

# EXTERNAL LIGHTING DESIGN REPORT

3A BLOSSOM WAY HEMEL HEMPSTEAD HERTFORDSHIRE

22 MARCH 2024

## Document Information

### Title and Number

Document Title
<b>External Lighting Design Report</b>

### Revision History

Revision	Author(s)	Reason for Changes	Date
<b>A</b>	POB	Planning Submission	FEB 2022
<b>B</b>	JH	Planning Submission	MAR 2022
<b>C</b>	JH	Planning Submission	MAR 2022
<b>D</b>	JH	Planning Submission	MAR 2022
<b>E</b>	CMC	Planning Submission	JUNE 2022
<b>F</b>	CMC	Planning Submission	MAR 2024

### Approvals

Name	Signature	Title	Date
<b>RP</b>		Manager, Design Engineering	

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## **PART 1 - GENERAL**

### **1.1 INTRODUCTION**

This External Lighting Design Report has been prepared on behalf of TPD Development LLC in support of a S.73 Application for the development of a Data Centre at 3A Blossom Way, Hemel Hempstead, Hertfordshire, HP2 4ZB. The Site falls within the administrative area of Dacorum Borough Council (DBC) and therefore the DBC Local Planning Authority will determine the planning application.

The External Lighting Design Report is one of a suite of technical reports forming part of the application for the Data Centre and associated infrastructure.

### **1.2 DESCRIPTION OF DEVELOPMENT**

The description of the development for which planning permission under S.73 is being sought ('the Proposed Development') is as follows:

*“Variation of Condition 16 (Approved Plans), Condition 6 (Hard and Soft Landscaping), Condition 8 (Parking Plan), Condition 9 (Flood Risk Assessment), Condition 10 (Surface Water Drainage) attached to Planning Permission Application Ref: 4/01922/19/MFA (Comprehensive redevelopment of the site to provide 21,726 sqm of flexible floorspace within use classes B1C/B2/B8 & ancillary offices, with car & cycling parking, access & landscaping) to facilitate the use of the building as a Data Centre and the addition of ancillary buildings, substation and technical plant”.*

### **1.3 PURPOSE AND STRUCTURE**

The remainder of this Statement is structured as follows:

- Part 1 introduces the scheme and proposed amendments.
- Part 2 provides a summary of the design standards that the external lighting equipment adheres to.
- Part 3 describes the key elements that of the lighting scheme and provides a summary of the lighting calculations.
- Part 4 provides overall conclusions.

### **1.4 PROPOSED AMENDMENTS**

Proposal details of variations from the approved scheme are set out as follows:

1. Inclusion of 4 water tanks enclosed within a screen
2. Inclusion of generators, exhaust flues and radiator exhaust ducts
3. Inclusion of a fuel filling point
4. Inclusion of a sprinkler pumphouse and associated tank
5. Inclusion of a security guard house
6. Reduction of the 275 consented car parking spaces to 53
7. Additional landscaping



8. Inclusion of an interim substation
9. A substation compound
10. Inclusion of Sally Port
11. Inclusion of Loading Bay
12. Security Fence (orange line on application drawings).

Other key characteristics of the proposed scheme are as follows:

- Site access location will remain as existing.
- Proposed pedestrian access off Maylands Avenue via stairs to be relocated to provide for level access.
- The height of the building will remain unchanged at 18m (as per the consented scheme).
- The Data Centre will require 32 double stacked containerised generators for emergency back-up power purposes, and an additional smaller generator to cover non-critical loads (e.g., office lights, office fire system) during an emergency. The generators flue exhausts are proposed at 25m in height, confirmed through air quality modelling. These will be located within a generator yard.
- Hybrid air coolers will be located outside the building within the generator yard.
- Fuel for the generators is stored in a belly tank below the lower generator of each pair. Each generator has a 16m<sup>3</sup> belly tank designed to BS799, with an integral bund to provide 110% capacity for the stored volume. The generators are filled from a central point with a single skin 40m<sup>3</sup> storage tank contained within a concrete bund sized to contain 110% of the tank volume.
- A two-bay HGV delivery point will be located on the east part of the Proposed Development site; the generator yard replaces the former 26 dock levellers along the northern facade.
- The substation compound will provide an electrical substation (132/33 kV), associated structures and a boundary fence and screen.
- Security fencing and internal roads will be provided.
- Drainage will include an attenuation tank that will discharge to the existing basin located to the south of the site.
- The Data Centre will be manned on a 24-hour basis once operational and up to 50 staff will be on site at any given time (i.e. a maximum of 50 day-time staff). It is estimated that up to 35 no. full time Data Centre staff will be on site on a daily basis during standard operation, including security staff with a further 7 no. night shift staff and 15 no. external staff/maintenance contractors/visitors.

## **PART 2 - DESIGN STANDARDS**

The proposed External Lighting scheme is based on best practice and National & International Industry Standards, incorporating the following;

- BS EN 12464-2 (2014) ‘Lighting for Work Places. Outdoor Work Places’
- BS EN 13201-2 (2015) ‘Road Lighting. Performance Requirements’
- BS 7671 (2018) +A1 (2020) ‘Requirements for Electrical Installations. IET Wiring Regulations’
- BS 5489-1 (2013) ‘Code of Practice for the Design of Road Lighting – Part 1: Lighting Roads and Public Amenity Areas’
- GN 01/20 (2020) ‘Guidance Notes for the Reduction of Obtrusive Light’ Institution of Lighting Professionals.
- CIE 150 (2017) ‘Guide on the limitation of the effects of obtrusive light from outdoor lighting installations’
- GN 08/18 (2018) ‘Bats and Artificial Lighting in the UK’. Institution of Lighting Professionals.
- LG06/16 (2016) CIBSE Lighting Guide 06. ‘The Exterior Environment’. CIBSE
- Building Regulations

All external lighting equipment shall be specified in accordance with the latest edition and amendments of all applicable standards, codes, laws and regulations listed below.

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC
- CE Marking Directive 93/68/EEC
- RoHS Directive: 2011/65/EC

Note: All electrical equipment and systems supplied shall conform to the appropriate EU Directive and shall carry the appropriate CE Marking.

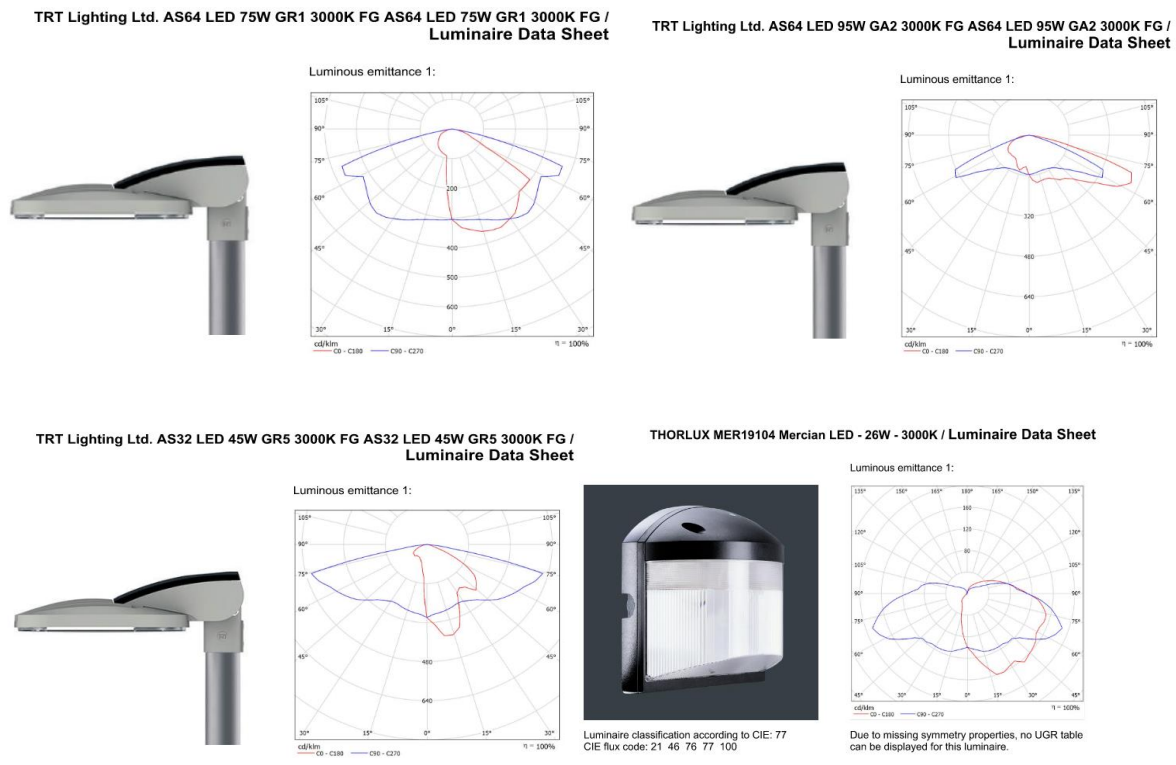
## **PART 3 - KEY ELEMENTS OF PROPOSED LIGHTING SCHEME**

To ensure the safe movement around the proposed development and to aid site surveillance, lighting is proposed along the fence lines and serving the access areas and pedestrian routes, as seen on the External Lighting Design Layout Plan (ref. 284474-XXX-00-XX-DR-E-01000- Rev E) enclosed at Appendix A, lighting is proposed in relation to the site only.

The key elements of the external perimeter lighting are set out below with excerpts of key performance specifications at Figure 1:

- 75 watt, 3000K, LED Column Mounted Luminaires mounted at 8 metre wall/pole - (“Type X1”, refer to Appendix B for locations)

- 95 watt, 3000K, LED Column Mounted Luminaires mounted at 8 metre wall /poles - (“Type X2”, refer to Appendix B for locations)
- 45 watt, 3000K, LED Column Mounted Luminaires on 8 metre poles - (“Type X3”, refer to Appendix B for locations)
- 26 WATT, 3000K, Thorlux MER19104 Mercian LED - 26W - 3000K wall mounted – (“Type M5E”, refer to Appendix B for locations)



**Figure 1: Lighting Specifications**

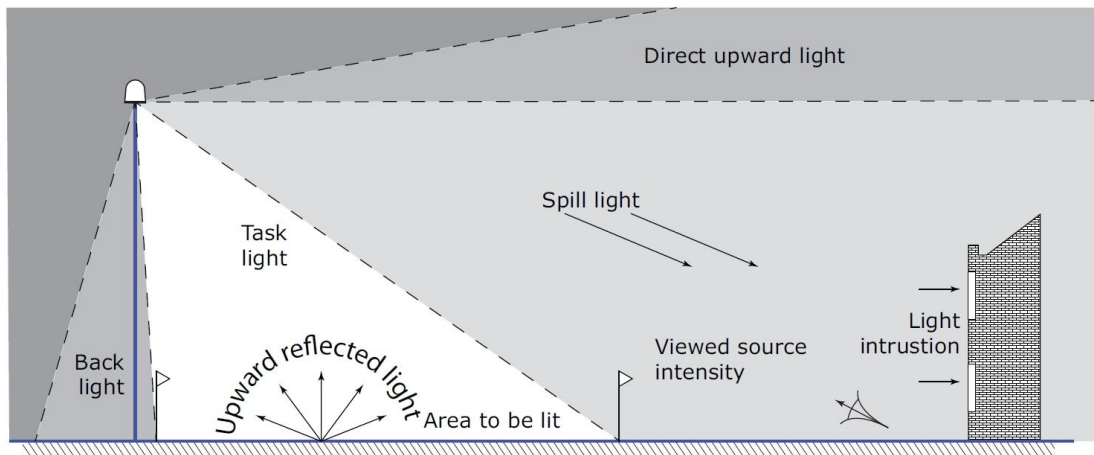
The external perimeter lighting is required during hours of darkness (dusk till dawn) and is controlled via timeclock and photocell arrangement.

The lighting design is optimised for the site to ensure no obtrusive glare, light spillage or other light nuisance on neighbouring uses. Further technical details of the proposed lighting can be found in Part 3 of this document.

**3.1 SITE LIGHTING BASIS OF DESIGN**

**3.2 LIGHT POLLUTION - OVERVIEW**

Obtrusive light from floodlighting within the site boundary onto adjacent roads / landscaped areas shall be minimized taking into consideration the following; (a) sky glow (direct upward waste light), (b) intrusive light and light into windows/windcreens), over illumination, and glare (viewed source intensity) - refer to Figure 2 below.



**Figure 2: Light Pollution**

**3.3 ENVIRONMENTAL CLASSIFICATION**

Predictive modelling has been undertaken to study, identify and reduce potential light pollution from the proposed site to achieve compliance with ILP GN 01/20 *Guidance Notes for the Reduction of Obtrusive Light* with reference to CIE 150 and BS EN 12464-2 Table 2, for Environmental Zone E3 – refer to Figure 3 below for excerpt from BS EN 12464-2.

Environmental Zone E3 is defined in BS EN 12464-2 Clause 4.5 as “medium district brightness areas, such as industrial or residential suburbs”.

Environmental zone	Light on properties		Luminaire intensity		Upward light ratio	Luminance	
	$E_v$ lx		$I$ cd			$R_{UL}$ %	$L_b$ cd·m <sup>-2</sup>
	Pre-curfew <sup>a</sup>	Post-curfew	Pre-curfew	Post-curfew	Building facade		Signs
E1	2	0	2 500	0	0	0	50
E2	5	1	7 500	500	5	5	400
E3	10	2	10 000	1 000	15	10	800
E4	25	5	25 000	2 500	25	25	1 000

**Figure 3: BS EN 12464-2 Maximum obtrusive light for exterior lighting installations**

### 3.4 OBTRUSIVE LIGHT LEVELS

In accordance with the Figure 3 above, the Environmental Zone will be designed to Classification E3, i.e. medium district brightness, with a maximum sky glow (Upward Light Ratio) of 5%, maximum intrusive light (onto windows of adjoining properties) of between 2 to 10 lux (pre and post curfew). There is no lighting curfew policy that identifies a need for the exterior lighting of this site to meet the stricter post-curfew obtrusive lighting requirements as outlined in the table above. However, as the proposed building shall operate as a 24/7 facility, values noted in BS EN 12464-2 Table 2 are ignored, and the more onerous “pre-curfew” values are applied to the design methodology (i.e. maximum trespass lighting level of 2 lux).

Potential problems from glare and over-illumination have been evaluated and addressed in the proposal. Luminaires with high quality optics have been selected and these shall with installed with aiming and commissioning to mitigate against potential light spill and sky glow issues.

The illumination spill calculations shall not take into consideration landscaping proposals which are intended to provide visual screening between adjacent properties and areas of illumination. Landscaping screening (trees) will further reduce light trespass below the required levels.

### 3.5 DESIGN LIGHTING LEVELS

The site lighting design is be based on “P1” requirements, as stipulated in BS EN 13201-2:2015, Clause 6 which is intended for “for pedestrians and pedal cyclists on footways, cycleways, emergency lanes and other road areas lying separately or along the carriageway of a traffic route, and for residential roads, pedestrian streets, parking places, schoolyards etc”.

Minimum maintained illuminance levels shall be designed to achieve between 5 and 15 lux, measured at road level.

Class	Horizontal illuminance		Additional requirement if facial recognition is necessary	
	$\bar{E}^a$ [minimum maintained] lx	$E_{min}$ [maintained] lx	$E_{v,min}$ [maintained] lx	$E_{sc,min}$ [maintained] lx
P1	15,0	3,00	5,0	5,0
P2	10,0	2,00	3,0	2,0
P3	7,50	1,50	2,5	1,5
P4	5,00	1,00	1,5	1,0
P5	3,00	0,60	1,0	0,6
P6	2,00	0,40	0,6	0,2
P7	performance not determined	performance not determined		

<sup>a</sup> To provide for uniformity, the actual value of the maintained average illuminance shall not exceed 1,5 times the minimum  $\bar{E}$  value indicated for the class.

**Figure 4: BS EN 13201-2:2015 Table 3, P Lighting Classes**

### **3.6 DETAILED DESIGN**

### **3.7 DESIGN CALCULATIONS**

The external lighting design and has been calculated in accordance with BS EN 12464-2 Environmental zone E3 requirements using Dialux lighting design software. The calculation results are included at Appendix B of this report.

### **3.8 SUMMARY OF CALCULATIONS**

The calculations show that the maximum permissible Upward Light Ratio (ULR) of 5% has not been exceeded. The lighting design calculations demonstrate that the proposed lighting installation achieves an upward light ration of 0%, thus the design is compliant with BS EN 12464-2 Environmental zone E3 requirements.

The maximum intrusive light (lux) of 2 lux on the vertical plan has not been exceeded. The lighting calculations demonstrate that the proposed lighting installation achieves a value of less than 0.1 lux, thus the design is compliant with BS EN 12464-2 Environmental zone E3 requirements. In addition, the Class of Road Lighting design is based on P1 requirements, as per BS EN 13201-2:2015.

The proposed lighting scheme is specifically designed as the worst case scenario, and where possible all recommended limitations on obtrusive light stipulated in the above mentioned standards are adhered to. It is also important to note that the minimal illumination spill onto adjacent roads does not take into consideration proposed landscaping (screening), this screening will further reduce light trespass onto these roads.

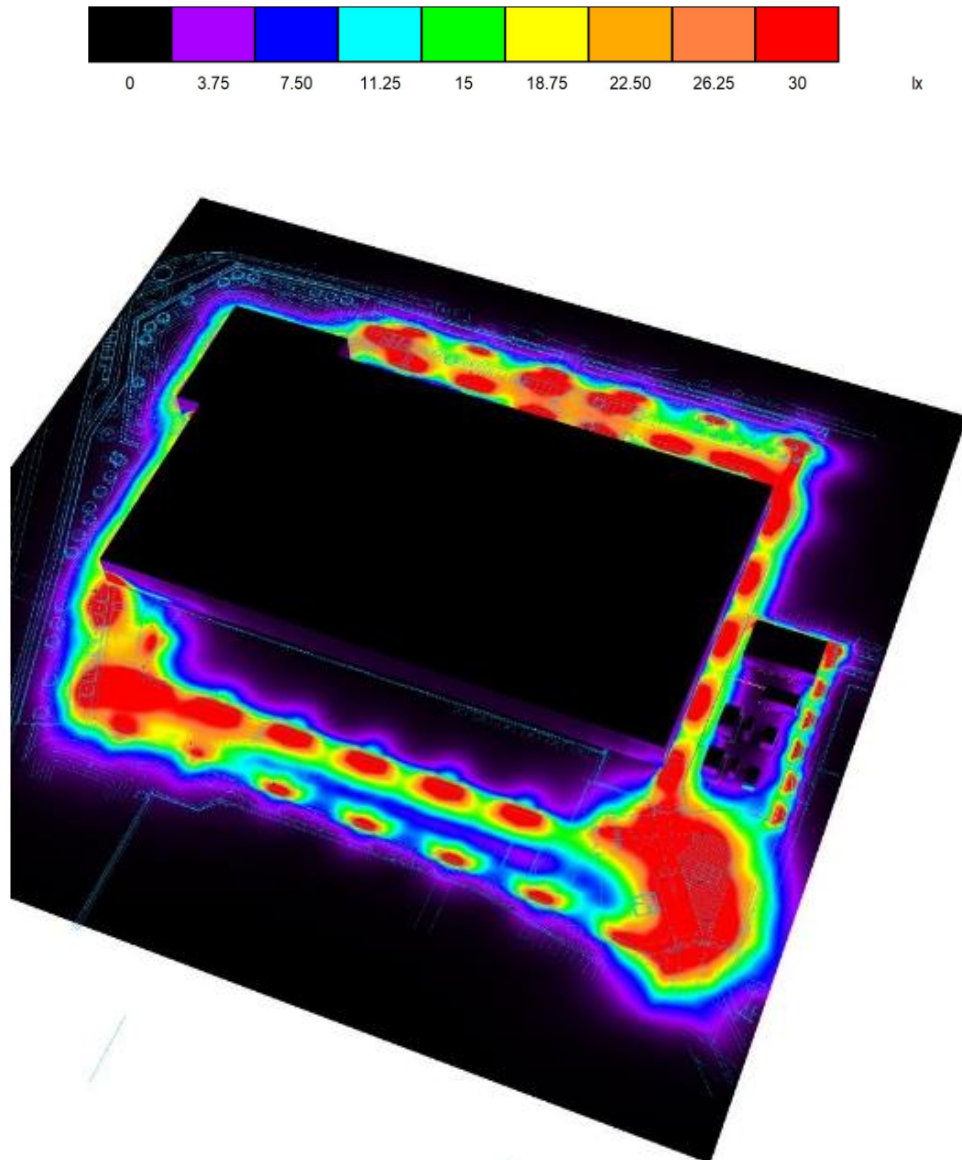
External lighting circuits shall be controlled by photocells and/or time switch as shown on the drawings.

## **PART 4 - DESIGN CONCLUSIONS**

This analysis demonstrates that the external lighting design is in compliance with the standards noted within this report.

#### 4.1 DESIGN CALCULATION IMAGES

Lighting design simulation results have been undertaken within Dialux software with full details included at Appendix B. Refer to Figure 5 below for excerpt of False Colour Rendering from the software.



**Figure 5:** False Colour Rendering

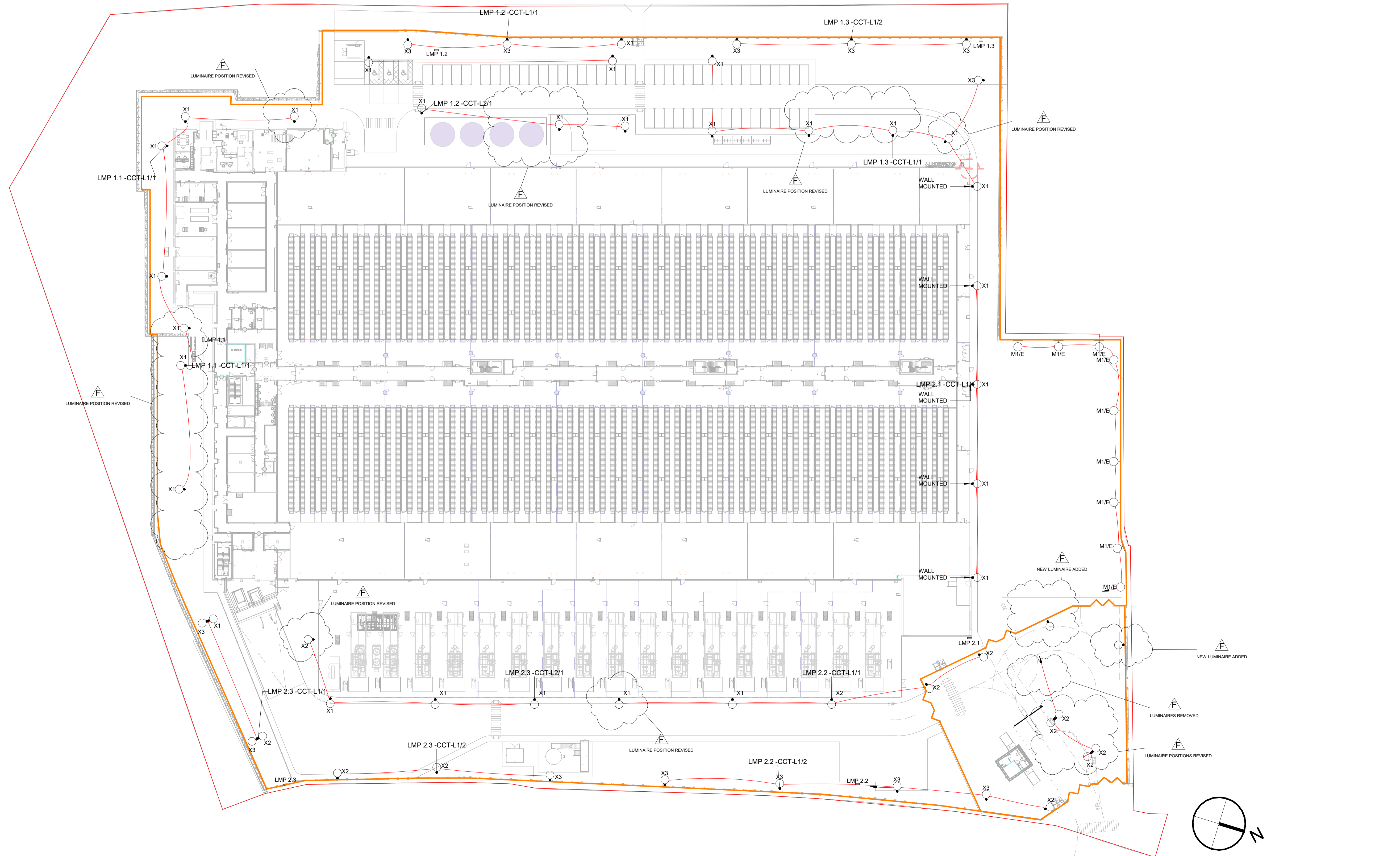
**PART 5 - APPENDICES**



**5.1 APPENDIX A – EXTERNAL LIGHTING DESIGN LAYOUT PLAN**

**5.2 APPENDIX B –EXTERNAL LIGHTING DESIGN CALCULATIONS**

LIGHTING LEGEND		
ID	LUMINAIRE DESCRIPTION	AREA
M1/E	THORLUX MER19104, MERCIAN 26W LED WITH INTEGRAL EMERGENCY CONTROL GEAR. SWITCHING TO BE CONTROLLED BY STANDALONE PHOTOCELL. FINAL MOUNTING HEIGHT TO BE AGREED ON SITE WITH ENGINEERING	EXTERNAL FENCE AROUND SUBSTATION
X1	TRT LIGHTING AS64 LED 75W GR1 3000K FG AS64 LED 75W GR1 3000K FG MOUNTED AT 8M	
X2	TRT LIGHTING AS64 LED 95W GA2 3000K FG AS64 LED 95W GA2 3000K FG MOUNTED AT 8M	
X3	TRT LIGHTING AS32 LED 45W GR5 3000K FG AS32 LED 45W GR5 3000K FG MOUNTED AT 8M	



NOTES

- DRAWING TO BE READ IN CONJUNCTION WITH ELECTRICAL SPECIFICATION, ARCHITECTURAL DRAWINGS, EXTERNAL SITE PHASING PLAN, AND CIVIL ENGINEER'S DRAWINGS.
- ALL LIGHTING DRAWINGS TO BE READ IN CONJUNCTION WITH LUMINAIRE SCHEDULES.
- SETTING OUT OF ALL EXTERNAL LIGHT FITTINGS, SENSORS AND SWITCHES TO BE APPROVED BY THE ARCHITECT, LANDSCAPE ARCHITECT AND BUILDING USERS, 4 WEEKS BEFORE INSTALLATION COMMENCEMENT.
- CONTRACTOR TO ENSURE THAT LIGHTING LOADS ARE WELL BALANCED ACROSS PHASES ON ALL PANELS.
- CABLES INSTALLED WITHIN THE MAIN BUILDING SHALL BE INSTALLED ON CABLE RACKS, TRAYS ETC.
- WALL MOUNTED LUMINAIRES WIRED THROUGH BUILDING WITH TERMINAL BOX INSIDE BUILDING AND FLEXIBLE CABLE WIRED THROUGH CONDUIT SLEEVE AND GLAND TO LUMINAIRES OUTSIDE.
- WIRING OF "ON BUILDING" EXTERNAL LIGHTING INSIDE BUILDING SHALL BE XP/LE/SWA CABLE (LSF TYPE) ON TRAY OR IN CONDUIT. WIRING OF "OFF BUILDING" LUMINAIRES SHALL BE WITHIN U/G DUCTS SHALL BE XLPE/SWA/LSF.
- TERMINAL BOXES SHALL BE PROVIDED WITH DIN RAIL MOUNTED TERMINALS.
- 24-7 DIGITAL TIME-SWITCH / PHOTOCELL AND HAND/OFF/AUTO CONTROL (TO OVERRIDE PHOTOCELL/TIMELOCK CONTROL) SHALL BE PROVIDED IN THE RELEVANT HPPs WITH REMOTE H/O/A SWITCHES LOCATED IN THE SECURITY OFFICE. A 12Vdc EXTERNAL LIGHTING INTERFACE RELAY SHALL BE INSTALLED WITHIN THE EXTERNAL LIGHTING DISTRIBUTION BOARD, TO INTERFACE SITE LIGHTING WITH SECURITY SYSTEMS INSTALLATIONS.
- ALL CIRCUITS MUST BE PROVIDED WITH LOCAL ISOLATION IN ACCORDANCE WITH THE MOST RECENT ITERATION OF BS 7671.
- REFER TO CIVIL ENGINEERS LAYOUTS FOR ELV/LV DUCTING ROUTES.
- SUPPLY CABLES FROM LIGHTING MINI PILLARS TO LIGHTING POLES SHALL BE ARMOURD 3c 16sqmm. CABLES FED VIA A 10A TYPE B MCB.
- ALL GALVANISED STEEL LIGHTING MINI PILLARS SHALL BE COUNTED TO GROUND VIA A 120SQMM COUNTERPOISE EARTH.

LEGEND

- SINGLE LUMINAIRE, POLE MOUNTED
- TWIN LUMINAIRES, MOUNTED ON SINGLE POLE
- SINGLE LUMINAIRE, WALL MOUNTED
- LMP - LIGHTING MINI PILLAR
- SMP - SECURITY MINI PILLAR
- SECURITY FENCE
- BOUNDARY LINE

F	25 MAR'24	PLANNING APPLICATION	DC	CMG		
E	10 JUN'22	PLANNING APPLICATION	DM	CMG		
D	14 MAR'22	PLANNING APPLICATION	ROF	JH		
C	04 MAR'22	PLANNING APPLICATION	DM	JH		
B	16 FEB'22	PLANNING APPLICATION	ROF	POB		
REV.	DATE	DESCRIPTION	DRN	ENG	CHK	APP

PROJECT: LHR095

TITLE: SITE LIGHTING AND ELECTRICAL SERVICES LAYOUT

DRAWING NO: 284474-XXX-00-XX-DR-E-01000

SCALE: 1:500

REV: F

## **549923-R8 LHR External Lighting**

R1 - introduced 3000K Colour Temperature

R2 - 16/02/22 new layout review

R3 - 04/03/22 substation added

R4 - 07/03/22 substation revision

R5 - 08/03/22 substation revision

R6 - 07/04/22 entrance change

R7 - 04/05/22 security perimeter revision

R8 - 07/06/23

Partner for Contact: Jonathon Harte  
Company: AWS

Date: 07.06.2023  
Operator: Janko Aschenbrenner

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 Unit G6 Riverview Business Park, Nangor Road, Dublin 12

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<b>Security Perimeter</b>	
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Isolines (E, Perpendicular)	28
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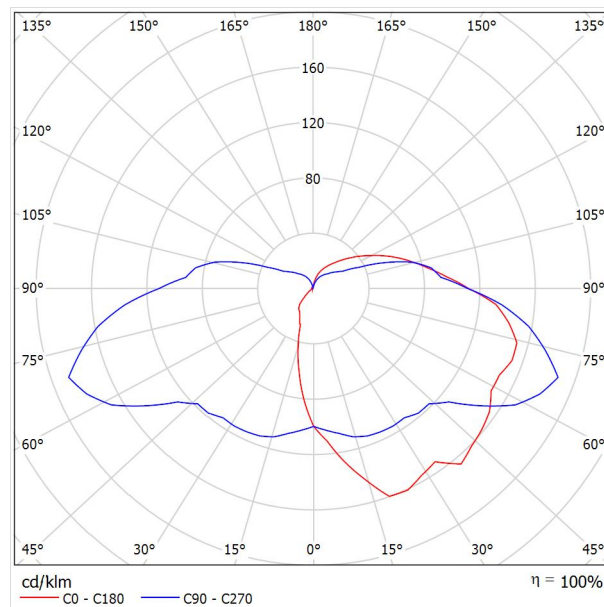


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### THORLUX MER19104 Mercian LED - 26W - 4000K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 77  
CIE flux code: 21 46 76 77 100

Vandal resistant luminaires photometrically designed to achieve wide luminaire spacing. Die cast aluminium body and impact resistant, flame-retardant prismatic polycarbonate cover. New - LED version.

Applications: walkways and entrance areas, commercial premises, educational institutes and hospital/healthcare buildings.

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

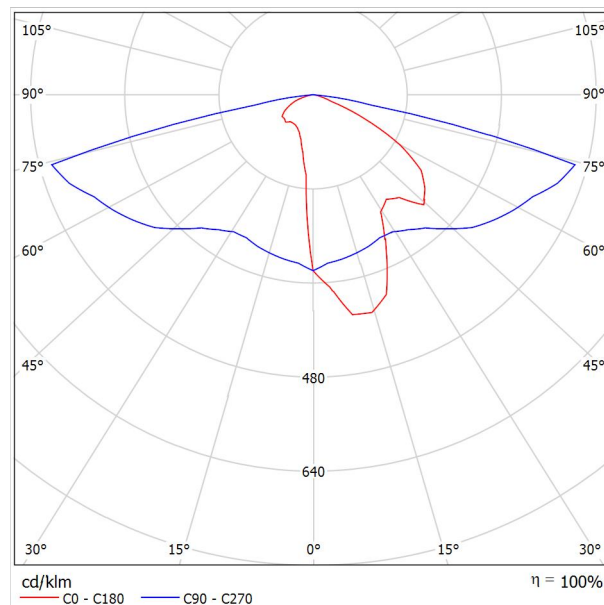
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### TRT Lighting Ltd. AS32 LED 45W GR5 3000K FG AS32 LED 45W GR5 3000K FG / Luminaire Data Sheet

See our luminaire catalog for an image of the luminaire.

Luminous emittance 1:



Luminaire classification according to CIE: 100  
CIE flux code: 32 65 94 100 100

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

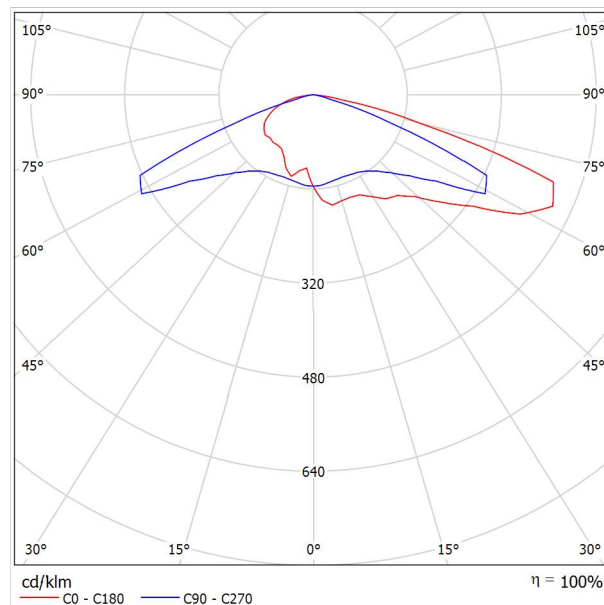
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## TRT Lighting Ltd. AS64 LED 95W GA2 3000K FG AS64 LED 95W GA2 3000K FG / Luminaire Data Sheet

Luminous emittance 1:

See our luminaire catalog for an image of the luminaire.



Luminaire classification according to CIE: 100  
CIE flux code: 24 56 93 100 100

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.



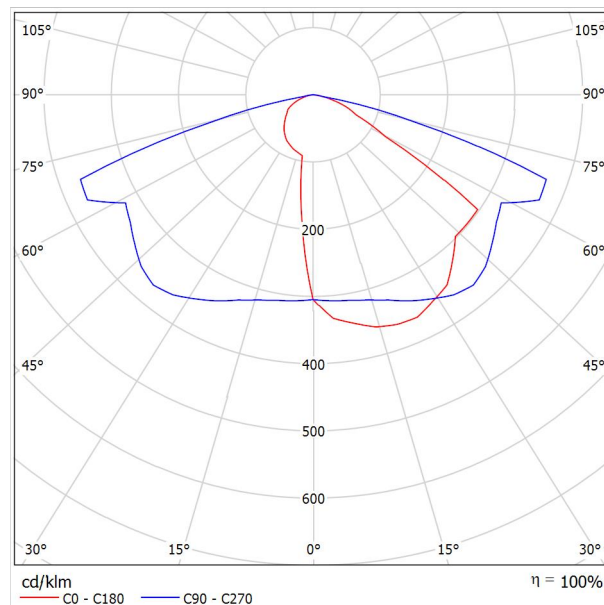
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## TRT Lighting Ltd. AS64 LED 75W GR1 3000K FG AS64 LED 75W GR1 3000K FG / Luminaire Data Sheet

See our luminaire catalog for an image of the luminaire.

Luminous emittance 1:



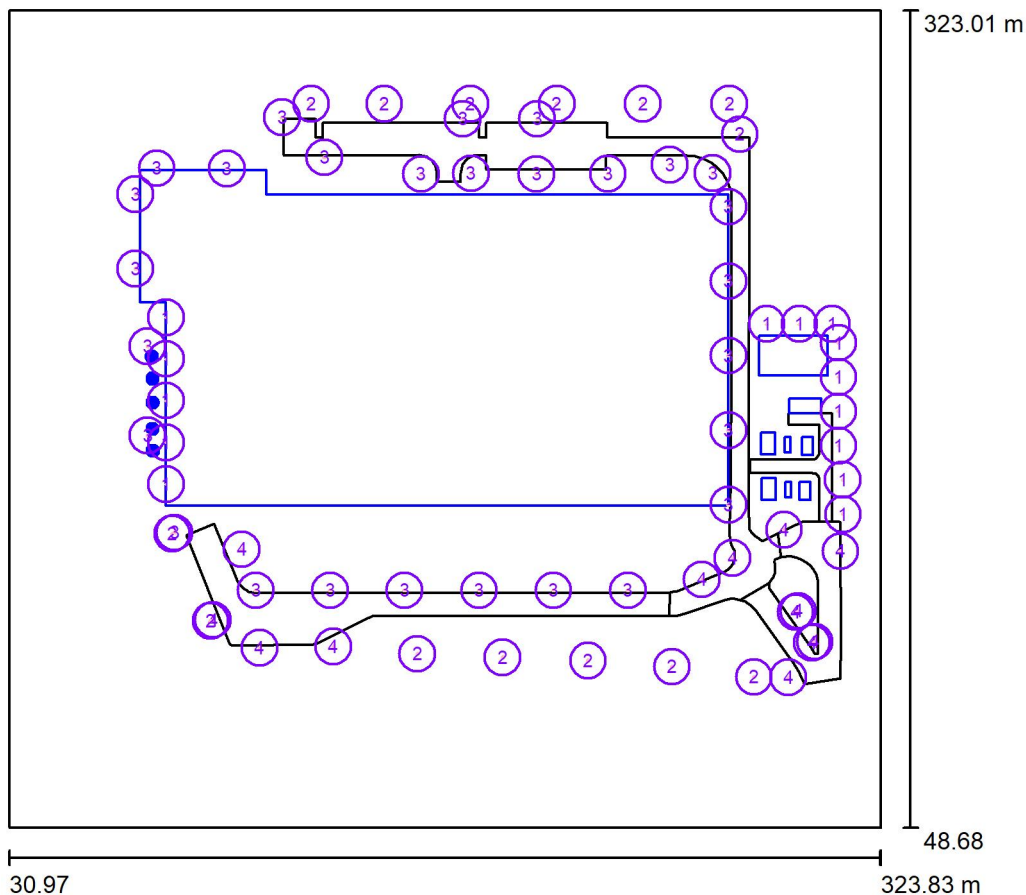
Luminaire classification according to CIE: 100  
CIE flux code: 39 74 97 100 100

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

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### Exterior Scene 1 / Planning data



Maintenance factor: 0.80, ULR (Upward Light Ratio): 1.0%

Scale 1:2543

#### Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	14	THORLUX MER19104 Mercian LED - 26W - 4000K (1.000)	3333	3330	30.0
2	14	TRT Lighting Ltd. AS32 LED 45W GR5 3000K FG AS32 LED 45W GR5 3000K FG (1.000)	5834	5858	45.0
3	28	TRT Lighting Ltd. AS64 LED 75W GR1 3000K FG AS64 LED 75W GR1 3000K FG (1.000)	10570	10570	75.0
4	13	TRT Lighting Ltd. AS64 LED 95W GA2 3000K FG AS64 LED 95W GA2 3000K FG (1.000)	12560	12562	95.0
Total:			587582	587898	4385.0

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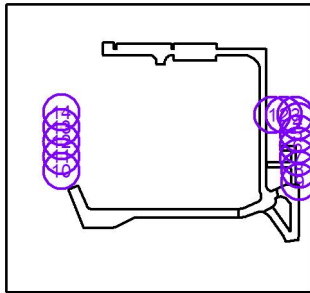
Fax

e-Mail janko.aschenbrenner@thorlux.ie

### Exterior Scene 1 / Luminaires (coordinates list)

#### THORLUX MER19104 Mercian LED - 26W - 4000K

3333 lm, 30.0 W, 1 x 1 x Mercian LED - 26W 4000K (Correction Factor 1.000).



No.	Position [m]			Rotation [°]		
	X	Y	Z	X	Y	Z
1	285.589	217.748	2.500	0.0	0.0	-90.0
2	296.589	217.748	2.500	0.0	0.0	-90.0
3	307.589	217.748	2.500	0.0	0.0	-90.0
4	309.787	211.400	2.500	0.0	0.0	-180.0
5	309.787	199.900	2.500	0.0	0.0	-180.0
6	309.787	188.400	2.500	0.0	0.0	-180.0
7	309.787	176.900	2.500	0.0	0.0	-180.0
8	311.166	165.400	2.500	0.0	0.0	-180.0
9	311.263	153.900	2.500	0.0	0.0	-180.0
10	83.763	163.997	2.500	0.0	0.0	180.0
11	83.763	177.997	2.500	0.0	0.0	180.0
12	83.763	191.997	2.500	0.0	0.0	180.0
13	83.763	205.997	2.500	0.0	0.0	180.0
14	83.763	219.997	2.500	0.0	0.0	180.0

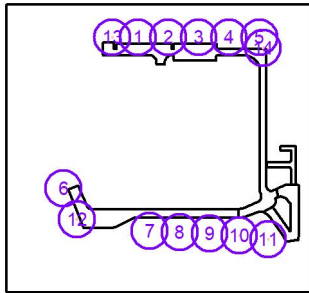
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Unit G6 Riverview Business Park, Nangor Road, Dublin 12

### Exterior Scene 1 / Luminaires (coordinates list)

**TRT Lighting Ltd. AS32 LED 45W GR5 3000K FG AS32 LED 45W GR5 3000K FG**  
 5834 lm, 45.0 W, 1 x 1 x 42 0045 0000 100 (Correction Factor 1.000).



No.	Position [m]			Rotation [°]		
	X	Y	Z	X	Y	Z
1	157.028	291.586	6.000	0.0	0.0	-90.0
2	186.028	291.586	6.000	0.0	0.0	-90.0
3	215.028	291.586	6.000	0.0	0.0	-90.0
4	244.028	291.586	6.000	0.0	0.0	-90.0
5	273.028	291.586	6.000	0.0	0.0	-90.0
6	85.794	147.447	8.000	0.0	0.0	-161.4
7	168.217	106.978	6.000	0.0	0.0	90.0
8	196.869	105.810	6.000	0.0	0.0	90.0
9	225.520	104.727	6.000	0.0	0.0	90.0
10	253.742	102.676	6.000	0.0	0.0	90.0
11	281.319	99.223	6.000	0.0	0.0	90.0
12	98.693	118.053	8.000	0.0	0.0	-161.4
13	132.536	291.607	6.000	0.0	0.0	-90.0
14	276.578	281.392	6.000	0.0	0.0	180.0

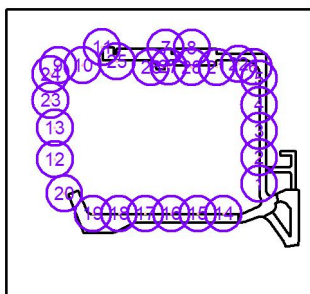
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Unit G6 Riverview Business Park, Nangor Road, Dublin 12

### Exterior Scene 1 / Luminaires (coordinates list)

**TRT Lighting Ltd. AS64 LED 75W GR1 3000K FG AS64 LED 75W GR1 3000K FG**  
 10570 lm, 75.0 W, 1 x 1 x 42 0075 0000 100 (Correction Factor 1.000).



No.	Position [m]			Rotation [°]		
	X	Y	Z	X	Y	Z
1	272.773	157.066	8.000	0.0	0.0	0.0
2	272.773	182.066	8.000	0.0	0.0	0.0
3	272.773	207.066	8.000	0.0	0.0	0.0
4	272.773	232.066	8.000	0.0	0.0	0.0
5	272.773	257.066	8.000	0.0	0.0	0.0
6	267.484	268.408	8.000	0.0	0.0	48.6
7	183.476	286.556	8.000	0.0	0.0	-90.0
8	208.476	286.556	8.000	0.0	0.0	-90.0
9	80.583	269.960	8.000	0.0	0.0	90.0
10	104.180	269.939	8.000	0.0	0.0	90.0
11	122.723	287.063	8.000	0.0	0.0	-90.0
12	77.508	180.247	6.000	0.0	0.0	180.0
13	77.508	210.247	6.000	0.0	0.0	180.0
14	238.918	128.263	8.000	0.0	0.0	-90.0
15	213.918	128.263	8.000	0.0	0.0	-90.0
16	188.918	128.263	8.000	0.0	0.0	-90.0
17	163.918	128.263	8.000	0.0	0.0	-90.0
18	138.918	128.263	8.000	0.0	0.0	-90.0
19	113.918	128.263	8.000	0.0	0.0	-90.0
20	86.567	147.716	8.000	0.0	0.0	18.6
21	232.216	268.153	8.000	0.0	0.0	90.0
22	253.037	271.165	8.000	0.0	0.0	90.0
23	73.468	236.303	8.000	0.0	0.0	180.0
24	73.468	261.303	8.000	0.0	0.0	180.0
25	136.935	273.660	8.000	0.0	0.0	90.0
26	169.394	268.057	8.000	0.0	0.0	90.0
27	186.226	268.278	8.000	0.0	0.0	90.0
28	208.262	268.063	8.000	0.0	0.0	90.0

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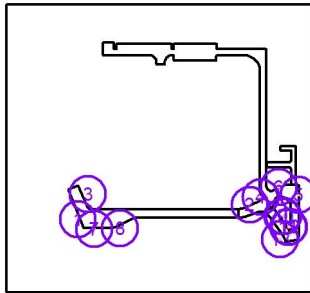
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### Exterior Scene 1 / Luminaires (coordinates list)

**TRT Lighting Ltd. AS64 LED 95W GA2 3000K FG AS64 LED 95W GA2 3000K FG**  
 12560 lm, 95.0 W, 1 x 1 x 42 0095 0000 100 (Correction Factor 1.000).



No.	Position [m]			Rotation [°]		
	X	Y	Z	X	Y	Z
1	99.507	118.347	8.000	0.0	0.0	18.6
2	263.838	132.018	8.000	0.0	0.0	-64.4
3	109.155	142.096	8.000	0.0	0.0	-160.0
4	274.158	139.202	8.000	0.0	0.0	-20.0
5	310.394	141.412	8.000	0.0	0.0	180.0
6	291.406	148.655	8.000	0.0	0.0	-90.0
7	115.162	109.023	8.000	0.0	0.0	90.0
8	139.927	109.464	8.000	0.0	0.0	90.0
9	295.332	121.017	8.000	0.0	0.0	-158.0
10	296.188	121.414	8.000	0.0	0.0	22.0
11	300.826	110.703	8.000	0.0	0.0	-158.0
12	301.760	111.068	8.000	0.0	0.0	22.0
13	292.912	99.177	8.000	0.0	0.0	7.0

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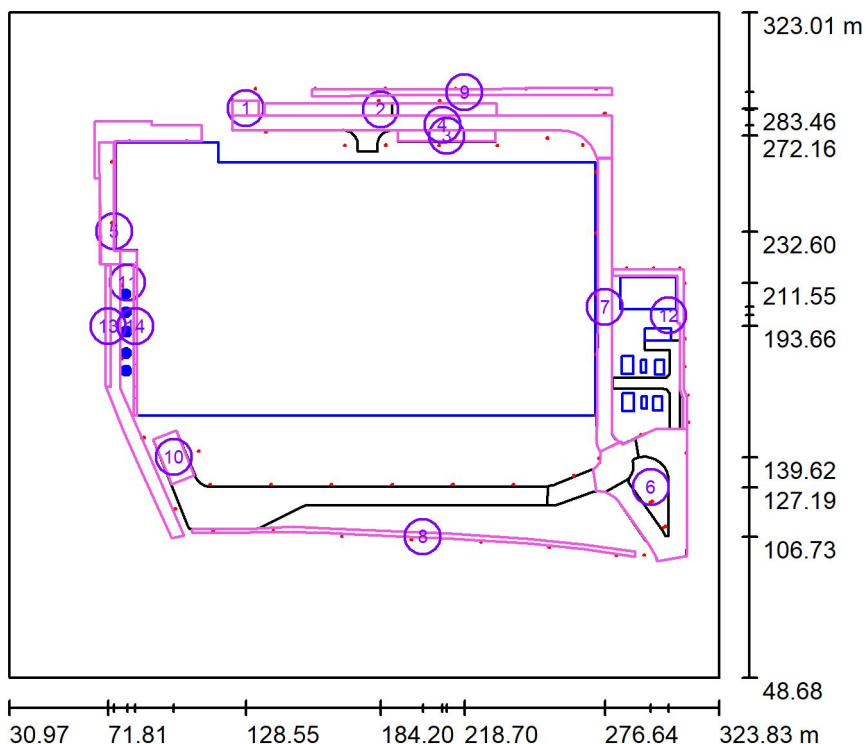
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### Exterior Scene 1 / Calculation surfaces (results overview)



Scale 1 : 3122

#### Calculation Surface List

No.	Designation	Type	Grid	$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
1	Acc. Parking	perpendicular	16 x 16	37	27	57	0.723	0.470
2	Parking 2	perpendicular	128 x 16	23	8.59	58	0.368	0.148
3	Parking 3	perpendicular	128 x 16	30	19	50	0.635	0.384
4	Road 1	perpendicular	128 x 128	25	8.86	53	0.354	0.169
5	Side Path	perpendicular	128 x 16	26	6.95	63	0.267	0.110
6	Main Site Entrance	perpendicular	128 x 128	35	14	75	0.414	0.193
7	Road 5	perpendicular	128 x 16	29	16	50	0.545	0.313
8	Security Perimeter	perpendicular	128 x 32	21	7.59	60	0.354	0.127
9	Security Perimeter	perpendicular	128 x 8	24	7.80	61	0.332	0.128

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## Exterior Scene 1 / Calculation surfaces (results overview)

### Calculation Surface List

No.	Designation	Type	Grid	$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
10	Loading Ramp	perpendicular	32 x 64	22	12	43	0.546	0.279
11	Security Perimeter	perpendicular	60 x 20	26	5.36	85	0.205	0.063
12	Substation Exterior Perimeter	perpendicular	128 x 128	29	9.56	66	0.327	0.144
13	Security Perimeter	perpendicular	8 x 128	21	9.94	39	0.464	0.253
14	Side Path	perpendicular	8 x 128	24	7.03	65	0.297	0.109

### Summary of Results

Type	Quantity	Average [lx]	Min [lx]	Max [lx]	u0	$E_{min} / E_{max}$
perpendicular	14	28	5.36	85	0.19	0.06

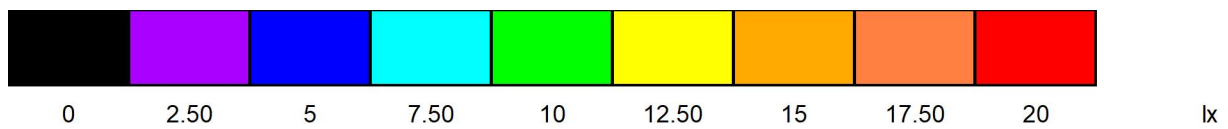
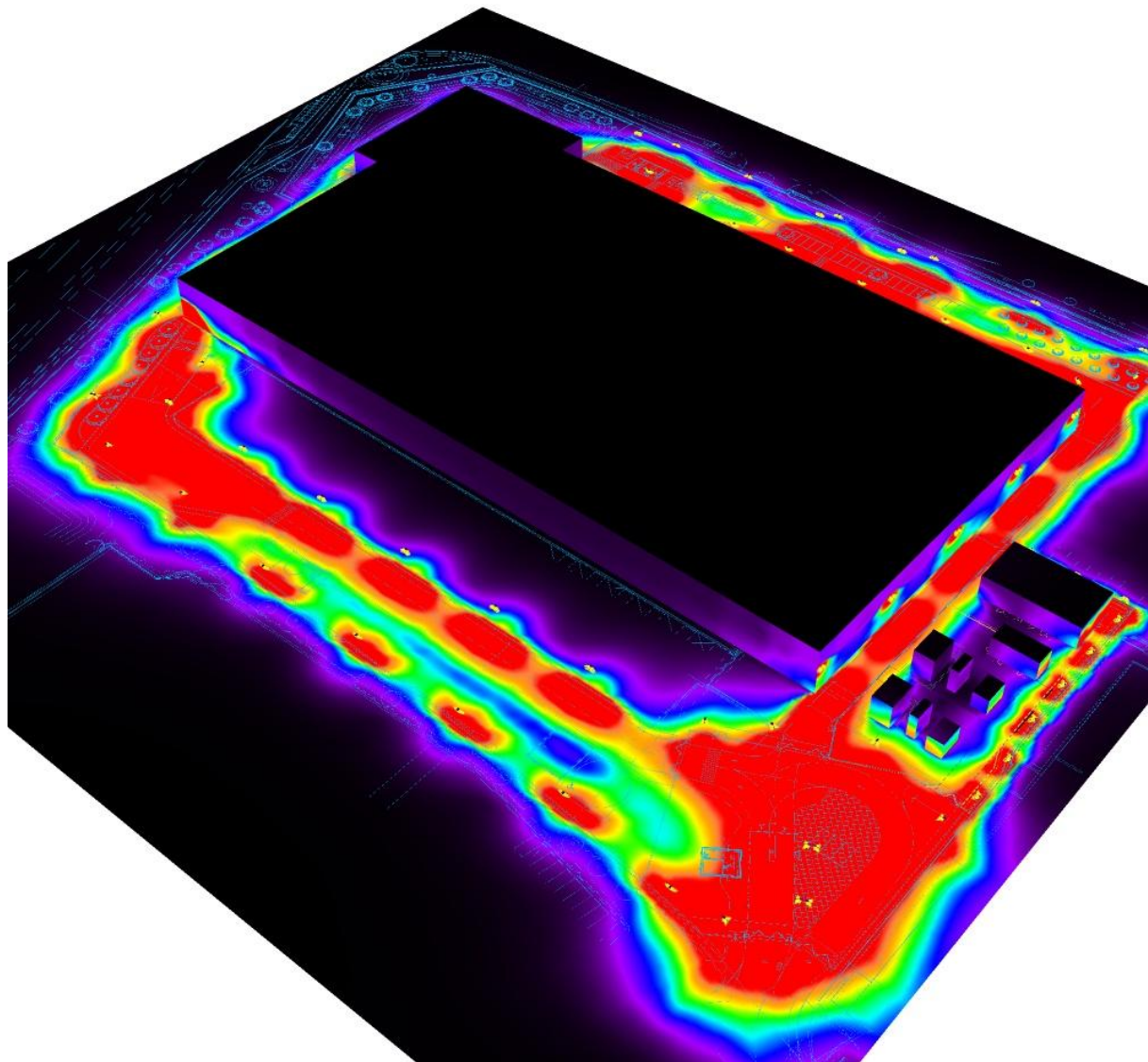


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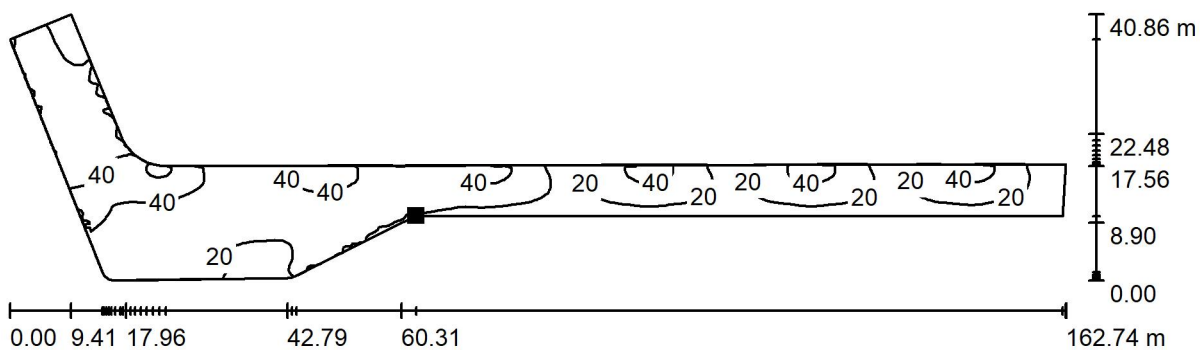
### Exterior Scene 1 / False Colour Rendering



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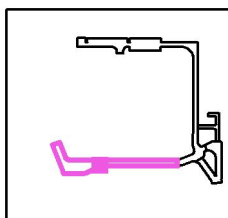
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### Exterior Scene 1 / Road 3 / Surface 1 / Isolines (E)



Values in Lux, Scale 1 : 1164

Position of surface in external scene:  
 Marked point:  
 (153.026 m, 119.694 m, 0.000 m)



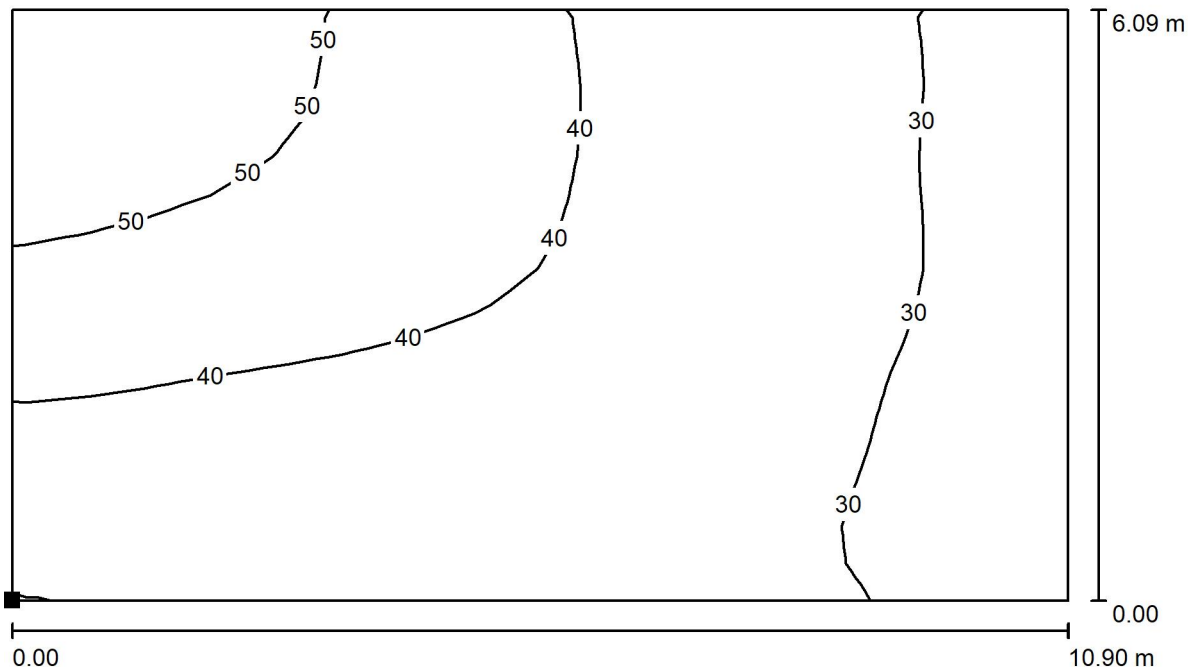
Grid: 128 x 128 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
27	11	63	0.395	0.171

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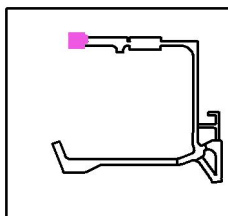
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### Exterior Scene 1 / Acc. Parking / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 78

Position of surface in external scene:  
 Marked point:  
 (123.100 m, 280.415 m, 0.000 m)



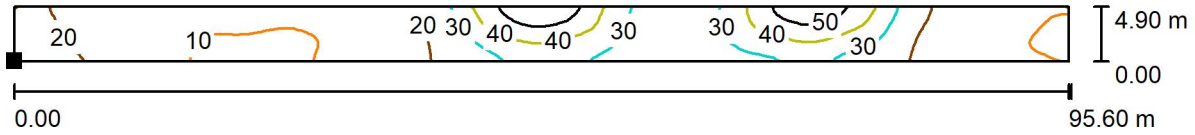
Grid: 16 x 16 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
37	27	57	0.723	0.470

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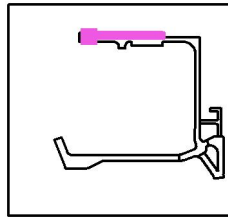
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### Exterior Scene 1 / Parking 2 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 684

Position of surface in external scene:  
 Marked point:  
 (136.400 m, 280.411 m, 0.000 m)



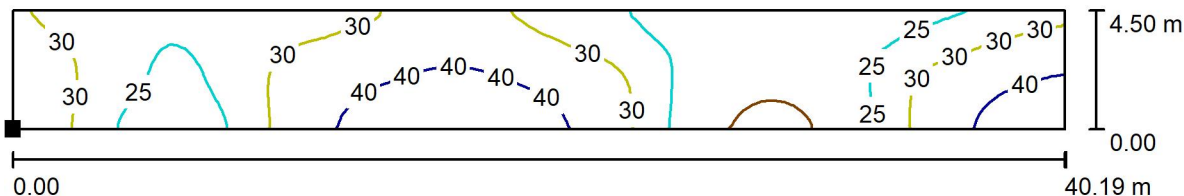
Grid: 128 x 16 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	$u_0$	$E_{min} / E_{max}$
23	8.59	58	0.368	0.148

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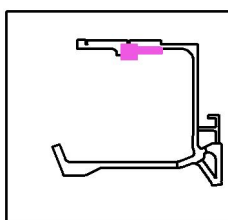
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### Exterior Scene 1 / Parking 3 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 288

Position of surface in external scene:  
 Marked point:  
 (191.320 m, 269.911 m, 0.000 m)



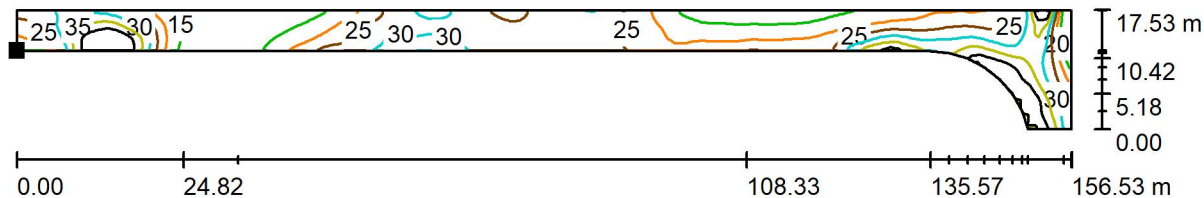
Grid: 128 x 16 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
30	19	50	0.635	0.384

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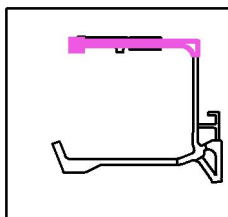
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### Exterior Scene 1 / Road 1 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 1120

Position of surface in external scene:  
 Marked point:  
 (123.194 m, 274.466 m, 0.000 m)



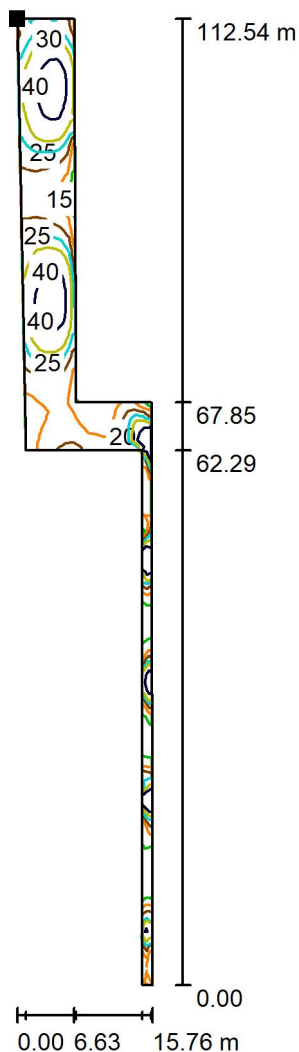
Grid: 128 x 128 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	$u_0$	$E_{min} / E_{max}$
25	8.86	53	0.354	0.169

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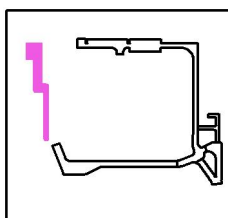
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### Exterior Scene 1 / Side Path / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 881

Position of surface in external scene:  
 Marked point:  
 (67.889 m, 269.245 m, 0.000 m)



Grid: 128 x 16 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
26	6.95	63	0.267	0.110

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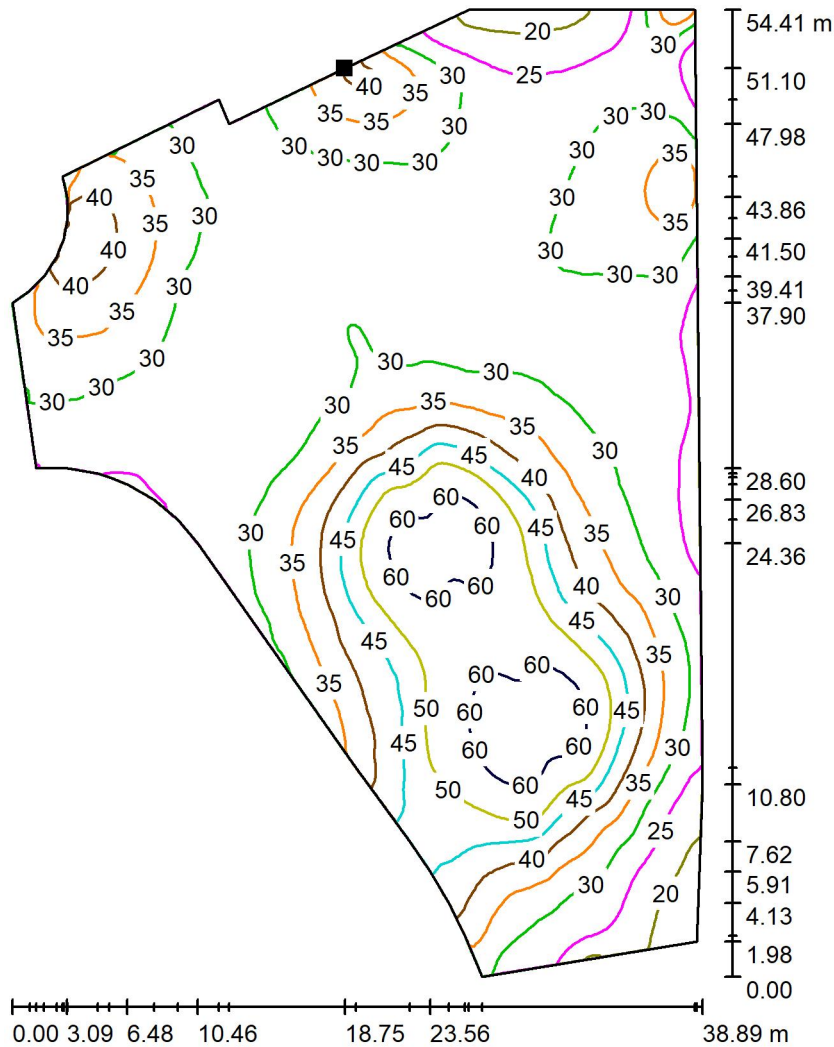
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### Exterior Scene 1 / Main Site Entrance / Isolines (E, Perpendicular)

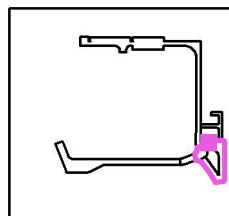


Values in Lux, Scale 1 : 426

Position of surface in external scene:

Marked point:

(290.486 m, 147.949 m, 0.000 m)



Grid: 128 x 128 Points

$E_{av}$  [lx]  
35

$E_{min}$  [lx]  
14

$E_{max}$  [lx]  
75

$u_0$   
0.414

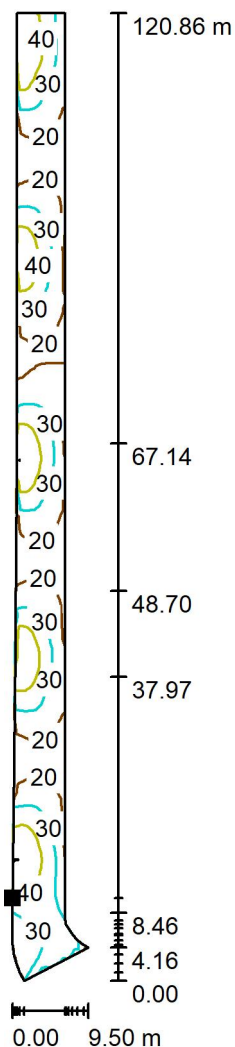
$E_{min} / E_{max}$   
0.193



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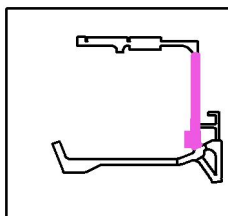
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### Exterior Scene 1 / Road 5 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 946

Position of surface in external scene:  
 Marked point:  
 (273.162 m, 152.151 m, 0.000 m)



Grid: 128 x 16 Points

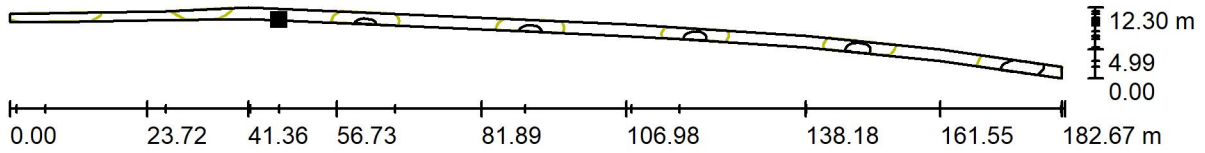
$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
29	16	50	0.545	0.313

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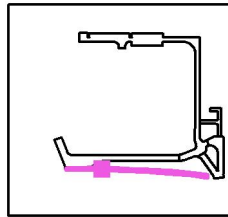
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### Exterior Scene 1 / Security Perimeter / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 1306

Position of surface in external scene:  
 Marked point:  
 (153.236 m, 108.739 m, 0.000 m)



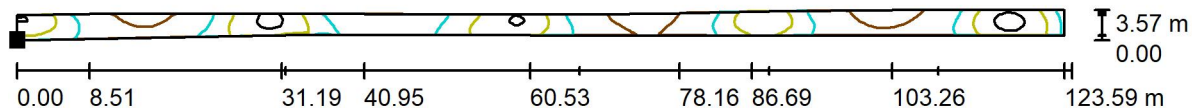
Grid: 128 x 32 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	$u0$	$E_{min} / E_{max}$
21	7.59	60	0.354	0.127

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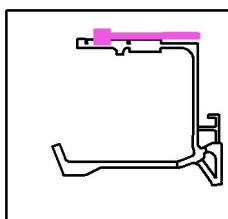
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### Exterior Scene 1 / Security Perimeter / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 884

Position of surface in external scene:  
 Marked point:  
 (156.012 m, 288.227 m, 0.000 m)



Grid: 128 x 8 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
24	7.80	61	0.332	0.128

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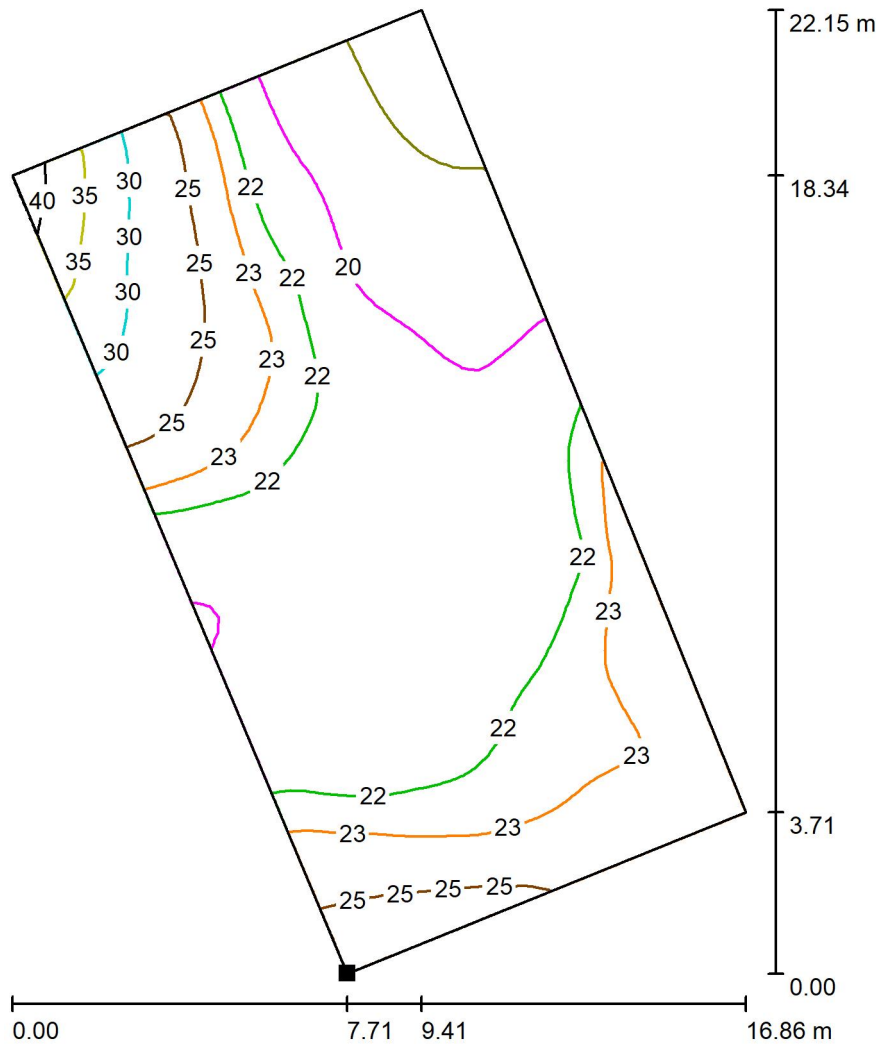
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### Exterior Scene 1 / Loading Ramp / Isolines (E, Perpendicular)

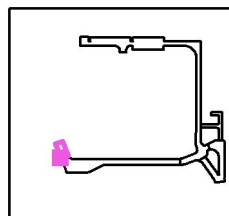


Values in Lux, Scale 1 : 174

Position of surface in external scene:

Marked point:

(98.120 m, 128.528 m, 0.000 m)



Grid: 32 x 64 Points

$E_{av}$  [lx]  
22

$E_{min}$  [lx]  
12

$E_{max}$  [lx]  
43

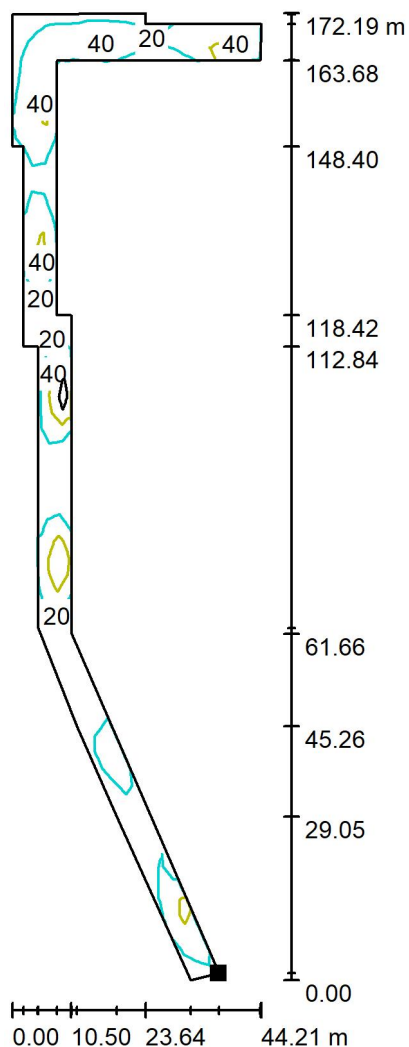
$u_0$   
0.546

$E_{min} / E_{max}$   
0.279

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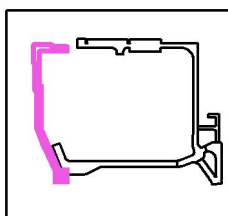
Operator Janko Aschenbrenner  
 Telephone  
 Fax  
 e-Mail janko.aschenbrenner@thorlux.ie

### Exterior Scene 1 / Security Perimeter / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 1347

Position of surface in external scene:  
 Marked point:  
 (102.899 m, 107.349 m, 0.000 m)



Grid: 60 x 20 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
26	5.36	85	0.205	0.063

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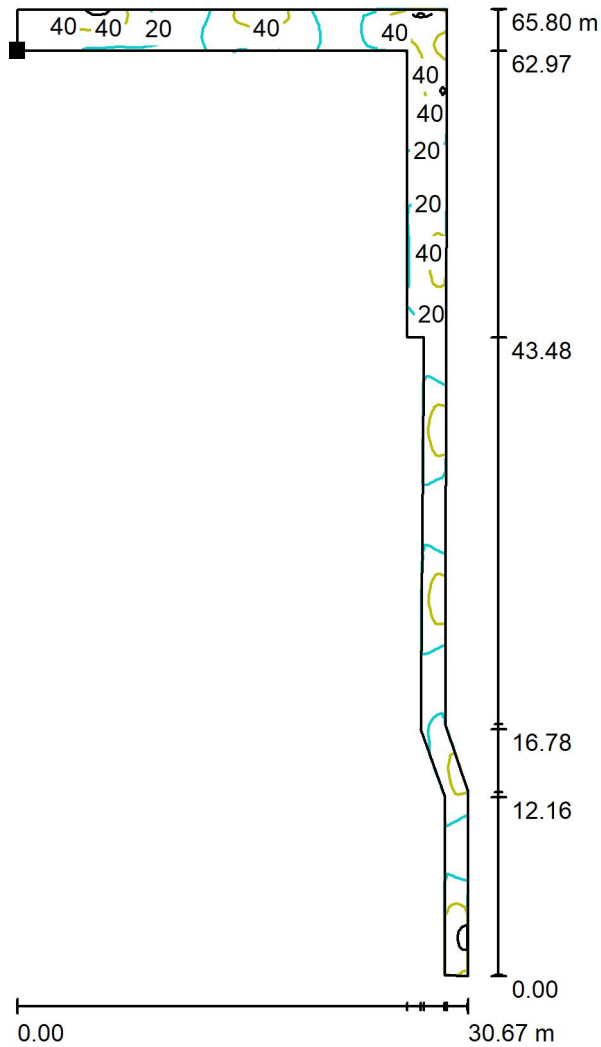
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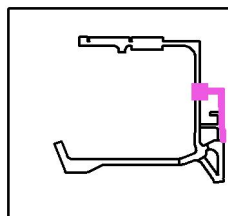
### Exterior Scene 1 / Substation Exterior Perimeter / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 515

Position of surface in external scene:

Marked point:  
(279.986 m, 214.226 m, 0.000 m)



Grid: 128 x 128 Points

$E_{av}$  [lx]  
29

$E_{min}$  [lx]  
9.56

$E_{max}$  [lx]  
66

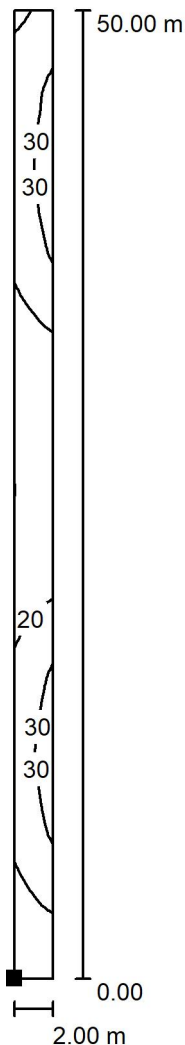
u0  
0.327

$E_{min} / E_{max}$   
0.144

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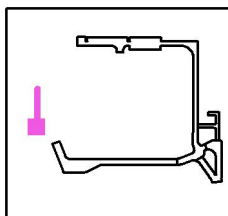
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### Exterior Scene 1 / Security Perimeter / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 391

Position of surface in external scene:  
 Marked point:  
 (70.809 m, 168.659 m, 0.000 m)



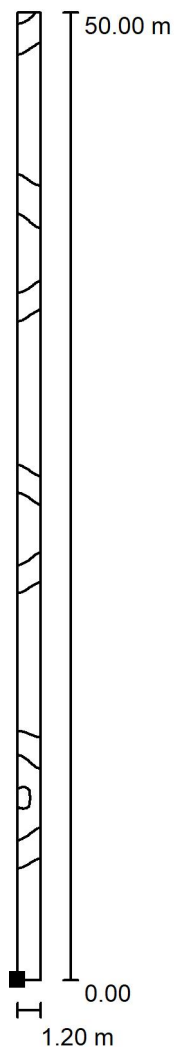
Grid: 8 x 128 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
21	9.94	39	0.464	0.253

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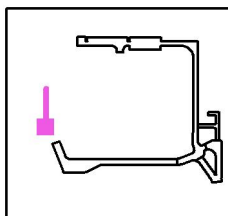
Operator Janko Aschenbrenner  
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 e-Mail janko.aschenbrenner@thorlux.ie

### Exterior Scene 1 / Side Path / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 391

Position of surface in external scene:  
 Marked point:  
 (82.416 m, 168.659 m, 0.000 m)



Grid: 8 x 128 Points

$E_{av}$ [lx]	$E_{min}$ [lx]	$E_{max}$ [lx]	u0	$E_{min} / E_{max}$
24	7.03	65	0.297	0.109