XLCC CABLE FACTORY - HUNTERSTON

Appendix 2.3: Lighting Impact Assessment

BSM13417
V2
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Document status				
Version	**Purpose of document**	**Authored by**	**Approved by**	**Date**
P01	Planning Application	Simon Bourke	Martin McKay	07/02/2022

Contents

EXECUTIVE SUMMARY

A lighting design that meets the following requirements:

- Be complaint with the Limitation of the Effects of Obtrusive Light designation E2,
- Meets the operational requirements of the proposed factory
- Meets the International Civil Aviation Organization and the UK Air Navigation Order (ANO) 20091 requirements for aircraft warning lights.

can be achieved through the use of appropriate lighting levels, and the use of appropriate luminaires, without additional mitigation measures.

1 INTRODUCTION

This report is to support the planning application for the XLCC at Hunterston.

The report assesses how an external lighting scheme that meets the operational requirements of the factory can achieve compliance with the requirements of the:

- Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations, 2nd Edition, published by Commission Internationale de' L'Eclairage (CIE) 150:2017.
- International Civil Aviation Organization (ICAO) requirements.

The Institute of Lighting Professionals has subsequently produced their guidance note, this document, provides supplementary guidance:

- Guidance Note GN01/21The Reduction of Obtrusive Light

For the purposes of this report the requirements in terms of lighting levels and light pollution are identical and Guidance Note GN01/21 has been used for the extraction of tables and guidance.

The external illumination requirements for the proposed development have been designated as E2 Rural low brightness zone.

The lighting to the development consists for three components:

- Factory perimeter and access roads
- Cable gantry and ship loading areas
- Aircraft warning lights to the cable tower

This report defines the illumination limits and requirements to minimise the impact of the new cable factory's external illumination on the local environment.

The report also demonstrates a suitable lighting strategy for the cable factory and provides evidence of how the proposed external lighting strategy can achieve the required operational illumination levels and also limits the effect of obtrusive light to acceptable levels,

2 OBTRUSIVE LIGHTING LIMITATION CRITERIA

The site is designated as an E2 environmental zone. To achieve compliance, the lighting design should not exceed the levels provided in the following tables:

Table 2: Environmental zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations
E4	Urban	High district brightness	Town / City centres with high levels of night-time activity

Table 3 (CIE 150 table 2): Maximum values of vertical illuminance on premises

Light technical parameter	Application conditions	Environmental zone				
		E0	E1	E2	E3	E4
Illuminance in the 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

Table 4 (CIE 150 table 3): Limits for the luminous intensity of bright luminaires[4]

Light technical parameter	Application conditions	Luminaire group (projected area A_p in m²)					
		$0<A_p \leq 0.002$	$0.002<A_p \leq 0.01$	$0.01<A_p \leq 0.03$	$0.03<A_p \leq 0.13$	$0.13<A_p \leq 0.50$	$A_p > 0.5$
Maximum luminous intensity emitted by luminaire (I in cd)[5]	E0 Pre-curfew Post-curfew	0 0	0 0	0 0	0 0	0 0	0 0
	E1 Pre-curfew Post-curfew	0.29 *d* 0	0.63 *d* 0	1.3 *d* 0	2.5 *d* 0	5.1 *d* 0	2,500 0
	E2 Pre-curfew Post-curfew	0.57 *d* 0.29 *d*	1.3 *d* 0.63 *d*	2.5 *d* 1.3 *d*	5.0 *d* 2.5 *d*	10 *d* 5.1 *d*	7,500 500
	E3 Pre-curfew Post-curfew	0.86 *d* 0.29 *d*	1.9 *d* 0.63 *d*	3.8 *d* 1.3 *d*	7.5 *d* 2.5 *d*	15 *d* 5.1 *d*	10.000 1,000
	E4 Pre-curfew Post-curfew	1.4 *d* 0.29 *d*	3.1 *d* 0.63 *d*	6.3 *d* 1.3 *d*	13 *d* 2.5 *d*	26 *d* 5.1 *d*	25,000 2,500

3 OPERATIONAL LIGHTING DESIGN REQUIREMENTS

The factory is intended to operate continuously during cable production and cable loading onto ships.

Therefore the lighting is intended to be on at all times during this period and there is no intended curfew period.

The lighting requirements for the different lighting zones are described below and shown in Appendix A.

3.1 Factory perimeter and access roads

The lighting to the factory perimeter, loading bays and access roads is to provide safe egress and access to the building, by providing illuminance at floor level to the following average illuminance levels in accordance with:

- BS5489 1:2013 Code of practice for the design of road lighting. Lighting of roads and public amenity areas
- BS EN 12464-2:2014 Light and lighting. Lighting of work places. Outdoor work places BS12193

Location	Minimum average lighting level
Access roads and pedestrian walkways	10 lux
Car parks	20 lux
Service yard	30 lux
Loading bay	50 lux

3.2 Cable gantry and ship loading areas

The cable gantry is only required to have access lighting for maintenance and is not required at all times.

The access ladders from ground level to the gantry required lighting and there will be mobile task lighting – for maintenance only. These lights can be turned off when not needed.

The ship loading areas will be lit by the ship lighting and this is outside the scope of this report.

Location	Minimum average lighting level
Cable gantries	10 lux

3.3 Aircraft warning lights to the cable tower

The lighting to the cable tower is required to meet the International Civil Aviation Organization (ICAO) and UK Air Navigation Order (ANO) 2016 guidelines for fixed obstacles.

The cable tower is 185m above ground level, and therefore invokes specific lighting requirements for aircraft warning, as tabulated below:

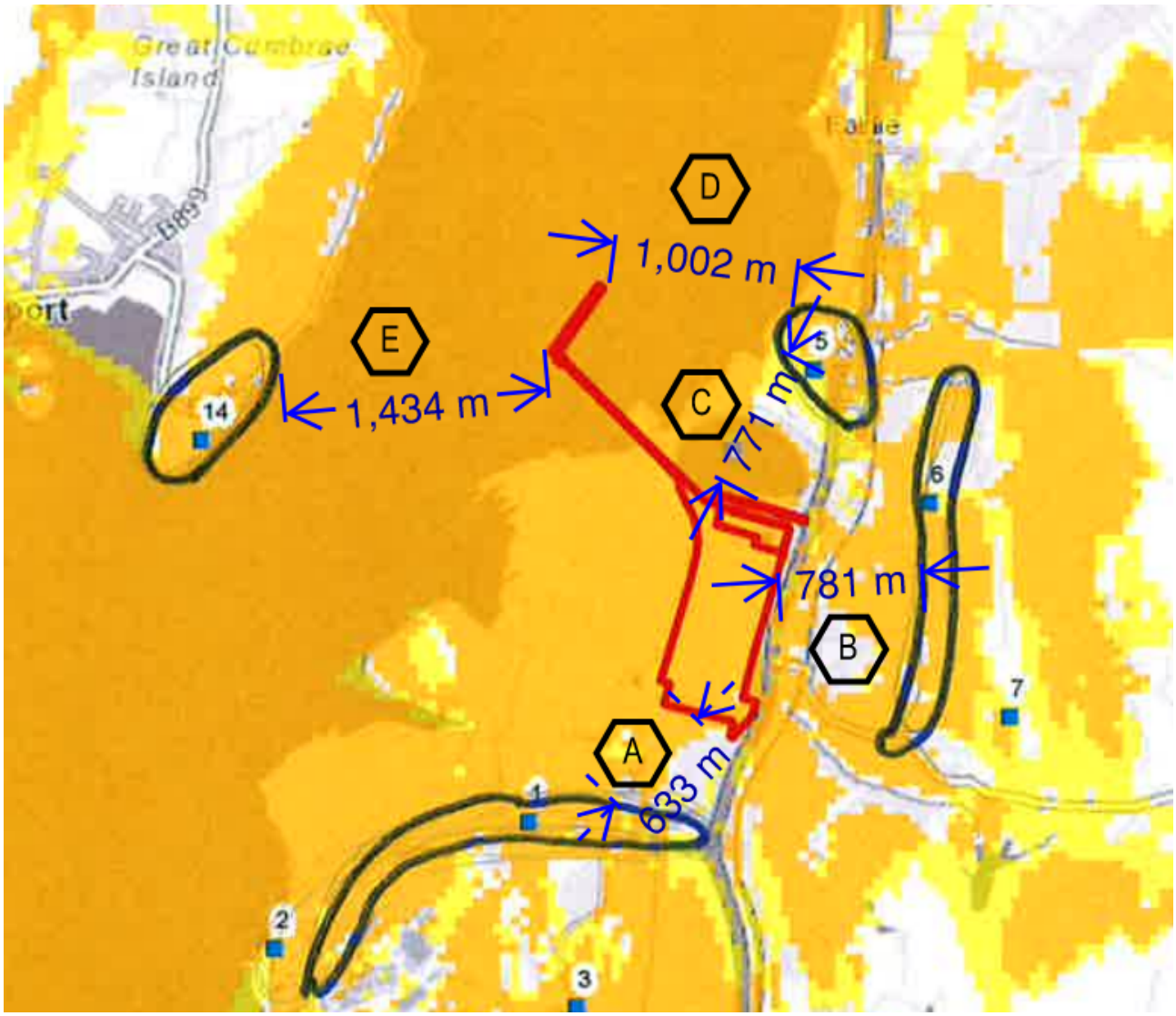
Location	Lighting requirements
Cable tower	• 2000 Candela red lights at the top and at 52m (max) increments • Operational 30 minutes before sunset and 30 minutes before sunrise • All sides of the tower to have warning lighting

4 RECEPTORS

The lighting to the factory and the gantry is located between 633m and 1434m from the nearest receptors.

The following receptors have been used to assess the impact of the lighting design on the surrounding area. as shown in the table and the image below:

Dimension	Receptor	Impact from	Distance to receptor from luminaires
Ⓐ	Power Station coastal path	Factory lighting	633m
Ⓑ	Black Hill	Factory lighting	781m
Ⓒ	Fairlie viewpoint	Factory lighting	771m
Ⓓ	Fairlie viewpoint	Gantry lighting	1002m
Ⓔ	Great Cumbrae island	Gantry lighting	1434m



5 LIGHTING STRATEGY

The luminaires proposed will be low energy, using LED lamps as the lighting sources to minimise carbon emissions. They all have downward light distribution and selectable distribution optics to minimise upward and sideways light output.

The luminaires have been selected to represent the types of luminaires that can achieve compliance and are tabulated below:

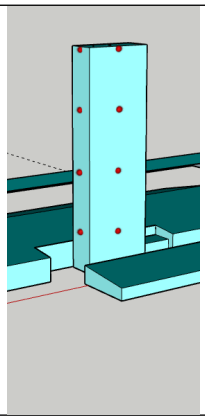
Product reference	**Reference on drawing** (see Appendix B)	**Description**	**Image**	**Locations used**
Kingfisher Viva City Pro	A A2	Pole mounted LED road luminaire with selectable distribution optics to suit the required application area.		Roadways and access paths and service yards mounted on lighting columns at 8m and 10m above ground.
Kingfisher Zactis	BW CW	Building mounted LED luminaire with selectable distribution optics to suit the required application area.		Building perimeter mounted at 10m
Kingfisher Viva City Flood	E EW F FW	Pole mounted floodlight luminaire with selectable distribution optics to suit the required application area.		Roadways and access paths and service yards mounted on lighting columns at 8m and 10m above ground.
Kingfisher Semita Urban	G	Bracket mounted LED floodlight		Cable gantry mounted on pole
CEL Aviation Lighting Medium Intensity Red 2,000cd Light	Not indicated	Aviation fixed obstruction warning light		Cable tower at the top and at 52m intervals

6 COMPLIANCE RESULTS

The lighting calculations are indicated in Appendix B and have been undertaken using approved lighting software.

The compliance targets have been met are described in the sections below:

6.1 Lighting levels for Operations and Aircraft Warning

Requirement	Location	Target	Achieved
Operational Lighting Average illuminance	Access roads and pedestrian walkways	10 lux	18.35 lux
	Car parks	20 lux	20.84 lux
	Service yard	30 lux	30.76 lux
	Loading bay	50 lux	56.2 lux
	Cable gantries	10 lux	10.11 lux
Aircraft warning	Cable tower	2000 Candela red lights at the top and at 52m	Lights mounted at top of tower and 52m intervals as shown by red dots on the image to the right. 

6.2 Upward light pollution

The luminaires selected have been positioned to have no upward light distribution and are angled to have no light above the horizontal plane as shown in the right hand image below:

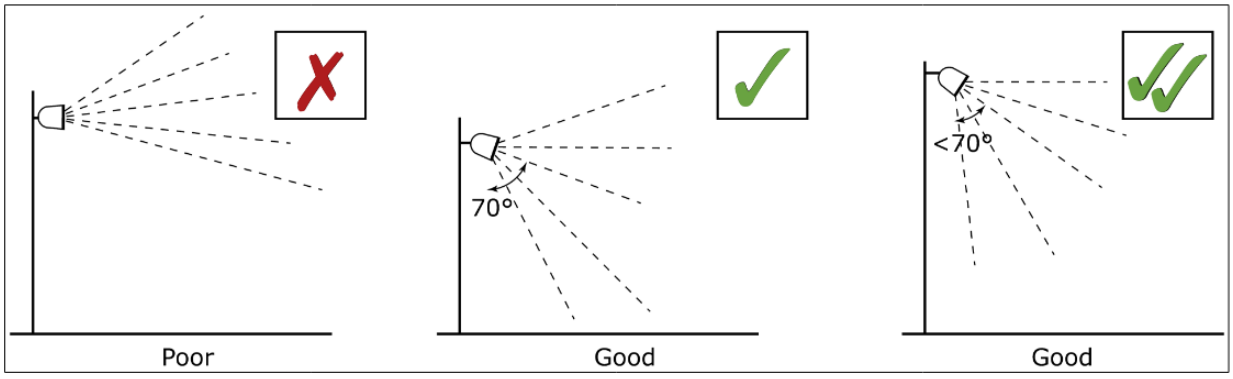
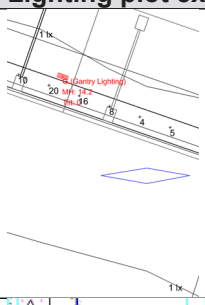
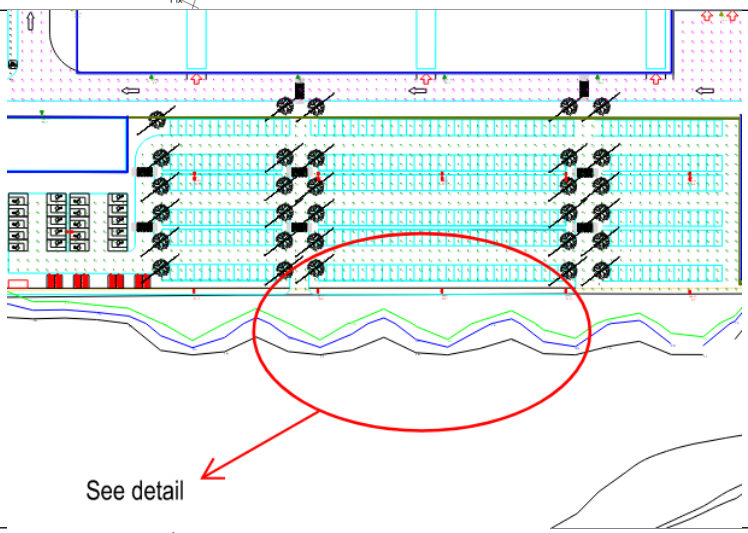
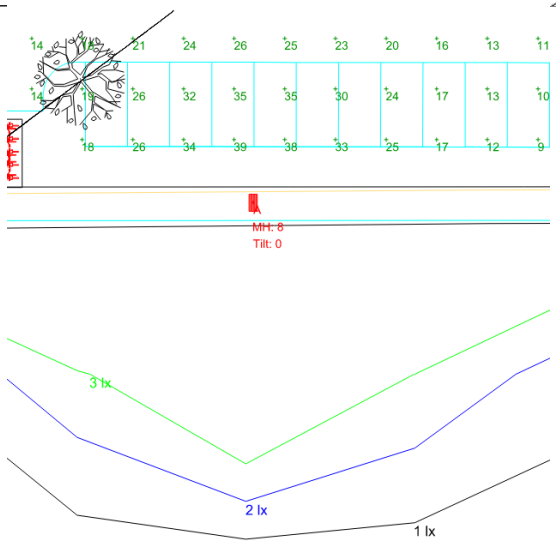


Figure 3: Luminaire aiming angles

6.3 Vertical illumination

The maximum levels of vertical illumination on nearby dwellings, premises or potential dwellings, and specifically windows are limited to 1 lux post curfew.

The nearest dwellings are over 600m away and therefore there will be no vertical illumination caused by spill light on the dwellings or premises. The following are extracts from Appendix B

Location	Lighting plot extract	Commentary
Cable Gantry		At a few metres from the gantry the light level is only at 1lux
Car park		See detail in the row below
Car Park detail		At less than 30m from the luminaire light level is only at 1lux

6.4 Lighting intensity

Lighting design software has yet to catch up with the requirements of table 3 of CIE 150, and is repeated as table 4 in Guidance Note GN01/21The Reduction of Obtrusive Light – see extract below:

Table 4 (CIE 150 table 3): Limits for the luminous intensity of bright luminaires[4]

Light technical parameter	Application conditions	Luminaire group (projected area A_p in m²)					
		$0<A_p \leq 0.002$	$0.002<A_p \leq 0.01$	$0.01<A_p \leq 0.03$	$0.03<A_p \leq 0.13$	$0.13<A_p \leq 0.50$	$A_p > 0.5$
Maximum luminous intensity emitted by luminaire (I in cd)[5]	E0 Pre-curfew Post-curfew	 0 0	 0 0	 0 0	 0 0	 0 0	 0 0
	E1 Pre-curfew Post-curfew	 0.29 *d* 0	 0.63 *d* 0	 1.3 *d* 0	 2.5 *d* 0	 5.1 *d* 0	 2,500 0
	E2 Pre-curfew Post-curfew	 0.57 *d* 0.29 *d*	 1.3 *d* 0.63 *d*	 2.5 *d* 1.3 *d*	 5.0 *d* 2.5 *d*	 10 *d* 5.1 *d*	 7,500 500
	E3 Pre-curfew Post-curfew	 0.86 *d* 0.29 *d*	 1.9 *d* 0.63 *d*	 3.8 *d* 1.3 *d*	 7.5 *d* 2.5 *d*	 15 *d* 5.1 *d*	 10.000 1,000

The guidance states the following:

> *The assessment of intensity as advised within Table 4 has been developed to assist the competent professional lighting designer in making the considerations necessary. At this time, and until software is available to assist the designer, they must make their best professional judgement and undertake some manual assessments, calculations and reviews, based upon software that is currently available to determine compliance or otherwise with intensity limits and values.*

The following luminaires have been selected as the potential most impact in terms of lighting intensity:

- Zactis floodlight which light the building perimeter
- Aviation warning lights

The maximum allowable light intensity for each luminaire is calculated below. The methodology is as described in Appendix 3 of Guidance Note GN01/21,and an example is given below:

Example:

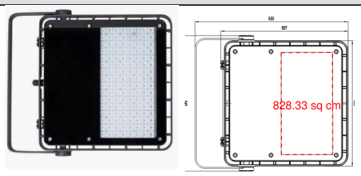
1. 15 cm luminaire

We are working in an E2 zone, the luminaire has a diameter of 15cm and the realistic expected maintained nearest observer position is 100m away.

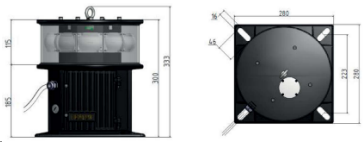
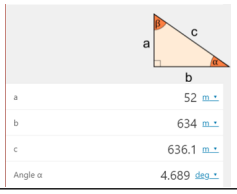
Based upon Table 4, this advises that the geometric mean of diameter is 14.1cm, and the corresponding representative A_p is 0.016. This places it within the luminaire group $0.01 < A_p \leq 0.03$ m² grouping. Reading down this column to E2, the pre-curfew maximum luminous intensity calculation is 2.5d where d from our case is 100m.

The limiting intensity to the identified observer is therefore 2.5 x 100 = 250 cd

Zactis luminaire - light intensity calculation

Calculation step	Details	Result
Conversion to a circular area and diameter		828cm = πr^2 r2 = 264 sq cm r = 16 cm d = 32 cm
Luminaire group	Aid to gauging A_p Luminaire diameter / 2 to 5 cm / 5 to 10 cm / 10 to 20 cm / 30 to 40 cm Geometric mean of diameter (cm) / 3.2 / 7.1 / 14.1 / 26.3 Corresponding A_p representative area (m^2) / 0.0008 / 0.004 / 0.016 / 0.063	Ap = 0.063
Maximum Intensity level	$0.01<A_p \leq 0.03$ Post-curfew 0.63 *d*	Assessment / Quantity / Unit Gerometric mean Luminaire diameter / 32 / cm Ap / 0.063 Luminiare Group / 0.03<Ap<0.13 Post Curfew intensity / 2.5d Nearest distance / 633 / m **Maximum luminaire intensity / 1583 / Candelas**
Level achieved	Calculation Summary Label / CalcType / Units / Avg / Max ObtrusiveLight_1_Cd_Seg1 / Obtrusive - Cd / N.A. / 58.91 / 63 ObtrusiveLight_1_Cd_Seg2 / Obtrusive - Cd / N.A. / 46.52 / 53	

Aircraft warning luminaire - light intensity calculation

Calculation step	Details	Result
Conversion to a circular area and diameter		**Aircraft warning light** Conversion to a circular area and diameter 11m x 27cm = 297 = πr^2 r2 = 95 sq cm r = 10 cm d = 19 cm
Luminaire group	Aid to gauging A_p Luminaire diameter / 2 to 5 cm / 5 to 10 cm / 10 to 20 cm / 30 to 40 cm Geometric mean of diameter (cm) / 3.2 / 7.1 / 14.1 / 26.3 Corresponding A_p representative area (m^2) / 0.0008 / 0.004 / 0.016 / 0.063	Ap = 0.016
Maximum Intensity level	$0.01<A_p \leq 0.03$ Post-curfew 0.63 *d*	Assessment / Quantity / Unit Gerometric mean Luminaire diameter / 19 / cm Ap / 0.016 Luminiare Group / 0.01<Ap<0.03 Post Curfew intensity / 1.3d Nearest distance / 633 / m **Maximum luminaire intensity / 823 / Candelas**
Level achieved	Optical characteristics - 20,000cd / 2,000cd (effective) - Colour aviation WHITE and RED - NVG compliant infrared (850nm) as an option - Horizontal beam 360° - Vertical beam 3° - Maximum intensity at -1° is less than 11 250cd (WHITE), 1125cd (RED) - Maximum intensity at -10° is less than 750cd (WHITE), 75cd (RED) The luminaires will be mounted at a height where the visble element of the luminaire wil be less than 10 degree and therefore the ligh intenstity to people viewing the luminaires from the receptor locations will be less than 10 degrees 	

7 SCHEDULE OF APPENDICES

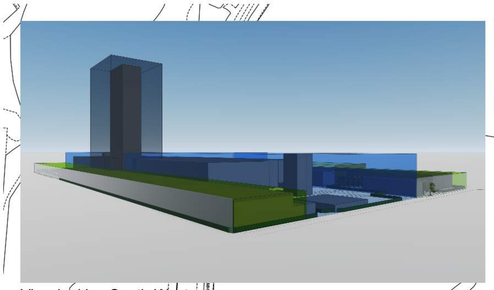
The following appendices are separate to this report and should be read in conjunction with this report:

Appendix A: External lighting levels – Masterplan overmark

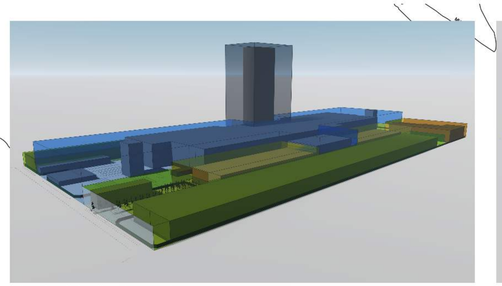
Appendix B: Lighting calculations

Appendix A

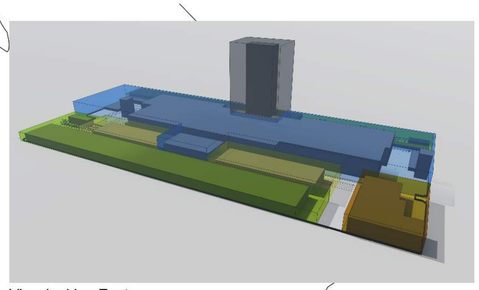
External lighting levels – Masterplan overmark



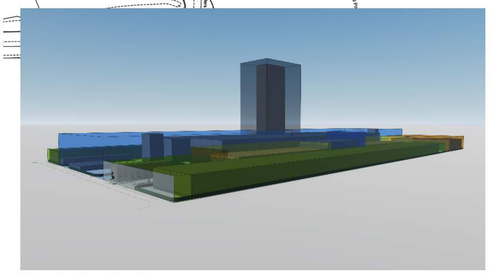
View looking South-West



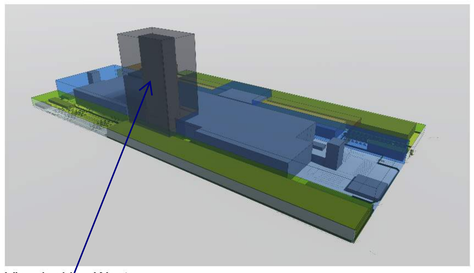
View looking South-East



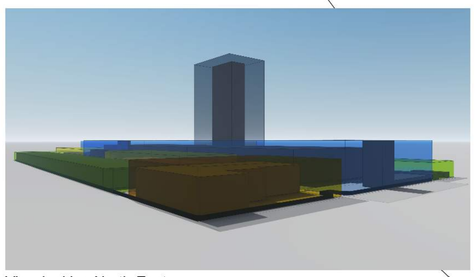
View looking East



View looking South



View looking West



View looking North-East

Note:
Images illustrate Parameters height zones in tranparent tone with solid masses representing the illustrative masterplan buildings

Cable Tower
No external lighting required.
Only aviation warning lights

Southhamnan Sands

HARBOR AREA
SHIP LOADING EQUIPMENT

Humberston Ore Terminal

Cable Gantry
Lighting is only required for maintenance access.

Illuminance 10 lux on the gantry floor to provide access for staff.

Conveyors between production facility and jetty - max height 12m above jetty level with min. 8m clearance to existing rail

Factory perimeter and access roads

Location	Minimum average lighting level
Access roads and pedestrian walkways	10 lux
Car parks	20 lux
Service yard	30 lux
Loading bay	30 lux

Maximum Building Height: 35m AOD +41.500 TO RIDGE
Maximum Building Height: 20m AOD +26.500 TO RIDGE
Maximum Building Height: 30m AOD +36.500 TO RIDGE
Maximum Building Height: 45m AOD +51.500 TO RIDGE
Maximum Building Height: 30m AOD +36.500 TO RIDGE
Maximum Building Height: 45m AOD +51.500
Maximum Building Height: 185m AOD +191.500 TOP OF TOWER
Maximum Building Height: 20m AOD +26.500 TO RIDGE

DEGASSING CHAMBERS

NO DIMENSIONS TO BE SCALED FROM THIS DRAWING

CDM - RESIDUAL HAZARDS The following are considered to be significant risks relevant to this drawing, which could not be fully mitigated or removed through design:

	CDM - RESIDUAL HAZARDS
1	
2	
3	etc.
	Further possible control measures have been identified within the Design Risk Assessments which may help to mitigate these and other identified risks further during the construction / maintenance process.

AREA SUMMARY

Redline Area:
50.67Ha/125.22Ac

Proposed Use:
Class 4: Business
Class 5: General Industry
Class 6: Storage or Distribution

Maximum Floorspace
281,500 sq.m (3,030,042 sq.ft) GEA

Proposed Maximum finished Unit Height
As shown based on an AOD baseline of 6.50m. Note maximum floorspace includes potential basement floorspace.

Planning Boundary

Primary Access route

Height Parameter Zones:

AOD +26.500 to Ridge

AOD +36.500 to Ridge

AOD +41.500 to Ridge

AOD +51.500 to Ridge

AOD +191.500 to Ridge

Note:
Service trenches (approximately 2.5m deep below ground level) to be distributed across the site - locations to be confirmed.

Client: XLCC

Project: XLCC Hunterston

Drawing Title:
Appendix A Lighting Impact Assessment
External lighting levels - masterplan over mark
Drawing based on Pick Everard drawing:

Job No.	Scale	Size	Rev
210685	1:2000	@ A0	P04

Drawing Number:
XLHU-SGP-XX-ZZ-DR-A-10004
Project Code - Originator - Zone - Level - Type - Role - Number

Scale	Size	Rev
1:2000	@ A0	P04

Appendix B

Lighting Calculations

Dimensions are not to be scaled from this drawing

Luminaire Schedule					
Symbol	Qty	Label	Arrangement	LLF	Description
	17	A	SINGLE	0.900	120w LED 4000k Viva City Pro 620mA with FW70 Optic column mounted at 8m
	14	A2	BACK-BACK	0.900	2 x 120w LED 4000k Viva City Pro 620mA with FW70 Optic column mounted at 8m
	2	BW	SINGLE	0.900	320w LED 4000k Zactis 808mA Floodlight with FW70 Optic wall mounted at 10m
	21	CW	SINGLE	0.900	320w LED 4000k Zactis 808mA Floodlight with FL50 Optic wall mounted at 10m
	5	E	SINGLE	0.900	117.6w LED 4000k Viva City Flood 780mA with AY70 Optic column mounted at 8m
	37	EW	SINGLE	0.900	117.6w LED 4000k Viva City Flood 780mA with AY70 Optic wall mounted at 10m
	2	F	SINGLE	0.900	117,6w LED 4000k Viva City Flood 780mA with FW70 Optic column mounted at 8m
	18	FW	SINGLE	0.900	117,6w LED 4000k Viva City Flood 780mA with FW70 Optic wall mounted at 10m
	103	G (Gantry Lighting)	SINGLE	0.900	6w LED 4000k Semita Urban bulkhead with cycle optic mounted on 3m extension pole on gantry

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Min/Avg	Min/Max
Access Roads	Illuminance	Lux	18.35	73	5	0.27	0.07
Bottom Left Car Park	Illuminance	Lux	20.84	66	6	0.29	0.09
Bottom Right Car Park	Illuminance	Lux	26.68	66	11	0.41	0.17
Gantry Maintenance Access Route	Illuminance	Lux	10.11	20	4	0.40	0.20
ObtrusiveLight_1_Cd_Seg1	Obtrusive - Cd	N.A.	58.91	63	54	0.92	0.86
ObtrusiveLight_1_Cd_Seg2	Obtrusive - Cd	N.A.	46.52	53	38	0.82	0.72
ObtrusiveLight_1_Ill_Seg1	Obtrusive - Ill	Lux	0.00	0	0	N.A.	N.A.
ObtrusiveLight_1_Ill_Seg2	Obtrusive - Ill	Lux	0.00	0	0	N.A.	N.A.
ObtrusiveLight_2_Cd_Seg1	Obtrusive - Cd	N.A.	62.13	121	50	0.80	0.41
ObtrusiveLight_2_Ill_Seg1	Obtrusive - Ill	Lux	0.00	0	0	N.A.	N.A.
Right Lorry Park	Illuminance	Lux	19.10	48	5	0.26	0.10
Service Yard Area	Illuminance	Lux	30.76	121	12	0.39	0.10
Top Left Car Park	Illuminance	Lux	29.69	50	17	0.57	0.34
Top Right Car Park	Illuminance	Lux	23.01	65	8	0.35	0.12
Unit 11 Loading Bay	Illuminance	Lux	60.14	117	27	0.45	0.23
Unit 7 Loading Bay	Illuminance	Lux	56.25	114	23	0.41	0.20
Walkways	Illuminance	Lux	12.16	68	3	0.25	0.04

Obtrusive Light - Compliance Report

Illuminance

Maximum Allowable Value:

	E2
Pre-curfew	5 lx
Post-curfew	1 lx

Calculations Tested (3):

Calculation Label	Test Results	Max. Illum.
ObtrusiveLight_1_Ill_Seg1	PASS	0
ObtrusiveLight_1_Ill_Seg2	PASS	0
ObtrusiveLight_2_Ill_Seg1	PASS	0

Luminous Intensity (Cd) At Vertical Planes

Maximum Allowable Value: 10000 Cd

Calculations Tested (3):

Calculation Label	Test Results
ObtrusiveLight_1_Cd_Seg1	PASS
ObtrusiveLight_1_Cd_Seg2	PASS
ObtrusiveLight_2_Cd_Seg1	PASS

Kingfisher Lighting

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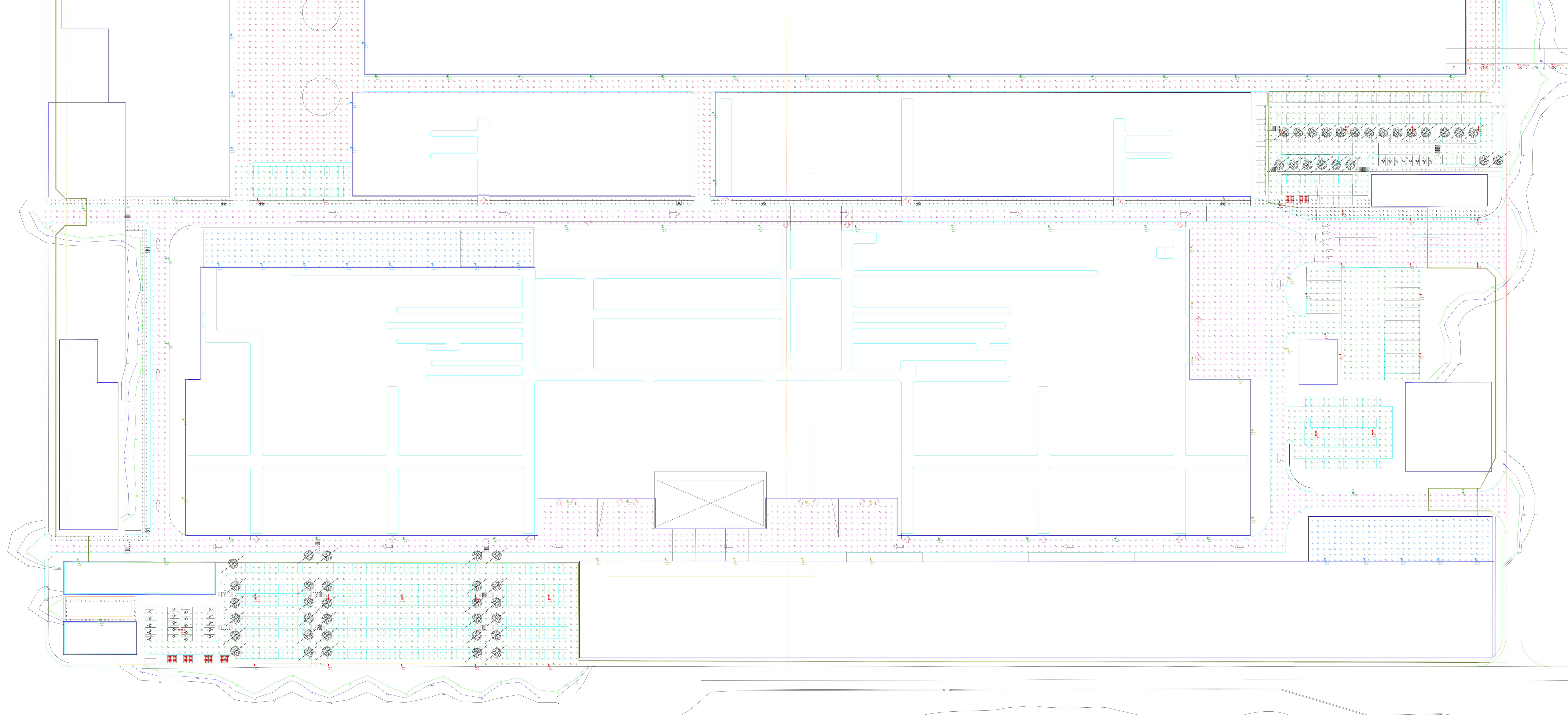

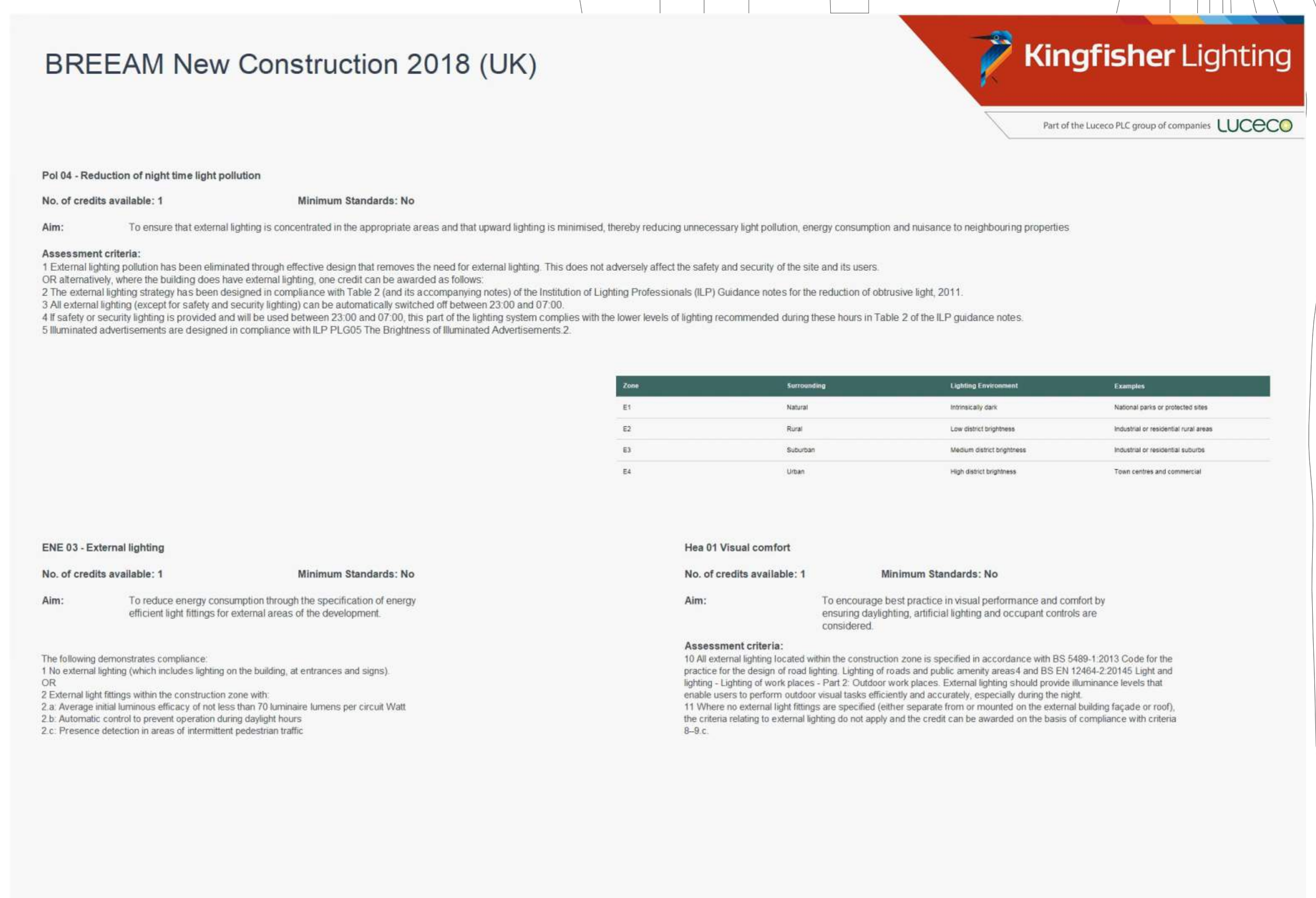

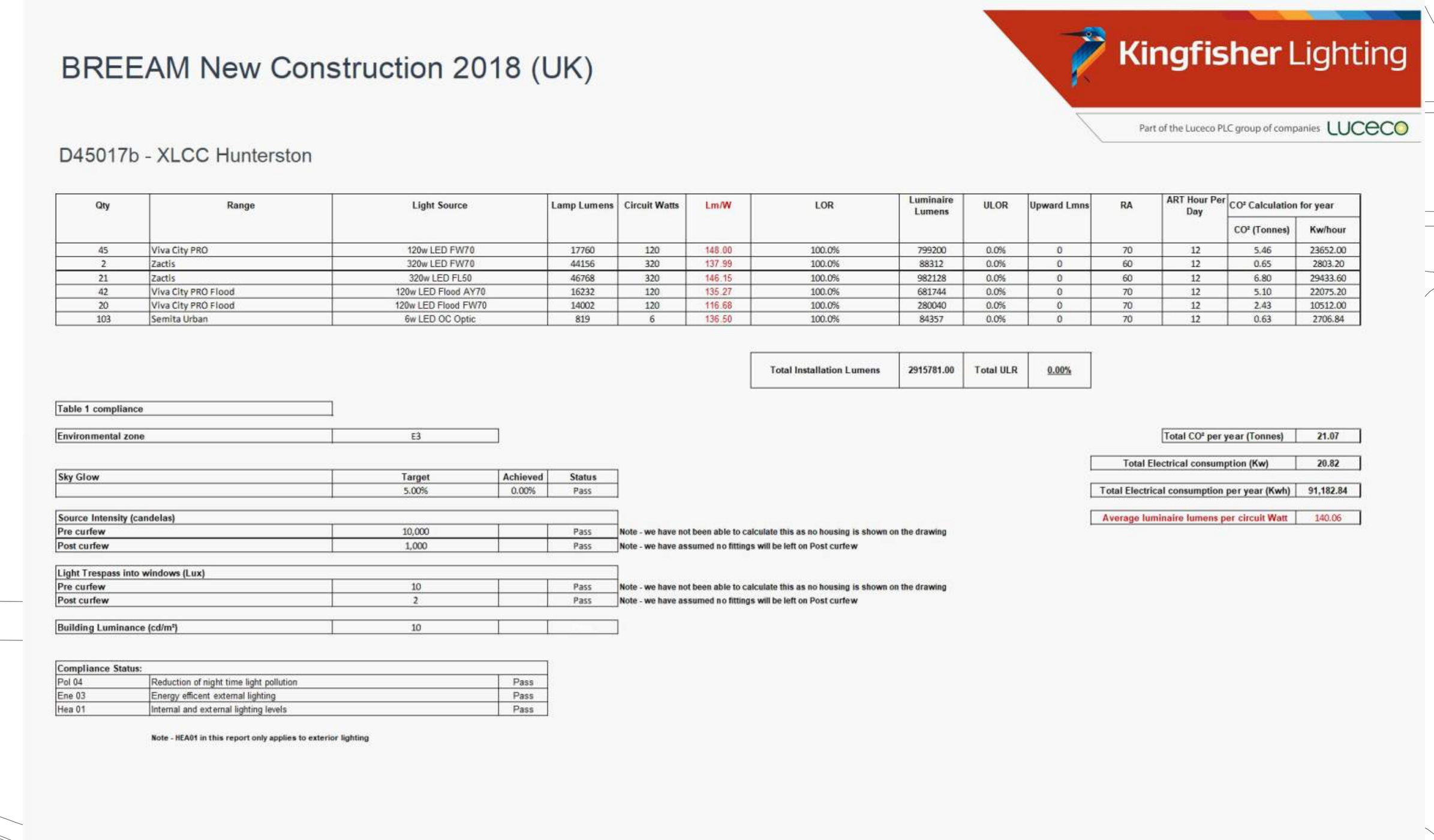

Appendix B
Lighting Calculations

N

XLCC Hunterston	Scale: 1: 1000 at A0	Project Number: D45017C
For our LED lighting designs a 0.9mf has been used. If this differs from the maintenance period for this project then you must advise us accordingly	Date: 3 February 2022	Drawing No.: D45017/JB/C
	Lighting Designer : Jamie Buck MSLL	

A lighting applications design service is provided by us in good faith and without charge, relating to Kingfisher products only. As such, whilst every endeavor is made for accuracy from information provided by yourselves, the final responsibility for the suitability of the design lies with the client. The company cannot, therefore, accept any liability or consequential loss incurred.

A0

Dimensions are not to be scaled from this drawing

Kingfisher Lighting

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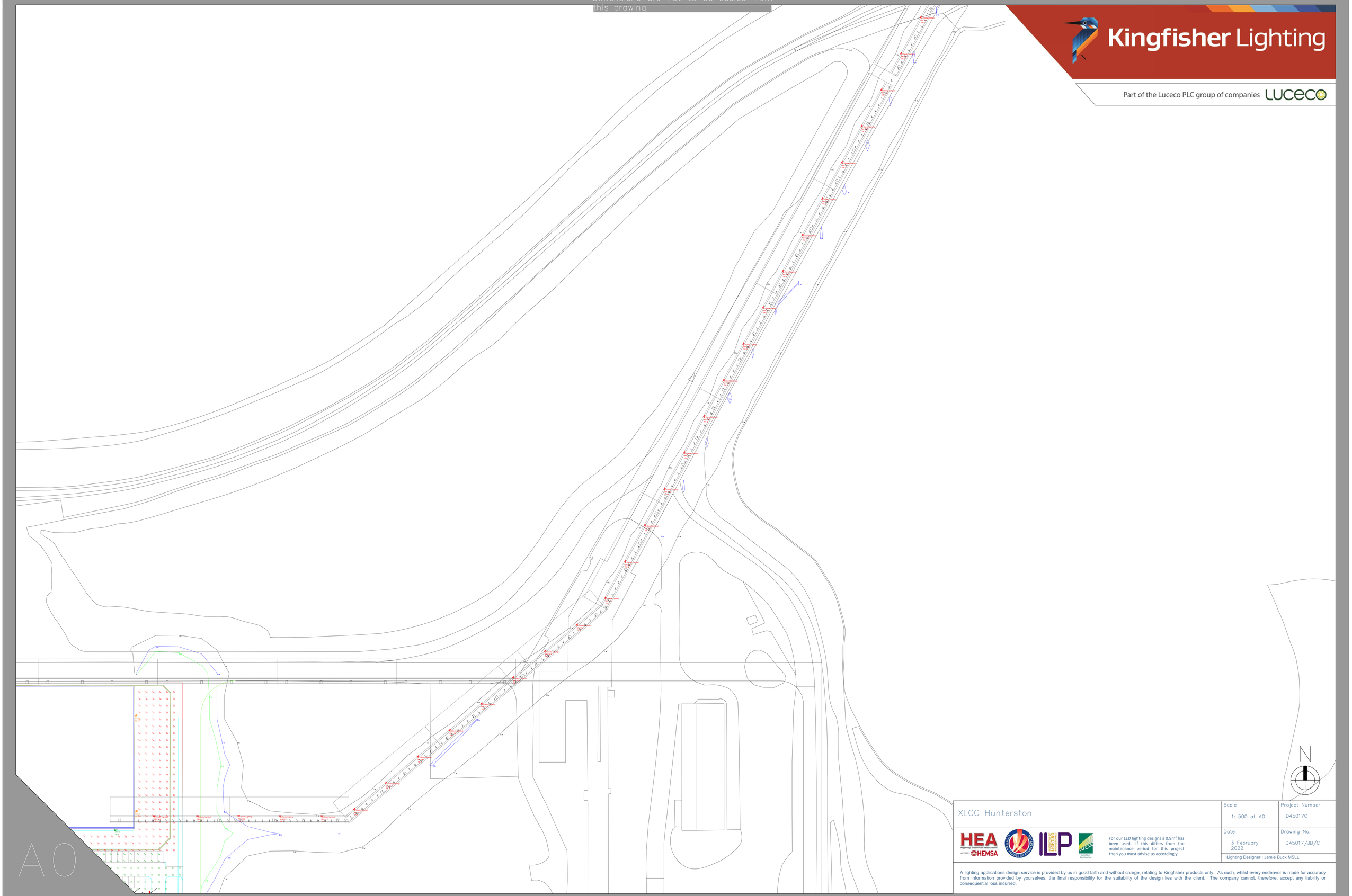

N

A0

XLCC Hunterston	Scale: 1: 500 at A0	Project Number: D45017C
	Date: 3 February 2022	Drawing No.: D45017/JB/C
	Lighting Designer : Jamie Buck MSLL	

HEA Highway Electrical Association HEMSA · ILP Institution of Lighting Professionals · Accredited Luminaire

For our LED lighting designs a 0.9mf has been used. If this differs from the maintenance period for this project then you must advise us accordingly

Dimensions are not to be scaled from this drawing

Kingfisher Lighting

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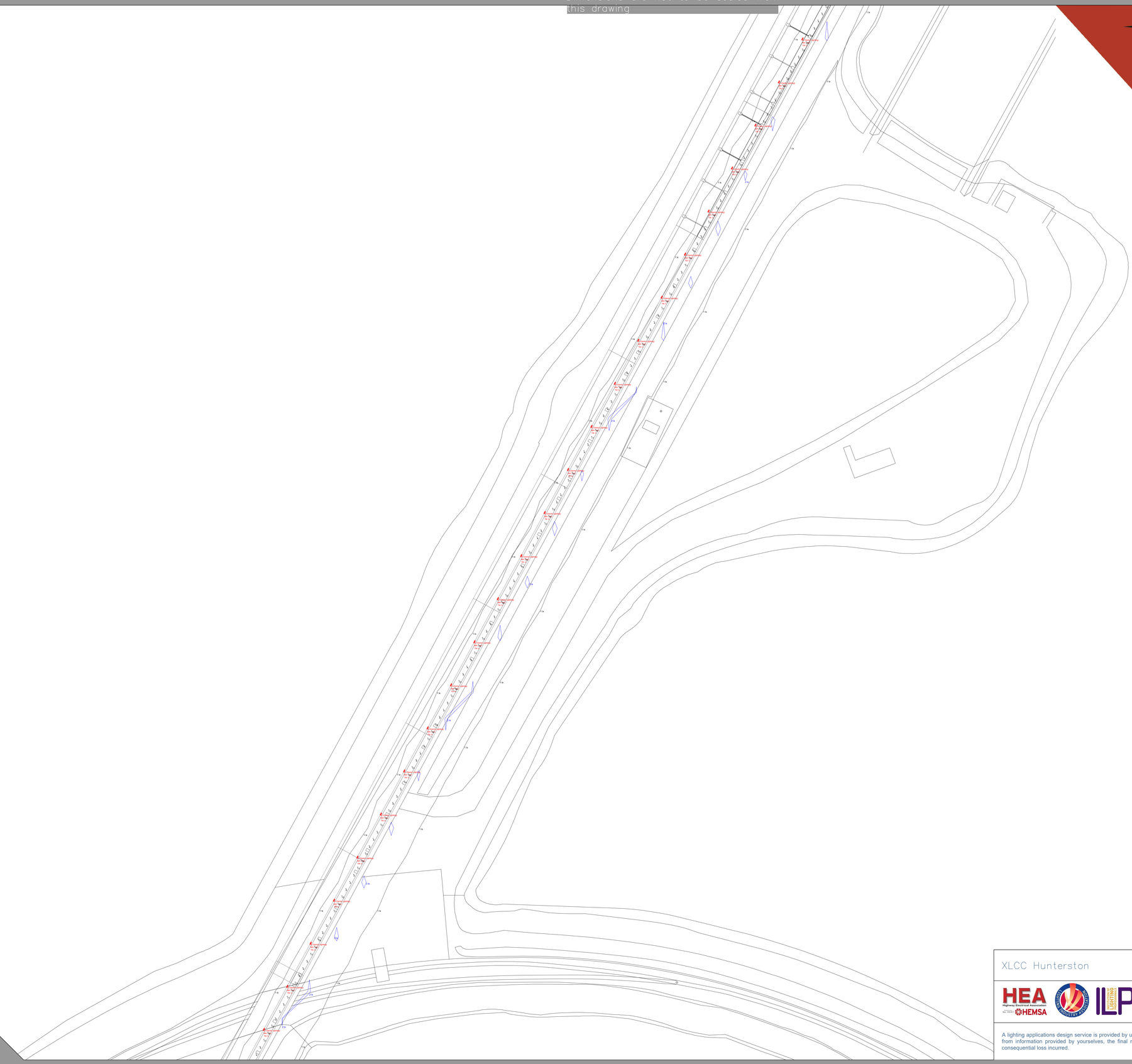


N

A0

XLCC Hunterston

Scale	Project Number
1: 500 at A0	D45017C
Date	Drawing No.
3 February 2022	D45017/JB/C

Lighting Designer : Jamie Buck MSLL

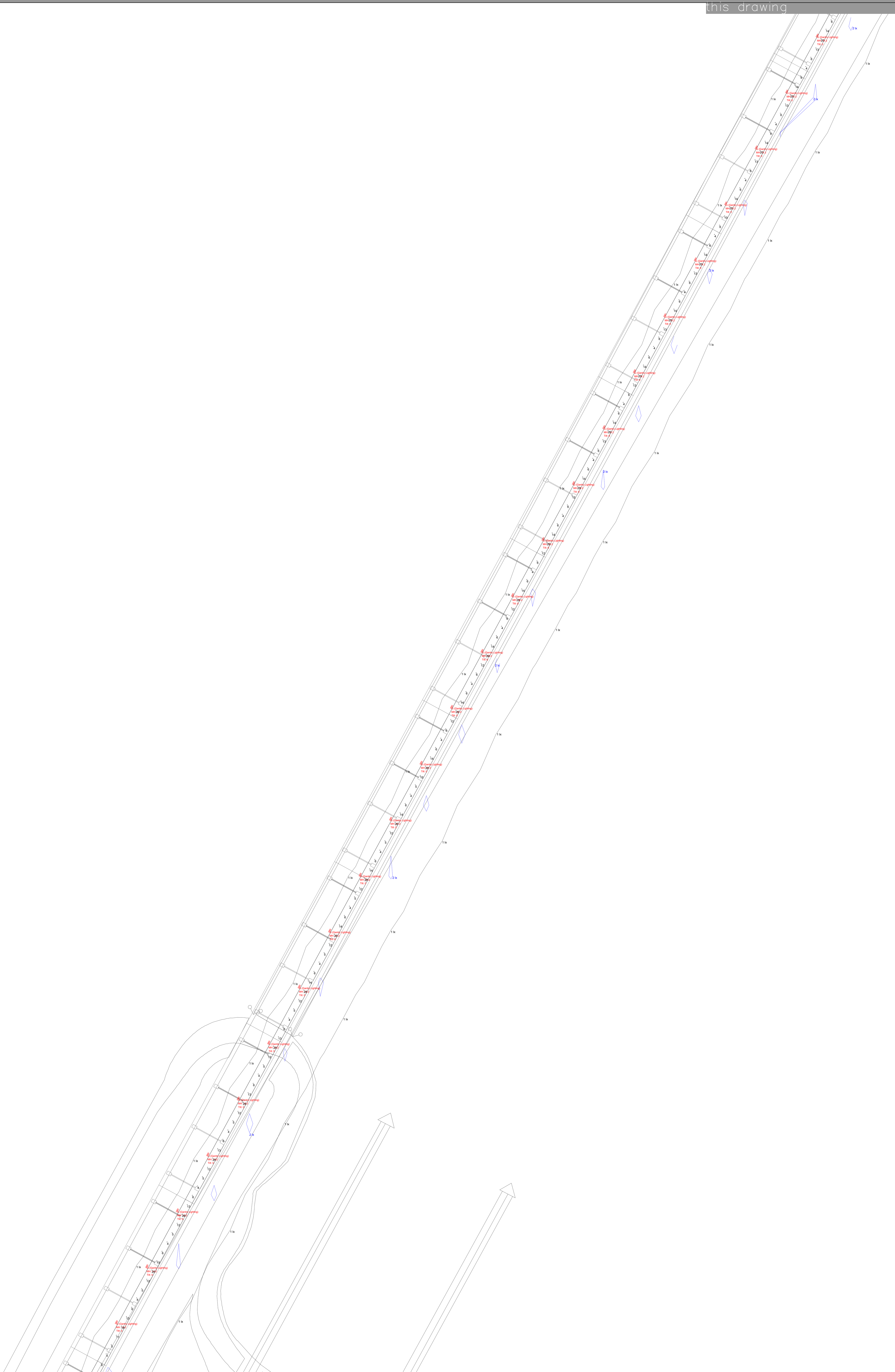
HEA Highway Electrical Association HEMSA

ILP Institution of Lighting Professionals

Approved Contractor

For our LED lighting designs a 0.9mf has been used. If this differs from the maintenance period for this project then you must advise us accordingly

Dimensions are not to be scaled from this drawing



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N

XLCC Hunterston	Scale 1: 500 at A0	Project Number D45017C
For our LED lighting designs a 0.9mf has been used. If this differs from the maintenance period for this project then you must advise us accordingly	Date 3 February 2022	Drawing No. D45017/JB/C
	Lighting Designer : Jamie Buck MSLL	

A0

Dimensions are not to be scaled from this drawing

Kingfisher Lighting

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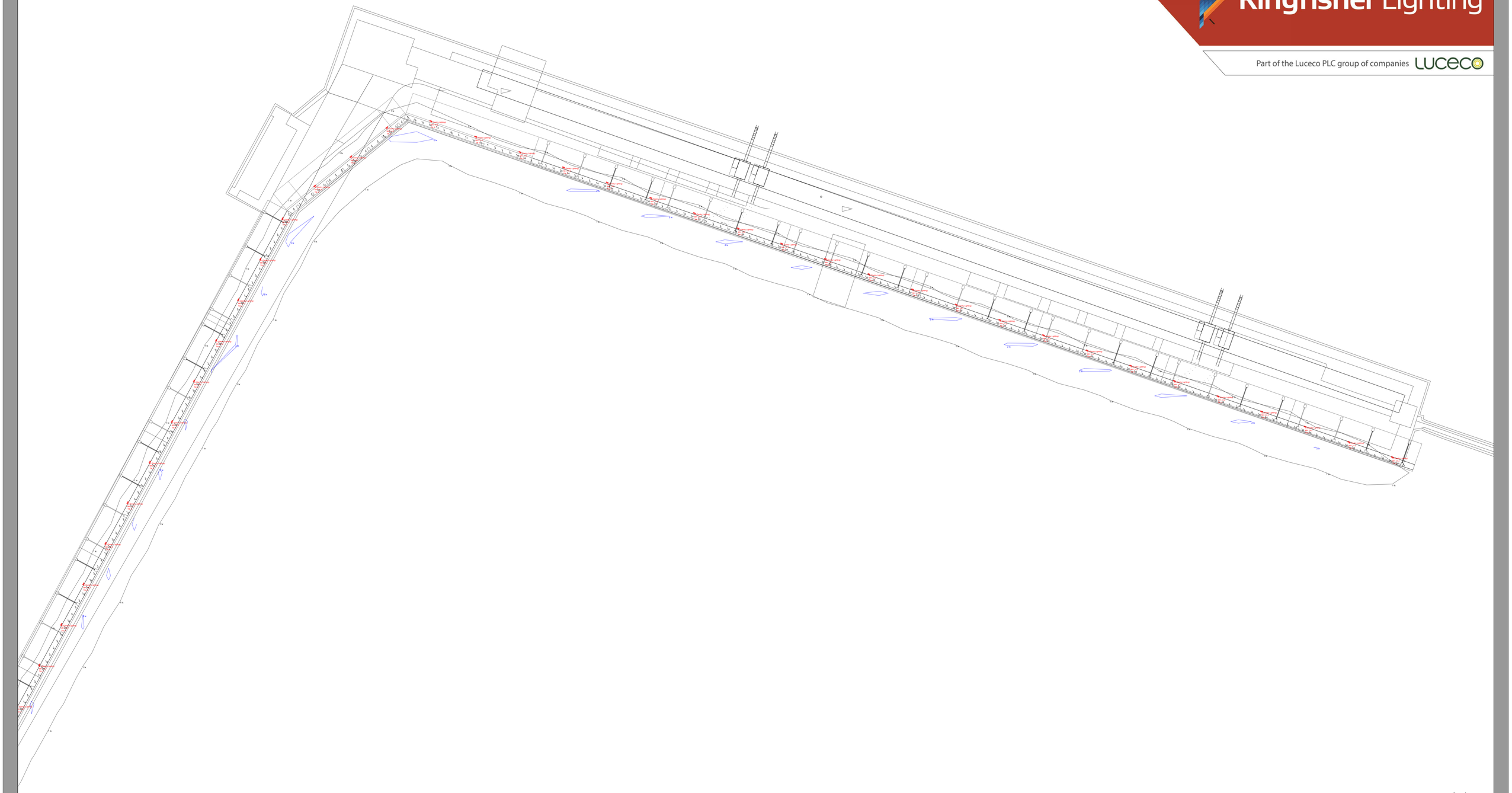

N

A0

XLCC Hunterston

Scale	Project Number
1: 500 at A0	D45017C
Date	Drawing No.
3 February 2022	D45017/JB/C

Lighting Designer : Jamie Buck MSLL

HEA Highway Electrical Association HEMSA

ILP Institution of Lighting Professionals

For our LED lighting designs a 0.9mf has been used. If this differs from the maintenance period for this project then you must advise us accordingly