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Wrexham Association Football Club

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Report

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WREXHAM AFC – KOP STAND DEVELOPMENT EXTERNAL LIGHTING ASSESSMENT

WREXHAM AFC – KOP STAND DEVELOPMENT EXTERNAL LIGHTING ASSESSMENT

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P01	22/09/2021	C Waldron	A Selvey	A Selvey	Draft issue
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P03	08/06/2022	C Waldron	A Selvey	A Selvey	Issue for Planning

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1. EXECUTIVE SUMMARY

This lighting assessment report provides details on the proposed floodlighting design to illuminate the football pitch for Wrexham AFC. Their stadium, known as 'The Racecourse Ground' is located on Mold Road, Wrexham. This report shall cover how the lighting levels are achieved, providing specifics on luminaires, their mounting heights and orientation. As well as discussing how light pollution has been controlled.

This lighting system has been designed to meet lighting levels for the following match requirements. The different lighting levels shall be achieved through the lighting controls system.

- UEFA Level 4
- Premier League
- EFL Championship
- EFL League 1
- EFL League 2
- National League
- Rugby Football Union (As shown in RFU Floodlighting Installation and Management Guide)

2. INTRODUCTION

The implementation of external lighting for Wrexham AFC stadium is unavoidable. To hold football matches out of daylight hours, artificial external lighting is required. This is to create a safe playing environment for the footballers and to achieve lighting levels required for TV broadcasters.

The proposed floodlight design incorporates 4 No. lighting columns which have been positioned at each of the corners of the pitch, these are also in line with recommendations from the architect. These columns shall replace the existing towers to achieve a more modern lighting installation.

Floodlights are also proposed to be mounted onto the stands; however, these are to cater for the higher lighting required for football matches played at different levels. Therefore, shall not be used to Wrexham AFC football matches in their current league.

The lighting required for different levels of football matches shall be controlled via a lighting controls system.

3. EXISTING LIGHTING

The existing lighting strategy utilises 4 No. lighting towers, with a single tower placed at either side of the Wrexhtrent Stand and the KOP Stand.



Figure 1 – Lighting Towers at The Racecourse Ground

The proposed lighting design requires 4 No. new columns to be installed at the 4 No corners of the football pitch with 2 No. at either side of the proposed KOP stand and Wrexhtrent Stand.

Guidance was provided by the architect on positioning of the lighting columns, this influenced the construction of the columns. To achieve the lighting levels the lighting columns have been designed with a forward cantilever of 20 degrees. The columns are 40m in height with the bottom 20m in the required tower positions and the upper 20m part of the 20-degree tilt. **Appendix 1** shows a detail of the proposed lighting columns.



Figure 2 – Lighting Columns with Cantilever Tilt at Leeds UTD Ground

To cater for the higher lighting levels required for different levels of football matches, luminaires are also required to be installed on all 4 No. of the stands. It is recommended that calculations are carried out by the structural engineer to ensure that the stands can withstand the extra load from the roof mounted lighting systems.

The existing floodlight luminaires shall not be reused as part of the new lighting design as they will not be as efficient as new luminaires.

4. LIGHTING LEVELS

Currently Wrexham AFC sits in the 5th tier of the English football league, this requires a lighting level of 350 lux to be achieved, which is what the floodlighting is designed to. Should the club reach promotion to the 4th tier of the English Football League, the lighting requirements will increase to 500 lux.

There are aspirations for the stadium to host Women's Euro International football matches. Based on recommendations given in the UEFA Stadium Lighting Guide 2016, this would mean an average lighting level of 800 lux is to be achieved on the football pitch.

The club has requested that the stadium lighting should be designed to UEFA Level 4, which is a lighting level of 1400 lux. However, as the Premier League lighting requirements are only marginally higher than UEFA Level 4, the stadium shall be designed to Premier League standards of 1500 lux, for future proofing.

Therefore, designing to 1500 lux will mean that the lighting levels will be more than adequate for club level football until the club reaches the top tiers of English football.

To avoid wasting energy by illuminating the pitch to 1500 lux at a constant, when the club is playing a fifth-tier English football league match, the proposed lighting design will have lighting controls to reduce lighting levels to 350 lux.

Please refer to **Appendix 2** for lighting calculation results across the horizontal plane of the football pitch for the lighting requirements for the Premier League and UEFA Level 4.

Refer to **Appendix 6** for lighting levels and lighting spill across the horizontal and vertical plane for EFL 1 & 2 lighting requirements.

Match Type	Lighting Level
	1500 lux
	800 lux
	500 lux
	350 lux
	200 lux
	

Table 1 – Lighting Level Requirements

5. LIGHTING OPERATIONAL HOURS

Discussions with the Wrexham AFC Stadium Operation Manager have confirmed that the utilisation of floodlighting during football matches is decided by the match referee. The operations manager stated that the referee opts to turn the floodlighting on for all matches, regardless of time, weather conditions and levels of daylight.

The stadium operations manager stated that for 3pm kick-offs, the floodlighting is usually turned on from 3pm till 6pm. For later kick-offs taking place around 7pm, the lighting is usually in operation from 6pm till 10pm.

Below is a football match event profile, with timings the stadium lighting shall be in operation. This is based upon the fixtures played in the stadium during the 2018/2019 National League. As the stadium hopes to host Welsh Women's National Team matches in European football competitions, the women's national teams home matches for the 2019/2020 Euro Qualifying campaign have also been added. Please note these did not take place at The Racecourse Ground.

Event Type	No. of Events	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
The Racecourse Ground																								
National League - Early Kick Off (12:30pm)	1																							
National League - Mid Afternoon Kick Off (3pm)	19																							
National League - Typical Late Kick Off (7pm)	4																							
FA Cup - Late Kick Off (8pm)	2																							
FA Trophy - Mid Afternoon Kick Off (3pm)	2																							
Welsh Womens National Team																								
World Cup Qualifier - Late Kick Off (7:00pm)	3																							
Friendlies - Early Kick Off (12pm)	2																							
Friendlies - Late Kick Off (7pm)	1																							
Welsh Mens National Team																								
UEFA Nations League - Late Kick Off (7:45pm)	2																							
Friendlies - Late Kick Off (7:45pm)	2																							
Euro Qualifier League - Early Kick Off (2:00pm)	1																							
Welsh Mens National Team (Rugby)																								
Test Match - Afternoon Kick Off (2:30pm)	2																							
Test Match - Late Afternoon Kick Off (5:20pm)	2																							
Six Nations - Early Kick Off (12:30pm)	2																							
Welsh Womens National Team (Rugby)																								
Six Nations - Early Kick Off (12:30pm)	2																							

Table 2 – Football Match Event Profile

As seen in the table above, the frequency of football matches being played late at night does not occur often. For the total number of events in Table 2, 69% of matches are played during Autumn and Winter, where daylight hours are reduced. This is where the floodlight light spill will impact the local environment the most.

Of those matches played during the colder seasons, 36% will be played at a late kick off. Meaning the lighting will be operational for 4 hours from 6pm till 10pm.

6. LIGHT SPILL

The areas highlighted in the figure below have been identified as main occupied areas which could be affected by the light pollution caused by the stadium floodlighting system.

What must be taken into consideration is that these areas will currently be illuminated by artificial lighting and are not dark, uninhabited areas. Behind the Wrexham Glyndwr University building is the Wrexham Glyndwr University building which has lighting columns to light the external car park. The residential properties on Mold Road will be subject to illumination from the street lighting. Wrexham Village University Accommodation shall also have building mounted perimeter lighting.



Figure 2 – Light Spill Affected Areas

Please refer to **Appendix 3** for light spill calculation results across the horizontal and vertical planes respectively – this is shown in the illumination summary table on calculation results. The horizontal planes measure light spill across a horizontal surface whereas the vertical plane measures light spill on a vertical plane back towards the stadium and the light sources.

See **Appendix 4** which shows the beam angles for the various luminaires used for floodlighting.

Regarding dark sky compliance, the design has been able to achieve 0.00% ULR which means zero upward light. This is due to utilising the luminaire shown in Table 3 combined with a visor.

The outcome of the ecology report was that there are no causes for concern for the floodlighting. The stadium construction will create loss of habitat for animals which is why a biodiverse roof will be implemented onto the KOP Stand. This won't be suitable for animals sensitive to light, such as bats, to make their habitat.

The ecology report also states the trees on the wooden embankment should be put under an ecological watching brief for precautionary measures. The light spill to this location is greatly reduced due to it being located behind the proposed KOP stand, which is a taller construction than the rest of the stands. The result of this is that it blocks more light being polluted.

7. LUMINAIRE ARRANGEMENT

The proposed design has 2 No new lighting columns situated either side of the Wrexrent Stand and 2 No. lighting columns at the KOP stand.

The two towers situated either side of the Wrexrent Stand have their luminaires mounted at 40m with 1 No. columns having 32 luminaires and the other 28 luminaires. This this is the same for the lighting columns located at the proposed KOP stand.

The luminaires used are 'Musco – TLC-LED-1500' and 'Musco TLC-LED-1200'. The characteristics of this luminaire are shown in the table below.

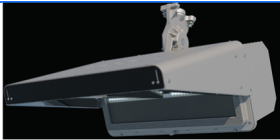
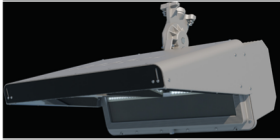
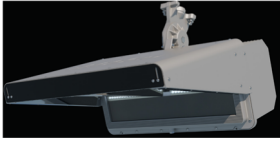
Image	Product	Lamp Type	Wattage	IP Rating	Efficiency	Dimming Mode
	Musco TLC-LED-1200	LED	1170	65	95%	Yes
	Musco TLC-LED-1500	LED	1430	65	95%	Yes
	Musco TLC-LED-1200	LED	1170	65	95%	Yes

Table 3 – Luminaire Schedule

A mixture of single and twin flood lights shall be mounted into the stands also. These shall not be in operation for English football league matches and only used for the higher levels of English Football and women's National Team matches.

Referring to the drawings in **Appendix 2**, it indicates that the roof mounted luminaires are mounted at a greater height than the height of the stands themselves. This is due to the low stand heights making it challenging for the UEFA Level 4 lighting level requirements to be achieved. To overcome the issues with the low stand heights, small structures will need to be built on top of the low stands. This is similar to the installation on the AFC Bournemouth stadium – refer to **Appendix 5**.

Structural checks will need to be conducted to ensure the stands are able to carry the additional load of structural frame and luminaires.

APPENDIX 1

LIGHTING COLUMN DETAIL

NOTES
All dimensions and levels to be checked on site
Any discrepancies are to be reported to the Architect before any work commences
This drawing shall not be scaled to ascertain any dimensions, work to figured dimensions only
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DISCLAIMER
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P1 08.06.22 WR PLANNING ISSUE

rev no.	rev date	rev by	description
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project

KOP Redevelopment

location

Racecourse Stadium

Employer

client



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key plan



drawing title

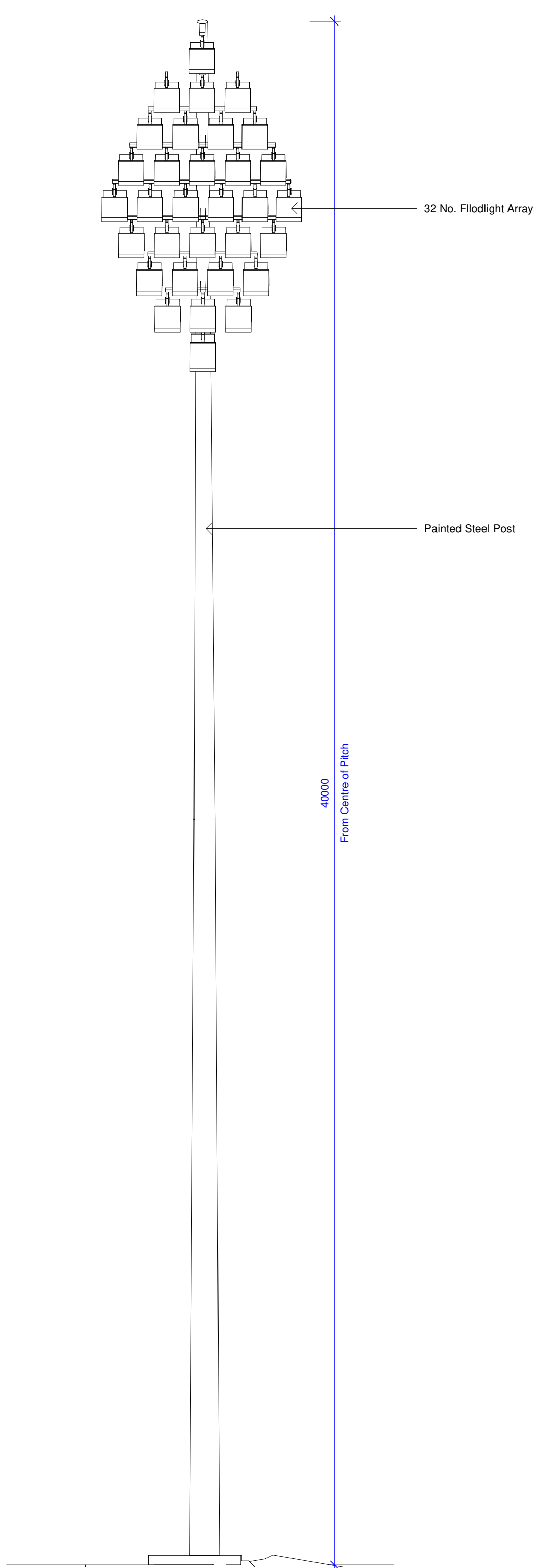
Floodlight Tower Details

AFL job number scale @ A1 drawn WR checked JR

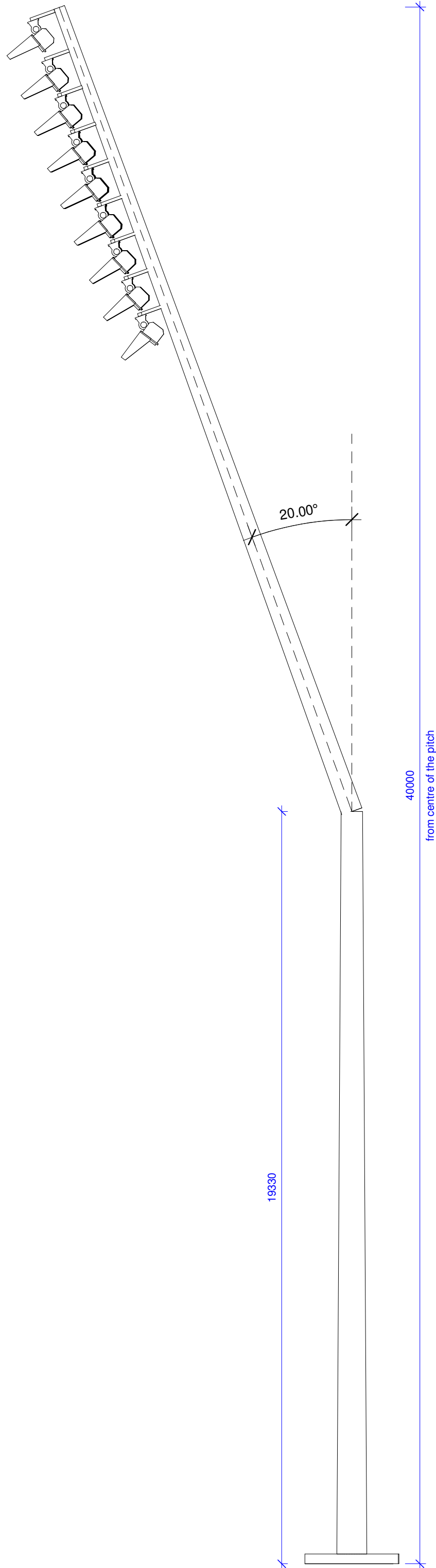
211509 1 : 100 rev date 08.06.22

dwg purpose	status	rev
PLANNING	S2	P1

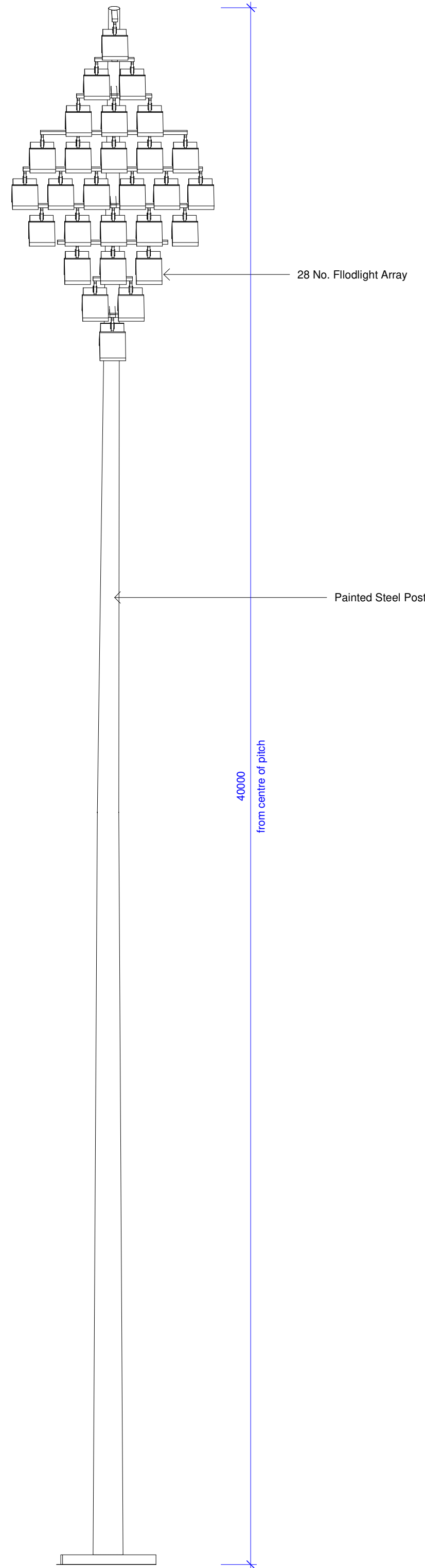
bim project origin zone level type role 5-digit no.
211509-AFL-ZZ-ZZ-DR-A-00203



1 P01 & P02 Floodlight towers
1 : 100



2 Floodlight Tower P01-04 Side Elevation
1 : 100



3 Tower Floodlight P03 & 04 Front Elevation
1 : 100

APPENDIX 2

PITCH LIGHTING LEVELS (HORIZONTAL PLANE)

Wrexham, Wales

ILLUMINATION SUMMARY

LUMINAIRE INFORMATION	
Applied Circuits:	A
No. of Luminaires:	192
Total Load:	263.12 kW

Installation Requirements: Results assume $\pm 3\%$ nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



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ILLUMINATION SUMMARY

0 20m 40m

ENGINEERED DESIGN By: Nick Rohrer · File #194992F · 27-Apr-22

Pole location(s) $\oplus$ dimensions are relative to 0,0 reference point(s) $\otimes$

Wrexham FC
Wrexham, Wales

GRID SUMMARY	
Name:	2.1 Wrexham AFC - UEFA B
Size:	105.0m x 68.0m
Spacing:	9.5m x 9.7m
Height:	1.0m above grade

ILLUMINATION SUMMARY	
MAINTAINED HORIZONTAL LUX	
	Entire Grid
Guaranteed Average:	1400
Scan Average:	1937.54
Maximum:	2356
Minimum:	1707
Guaranteed Min / Avg:	0.6
Min / Avg:	0.88
Min / Max:	0.72
UG (adjacent pts):	1.16
CU:	0.63
No. of Points:	96
LUMINAIRE INFORMATION	
Applied Circuits:	A
No. of Luminaires:	192
Total Load:	263.12 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

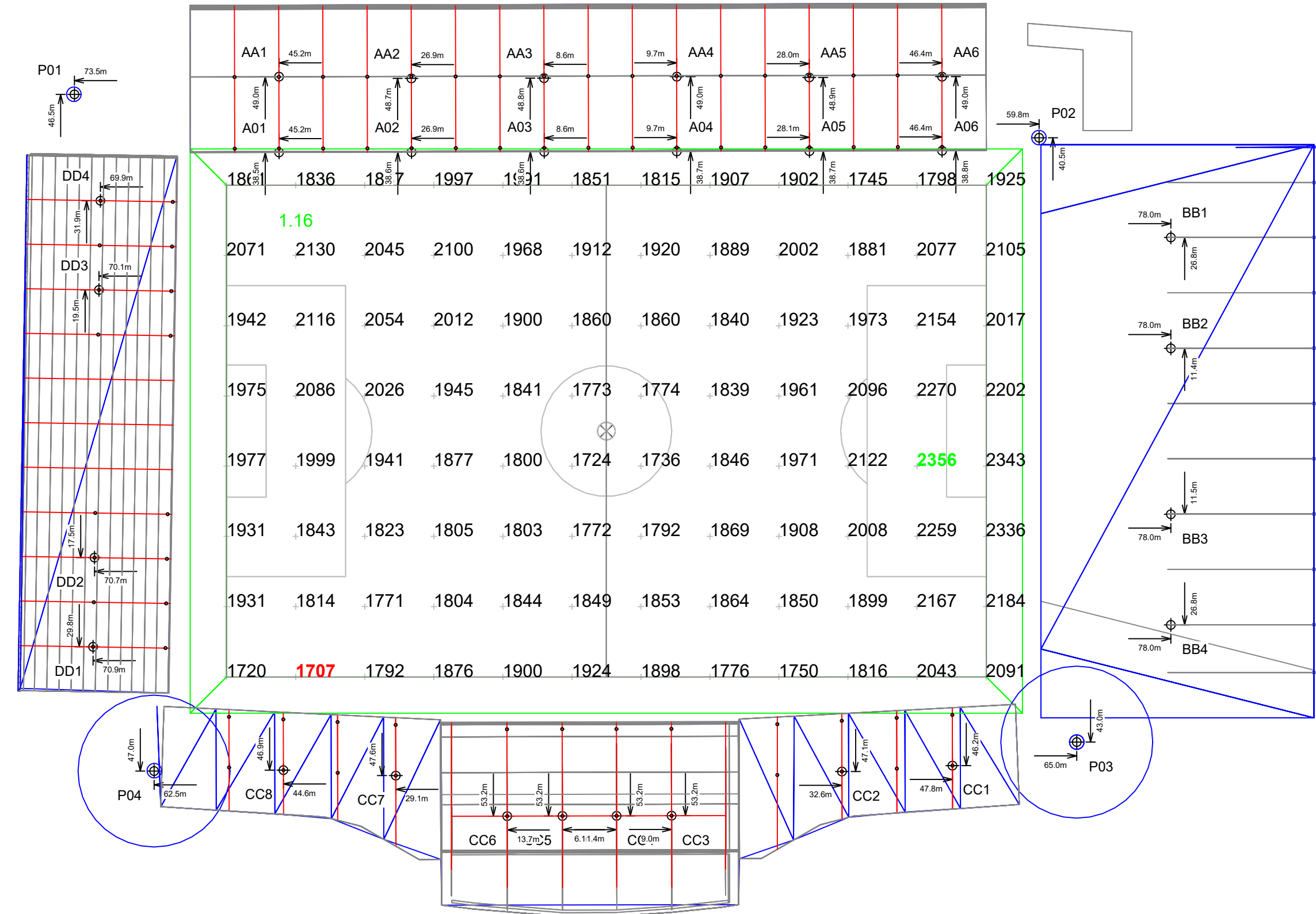
Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.

Installation Requirements: Results assume $\pm 3\%$ nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



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ILLUMINATION SUMMARY



APPENDIX 3

LIGHTING SPILL (HORIZONTAL PLANE)

Wrexham FC
Wrexham, Wales

GRID SUMMARY	
Name:	3.1 Wrexham AFC - 200m Spill
Spacing:	10.0m x 10.0m
Height:	1.0m above grade

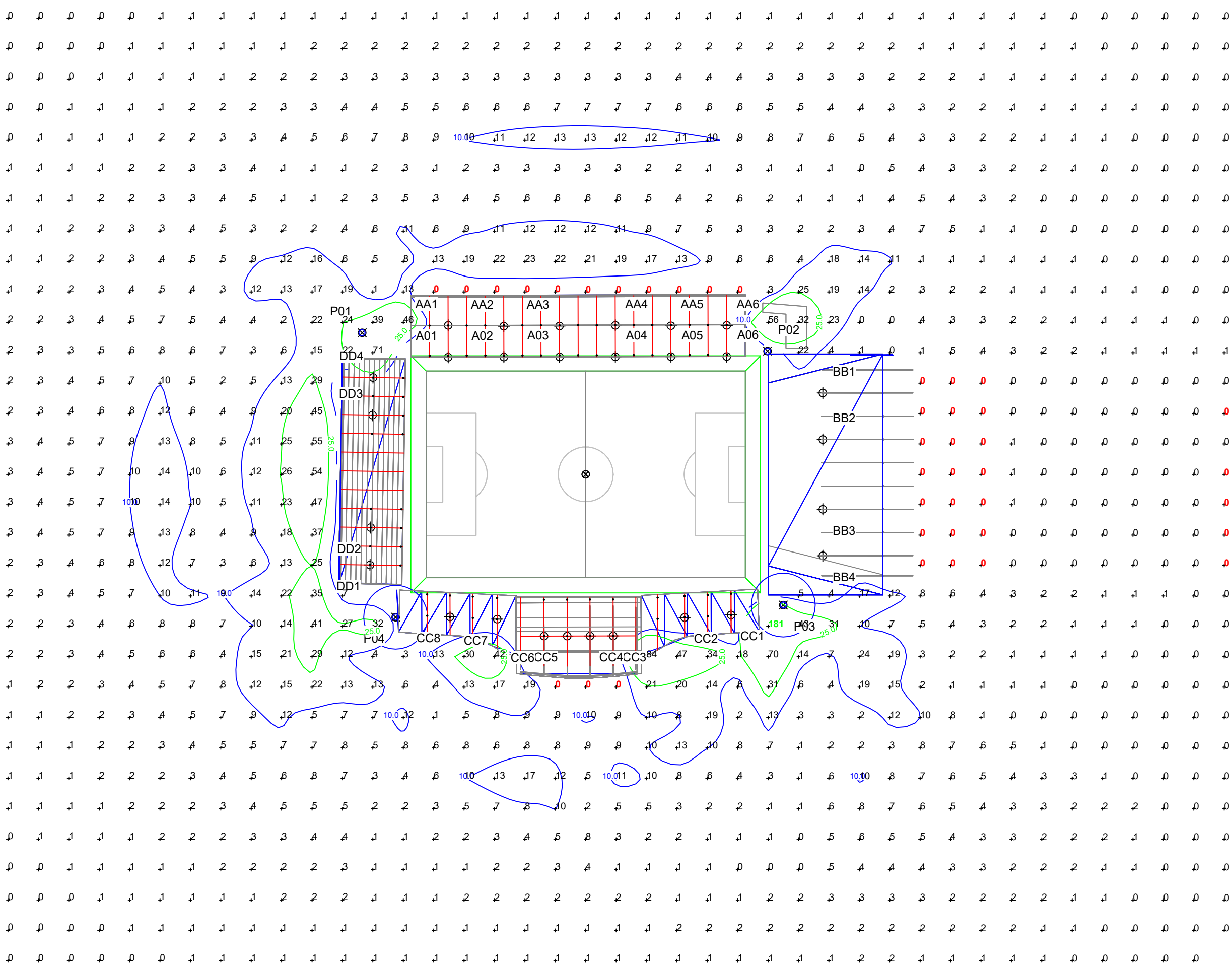
ILLUMINATION SUMMARY	
HORIZONTAL LUX	
Scan Average:	Entire Grid 2.9516
Maximum:	181.07
Minimum:	0.00
CU:	0.02
No. of Points:	1838
LUMINAIRE INFORMATION	
Applied Circuits:	A
No. of Luminaires:	192
Total Load:	263.12 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.

Installation Requirements: Results assume $\pm 3\%$ nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



Pole location(s) ⚓ dimensions are relative to 0,0 reference point(s) ⊗



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ILLUMINATION SUMMARY

Wrexham FC
Wrexham, Wales

GRID SUMMARY	
Name:	3.1 Wrexham AFC - 200m Spill
Spacing:	10.0m x 10.0m
Height:	1.0m above grade

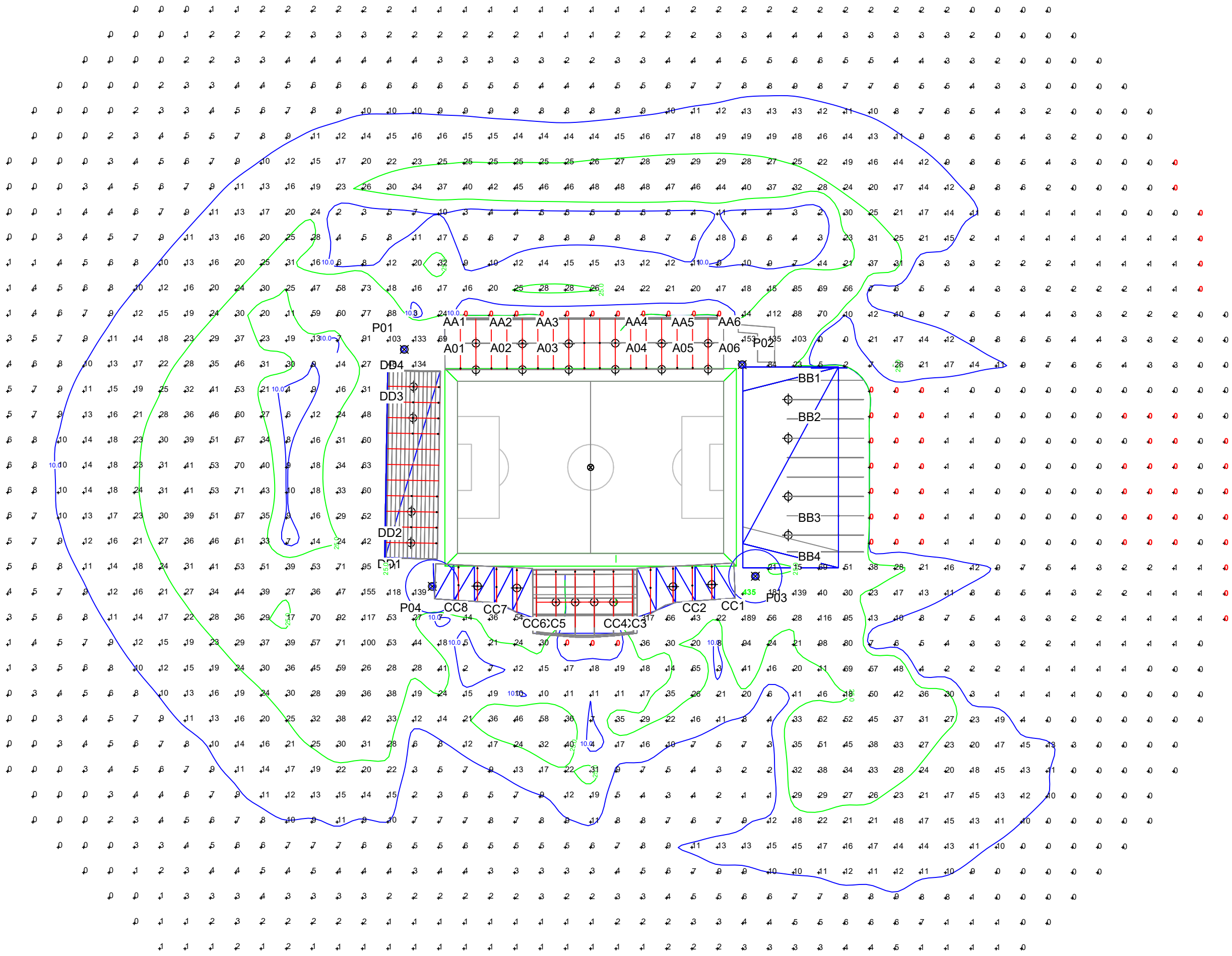
ILLUMINATION SUMMARY	
MAX VERTICAL LUX	
Scan Average:	Entire Grid 11.5561
Maximum:	435.25
Minimum:	0.00
CU:	0.02
No. of Points:	1838
LUMINAIRE INFORMATION	
Applied Circuits:	A
No. of Luminaires:	192
Total Load:	263.12 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.

Installation Requirements: Results assume $\pm 3\%$ nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



APPENDIX 4

LUMINAIRE BEAM ORIENTATION

EQUIPMENT LAYOUT

INCLUDES:
· Wrexham AFC

Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.

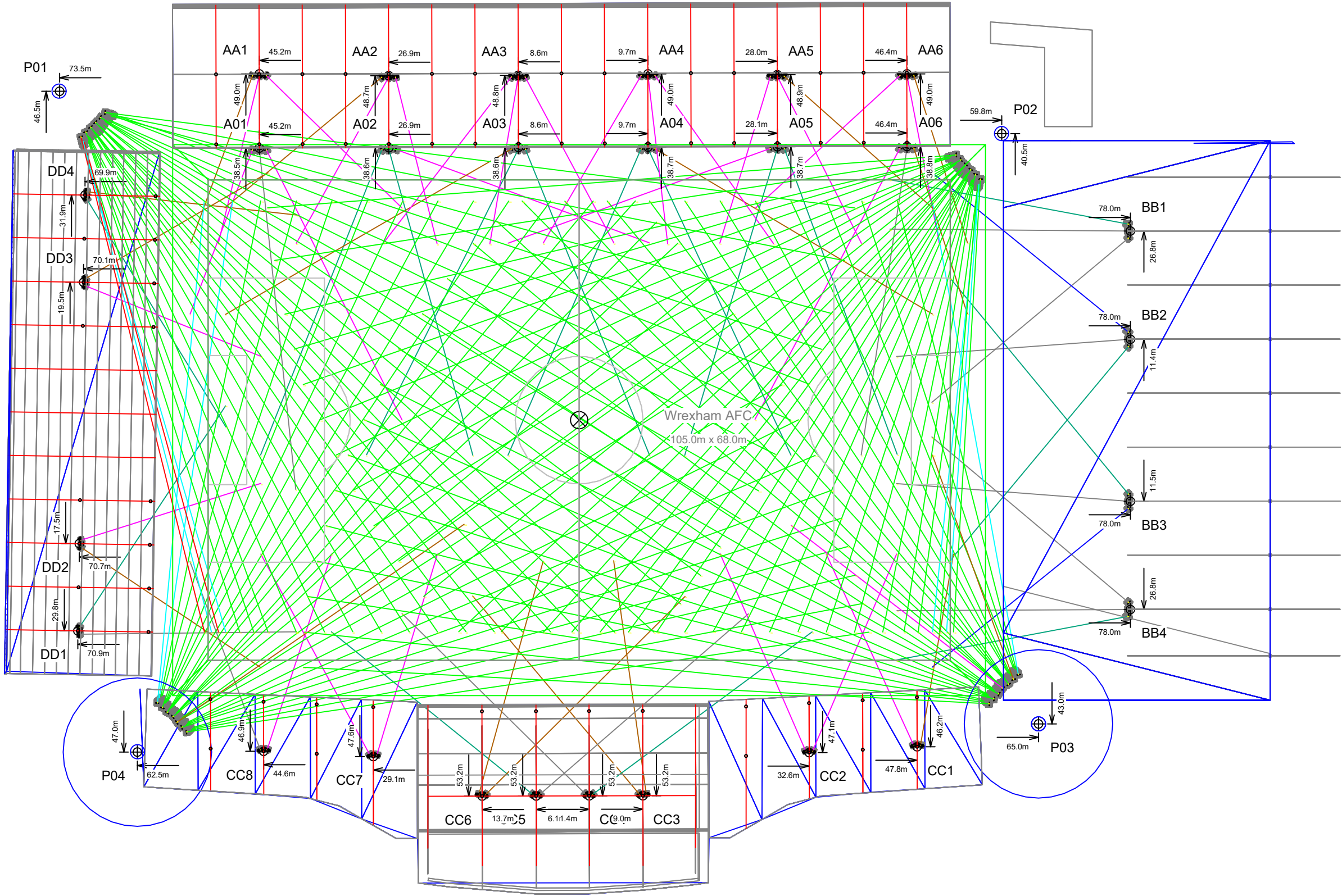
Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

EQUIPMENT LIST FOR AREAS SHOWN

QTY	Pole			Luminaires		
	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE
6	AA1, AA2 AA3, AA4 AA5, AA6		9m	9m	TLC-LED-1200	3
6	A01, A02 A03, A04 A05, A06		15m	15m	TLC-LED-1500	3
4	BB1, BB2 BB3, BB4		21m	21m	TLC-LED-1500	3
1	CC5		15.2m	15.2m	TLC-LED-1200	2
1	CC3		15.21m	15.21m	TLC-LED-1200	2
1	CC4		15.2m	15.2m	TLC-LED-1200	2
1	CC7		10.88m	10.88m	TLC-LED-1200	2
1	CC6		15.2m	15.2m	TLC-LED-1200	2
1	CC8		9.32m	9.32m	TLC-LED-1200	2
1	CC2		10.13m	10.13m	TLC-LED-1200	2
1	CC1		8.65m	8.65m	TLC-LED-1200	2
1	DD3		11.57m	11.57m	TLC-LED-1200	2
1	DD2		11.53m	11.53m	TLC-LED-1200	2
1	DD1		11.52m	11.52m	TLC-LED-1200	2
1	DD4		11.58m	11.58m	TLC-LED-1200	2
2	P01, P02	40m	-	40m	TLC-LED-1500	32
2	P03, P04	40m	-	40m	TLC-LED-1500	28
32	TOTALS					192

SINGLE LUMINAIRE AMPERAGE DRAW CHART

Ballast Specifications (.90 min power factor)	Line Amperage Per Luminaire (max draw)						
	208 (60)	220 (60)	240 (60)	277 (60)	347 (60)	380 (60)	480 (60)
Single Phase Voltage	208	220	240	277	347	380	480
TLC-LED-1200	7.0	6.6	6.1	5.2	4.2	4.0	3.0
TLC-LED-1500	8.5	8.1	7.4	6.4	5.1	4.7	3.7



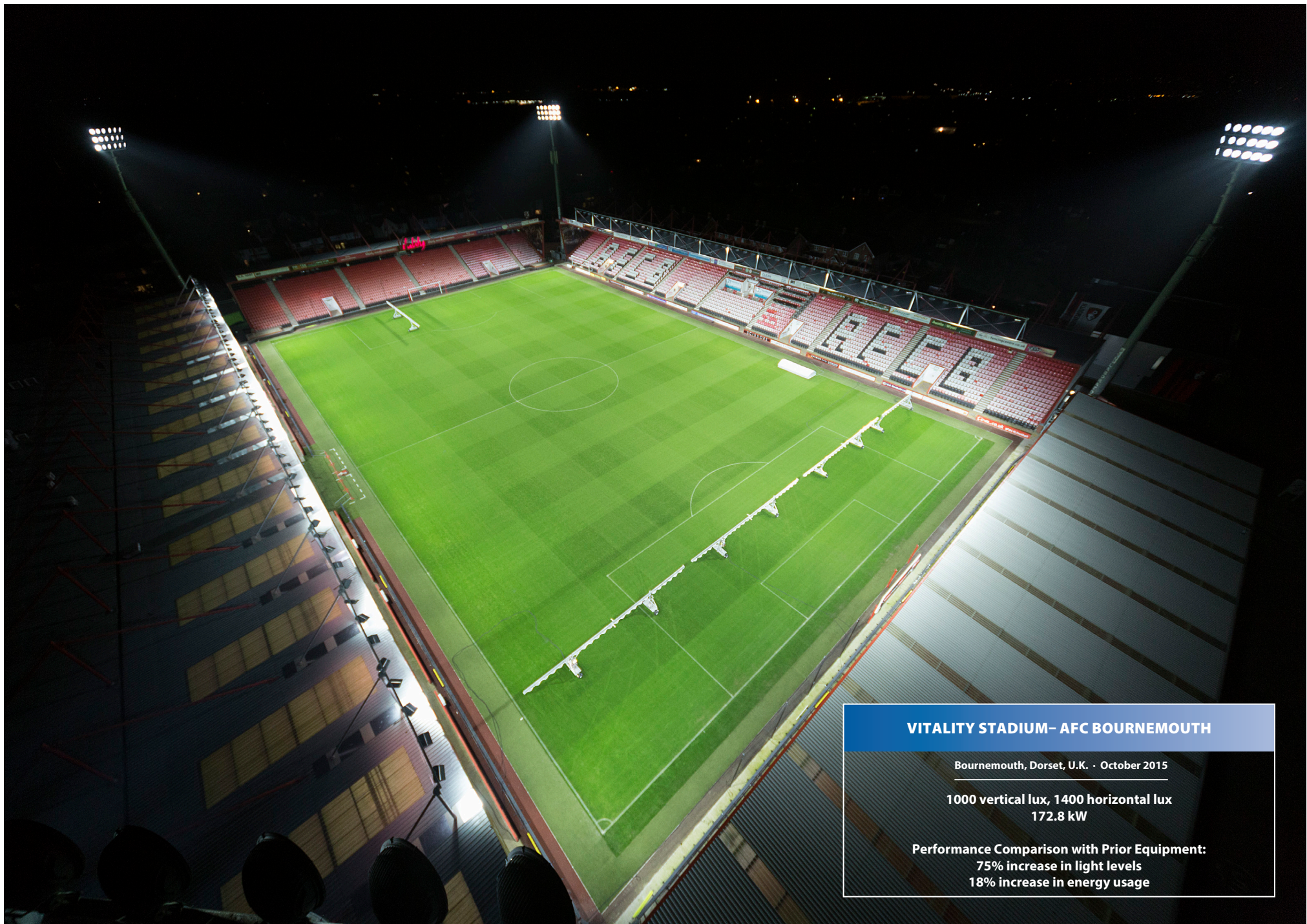
Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗



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APPENDIX 5

AFC BOURNEMOUTH STAND MOUNTED STRUCTURES



VITALITY STADIUM – AFC BOURNEMOUTH

Bournemouth, Dorset, U.K. · October 2015

1000 vertical lux, 1400 horizontal lux
172.8 kW

Performance Comparison with Prior Equipment:
75% increase in light levels
18% increase in energy usage

APPENDIX 6

EFL 1 & 2 LIGHTING RESULTS AND LIGHT SPILL

Wrexham FC
Wrexham, Wales

GRID SUMMARY	
Name:	1.1 Wrexham AFC - Premier League
Size:	105.0m x 68.0m
Spacing:	9.5m x 9.7m
Height:	1.0m above grade

ILLUMINATION SUMMARY	
MAINTAINED HORIZONTAL LUX	
Entire Grid	
Guaranteed Average:	500
Scan Average:	504.57
Maximum:	614
Minimum:	444
Guaranteed Min / Avg:	0.7
Min / Avg:	0.88
Min / Max:	0.72
UG (adjacent pts):	1.16
CU:	0.66
No. of Points:	96
LUMINAIRE INFORMATION	
Applied Circuits:	A
No. of Luminaires:	192
Total Load:	65.78 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

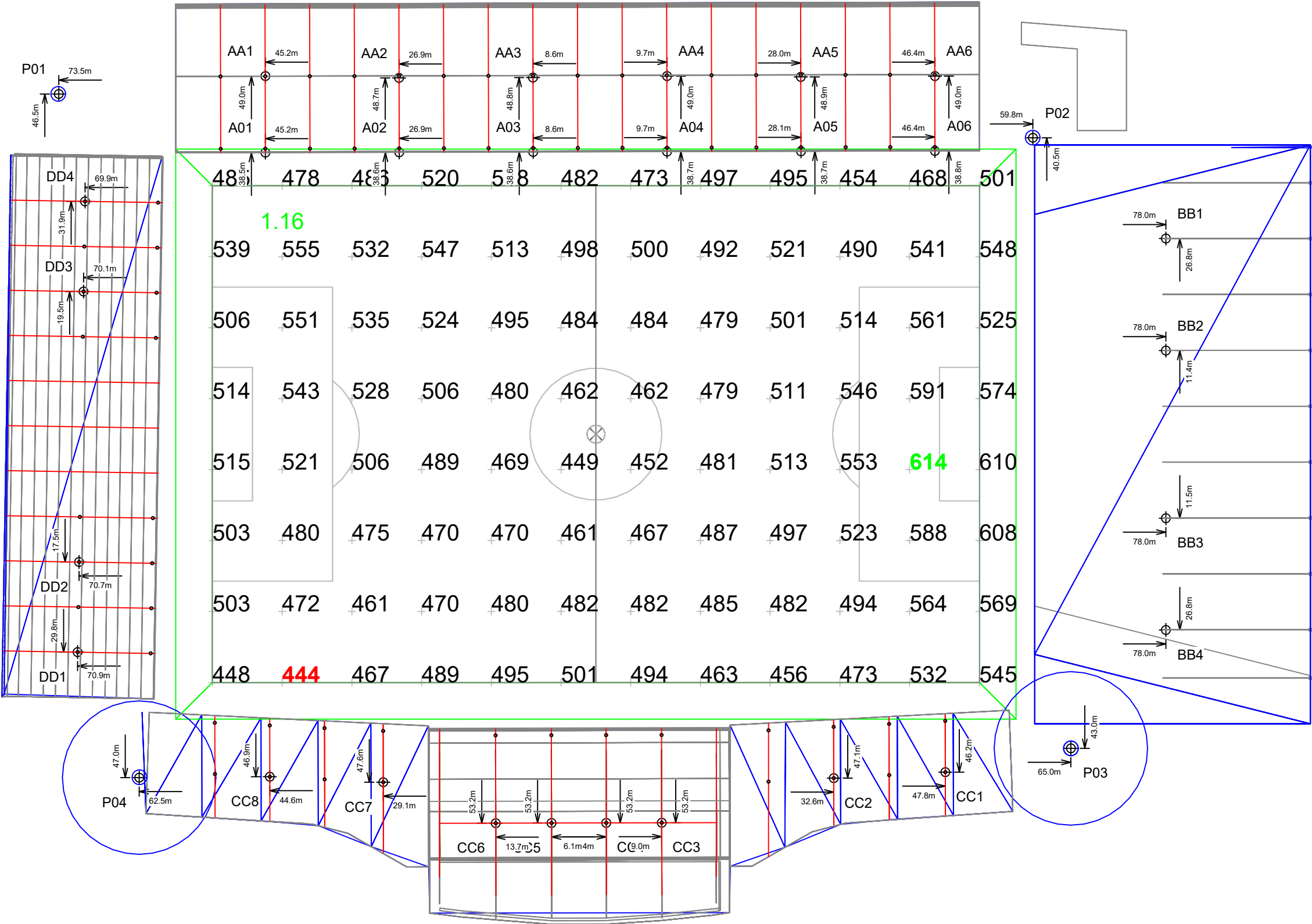
Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.

Installation Requirements: Results assume $\pm 3\%$ nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



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ILLUMINATION SUMMARY



Pole location(s) Ⓢ dimensions are relative to 0,0 reference point(s) ⊗

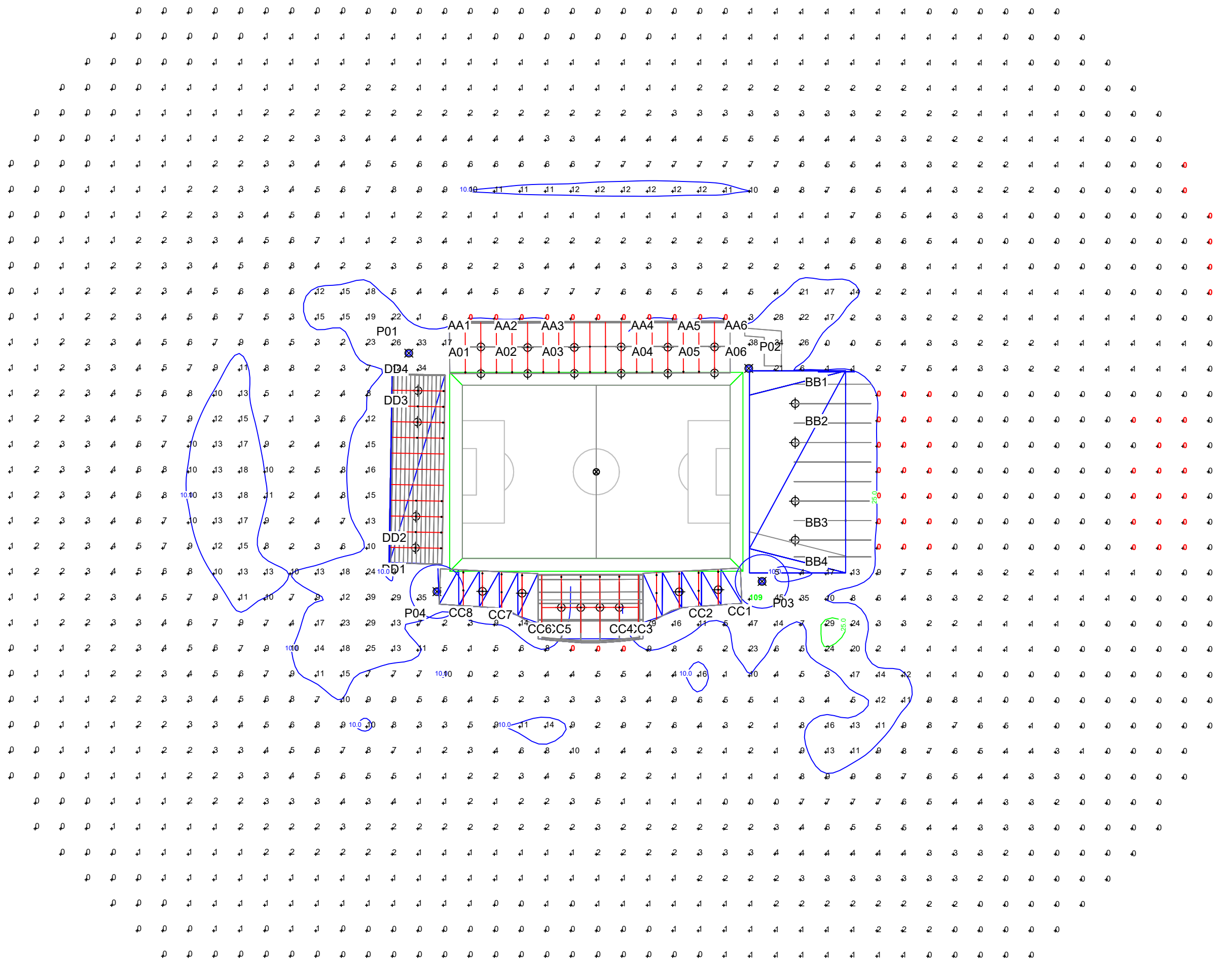
Wrexham, Wales

ILLUMINATION SUMMARY	
MAX VERTICAL LUX	
Scan Average:	Entire Grid 2.8890
Maximum:	108.81
Minimum:	0.00
CU:	0.02
No. of Points:	1838
LUMINAIRE INFORMATION	
Applied Circuits:	A
No. of Luminaires:	192
Total Load:	65.78 kW

Installation Requirements: Results assume $\pm 3\%$ nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



ILLUMINATION SUMMARY



Pole location(s) $\oplus$ dimensions are relative to 0,0 reference point(s) $\otimes$