

# Aviation Lighting Scheme

Fusion Manchester Devco Ltd

Student Accommodation Manchester

July 2023

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## ADMINISTRATION PAGE

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| Issue | Date      | Detail of Changes                              |
|-------|-----------|------------------------------------------------|
| 1     | May 2023  | Initial issue                                  |
| 2     | July 2023 | Inclusion of European regulations and CAP 1168 |

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## EXECUTIVE SUMMARY

### Report Overview

Pager Power has been retained to produce an aviation lighting scheme for a proposed building development located on Deansgate Street and Bridgewater Viaduct in central Manchester.

### Planning Condition

The purpose of this report is to address the following planning condition:

*Development shall not commence unless and until a scheme for the provision of obstacle lighting has been submitted to and approved in writing by the local planning authority, in consultation with the Aerodrome Safeguarding Authority for Manchester Airport. The approved obstacle lighting scheme shall be implemented before first occupation of the development and retained thereafter.*

### Lighting Scheme Considerations

The following was undertaken to determine the lighting scheme for the proposed development:

- Obstacle Limitation Surfaces (OLS) assessment for Manchester Airport.
- A review of the following publications:
  - Air Navigation Order 2016: Article 222.
  - Civil Aviation Authority Civil Aviation Publication 168 and 1168.
  - European Aviation Safety Agency: Certification Specifications and Guidance Material for Aerodrome Design (EASA CS-ADR-DSN).

### Overall Conclusion

The OLS assessment has shown that the proposed development is clear of the Outer Horizontal Surface by 83.72m.

The cited guidance state that an obstacle is defined as an object that is 150m above ground level (agl) or more and not in the vicinity of a licensed aerodrome. The proposed development is therefore not considered an obstacle as it is less than 150m agl and in the vicinity of Manchester Airport because it is within its controlled airspace.

CAP 168 and EASA CS ADR-DSN.Q.848 dictate that structures less than 150m agl could still require lighting if it is deemed a potential hazard to safety or an extensive obstacle. The proposed development is not deemed a hazard to safety or an extensive obstacle because it does not infringe the OLS.

Based on the results of the OLS assessment and the review of the guidance, the proposed development does not require aviation lighting.

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## ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 58 countries within South Africa, Europe, America, Asia and Australasia.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

- Renewable energy projects.
- Building developments.
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

## 1 INTRODUCTION

### 1.1 Overview

Pager Power has been retained to produce an aviation lighting scheme for a proposed building development located on Deansgate Street and Bridgewater Viaduct in central Manchester.

This report includes the following:

- Assessment of the Obstacle Limitation Surfaces for Manchester Airport.
- A review of relevant guidance:
  - Air Navigation Order 2016: Article 222.
  - Civil Aviation Authority Civil Aviation Publications 168.
- Overall conclusions.

### 1.2 Planning Condition

The purpose of this report is to address the following planning condition:

*Development shall not commence unless and until a scheme for the provision of obstacle lighting has been submitted to and approved in writing by the local planning authority, in consultation with the Aerodrome Safeguarding Authority for Manchester Airport. The approved obstacle lighting scheme shall be implemented before first occupation of the development and retained thereafter.*

## 2 PROPOSED DEVELOPMENT DETAILS

### 2.1 Proposed Development Site Plan

The proposed development site plan is shown in Figure 1<sup>1</sup> below.

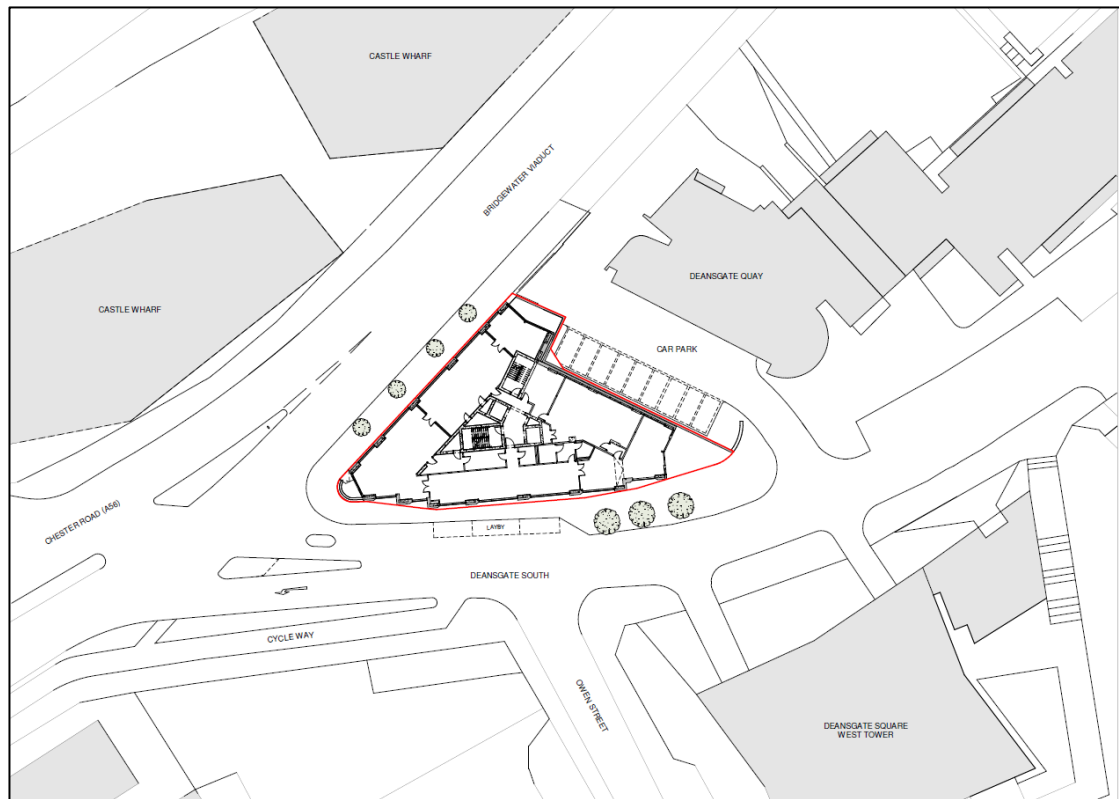


Figure 1 Proposed development site plan

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<sup>1</sup> Source: 20269-2001-T-02-General Arrangement - Site Plan.pdf (copped)

## 2.2 Development Site Layout – Aerial Image

The proposed development footprint (blue outlined area) overlaid onto aerial imagery is shown in Figure 2 below.

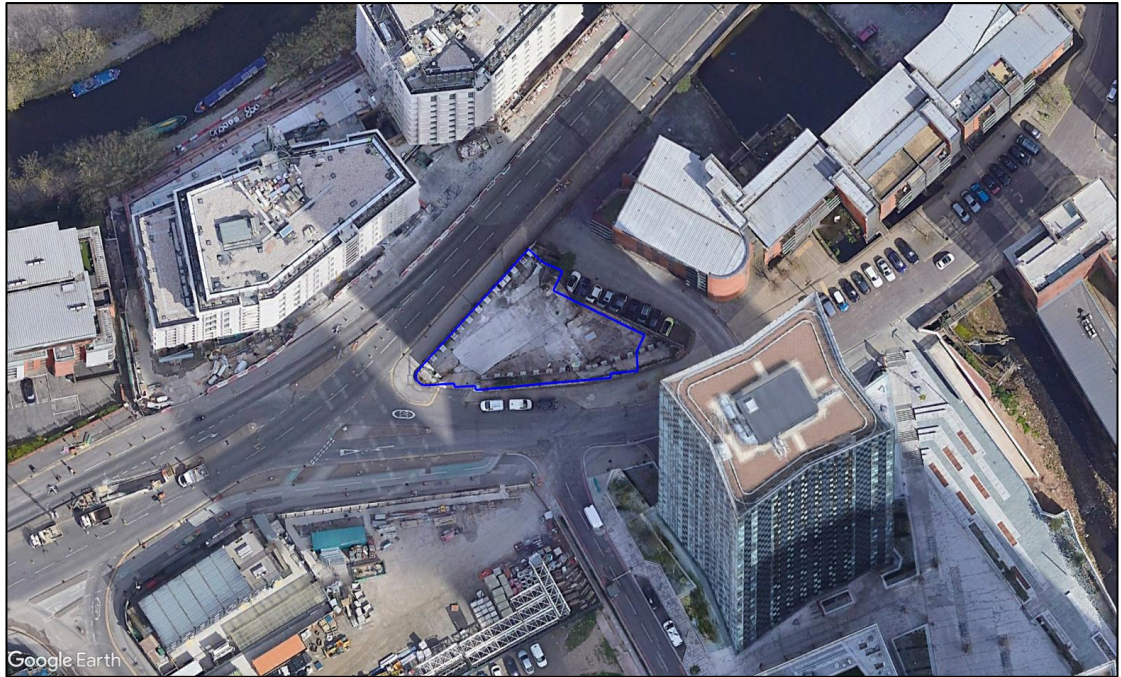


Figure 2 Proposed development footprint – aerial image

### 3 OBSTACLE LIMITATION SURFACES

#### 3.1 Overview

Obstacle Limitation Surfaces (OLS) are imaginary planes defined in three dimensions for physical safeguarding purposes (i.e., ensuring that physical structures do not present a safety hazard at an airfield) and are defined around licensed airfields.

The dimensions and geometry of the surfaces are constructed based on detailed rules defined in the UK Civil Aviation Authority's Civil Aviation Publication 168. The size of the surfaces is dependent on the number of runways, their dimensions and the procedures carried out at the airfield.

#### 3.2 Manchester Airport OLS

The OLS for Manchester Airport have been modelled with respect to the proposed development location. The OLS for Manchester Airport are presented in Figure 3 on the following page along with the proposed development as a red cross.

The figure shows that the proposed development lies horizontally within the Outer Horizontal Surface (OHS)<sup>2</sup>, shown by the grey outlined area.

The results of the OLS assessment for the proposed development are presented in Table 1 below.

| Relevant Surface | Result                 |
|------------------|------------------------|
| OHS              | <u>Clear</u> by 83.72m |

Table 1 OLS results

<sup>2</sup> The OHS is a flat surface with an altitude of 161.52m AOD.

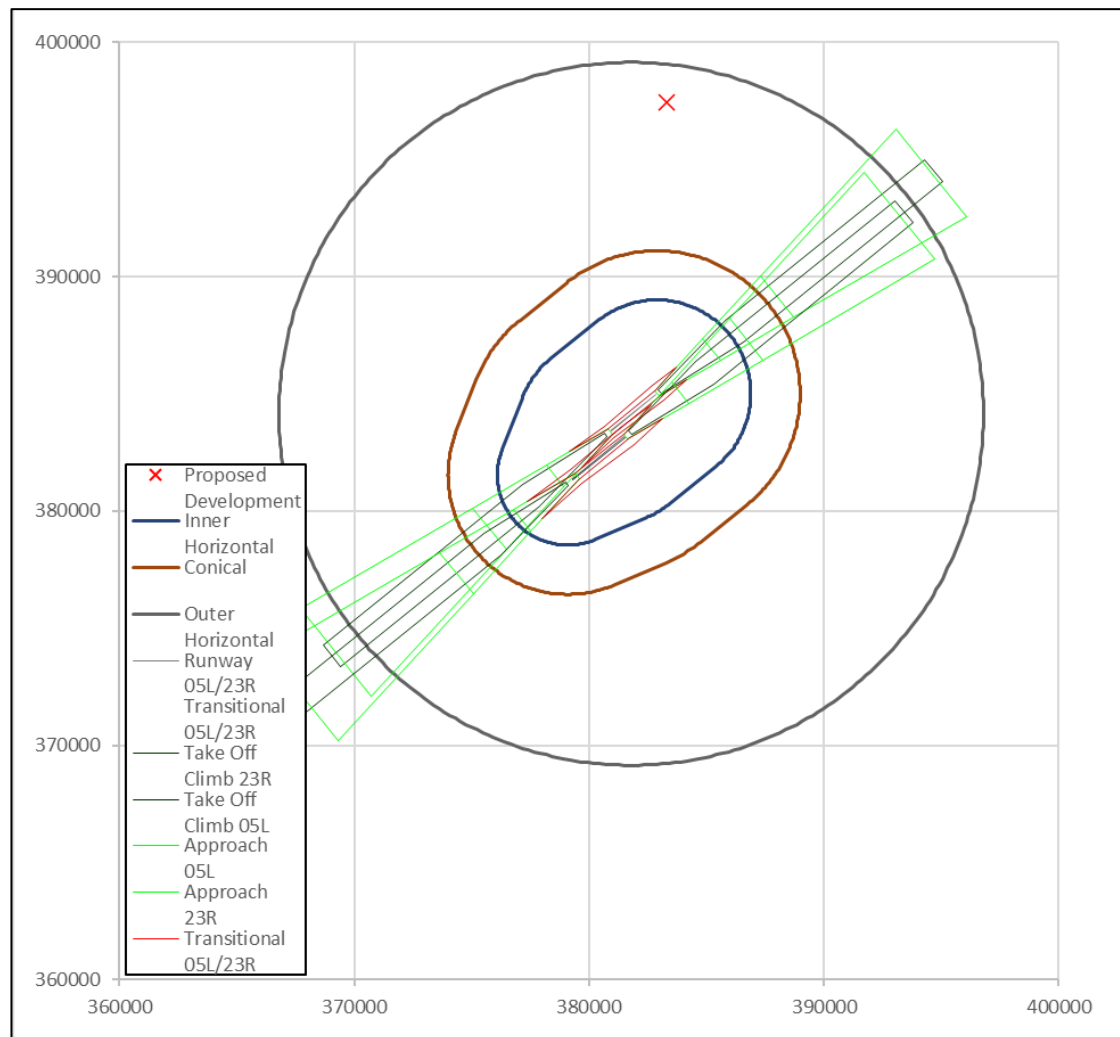


Figure 3 Manchester Airport OLS chart

### 3.3 OLS Conclusions

The analysis has shown that the proposed development is clear of the OHS by 83.72m.

## 4 AVIATION LIGHTING GUIDANCE REVIEW

### 4.1 Overview

The following section presents a review of the relevant aviation lighting guidance.

### 4.2 Air Navigation Order: Article 222 – Overview

The following presents Article 222 of the Air Navigation Order<sup>3</sup>. Key points relating to design of the lighting scheme are underlined.

#### *Lighting of en-route obstacles*

*222. – (1) The person in charge of an en-route obstacle must ensure that it is fitted with medium intensity steady red lights positioned as close as possible to the top of the obstacle and at intermediate levels spaced so far as practicable equally between the top lights and ground level with an interval of not more than 52 metres.*

*(2) The person in charge of an en-route obstacle must, subject to paragraph (3), ensure that by night the lights required to be fitted by this article are displayed.*

*(3) In the event of the failure of any light which is required by this article to be displayed by night the person in charge must repair or replace the light as soon as reasonably practicable.*

*(4) At each level on the obstacle where lights are required to be fitted, sufficient lights must be fitted and arranged so as to show when displayed in all directions.*

*(5) In any particular case the CAA may direct that an en-route obstacle must be fitted with and must display such additional lights in such positions and at such times as it may specify.*

*(6) A permission may be granted for the purposes of this article for a particular case or class of cases or generally.*

*(7) This article does not apply to any en-route obstacle for which the CAA has granted a permission to the person in charge permitting that person not to fit and display lights in accordance with this article.*

*(8) In this article, an 'en-route obstacle' means any building, structure or erection, the height of which is 150 metres or more above ground level, but it does not include a building, structure or erection—*

*(a) which is in the vicinity of a licensed aerodrome; and*

*(b) to which section 47 of the Civil Aviation Act 1982(a) (warning of presence of obstructions near licensed aerodromes) applies.*

---

<sup>3</sup> Source: The Air Navigation Order 2016. Last accessed 28/09/2022.

#### 4.2.1 Key Points

The key points presented within the guidance are discussed within Table 2 below.

| Section  | Comments and Discussion                                                                                                                                                                                                                                                      |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 222. (1) | It is stated that en-route obstacles should be lit with 'medium intensity steady red lights' as close to the top as possible, in addition to intermediate lighting at no bigger distance than 52 metres between each light.                                                  |
| 222. (4) | It is stated that all lights should be visible from all directions.                                                                                                                                                                                                          |
| 222. (8) | It is stated that an 'en-route obstacle' means any building 150m agl or more excluding those 'in the vicinity' of a licensed aerodrome or where section 47 applies.<br><br>The proposed development is not considered an en-route obstacle because it is less than 150m agl. |

Table 2 ANO 222 comments and discussion

### 4.3 CAP 168: Licensing of Aerodromes – Overview

The following text is taken from the relevant sections of CAP 168<sup>4</sup>. Some paragraphs have been omitted due to references to wind turbines, masts etc. Key points relating to design of the lighting scheme are underlined.

#### Chapter 4 The assessment and treatment of obstacles

##### Marking and lighting of obstacles and unserviceable surface areas

##### General

4.74 All objects which extend to a height of 150 m or more above ground elevation are regarded as obstacles and shall be lit in accordance with ANO Article 219. Other objects of a lesser height may be assessed as hazards to aviation and also treated as obstacles. They should be marked and/or lit as detailed in the following paragraphs.

##### Objects to be marked or lit

4.76 Objects which are deemed by the CAA to be en route obstacles should be marked and/or lit.

4.77 Other objects inside (and outside) the obstacle limitation surfaces should be marked and/or lighted if an aeronautical study indicates that they could constitute a hazard to aircraft (this includes adjacent to visual routes, e.g. waterways, or highways). Wind turbines, whether on, near or away from the immediate vicinity of an aerodrome, which are deemed to be obstacles, should be marked and/or lit accordingly.

<sup>4</sup> CAP 168 Licensing of Aerodromes, Edition 12, January 2022. Last accessed 28/09/2022.

### **Lighting of obstacles**

4.101 Obstacle lights should be used to indicate the existence of objects which are to be lit as follows:

1. Low intensity steady red obstacle lights should be used on obstacles less than 45 m high, except that medium intensity steady red lights should be used to light such obstacles as an elongated structure, an obstacle in the outer area of the approach or high ground adjacent to the aerodrome circuit. There are two types of low intensity obstacle lights for fixed obstacles:

Group A and Group B (see table 6A.1).

a) Low intensity Group A lights should be used for obstacles on the movement area where Group B lights may cause dazzle.

b) Low intensity Group B lights should be used away from the movement area or in areas on the movement area with high levels of background illuminance.

2. Medium intensity red steady obstacle lights should be used on obstacles between 45 m and less than 150 m in height.

3. Medium intensity steady red obstacle lights should be used to indicate the presence of:

a) an obstacle if its height is 150 m or more; or

b) a tower supporting overhead wires, cables etc. of any height where an aeronautical study indicates such lights to be essential for recognition of the presence of the obstacle.

4.102 However, where an aeronautical study conducted by the CAA concludes that greater conspicuity of the obstacle through the use of a higher specification light is required, the use of a high intensity flashing white obstacle light will be considered by the CAA.

**Location of obstacle lights (figure 4.18)** (presented in Figure 4 on the following page)

4.104 The top light

1. Except in the case of a chimney or other similar structure, one or more lights should be located at the top of the obstacle. The lights should be so arranged as to indicate the highest points or edges of the obstacle relative to the obstacle limitation surface. If two or more edges are of the same height, the edge nearest the flight path should be lit. On facing sides of groups of obstacles, lights may be omitted with the approval of the CAA, and the group treated as one solid obstacle.

### **Intermediate lights**

4.105 Where the top of an obstacle is more than 45 m above the level of the surrounding ground, additional lights should be provided at intermediate levels. These additional lights should be spaced as equally as practicable between the top light and ground level as follows:

1. when low or medium intensity obstacle lights are used the spacing should not exceed 52 m;

...

4. at each level the lights should be arranged to give full cover in azimuth.

## Low intensity obstacle lights

4.115 On fixed obstacles, low intensity lights should be steady red and omnidirectional.

## Medium intensity obstacle lights

4.116 Medium intensity obstacle lights should be steady red light.

**Figure 4.18 Lighting of objects**

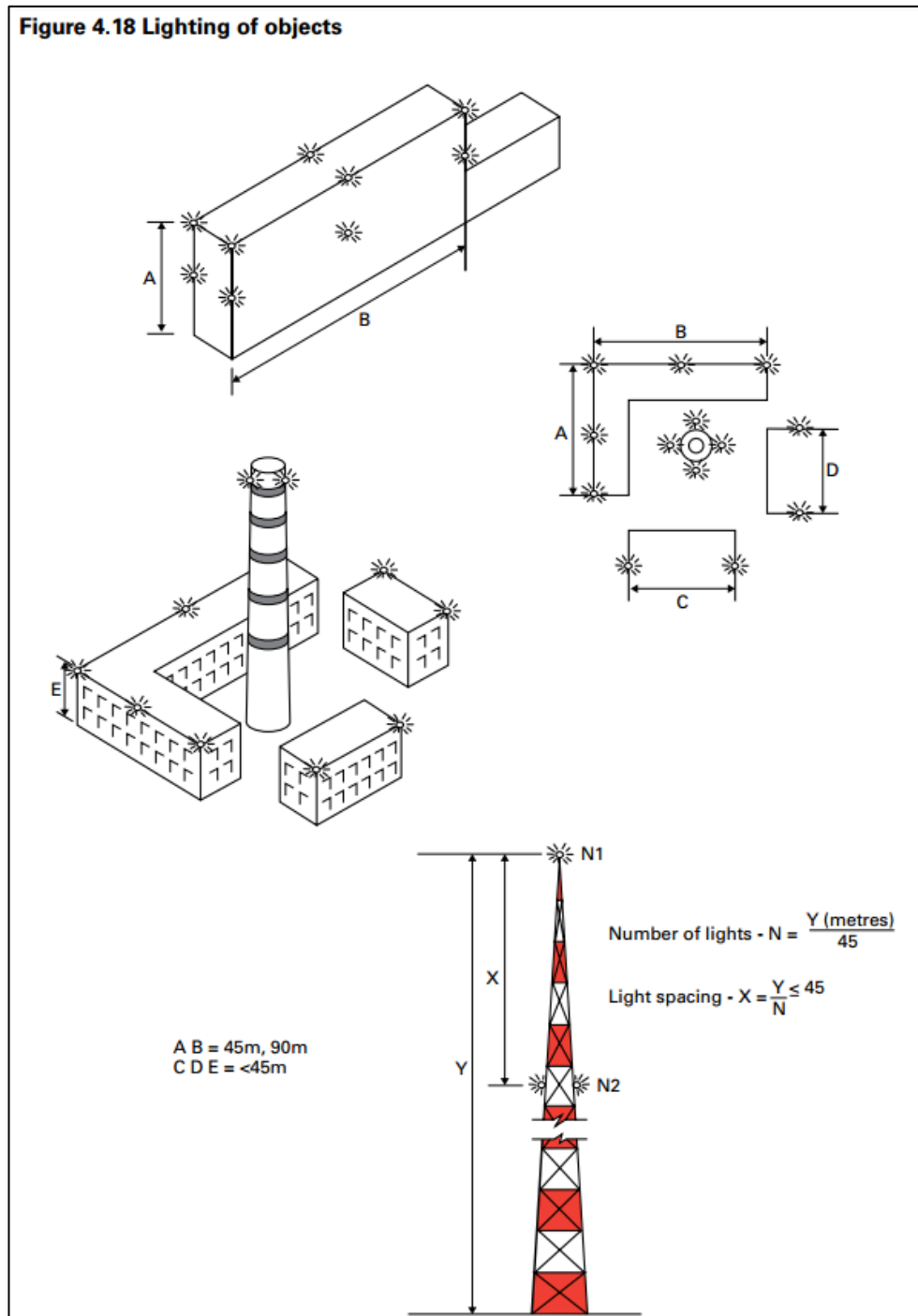


Figure 4 Figure 4.18 from CAP 168 - Lighting of Objects

#### 4.3.1 Key Points

The key points presented within the guidance are discussed within Table 3 below.

| Section                | Comments and Discussion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chapter 4<br>4.74      | <p>Cap 168 (in accordance with ANO Article 222) states that obstacles of 150m agl or more should be lit. Those less than 150m agl could still require lighting if it is deemed a potential hazard to safety.</p> <p>The proposed development is not considered an obstacle because it lies entirely within Manchester Airport's controlled airspace and the maximum height is less than 150m agl.</p> <p>The proposed development is not deemed a hazard to safety because it does not infringe the OLS.</p> |
| Chapter 4<br>4.77      | <p>Objects should be lit if deemed to be a hazard to aviation safety.</p> <p>The proposed development is not deemed a hazard to safety because it does not infringe the OLS.</p>                                                                                                                                                                                                                                                                                                                             |
| Chapter 4<br>4.101 - 2 | <p>Medium intensity red steady obstacle lights should be used on obstacles between 45 m and 150 m in height.</p> <p>The proposed development is within these limits but is not considered an obstacle.</p>                                                                                                                                                                                                                                                                                                   |
| Chapter 4<br>4.104 - 1 | <p>Lights should be arranged as to indicate the highest points or edges of the obstacle relative to the obstacle limitation surface. If two or more edges are of the same height, the edge nearest the flight path should be lit.</p>                                                                                                                                                                                                                                                                        |
| Chapter 4<br>4.105 - 1 | <p>The guidance states that intermediate lighting is required for obstacles above 45m agl and should be spaced as equally as practicable with no more than 52m in vertical spacing.</p> <p>The proposed development is within these limits but is not considered an obstacle.</p>                                                                                                                                                                                                                            |
| Chapter 4<br>4.105 - 4 | <p>Each intermediate light should be arranged to give lighting coverage to the full azimuth range.</p>                                                                                                                                                                                                                                                                                                                                                                                                       |
| Chapter 4<br>4.115     | <p>The guidance states that low intensity obstacle lights should be steady red and omnidirectional.</p>                                                                                                                                                                                                                                                                                                                                                                                                      |

Table 3 CAP 168 comments and discussion

#### 4.4 CAP 1168

The relevant extract of CAP 1168<sup>5</sup> is presented in Figure 5 below. The relevant section is highlighted in blue.

| Aeronautical Ground Lighting – Minimum Certification Requirements |                         |                    |            |                  |                     |                       |                     |            |       |                                                    |
|-------------------------------------------------------------------|-------------------------|--------------------|------------|------------------|---------------------|-----------------------|---------------------|------------|-------|----------------------------------------------------|
|                                                                   | Day or Night Operations |                    |            |                  |                     | Night Only Operations |                     |            | Notes | Certification Specification (CS)<br><br>Reference. |
|                                                                   | App. Cat II & III       | T/O RVR (see note) | App. Cat I | T/O RVR 400-800m | App. N/P Instrument | T/O RVR 800-1200m     | App. Non-Instrument | T/O >1200m |       |                                                    |
| Illuminated Signs                                                 | R                       | R                  | R          | R                | R                   | R                     | R                   | O          | 9     | CS ADR-DSN.M.775                                   |
| Stop bars                                                         | R                       | R                  | O          | R                | -                   | -                     | -                   | -          | 10    | CS ADR-DSN.M.730                                   |
| Runway Guard                                                      | R                       | R                  | O          | R                | R                   | R                     | -                   | -          | 11    | CS ADR-DSN.M.745                                   |
| Obstacle                                                          | R                       | R                  | R          | R                | R                   | R                     | R                   | R          | 12    | CS ADR-DSN.Q.840; 850                              |
| Alt. Input Power Supply                                           | R                       | R                  | R          | R                | O                   | O                     | O                   | O          |       | CS ADR-DSN.S.880                                   |
| Illuminated Wind Sleeve                                           | R                       | R                  | R          | R                | R                   | R                     | R                   | R          |       | CS ADR-DSN.K.490                                   |

Figure 5 Aeronautical Ground Lighting, CAP 1168 requirements

The certification specification for obstacle lighting refers to the EASA CS-ADR-DSN<sup>6</sup> document, section CS ADR-DSN.Q840; 850 (section 850 does not contain any information relating to obstacle lighting and has therefore not been considered). See the following section for an explanation of these criteria and its application to this development.

#### 4.5 European Aviation Safety Agency<sup>7</sup>: Certification Specifications and Guidance Material for Aerodrome Design<sup>8</sup> – Overview

The EASA guidance does not formally apply to UK aerodromes following the United Kingdom's (UK) decision to leave to the European Union (EU). However, it has been considered because of its technical merit and has been specifically requested by Manchester Airport.

The following text is taken from the relevant sections of the EASA CS-ADR-DSN<sup>9</sup> document. Key points relating to design of the lighting scheme are underlined.

<sup>5</sup> Source: 2017, Guidance Material for Organisations, Operations and Design Requirements for Aerodromes.

<sup>6</sup> European Aviation Safety Agency, Certification Specifications and Guidance Material for Aerodromes Design. Issue 6, 29 March 2022 (last accessed 28/04/23).

<sup>7</sup> EASA.

<sup>8</sup> CS-ADR-DSN.

<sup>9</sup> European Aviation Safety Agency, Certification Specifications and Guidance Material for Aerodromes Design. Issue 6, 29 March 2022 (last accessed 28/04/23).

## CHAPTER Q – VISUAL AIDS FOR DENOTING OBSTACLES

### CS ADR-DSN.Q.840 Objects to be marked and/or lighted within the lateral boundaries of the obstacle limitation surfaces

(a) Applicability: The specifications for objects to be marked and/or lighted within the lateral boundaries of the obstacle limitation surfaces apply only to the area under control of the aerodrome operator.

(b) Elevated aeronautical ground lights within the movement area should be marked so as to be conspicuous by day. Obstacle lights should not be installed on elevated ground lights or signs in the movement area.

(c) All obstacles within the distance specified in Table D-1, column (11), (12) or (13), from the centre line of a taxiway, an apron taxiway or aircraft stand taxilane should be marked and, if the taxiway, apron taxiway or aircraft stand taxilane is used at night, lighted.

(d) A fixed obstacle that extends above a take-off climb, approach or transitional surface within 3 000 m of the inner edge of the take-off climb or approach surface should be marked and if the runway is used at night, lighted, except that:

(1) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

(2) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day, and its height above the level of the surrounding ground does not exceed 150 m;

(3) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day if medium intensity lights, Type A, are deemed insufficient; and

(4) the lighting may be omitted where the obstacle is a lighthouse and an safety assessment indicates the lighthouse light to be sufficient.

(e) A fixed object, other than an obstacle, adjacent to a take-off climb, approach or transitional surface should be marked and, if the runway is used at night, lighted, if such marking and lighting is considered necessary to ensure its avoidance, except that the marking may be omitted when:

(1) the object is lighted by medium-intensity obstacle lights, Type A, by day, and its height above the level of the surrounding ground does not exceed 150 m; or

(2) the object is lighted by high-intensity obstacle lights by day if medium intensity lights, Type A, are deemed insufficient.

(f) A fixed obstacle that extends above a horizontal surface should be marked and if the aerodrome is used at night, lighted, except that:

(1) such marking and lighting may be omitted when:

(i) the obstacle is shielded by another fixed obstacle; or

(ii) for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or

(iii) a safety assessment shows the obstacle is not of operational significance.

(2) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day, and its height above the level of the surrounding ground does not exceed 150 m;

(3) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day if medium intensity lights, Type A, are deemed insufficient; and

(4) the lighting may be omitted where the obstacle is a lighthouse and a safety assessment indicates the lighthouse light to be sufficient.

(g) A fixed object that extends above an obstacle protection surface should be marked and, if the runway is used at night, lighted, except that such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle.

[Issue: ADR-DSN/3]

**CS ADR-DSN.Q.841 Objects to be marked and/or lighted outside the lateral boundaries of the obstacle limitation surfaces**

(a) Applicability: The specifications for objects to be marked and/or lighted outside the lateral boundaries of the obstacle limitation surfaces apply only to the area under control of the aerodrome operator.

(b) Obstacles in accordance with CS ADR-DSN.J.487 should be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

(c) When considered as an obstacle, other objects outside the obstacle limitation surfaces should be marked and/or lighted.

[Issue: ADR-DSN/3]

...

**CHAPTER Q – VISUAL AIDS FOR DENOTING OBSTACLES**

**CS ADR-DSN.Q.846 Lighting of fixed objects**

(a) The presence of objects which should be lighted, as specified in CS ADR-DSN.Q.840 and CS ADR-DSN.Q.841 should be indicated by low-, medium- or high-intensity obstacle lights, or a combination of such lights.

(b) Low-intensity obstacle lights, Types A, B, C and D, medium-intensity obstacle lights, Types A, B and C and high-intensity obstacle lights Types A and B, should be in accordance with the specifications in Table Q-1, CS ADR-DSN.U.930 and Figure U-1A or U-1B, as appropriate.

(c) The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked should be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object or by an adjacent object, additional lights should be provided on that adjacent object, or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

*(d) In case of an object to be lighted one or more low-, medium- or high-intensity obstacle lights should be located as close as practicable to the top of the object.*

*(e) In the case of chimney or other structure of like function, the top lights should be placed sufficiently below the top so as to minimise contamination by smoke, etc. (see Figure Q-2).*

*(f) In the case of a tower or antenna structure indicated by high-intensity obstacle lights by day with an appurtenance such as a rod or an antenna greater than 12 m where it is not practicable to locate a high-intensity obstacle light on the top of the appurtenance, such a light should be located at the highest practicable point, and, if practicable, a medium-intensity obstacle light, Type A, mounted on the top.*

*(g) In the case of an extensive object or of a group of closely spaced objects to be lighted that are:*

*(1) Penetrating a horizontal obstacle limitation surface (OLS) or located outside an OLS, the top lights should be so arranged as to at least indicate the points or edges of the object highest in relation to OLS or above the ground, and so as to indicate the general definition and the extent of the objects; and*

*(2) Penetrating a sloping OLS, the top lights should be so arranged as to at least indicate the points or edges of the object highest in relation to the OLS, and so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area should be marked.*

*(h) When the obstacle limitation surface concerned is sloping and the highest point above the obstacle limitation surface is not the highest point of the object, additional obstacle lights should be placed on the highest point of the object.*

*(i) Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and*

*(1) Low-intensity lights are used, they should be spaced at longitudinal intervals not exceeding 45 m.*

*(2) Medium-intensity lights are used, they should be spaced at longitudinal intervals not exceeding 900 m.*

*(j) High-intensity obstacle lights, Type A, and medium-intensity obstacle lights, Types A and B, located on an object should flash simultaneously.*

*(k) The installation setting angles for high-intensity obstacle lights, Type A, should be in accordance with Table Q-5.*

*[Issue: ADR-DSN/3]*

*[Issue: ADR-DSN/4]*

**CS ADR-DSN.Q.847 Lighting of fixed objects with a height less than 45 m above ground level**

*(a) Low-intensity obstacle lights, Type A or B, should be used where the object is a less extensive one and its height above the surrounding ground is less than 45 m.*

(b) Where the use of low-intensity obstacle lights, Type A or B, would be inadequate, or an early special warning is required, then medium- or high-intensity obstacle lights should be used.

(c) Low-intensity obstacle lights, Type B, should be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with subparagraph (d), below.

(d) Medium-intensity obstacle lights, Type A, B, or C, should be used where the object is an extensive one. Medium-intensity obstacle lights, Types A and C, should be used alone, whereas medium-intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.

[Issue: ADR-DSN/3]

**CS ADR-DSN.Q.848 Lighting of fixed objects with a height 45 m to a height less than 150 m above ground level**

(a) Medium-intensity obstacle lights, Type A, B, or C, should be used where the object is an extensive one. Medium-intensity obstacle lights, Types A and C, should be used alone, whereas medium intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.

(b) Where an object is indicated by medium-intensity obstacle lights, Type A, and the top of the object is more than 105 m above the level of the surrounding ground, or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights should be provided at intermediate levels. These additional intermediate lights should be spaced, as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings as appropriate, with the spacing not exceeding 105 m.

(c) Where an object is indicated by medium-intensity obstacle lights, Type B, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights should be provided at intermediate levels. These additional intermediate lights should be alternately low intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and should be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings as appropriate, with the spacing not exceeding 52 m.

(d) Where an object is indicated by medium-intensity obstacle lights, Type C, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights should be provided at intermediate levels. These additional intermediate lights should be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

(e) Where high-intensity obstacle lights, Type A, are used, they should be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in paragraph CS ADR-DSN.Q.846(d), except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

*[Issue: ADR-DSN/3]*

...

Tables 4-7 on the following pages are taken from the document and pertain to the text on the previous pages.

| (1)                                                                                                                                        | (2)                 | (3)                          | (4)                                                   |                                         |                                        | (6)                         | (7) |
|--------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------|-------------------------------------------------------|-----------------------------------------|----------------------------------------|-----------------------------|-----|
| Light type                                                                                                                                 | Colour              | Signal type/<br>(Flash Rate) | Peak intensity (cd) at given Background Luminance (b) |                                         |                                        | Light Distribution<br>Table |     |
|                                                                                                                                            |                     |                              | Day<br>(Above 500 cd/m <sup>2</sup> )                 | Twilight<br>(50-500 cd/m <sup>2</sup> ) | Night<br>(Below 50 cd/m <sup>2</sup> ) |                             |     |
| Low-intensity Type A (fixed obstacle)                                                                                                      | Red                 | Fixed                        | N/A                                                   | N/A                                     | 10                                     | Table Q-2                   |     |
| Low-intensity Type B (fixed obstacle)                                                                                                      | Red                 | Fixed                        | N/A                                                   | N/A                                     | 32                                     | Table Q-2                   |     |
| Low-intensity Type C (mobile obstacle)                                                                                                     | Yellow/<br>Blue (a) | Flashing<br>(60-90 fpm)      | N/A                                                   | 40                                      | 40                                     | Table Q-2                   |     |
| Low-intensity Type D (follow-me vehicle)                                                                                                   | Yellow              | Flashing<br>(60-90 fpm)      | N/A                                                   | 200                                     | 200                                    | Table Q-2                   |     |
| Low-intensity, Type E                                                                                                                      | Red                 | Flashing<br>(c)              | N/A                                                   | N/A                                     | 32                                     | Table Q-2<br>(Type B)       |     |
| Medium-intensity Type A                                                                                                                    | White               | Flashing<br>(20-60 fpm)      | 20 000                                                | 20 000                                  | 2 000                                  | Table Q-3                   |     |
| Medium-intensity Type B                                                                                                                    | Red                 | Flashing<br>(20-60 fpm)      | N/A                                                   | N/A                                     | 2 000                                  | Table Q-3                   |     |
| Medium-intensity Type C                                                                                                                    | Red                 | Fixed                        | N/A                                                   | N/A                                     | 2 000                                  | Table Q-3                   |     |
| High-intensity Type A                                                                                                                      | White               | Flashing<br>(40-60 fpm)      | 200 000                                               | 20 000                                  | 2 000                                  | Table Q-3                   |     |
| High-intensity Type B                                                                                                                      | White               | Flashing<br>(40-60 fpm)      | 100 000                                               | 20 000                                  | 2 000                                  | Table Q-3                   |     |
| (a) <a href="#">CS ADR-DSN.Q.850(b)</a>                                                                                                    |                     |                              |                                                       |                                         |                                        |                             |     |
| (b) For flashing lights, effective intensity as determined in accordance with ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids. |                     |                              |                                                       |                                         |                                        |                             |     |
| (c) For wind turbine application, to flash at the same rate as the lighting on the nacelle.                                                |                     |                              |                                                       |                                         |                                        |                             |     |

Table 4 Table Q-1. Characteristics of obstacle lights

|        | Minimum intensity (a) | Maximum intensity (a) | Vertical beam spread (f) |           |
|--------|-----------------------|-----------------------|--------------------------|-----------|
|        |                       |                       | Minimum beam spread      | Intensity |
| Type A | 10 cd (b)             | N/A                   | 10°                      | 5 cd      |
| Type B | 32 cd (b)             | N/A                   | 10°                      | 16 cd     |
| Type C | 40 cd (b)             | 400 cd                | 12(d)                    | 20 cd     |
| Type D | 200 cd (c)            | 400 cd                | N/A(e)                   | N/A       |

Note: This table does not include recommended horizontal beam spreads. [CS ADR-DSN.Q.846\(c\)](#) requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

(a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with ICAO, Aerodrome Design Manual, Part 4, Visual Aids.

(b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

(c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

(d) Peak intensity should be located at approximately 2.5° vertical.

(e) Peak intensity should be located at approximately 17° vertical.

(f) Beam spread is defined as the angle between the horizontal plan and the directions for which the intensity exceeds that mentioned in the 'intensity' column.

Table 5 Table Q-2. Light distribution for low-intensity obstacle lights

| Benchmark intensity | Minimum requirements          |                       |                       |                          |               | Recommendations              |                       |                       |                          |               |
|---------------------|-------------------------------|-----------------------|-----------------------|--------------------------|---------------|------------------------------|-----------------------|-----------------------|--------------------------|---------------|
|                     | Vertical elevation angle (b)  |                       |                       | Vertical beam spread (c) |               | Vertical elevation angle (b) |                       |                       | Vertical beam spread (c) |               |
|                     | 0°                            |                       | -1°                   |                          |               | 0°                           |                       | -1°                   |                          |               |
|                     | Minimum average intensity (a) | Minimum intensity (a) | Minimum intensity (a) | Minimum beam spread      | Intensity (a) | Maximum intensity (a)        | Maximum intensity (a) | Maximum intensity (a) | Maximum beam spread      | Intensity (a) |
| 200 000             | 200 000                       | 150 000               | 75 000                | 3°                       | 75 000        | 250 000                      | 112 500               | 7 500                 | 7°                       | 75 000        |
| 100 000             | 100 000                       | 75 000                | 37 500                | 3°                       | 37 500        | 125 000                      | 56 250                | 3 750                 | 7°                       | 37 500        |
| 20 000              | 20 000                        | 15 000                | 7 500                 | 3°                       | 7 500         | 25 000                       | 11 250                | 750                   | N/A                      | N/A           |
| 2 000               | 2 000                         | 1 500                 | 750                   | 3°                       | 750           | 2 500                        | 1 125                 | 75                    | N/A                      | N/A           |

Note: This table does not include recommended horizontal beam spreads. [CS ADR-DSN.Q.846\(c\)](#) requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

(a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

(b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.

(c) Beam spread is defined as the angle between the horizontal plan and the directions for which the intensity exceeds that mentioned in the ‘intensity’ column.

Note: an extended beam spread may be necessary under specific configuration and justified by a safety assessment.

Table 6 Table Q-3. Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table Q-1

| Height of light unit above terrain (AGL) |               | Angle of the peak of the beam above the horizontal |
|------------------------------------------|---------------|----------------------------------------------------|
| Greater than                             | Not exceeding |                                                    |
| 151 m                                    |               | 0°                                                 |
| 122 m                                    | 151 m         | 1°                                                 |
| 92 m                                     | 122 m         | 2°                                                 |
|                                          | 92 m          | 3°                                                 |

Table 7 Table Q-5. Installation setting angles for high-intensity obstacle lights

#### 4.5.1 Key Points

The key points presented within the guidance are discussed within Table 8 below.

| Section   | Comments and Discussion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.840 (a) | The development lies laterally within Outer Horizontal Surface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Q.840 (d) | There is no requirement for lighting as the development does not extend above the take-off climb, approach or transitional surface.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Q.840 (e) | There is no requirement for lighting as the development is not considered adjacent to the take-off climb, approach or transitional surface, as per the results of the OLS assessment.                                                                                                                                                                                                                                                                                                                                                                                                    |
| Q.840 (f) | There is no requirement for lighting as the development does not extend above a horizontal surface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Q.841 (g) | The development does not extend above an obstacle limitation surface under EASA guidance and therefore no lighting is required.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Q.841 (c) | It states that obstacles outside the OLS should be lit.<br>The proposed development is not considered to be an obstacle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Q.846 (a) | The guidance states that an object that should be lit, should be illuminated by low, medium or high intensity obstacle lights.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Q.846 (c) | The number and arrangement of obstacle lights at each level should be marked such that the object is indicated from every angle in azimuth. Where a light is shielded, additional lights should be provided on that object in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.<br><br>The development does not vertically infringe upon the OLS as defined within the EASA guidance however the development lies laterally within these surfaces. |
| Q.846 (d) | In case of an object to be lighted, one or more low-, medium- or high-intensity obstacle lights should be located as close as practicable to the top of the object.                                                                                                                                                                                                                                                                                                                                                                                                                      |

| Section   | Comments and Discussion                                                                                                                                                                                                                                                                                                         |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.848 (a) | <p>Considers lighting of fixed objects with a height 45 m to a height less than 150 m above ground level.</p> <p>Medium-intensity obstacle lights, Type A, B, or C, should be used where the object is considered an extensive one.</p> <p>The development is within these limits but there is no requirement for lighting.</p> |
| Q.848 (b) | This is not applicable because the development will not be lit.                                                                                                                                                                                                                                                                 |
| Q.848 (c) | This is not applicable because the development will not be lit.                                                                                                                                                                                                                                                                 |
| Q.848 (d) | This is not applicable because the development will not be lit.                                                                                                                                                                                                                                                                 |

Table 8 EASA CS-ADR-DSN comments and discussion

## 4.6 Guidance Discussion

The cited guidance state that an obstacle is defined as an object that is 150m agl or more and not in the vicinity of a licensed aerodrome. The proposed development is therefore not considered an obstacle as it is less than 150m agl and in the vicinity of Manchester Airport because it is within its controlled airspace.

CAP 168 and EASA CS ADR-DSN.Q.848 dictate that structures less than 150m agl could still require lighting if it is deemed a potential hazard to safety or an extensive obstacle. The proposed development is not deemed a hazard to safety or an extensive obstacle because it does not infringe the OLS.

Based on a review of the guidance, the proposed development does not require aviation lighting.

## 5 CONCLUSIONS

### 5.1 Overall Conclusion

The following was undertaken to determine the lighting scheme for the proposed development:

- Obstacle Limitation Surfaces assessment for Manchester Airport.
- A review of the following publications:
  - Air Navigation Order 2016: Article 222.
  - Civil Aviation Authority Civil Aviation Publication 168 and 1168.
  - European Aviation Safety Agency: Certification Specifications and Guidance Material for Aerodrome Design (EASA CS-ADR-DSN).

The OLS assessment has shown that the proposed development is clear of the OHS by 83.72m.

The cited guidance state that an obstacle is defined as an object that is 150m agl or more and not in the vicinity of a licensed aerodrome. The proposed development is therefore not considered an obstacle as it is less than 150m agl and in the vicinity of Manchester Airport because it is within its controlled airspace.

CAP 168 and EASA CS ADR-DSN.Q.848 dictate that structures less than 150m agl could still require lighting if it is deemed a potential hazard to safety or an extensive obstacle. The proposed development is not deemed a hazard to safety or an extensive obstacle because it does not infringe the OLS.

Based on the results of the OLS assessment and the review of the guidance, the proposed development does not require aviation lighting.



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