
 Order No. : L625804HL/L625804HL
 Luminaire name : PROLED FLEX STRIP IP68 300 HE+ MONO
 Equipment : 1 x LED 9.6 W / 1000 lm



2.2 Summary, Exterior 1

2.2.6 Result overview, Entrance



General

Calculation algorithm used	Average indirect fraction
Height of evaluation surface	-0.00 m
Maintenance factor	0.80
Total luminous flux of all lamps	333435 lm
Total power	2834.6 W
Total power per area (12972.10 m ²)	0.22 W/m ²
Upward light ratio (ULR)	0.32

Illuminance

Average illuminance	Eav	118 lx
Minimum illuminance	Emin	53 lx
Maximum illuminance	Emax	183 lx
Uniformity Uo	Emin/Em	1:2.23 (0.45)
Diversity Ud	Emin/Emax	1:3.47 (0.29)

Type No. Make

Thorlux Lighting

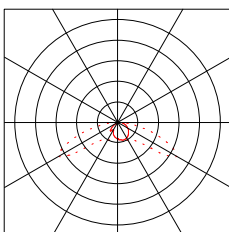
2.2 Summary, Exterior 1

2.2.6 Result overview, Entrance

1 26



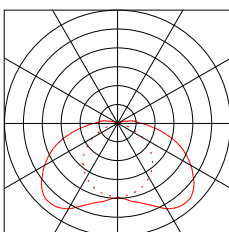
Order No. : ERL19069
 Luminaire name : Realta
 Equipment : 1 x 8 W / 1320 lm



3 11



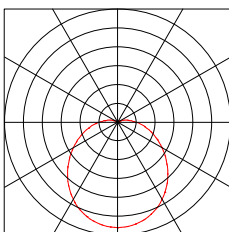
Order No. : EAL20230
 Luminaire name : A-Line - Ligature-Resistant
 Equipment : 1 x 41 W / 8145 lm



4 8



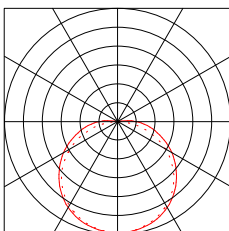
Order No. : TAN19209
 Luminaire name : Arcadian
 Equipment : 1 x 27 W / 3565 lm



6 181

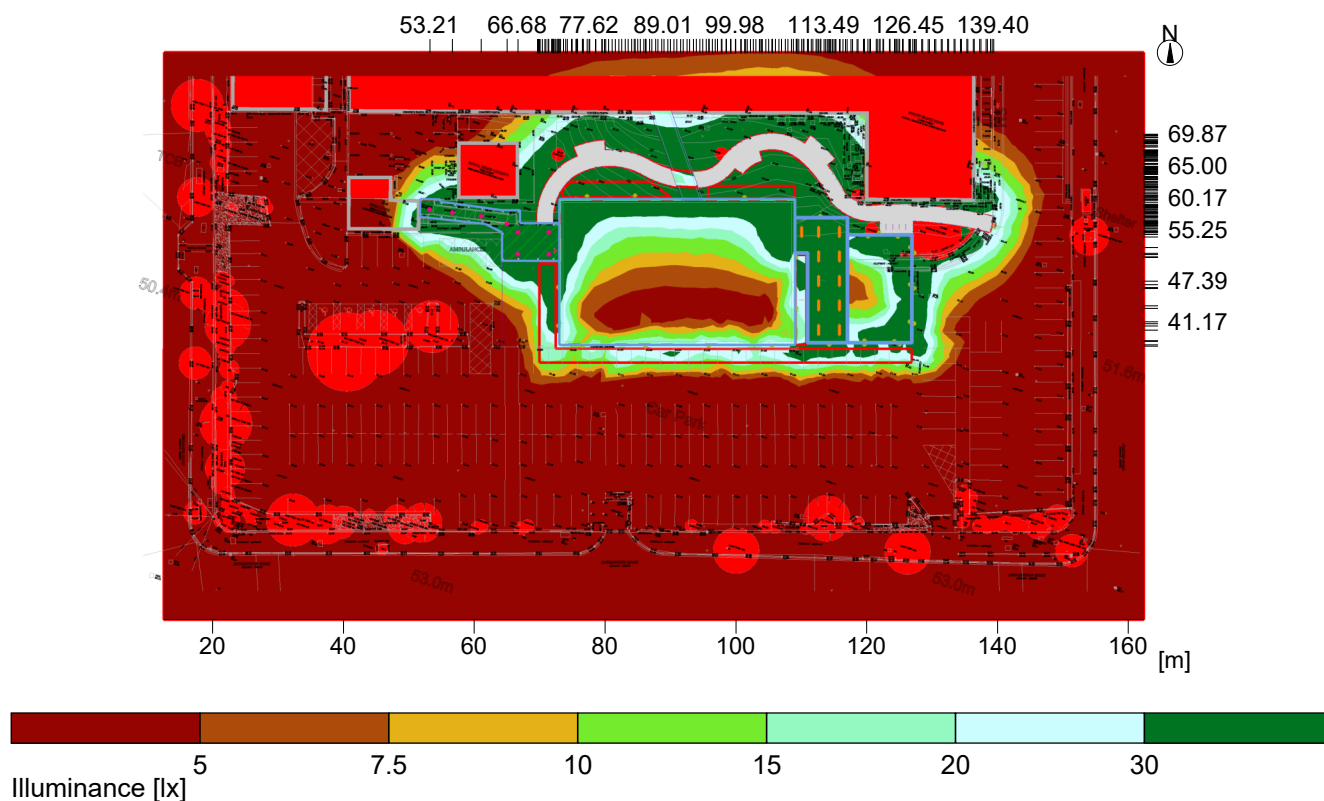


PROLED
 Order No. : L625804HL/L625804HL
 Luminaire name : PROLED FLEX STRIP IP68 300 HE+ MONO
 Equipment : 1 x LED 9.6 W / 1000 lm



2.2 Summary, Exterior 1

2.2.7 Result overview, Evaluation area 1



General

Calculation algorithm used
 Maintenance factor

Average indirect fraction
 0.80

Total luminous flux of all lamps
 Total power
 Total power per area (12972.10 m²)

333435.00 lm
 2834.6 W
 0.22 W/m² (1.90 W/m²/100lx)

Evaluation area 1

Reference plane 1.1

Horizontal
 Em 11.5 lx
 Emin 0 lx
 Emin/Eav (Uo) 0.00
 Emin/Emax (Ud) 0.00
 Upward light ratio (ULR) 0.32
 Position 0.00 m

Type No. Make

Thorlux Lighting

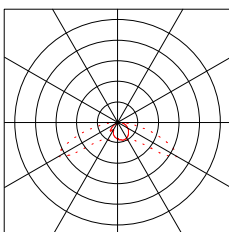
2.2 Summary, Exterior 1

2.2.7 Result overview, Evaluation area 1

1 26



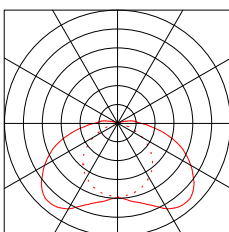
Order No. : ERL19069
 Luminaire name : Realta
 Equipment : 1 x 8 W / 1320 lm



3 11



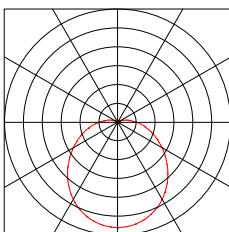
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4 8



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 Luminaire name : Arcadian
 Equipment : 1 x 27 W / 3565 lm



6 181



PROLED
 Order No. : L625804HL/L625804HL
 Luminaire name : PROLED FLEX STRIP IP68 300 HE+ MONO
 Equipment : 1 x LED 9.6 W / 1000 lm

