# Manor Farm:

# Aviation Safeguarding Assessment for Planning

## KLG186/R2/Issue 2

**December 2024**

K L Grant Consulting Ltd.

# Authorisation Sheet

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# Summary

Manor Farm Propco Limited are seeking planning permission for a proposed data centre and battery energy storage system development at Manor Farm, Colnbrook. The site lies approximately 2 km to the west of the western end of the northern runway at London Heathrow Airport, in an area subject to aerodrome safeguarding, the process by which airspace required for safe and efficient take-off and landing at airports is maintained free of new development. The site is also located within the safeguarding area for RAF Northolt.

Specific height limits apply at the site, according to international standards and recommended practices of the International Civil Aviation Organisation (ICAO), as implemented in the UK by the Civil Aviation Authority (CAA) and set out in Civil Aviation Publication (CAP) 168 on aerodrome licensing.

Two distinct height constraints associated with operations at London Heathrow Airport apply in the area of the proposed development:

- Aerodrome licensing requirements, prescribed in terms of the obstacle limitation surfaces (OLS) for the Airport;
- Operational requirements, prescribed by PANS-OPS criteria for instrument procedure design, employed for the design of operational procedures for take-off and approach that take account of the existing obstacle environment in the vicinity of the Airport and which generally lie above the OLS.

To support the design process, an initial review of the height constraints that apply across the Site which will avoid impacts on the safety or efficiency of operations at London Heathrow Airport has been undertaken. The proposed data centre design has been developed on this basis with the design intent that the maximum building heights and cranes used for construction will comply with the obstacle limitation surfaces at London Heathrow Airport. An aviation safeguarding assessment of the proposed development has now been completed to confirm that it complies with all relevant aviation safeguarding requirements.

The following conclusions may be drawn from the aviation safeguarding assessment:

- Assessment of the site location in relation to London Heathrow Airport's OLS has determined that the site is located within the area covered by the Runway 09L approach surface (APPS), Runway 27R take-off climb surface (TOCS) and the inner horizontal surface (IHS). The take-off climb surface at London Heathrow gives rise to the most constraining height limits across the site of between 62.4 m AOD and 66.0 m AOD across the proposed data centre footprint.
- The site is also located within the outer horizontal surface for RAF Northolt Aerodrome, however, this gives rise to a less limiting constraint than the London Heathrow Airport OLS.
- A minimum margin of 11 m is identified between the OLS and the top of the proposed data centre. Whilst some careful consideration of construction plans is required to ensure that cranes will comply with the aviation constraints at this location, a feasible construction methodology can be achieved within the identified OLS constraints.
- Preliminary assessment of the instrument flight procedures in use at London Heathrow indicates that cranes which extend up to the OLS are unlikely to have any significant impact on flight operations.

- In addition to the physical safeguarding of flight procedures, proposed development close to the airport has the potential to impact on-airport navigational aids. Preliminary assessment indicates that the proposed data centre is outside the technical safeguarding frames indicated in CAA guidance to be areas of particular concern. It is expected that development up to the 2% approach surface limits identified will not impact the ILS system.
- Given the overall height and scale of the proposed buildings in comparison to the Heathrow Terminal 5 building located along the sightline from the H10 radar to the proposed data centre, it is unlikely that the proposed development will impact the H10 en-route radar located at Heathrow Airport.
- The potential for venting of heated air from generator exhausts from the top of the proposed data centre has been identified as a possible hazard to aircraft on approach to or taking off from London Heathrow Airport. The developer is currently undertaking a more detailed study to consider the potential impacts of plume rise on aircraft landing and taking-off from London Heathrow Airport.
- Whilst the proposed development may provide some limited opportunities for increased bird populations within the vicinity of the aerodrome, the development details need to be considered in the context of the surrounding environment and existing state of the site. Therefore, preliminary review of the potential bird hazard associated with the proposed development indicate that it is unlikely to result in any significant impacts and any issues that might arise can be addressed by the adoption of well-established management measures, if considered appropriate.
- The external lighting strategy for the proposed development has been developed to be in keeping with the surrounding context and aims to strike a balance between security requirements and environmental impacts. The proposed lighting scheme has been designed *'taking the local context, Client needs, aviation requirements, and ecology concerns into consideration'*. The lighting strategy specifies column down lights with '*negligible upward light spill'* to meet light pollution requirements; these constraints will also ensure that there will be no direct glare towards aircraft on approach or taking off from Heathrow airport.

# Contents

# 1 Introduction

Manor Farm Propco Limited are seeking planning permission for proposed data centre and battery energy storage system development at Manor Farm, Colnbrook. The site lies approximately 2 km to the west of the western end of the northern runway at London Heathrow Airport, in an area subject to aerodrome safeguarding, the process by which airspace required for safe and efficient take-off and landing at airports is maintained free of new development. The site is also located within the safeguarding area for RAF Northolt.

Specific height limits apply at the Site, according to international standards and recommended practices of the International Civil Aviation Organisation (ICAO) [1], as implemented in the UK by the Civil Aviation Authority (CAA) and set out in Civil Aviation Publication (CAP) 168 on aerodrome licensing [2].

Two distinct height constraints associated with operations at London Heathrow Airport apply in the area of the Site:

- Aerodrome licensing requirements, prescribed in terms of the obstacle limitation surfaces (OLS) for the Airport [1,2];
- Operational requirements [3], prescribed by PANS-OPS criteria for instrument procedure design, employed for the design of operational procedures for take-off and approach that take account of the existing obstacle environment in the vicinity of the airport and which generally lie above the OLS.

To support the design process, an initial review of the height constraints that apply across the Site which will avoid impacts on the safety or efficiency of operations at London Heathrow Airport has been undertaken [4]. The proposed data centre design has been developed on this basis with the design intent that the maximum building heights and cranes used for construction will comply with the obstacle limitation surfaces at London Heathrow Airport.

Following design freeze, this aviation safeguarding assessment of the proposed development confirms that it complies with all relevant aviation safeguarding requirements and comprises the following sections:

- An initial summary description of the site and its location relative to London Heathrow Airport and RAF Northolt;
- A specification for the runway characteristics at London Heathrow Airport and RAF Northolt which is used to determine the limiting height constraints across the development area.
- A physical safeguarding assessment of the development against the OLS criteria.
- A physical safeguarding assessment of the development against the operational criteria, in particular PANS-OPS instrument flight procedure design requirements.
- Further physical safeguarding assessment of the potential use of cranes above finished building height.
- An account of relevant technical safeguarding considerations.
- A brief consideration of other potential safeguarding considerations.
- A summary of the overall findings and conclusions to be drawn from the assessment.

# 2 Aerodrome Characteristics

## 2.1 London Heathrow Airport

For the purposes of the safeguarding assessment, it is necessary to work in terms of runway-aligned coordinates, referenced against the northern runway at London Heathrow Airport and these are as summarised in Table 1. The aerodrome reference point (ARP), located at the mid-point of Runway 07/25, is a further useful reference point and its coordinates are also given in Table 1.

**Table 1: London Heathrow Airport Northern Runway Characteristics**

| Parameter | Runway 09L Threshold | Runway 27R Threshold | ARP |
|---|---|---|---|
| WGS84 Latitude | 51°28'39.00"N | 51°28'39.63"N | 51°28'39"N |
| WGS84 Longitude | 00°29'05.97"W | 00°25'59.82"W | 00°27'41"W |
| OSGB Easting | 505308.29 | 508898.61 | 506947.32 |
| OSGB Northing | 176481.28 | 176576.37 | 176515.46 |
| Elevation (ft AOD) | 78.6 | 78.1 | 83 |
| Elevation (m AOD) | 23.96 | 23.80 | 25.30 |

## 2.2 RAF Northolt

For the purposes of the safeguarding assessment, it is also necessary to work in terms of runway-aligned coordinates, referenced against the runway at RAF Northolt Aerodrome. The coordinates of the two runway thresholds are provided in the military aeronautical information publication (MIL AIP) [5] and are as summarised in Table 2. The aerodrome reference point (ARP), located at the mid-point of Runway 07/25, is a further useful reference point and its coordinates are also given in Table 2.

**Table 2: RAF Northolt Aerodrome Runway Characteristics**

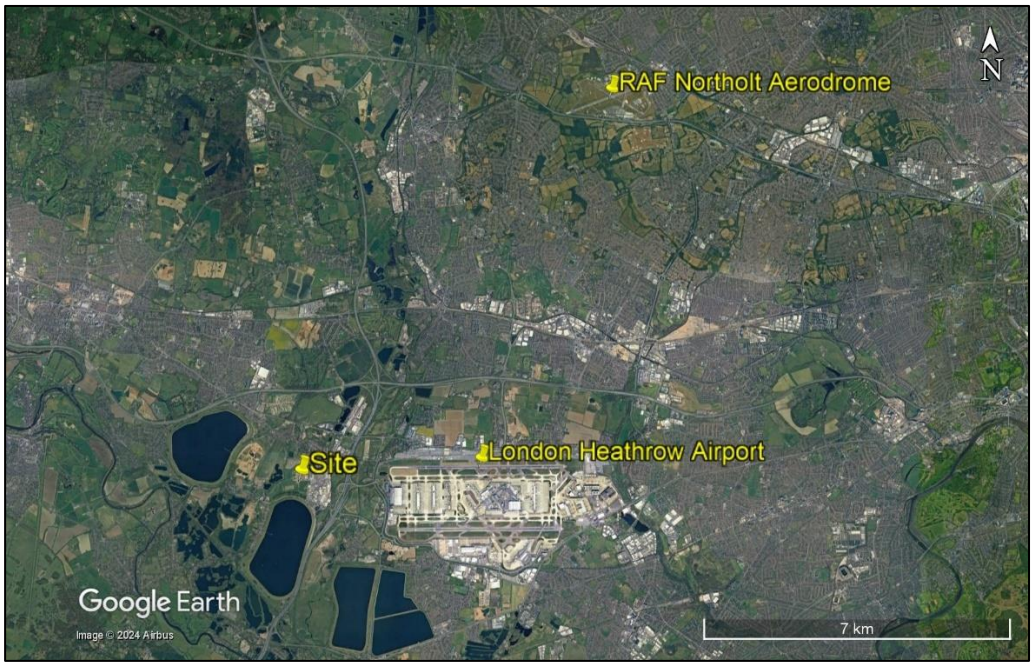
| Parameter | Runway 07 Threshold | Runway 25 Threshold | ARP |
|---|---|---|---|
| WGS84 Latitude | 51°33'01.43" N | 51°33'19.16" N | 51°33'09.77" N |
| WGS84 Longitude | 00°25'46.99" W | 00°24'29.53" W | 00°25'10.55" W |
| OSGB Easting | 508972.57 | 510452.44 | 509668.79 |
| OSGB Northing | 184668.82 | 185248.77 | 184941.57 |
| Elevation (ft AOD) | 113.99 | 124.29 | 126 |
| Elevation (m AOD) | 34.74 | 37.88 | 38.40 |

# 3 Site and Development Description

## 3.1 Site Specification

The site lies approximately 2.2 km to the west of Heathrow Airport and approximately 11 km to the south-west of RAF Northolt Aerodrome, as shown in Figure 1.

**Figure 1: Site location in relation to nearby aerodromes**




The site lies to the west of the western end of the northern runway, Runway 09L/27R, at Heathrow Airport adjacent to Poyle road. The site boundary in relation to the airport runways is shown in Figure 2. The eastern boundary of the site is approximately 2.2 km to the west of the Runway 09L threshold at and the extends from about 50 m to 650 m to the south of the Runway 09L extended centreline.

**Figure 2: Site development boundary in relation to London Heathrow Airport**

Figure 3 shows a site masterplan; the red line marks the development boundary. The main data centre buildings are proposed to be contained within the larger northern area within the development boundary and a battery energy storage is proposed in the smaller southern area. Equipment within the battery yard will extend no more than approximately 4.5 m above ground level and therefore this assessment focuses on the main 3 storey data centre building in the northern area. A closer plan view of the proposed data centre in this northern area is provided in Figure 4.

**Figure 3: Site Plan showing development boundary**

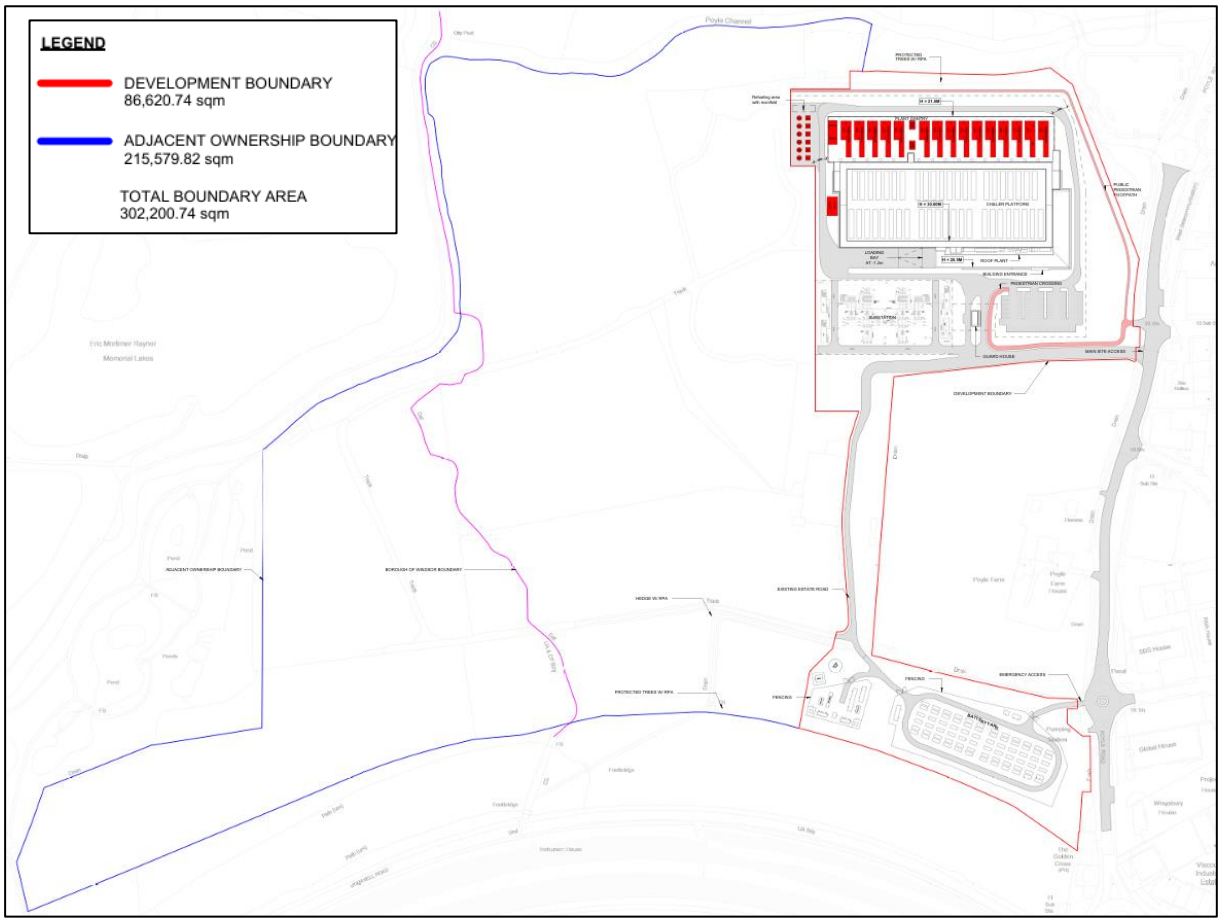


**Figure 4: Plan view of proposed data centre**

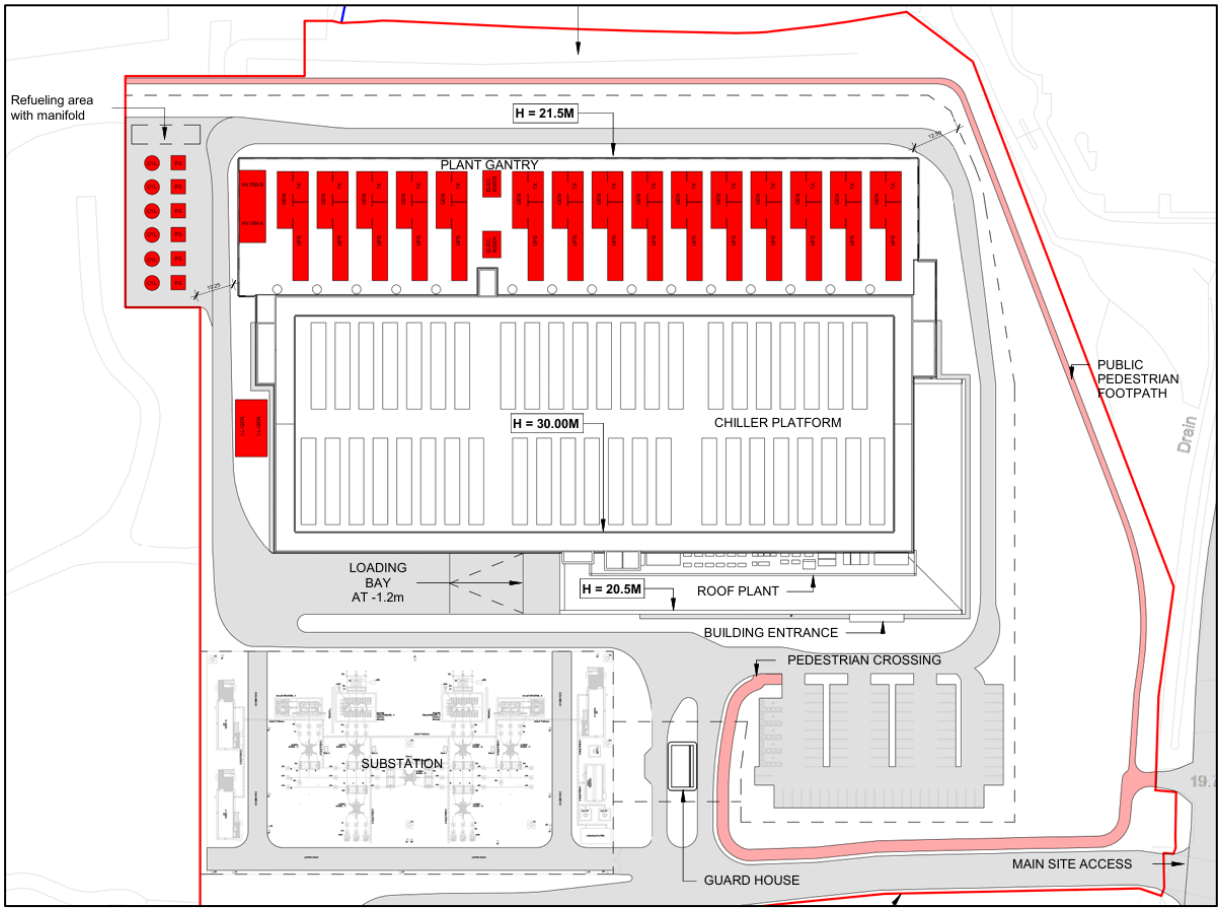
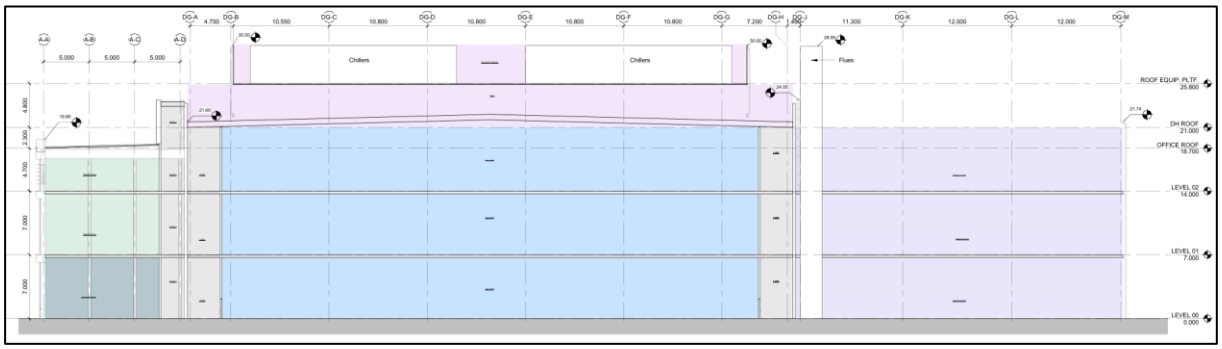



Figure 5 provides a section through the main data centre building. The maximum height of the proposed data centre building is 30 m above ground level. Ground level is proposed to be set at 21.4 m AOD, resulting in a maximum building height of 51.4 m AOD. This maximum height corresponds to the central part of the data centre, where the chiller platform is located. On the eastern side of the building, closest to the airport, offices are proposed and extend to a lower height of 43.14 m AOD. Generator flues will be located at the northern perimeter of the chiller platform and are proposed to extend up to a maximum height of 51.4 m AOD.

**Figure 5: North/south section through data centre**




To provide reference points for the assessment, OS grid coordinates for the most critical corners of the proposed data centre are provided in Table 3. For the purposes of this assessment, it is useful to work in terms of runway-aligned coordinates in which the site locations are specified with respect to their longitudinal distance, X, from the runway

threshold and lateral distance, Y, from the runway extended centreline. These are also provided in Table 3.

**Table 3: Proposed data centre assessment points**

| Ref | OS Grid Coordinates | | Heathrow RWY 09L Aligned | | Heathrow RWY 27R Aligned | | Maximum Height (m AOD) |
|---|---|---|---|---|---|---|---|
| | Easting | Northing | X (m) | Y (m) | X (m) | Y (m) | |
| Chiller-NE | 503002.3 | 176287.6 | 2310.3 | 132.6 | -5901.9 | -132.6 | 51.40 |
| Chiller-SE | 503002.3 | 176231.2 | 2311.8 | 189.0 | -5903.4 | -189.0 | 51.40 |
| Chiller-SW | 502845.1 | 176231.2 | 2468.9 | 184.8 | -6060.5 | -184.8 | 51.40 |
| Chiller-NW | 502845.1 | 176287.6 | 2467.4 | 128.4 | -6059.0 | -128.4 | 51.40 |
| Office-NE | 503020.3 | 176270.0 | 2292.8 | 150.6 | -5884.3 | -150.6 | 43.14 |
| Office-SE | 503020.3 | 176210.4 | 2294.3 | 210.2 | -5885.9 | -210.2 | 43.14 |

# 4 Physical Safeguarding Assessment

## 4.1 Outline of Constraints and Method

A number of distinct aviation-related height constraints apply in respect of the development site, associated with the safeguarding of operations at civil aerodromes:

- General safeguarding criteria, prescribed by the UK Civil Aviation Authority (CAA) in the context of aerodrome licensing and in accordance with International Civil Aviation Organisation (ICAO) standards, which are defined by a series of obstacle limitation surfaces (OLS) [1, 2, 6]. The OLS are a set of predominantly planar surfaces arranged about the runway and flight paths to and from it. Infringements of the OLS are generally not permitted but infringements of some surfaces may be allowed where it can be shown that these would not adversely affect the safety or regularity of aircraft operations.
- More specific criteria for the protection of flight procedures undertaken at individual airports, in accordance with ICAO standards and practices, as defined in ICAO PANS OPS [3]. These criteria take account of the existing obstacle environment during the design of specific instrument flight procedures at individual airports. They are quite often less restrictive than the OLS, allowing for the possibility that temporary infringements of the OLS, for example by cranes during construction, might be permitted without any adverse impact on operations.

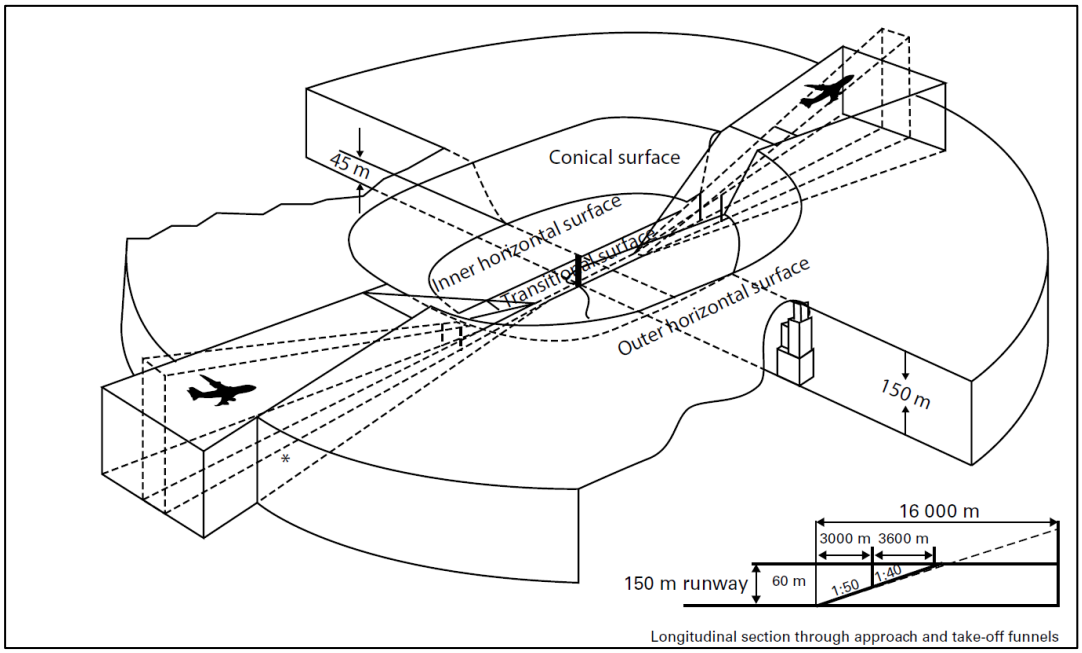
The Military Aviation Authority (MAA) adopts standards [7] for safeguarding at military aerodromes that are essentially equivalent to those applicable at civil aerodromes in accordance with UK and international standards [1,2].

## 4.2 London Heathrow Airport Safeguarding

### *4.2.1 Obstacle Limitation Surfaces*

The obstacle limitation surfaces (OLS) are a set of predominantly planar surfaces arranged about the runway as shown schematically in Figure 6.

**Figure 6: Schematic Representation of OLS**



Referring to the runway aligned coordinates given in Table 3 and the surface specifications set out in Civil Aviation Publication (CAP) 168, the site is determined to be located within the area covered by the Runway 09L approach surface (APPS), Runway 27R take-off climb surface (TOCS) and the inner horizontal surface (IHS) for London Heathrow Airport.

CAP168 identifies four runway reference categories depending on runway dimensions and the maximum aircraft wingspan that will use the runway. The northern runway at London Heathrow Airport is a Code 4F runway.

The APPS for a straight-in approach to a Code 4 runway consists of 3 sections. The first section originates at a point 60 m before the runway threshold and extends 3,000 m with a slope of 2%. The second section extends a further 3,600 m with a slope of 2.5%. The final section is a level surface at the height of 150 m above the runway threshold. All sections splay out from an initial width of 280 m by a 15% divergence.

The TOCS for a Code 4 runway also has a maximum 2% slope, but the origin of this surface is at the departure end of runway (DER). The DER is at the end of the take-off run available (TORA). The Runway 09L/27R Type A chart for London Heathrow Airport [8] provides the declared distances for the runway in both directions. The TORA for Runway 27L is identified as 3,960 m as it includes 78 m of clearway at the western end of the runway. The DER, at the end of this clearway is located 368 m to the west of the Runway 09L threshold. The TOCS splays out by 12.5% from an initial width of 180 m to a maximum of 1,800 m, assumed to take account of track heading changes of greater than 15°.

It is noted that CAP168 and the equivalent ICAO standards state the following in relation to the slope of the TOCS:

*"Where no object reaches the 2% (1:50) surface slope specified for runways where the code number is 3 or 4, the slope should be reduced until it touches the first immovable object or reaches 1.6% (1:62.5), whichever is the steeper. If the slope is reduced, the length of the surface should be increased to afford protection on the climb to a height of 1000 ft."*

A review of the Type A chart obstacles indicates that there are immovable objects under the TOCS which would prevent a reduction in the slope below 2%.

The IHS is contained in a horizontal plane located 45 m above the elevation of the lowest runway threshold existing or proposed for the aerodrome. At London Heathrow Airport, the lowest runway threshold elevation is identified as 22.95 m AOD for Runway 09R. Therefore, the IHS at London Heathrow Airport is at a height of 67.95 m AOD. For a Code 4 runway, the IHS extends out to a radius of 4,000 m from the end of the runway strip, at 60 m beyond the Runway 09L threshold.

To the east of the site, the transitional surface (TRANS) rises with a 1:7 slope from the edge of the runway strip up to a height of 45 m above the runway threshold elevation to meet the IHS.

Figure 7 shows the location of the site and proposed data centre in relation to these OLS. Table 4 provides the obstacle limitation surface height limits identified at the corners of the proposed data centre. The take-off climb surface is determined to be more limiting than the approach surface, however, the surface is not as wide as the approach surface. The approach surface is determined to be 6.2 m higher than the take-off climb surface cross the site. Outside of these surfaces, over the southern development area, the inner horizontal surface applies.

**Figure 7: Site location in relation to Heathrow OLS**

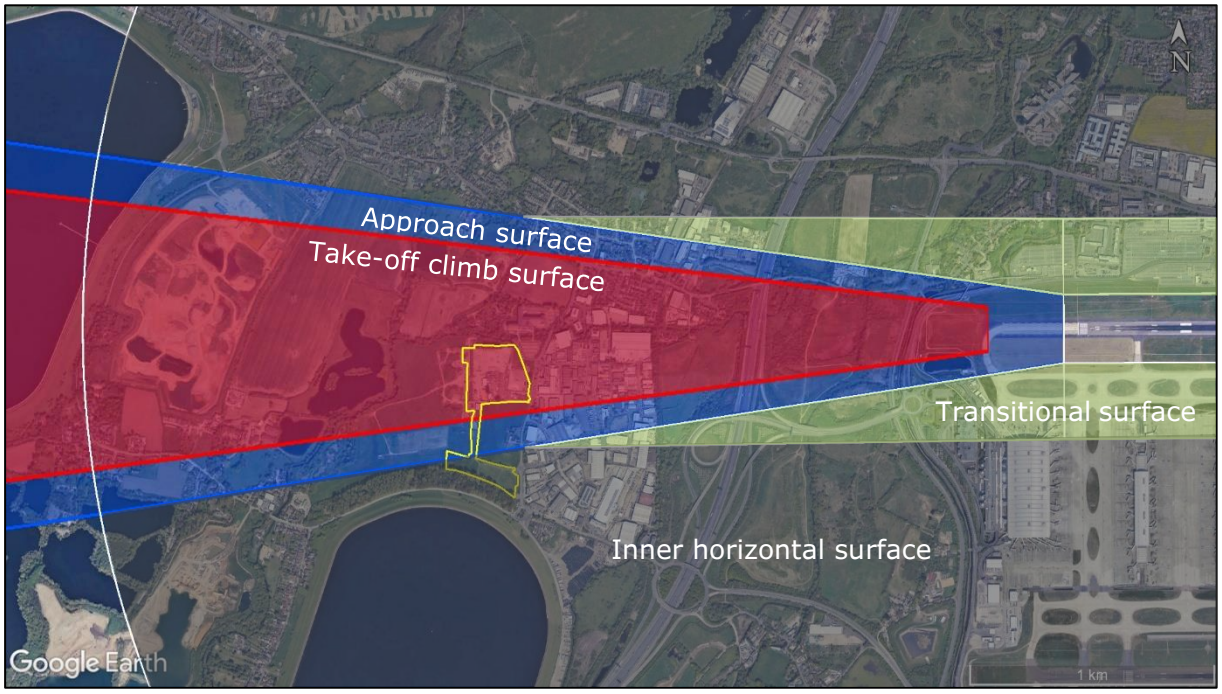


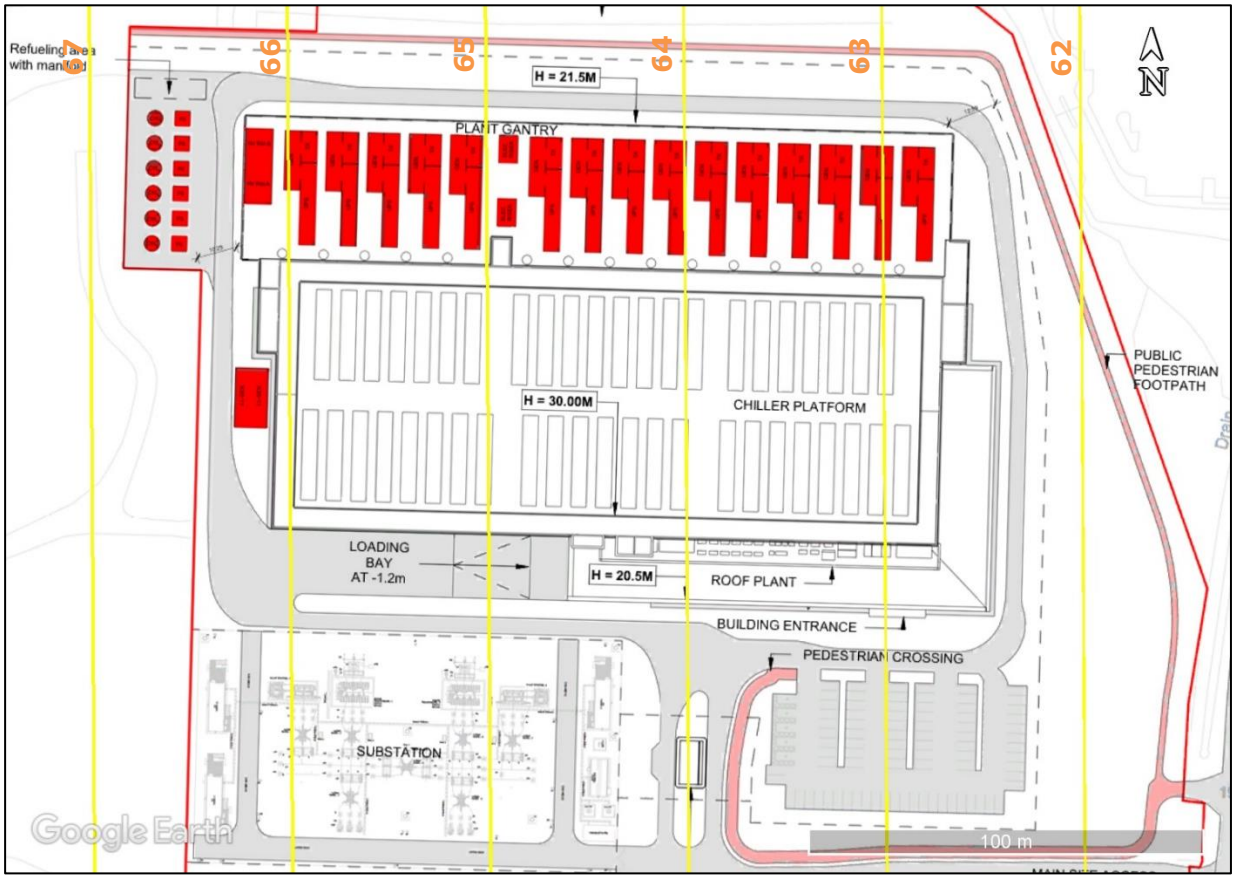

**Table 4: London Heathrow OLS Assessment**

| Reference Point | OS Grid Coordinates | | OLS Height Limit (m AOD) | | Maximum Building Height (m AOD) | Minimum Margin (m) |
|---|---|---|---|---|---|---|
| | Easting | Northing | TOCS | APPS | | |
| Chiller-NE | 503002.3 | 176287.6 | 62.79 | 68.96 | 51.40 | 11.39 |
| Chiller-SE | 503002.3 | 176231.2 | 62.82 | 68.99 | 51.40 | 11.42 |
| Chiller-SW | 502845.1 | 176231.2 | 65.97 | 72.14 | 51.40 | 14.57 |
| Chiller-NW | 502845.1 | 176287.6 | 65.94 | 72.11 | 51.40 | 14.54 |
| Office-NE | 503020.3 | 176270.0 | 62.44 | 68.61 | 43.14 | 19.30 |
| Office-SE | 503020.3 | 176210.4 | 62.48 | 68.64 | 43.14 | 19.34 |

Figure 8 provide height contours in 1 m intervals across the proposed data centre. It is evident from this figure and Table 4 that the proposed data centre at a maximum height of 51.4 m AOD complies with the OLS requirements and a minimum margin of 11.39 m is identified between the top of the 30 m high data centre and the TOCS.

With the potential for a third runway at London Heathrow Airport in the future, it is prudent to consider the safeguarding of that possibility, taking account of the anticipated runway location to the north and west of the existing northern runway. Based on the available plans within the 2019 consultation documentation [9], a displacement of approximately 1.1 km to the north and around 1.7 km to the west of Runway 09L/27R is estimated. On this basis, the proposed data centre would be approximately 0.6 km to the west of the new runway western threshold and approximately 1.2 km to the south of the new extended runway centreline. Therefore, it is evident the proposed data centre would be outside the APPS, TOCS and TRANS surfaces defined around a third runway so would not impact on the proposed future airport expansion.

**Figure 8: OLS Height contours across proposed data centre (m AOD)**




### *4.2.2 Flight Operations*

It is expected that proposed development up to the identified obstacle limitation surface height limits will not have any impact on operational criteria associated with the flight procedures, however, some general consideration of these to ensure that they are fully safeguarded by the OLS is prudent.

The final approach segment of the Runway 09L approach procedures involve descent along a standard 3° glide path, aligned with the runway extended centreline. ILS, RNP and localiser only approach procedures are identified. A detailed review of the ILS approach procedures determines that the site is located within the PANS-OPS X surface for Category I and Category II approach operations and obstacles below this surface will not impact the procedure design. The X surface heights are determined to be greater than the OLS, confirming that the OLS fully safeguard this flight procedure. For the localiser only procedures, the obstacle clearance altitudes are sufficiently high to ensure that the proposed data centre and cranes up to the OLS will not impact these procedures. For the RNP LNAV/VNAV procedures the final approach surface will be above the OLS and the proposed development and cranes up to the OLS will not impact these procedures. For the RNP LNAV procedure, the obstacle clearance altitudes are sufficiently high to ensure that the proposed data centre and cranes up to the OLS will not impact these procedures.

PANS-OPS also defines a visual segment surface (VSS) for to protect the visual segment of the approach procedures The slope of the VSS is equal to the glide path angle minus 1.12° and originates at 60 m before the threshold. Therefore, the origin of the VSS therefore corresponds with the origin of the approach surface and the width at origin and the divergence of the VSS are not less than the values for the approach surface, according to the nature of the instrument approach procedure. In the case of the 3° glide path angle

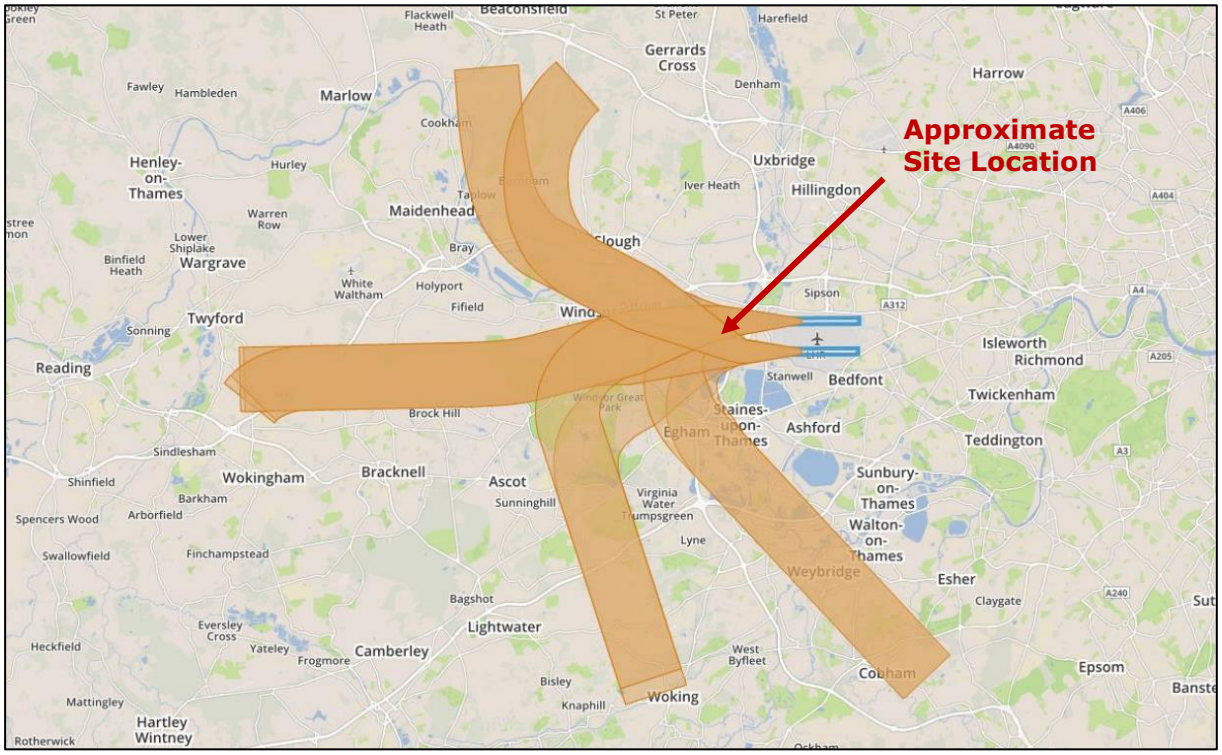
at London Heathrow Airport, the corresponding angle of the VSS is therefore 1.88°, equivalent to a slope of 3.28%. The slope of the approach surface at London Heathrow Airport is 2%, substantially less than the angle of the VSS. It is therefore readily seen that the approach surface will provide more than adequate protection for the VSS requirement applicable to the visual segment of the instrument approach.

Missed approaches, where aircraft on a westerly approach to Runway 27R or Runway 27L decide not to land and undertake a go-around are a further consideration. As for Runway 09L, ILS, RNP and localiser only approach procedures are identified. The flight procedure charts for Runway 27L missed approaches indicate a turn to the south, away from the site. Runway 27R missed approaches involve a turn to the north shortly after initiating a go-around. However, aircraft must climb straight ahead until reaching a height of 1580 feet (482m) and a minimum obstacle clearance of 50 m will apply within the turn area. Therefore, it is evident that development and cranes up to the OLS across the site will not erode the minimum obstacle clearance required to initiate a turn for these procedures.

Prior to the turn, the straight missed-approach criteria will apply before reaching this height. For the ILS procedure, the obstacle height limits will be defined by the PANS-OPS OAS surfaces. The height of the Z surface for these procedures is determined to be greater than the OLS across the site and proposed development and cranes up to the OLS at the site will not impact this procedure. For the localiser only procedures, the obstacle clearance altitudes are sufficiently high to ensure that the proposed data centre and cranes up to the OLS will not impact these procedures. For the RNP procedures the Z surface will be above the OLS and the proposed development and cranes up to the OLS will not impact these procedures.

For departure operations, the identified noise preferential routes indicate potential flight paths directly over the site for both Runway 27R and Runway 27L departures, as shown in Figure 9. The standard minimum procedure climb gradient of 3.3% applies for Runway 27R and Runway 27L departures. On the basis of this standard climb gradient, it is expected that the proposed data centre and cranes up to the OLS will not impact these procedures. Furthermore, the noise abatement procedures specify that aircraft much have reached a minimum of 1000 feet above aerodrome level at 6.5 km from the ‘start of roll’ and thereafter maintain a minimum climb gradient of 4% until reaching an altitude of 4000 ft. Therefore, in order to comply with these requirements, aircraft climb rates will be substantially greater than the minimum 3.3% procedure design gradient specified for the Runway 27R standard instrument departures (SIDs).

**Figure 9: Westerly Departure Flight Paths (Noise Preferential Routes)**




In addition to normal operations, safeguarding constraints in relation to non-standard operations, such as one-engine inoperative take-offs, are a further consideration. Operational performance standards require that aircraft operators ensure that an adequate vertical margin is achieved during departure with respect to all obstacles in the take-off path with the critical engine of a multi-engine commercial transport aircraft inoperative. Under the IR-OPS Implementing Rules of the European Aviation Safety Agency (EASA), airlines must comply with the defined vertical clearance margin requirements with respect to existing obstacles along the departure path. These obstacles may limit the available payload during departure and, to maintain current levels of operational efficiency, it will be important that the introduction of more restrictive obstacles is avoided. In the event of an engine failure on take-off, or a late missed approach, the maximum climb rate of the aircraft may be compromised, and it may not be possible to gain sufficient height to clear the existing tall buildings, on a straight-out departure path, safely. It is to be expected that the take-off climb surface sufficiently safeguards these operations and, due to the existing obstacle environment, obstacles marginally above the TOCS may not impact on these criteria, although consultation with the airport would be required to confirm this.

## 4.3 RAF Northolt Aerodrome Safeguarding

The main runway at RAF Northolt Aerodrome is a Code 3 precision approach runway (equal to or greater than 1,200 m and less than 1,800 m). The Military Aviation Authority (MAA) regulates all Defence Aviation activities. Regulatory requirements for aerodrome safeguarding are set out within Regulatory Articles (RA) series 3500 to 3599 of the MAA Regulatory Publications (MRP) which cover aerodrome design and safeguarding. The specification for the obstacle limitation surfaces at military aerodromes are set out in Annex A of RA 3512 [7] and these specifications are essentially consistent with the equivalent specifications for non-military aerodromes specified in ICAO Annex 14 [1].

Table 5 provides the distances of the proposed data centre corners from the Northolt Aerodrome Reference Point (ARP) and locations of the identified assessment points in Runway 07 aligned coordinates, specified by their longitudinal distance, X, from the runway

threshold and lateral distance, Y, from the runway extended centreline. In accordance with the OLS specifications, the site is determined to be located within the area covered by the outer horizontal surface (OHS) for RAF Northolt. The outer horizontal surface is a level surface that extends beyond the periphery of the conical surface to a minimum distance of 15 km from the aerodrome reference point at 150 m above the aerodrome reference elevation of 34.7 m AOD provided by the lowest of the runway thresholds. On that basis, the height of the outer horizontal surface is determined to be 184.7 m AOD. This height limit is significantly less constraining than the OLS for London Heathrow and given the significant distance from the site to RAF Northolt and its proximity to London Heathrow Airport, it is evident that flight procedures in operation at RAF Northolt Aerodrome will not be impacted by the proposed development and cranes up to the identified Heathrow OLS limits.

**Table 5: RAF Northolt OLS Assessment**

| Reference Point | OS Grid Coordinates | | Distance from Northolt ARP (m) | Runway 07 aligned coordinates (m) | |
|---|---|---|---|---|---|
| | Easting | Northing | | X | y |
| Chiller-NE | 503002.3 | 176287.6 | 10924 | 8616.7 | 5625.0 |
| Chiller-SE | 503002.3 | 176231.2 | 10969 | 8637.3 | 5677.5 |
| Chiller-SW | 502845.1 | 176231.2 | 11065 | 8783.7 | 5620.2 |
| Chiller-NW | 502845.1 | 176287.6 | 11021 | 8763.1 | 5567.7 |
| Office-NE | 503020.3 | 176270.0 | 10927 | 8606.4 | 5647.9 |
| Office-SE | 503020.3 | 176210.4 | 10974 | 8628.1 | 5703.4 |

## 4.4 Use of Construction Cranes

As noted earlier, the site is located within the area covered by the approach surface, take-off climb surface and inner horizontal surfaces at London Heathrow Airport and within the outer horizontal surface for RAF Northolt Aerodrome. The take-off climb surface at London Heathrow gives rise to the most constraining height limits across the site of between 62.4 m AOD and 66.0 m AOD across the proposed data centre footprint. On that basis, a minimum margin of 11 m is identified between this surface and the top of the proposed data centre.

Headroom of the order of 10 m to 12 m is typically required as a minimum for the use of a single saddle jib tower crane. A further 10 m would be required if a second saddle jib crane with an overlapping operating area were to be employed. Luffing jib cranes, which may be preferred to saddle jib cranes where there is limited scope for jib over sail across areas adjacent to the site, require more headroom, typically 40 m or more, according to the jib length.

Therefore, whilst some careful consideration of construction planning is required to ensure that cranes will comply with the aviation constraints at this location it would appear that a feasible construction methodology can be achieved within the identified OLS constraints.

Due to the displaced threshold, the APPS heights are approximately 6 m above those determined for the TOCS and some existing infringements of the TOCS are identified. Therefore, in the event that greater headroom for construction was required, it may be possible to secure agreement with the airport for temporary infringement of the TOCS at this location. Early engagement with London Heathrow Airport is recommended to develop a workable construction methodology that avoids impacts on airport operations.

# 5 Technical Safeguarding

Technical safeguarding is the process employed to protect radio signals that support aircraft operations from being adversely affected by physical or electromagnetic changes in their transmission environment. Most physical objects act as potential reflectors or diffractors of radio signals. A combination of object size, material, proximity and incident radio wavelength determine the extent to which objects act as reflectors or diffractors.

In addition to the physical safeguarding of flight paths, there is a requirement for the technical safeguarding of airport operations to ensure that there are no adverse impacts on navigational aids. In general, it is expected that developments that comply with the limits defined by the OLS will not conflict with the requirements for the technical safeguarding of the relevant navigational aids located at Northolt and London Heathrow.

Navigational aids requiring protection include various instruments that provide direct guidance to aircraft and radar systems that support air traffic control. The technical safeguarding criteria for the protection of navigational aids are conceptually similar to those for physical safeguarding according to the OLS. A series of "frames" of defined geometry arranged about the different types of navigational aid are identified [10] in which it is considered that new structures may potentially lead to adverse impacts on these facilities. Frame sizes associated with specific types of equipment is provided and addresses the following types of equipment in use at aerodromes:

- ILS Localiser;
- ILS Glide Path;
- Distance Measuring Equipment (DME);
- Non directional beacon (NDB).

A proposal to locate a new structure inside the frame of a navigational aid would trigger a more detailed assessment to determine whether or not the proposed new structure would, in practice, adversely affect the signals concerned. At the location and heights being proposed, the proposed development site is outside the geometrical frames that apply to equipment located at these aerodromes and it is expected that development up to the OLS will not adversely impact these navigational aids.

In addition, consideration needs to be given to the safeguarding of radar equipment employed for the support of air traffic control. In that context, impacts of tall buildings on the operation of the H10 radar located on the south side of London Heathrow Airport are a recognised potential concern.

New tall buildings can give rise to two adverse impacts: interruption of radar coverage behind the buildings where airspace is shielded by them; reflections of signals from aircraft that lead to the generation of "false targets" along the line of the buildings.

The extent to which any new development may adversely impact the radar will be dependent upon the height of the structure relative to the radar and its distance from the radar, having regard to the curvature of the earth and the associated influence on sight lines. These parameters determine the extent to which a new structure may stand above its general surroundings and lead to additional restrictions on radar coverage. The presence of existing tall buildings that would shield sight lines from the radar are a further factor influencing the nature of impacts.

Given the overall height of the proposed data centre, in comparison to the Terminal 5 building which is located approximately halfway between the H10 radar and the site, it is unlikely that the proposed data centre will be a significant concern.

# 6 Pluming and Venting

The potential for venting of heated air from the coolers and generator exhausts from the tops of the proposed data centre has been identified as a potential concern in relation to aircraft on approach to or taking off from London Heathrow Airport. It is understood from previous experience of a proposed data centre application at a similar location in relation to the flight paths to and from a UK aerodrome that the primary concern is regarding the exhausts and potential impact on smooth descent of aircraft in the final stages of the approach due to thermal effects.

Whilst pluming and venting is recognised as a potential safeguarding issue within CAA regulations, the UK CAA does not currently have any specific guidance on this issue and during previous consultation have indicated that guidance issued by the Australian Civil Aviation Safety Authority [11] would provide a good reference point for assessment. This guidance sets out screening criteria for initial assessment of plume vertical velocities of 4.3 m/s. It also identifies tolerable risk levels for locations in relation to the OLS. At the proposed data centre location, it indicates that the probability of moderate turbulence needs to be below $1x10^{-5}$ per flight operation.

The developer is currently undertaking a more detailed study to consider the potential impacts of plume rise on aircraft landing and taking-off from London Heathrow Airport. This study involves CFD modelling of plumes under a range of climatic conditions to establish the vertical velocities at the identified protection surfaces in accordance with the Australian CASA guidance [11].

# 7 Bird Hazard Management

Under international standards, safeguarding in respect of bird hazards applies out to a defined radial distance of 13 km around airports. The proposed development is within this safeguarded area. Some preliminary guidance on bird hazard management is provided below.

ICAO guidance [12] identifies bird attractants falling within three general categories that should be minimised in development at or near airports, as follows:

- Food
- Water
- Shelter

Guidance provided by the UK CAA [13] identifies the same broad issues as primary considerations in bird hazard management near airports.

ICAO guidance states the following in respect of bird attraction associated with buildings:

*"Structures. Architects should consult biologists during the design phase of buildings, hangars, bridges and other structures at airports to minimize exposed areas that birds can use for perching and nesting. When perching sites are present in older structures (such as rafter and girded areas in hangars, warehouses and under bridges) access to these sites can often be eliminated with netting. Anti-perching devices, such as spikes, can be installed on ledges, roof peaks, rafters, signs, posts and other roosting and perching areas to keep certain birds from using them. Changing the angle of building ledges to 45 degrees or more will deter birds. However, it is emphasized that incorporating bird exclusion or deterrence into the design of structures is the most effective, long-term solution."*

The CAA provide the following general guidance on building design:

*"When new buildings are being designed they should:*

- *prevent wildlife gaining access to the interior and roof spaces*
- *use self-closing doors or plastic strip curtains or other mechanisms to prevent access by wildlife*
- *be without roof attractions - consider implications of green, flat and shallow pitched structures*
- *have minimal roof overhangs and be without ledges beneath overhangs or external protrusions*
- *allow easy access to rooftops in case it becomes necessary to take action against nesting gulls or waders that colonise large flat or shallow-pitched roofs. Gulls will also use steeply sloping roofs where the nests can be lodged behind vents, skylights, and in gullies etc."*

The CAA note further that sheltered ledges, access holes and crevices within and underneath structures can prove ideal nesting locations for feral pigeons, stock doves, pied wagtails and starling whilst rooftops themselves, including green roofs, may be attractive to gulls or wading birds such as oystercatchers, for nesting, loafing and roosting.

Water acts as a bird attractant and water features should be avoided in landscaping plans for development near airports. Management of water accumulations that may otherwise attract birds may be required during site preparation and construction activities.

Potential food attractants include food waste as well as landscaping features. Standard guidance recommends the avoidance of berry bearing plants that may attract birds and the avoidance of the creation of areas of dense cover for roosting by flocking species of birds. Careful attention to the management of wastes that might give rise to food sources is also recommended.

Modern aircraft are designed to be resilient to bird strike. Civil aircraft design and certification requirements specify the necessary tolerance of aircraft to defined bird strike events. Key elements of these standards include the ability of an engine to withstand ingestion of birds without catching fire, suffering uncontained failure or becoming impossible to shut down, whilst retaining some partial thrust for a specified period after the strike. These standards should ensure that any multi-engine civil aircraft will be able to withstand engine ingestion of a single "large" bird without endangering the aircraft, even if the engine is destroyed beyond economic repair, and similarly to withstand ingestion of a certain number of "small" and "medium" sized birds without endangering the aircraft.

The primary hazard that may give rise to serious consequences is therefore a multiple bird strike involving larger species, including in particular water birds such as gulls, geese and swans which may potentially be encountered in flocks by aircraft during take-off and landing operations. Whilst the proposed development may provide some limited opportunities for increased bird populations within the vicinity of the aerodrome, the development details need to be considered in the context of the surrounding environment and existing state of the site. As shown in Figure 10, it is evident that the site is surrounded by existing agricultural land, hedgerows, trees and water bodies and is adjacent to the Arthur Jacob Nature Reserve. The Reserve consists of four former gravel pits which have been converted from derelict land into lagoons managed for wildlife and includes both dry and wet woodland areas and islands within the lagoons, providing plenty of opportunities for nesting and roosting birds.

**Figure 10: Site location in relation to existing landscape**

Therefore, whilst the proposed development may include some pond areas, in the context of the existing water bodies and relatively undisturbed nature areas adjacent to the site, it is unlikely that these ponds would result in any significant increase in the populations of water birds such as geese and swans, over and above the existing baseline, and the majority of trees and hedgerow incorporated into the proposals are retention of existing natural features.

Furthermore, it is expected that the attractiveness of the building's flat roof areas will be diminished by the roof plant and corresponding noise and localised heat generated by this equipment. These areas will also be accessible for maintenance of plant and other equipment and that access will provide opportunities for mitigation, should any issues arise.

# 8 Lighting and Reflective Glare

Requirements in respect of potentially dangerous, confusing or dazzling lights are set out in the Air Navigation Order (ANO), as described in Civil Aviation Publication (CAP) 393 [14]. ANO Article 224 in respect of "Lights liable to endanger" states the following:

*A person must not exhibit in the United Kingdom any light which:*

*(a) by reason of its glare is liable to endanger aircraft taking off from or landing at an aerodrome; or*

*(b) by reason of its liability to be mistaken for an aeronautical ground light is liable to endanger aircraft.*

ANO Article 225 in respect of "Lights which dazzle or distract" states the following:

*A person must not in the United Kingdom direct or shine any light at any aircraft in flight so as to dazzle or distract the pilot of the aircraft.*

CAP 168 [15] provides some practical interpretation of these requirements, as follows:

*Dangerous and Confusing Lights*

*6.10 The ANO states that a person shall not exhibit in the UK any light which is liable to endanger aircraft taking-off or landing or which is liable to be mistaken for an aeronautical light.*

*6.11 A light may endanger aircraft when:*

1. *the intensity causes glare in the direction of an approaching aircraft;*
2. *the colour (e.g. advertising signs) causes it to be mistaken for an aeronautical light;*
3. *viewed from the air, lights make a pattern (e.g. a row of street lights) similar to an approach or runway lighting pattern;*
4. *the overall amount of illumination near the approach to a runway detracts from the effectiveness of the AGL, particularly in poor visibility.*

*6.12 Lasers are a source of special concern because even brief exposure to the light from such devices can cause temporary blindness. Guidance on the use of lasers with regard to aviation safety has been produced by the CAA and is contained in CAP 736, Guide for the Operation of Lasers, Searchlights and Fireworks in United Kingdom Airspace.*

*6.13 The licence holder should ensure that arrangements exist whereby local planning authorities may receive appropriate advice about the lighting implications of planning applications before such applications are determined.*

*6.14 Particular attention should be paid to lights in the following areas:*

1. *For instrument approach runways*

   *A rectangular area 750 m on each side of the centreline and extended centreline of the runway extending to a distance of 4,500 m before the threshold.*

2. *For non-instrument runways*

   *An area 220 m wide equally disposed about the centreline of the runway and increasing in width along the extended centreline from 220 m at the threshold to 950 m wide at a distance of 3,000 m from the threshold.*

In respect of lighting, it is evident that conventional building lighting can normally be designed so as not to be dangerous and confusing in the context of the regulations. The external lighting strategy [16] for the proposed development has been developed to be in keeping with the surrounding context and aims to strike a balance between security requirements and environmental impacts. The proposed lighting scheme has been designed *'taking the local context, Client needs, aviation requirements, and ecology concerns into consideration'.* The lighting strategy specifies column down lights with 'negligible upward light spill' to meet light pollution requirements; these constraints will also ensure that there will be no direct glare towards aircraft on approach or taking off from Heathrow airport.

In addition to artificial lighting, large glass structures and roof-mounted PV panels might allow strong reflections of sunlight, and those located close to the approach path to a runway are of potential concern due to the possible impairment of visual reference that they might cause, in particular at a more critical time during landing. A sustained glare during the final approach phase of flight might affect a pilot's ability to maintain adequate visual reference to the runway and a short burst of intense light may affect visual function for some time after the event. Where vision is not impaired, reflections might still cause some level of distraction. Temporary impairment of the sight of ATC personnel due to this type of effect may also present a potential threat to safe airport operations.

It is understood that the no detailed PV panel arrangement or specification is available at this stage of the design process. In the event that PV panels form part of the final design, they will be specified with an anti-reflective coating and mounted on frames which will ensure the angle of the panels can be adjusted to minimise any potential glare impacts towards aeronautical targets.

# 9 Conclusions

The following conclusions may be drawn from the aviation safeguarding assessment:

- Assessment of the site location in relation to London Heathrow Airport's OLS has determined that the site is located within the area covered by the Runway 09L approach surface (APPS), Runway 27R take-off climb surface (TOCS) and the inner horizontal surface (IHS). The take-off climb surface at London Heathrow gives rise to the most constraining height limits across the site of between 62.4 m AOD and 66.0 m AOD across the proposed data centre footprint.
- The site is also located within the outer horizontal surface for RAF Northolt Aerodrome, however, this gives rise to a less limiting constraint than the London Heathrow Airport OLS.
- A minimum margin of 11 m is identified between the OLS and the top of the proposed data centre. Whilst some careful consideration of construction plans is required to ensure that cranes will comply with the aviation constraints at this location, a feasible construction methodology can be achieved within the identified OLS constraints.
- Preliminary assessment of the instrument flight procedures in use at London Heathrow indicates that cranes which extend up to the OLS are unlikely to have any significant impact on flight operations.
- In addition to the physical safeguarding of flight procedures, proposed development close to the airport has the potential to impact on-airport navigational aids. Preliminary assessment indicates that the proposed data centre is outside the technical safeguarding frames indicated in CAA guidance to be areas of particular concern. It is expected that development up to the 2% approach surface limits identified will not impact the ILS system.
- Given the overall height and scale of the proposed buildings in comparison to the Heathrow Terminal 5 building located along the sightline from the H10 radar to the proposed data centre, it is unlikely that the proposed development will impact the H10 en-route radar located at Heathrow Airport.
- The potential for venting of heated air from generator exhausts from the top of the proposed data centre has been identified as a possible hazard to aircraft on approach to or taking off from London Heathrow Airport. The developer is currently undertaking a more detailed study to consider the potential impacts of plume rise on aircraft landing and taking-off from London Heathrow Airport.
- Whilst the proposed development may provide some limited opportunities for increased bird populations within the vicinity of the aerodrome, the development details need to be considered in the context of the surrounding environment and existing state of the site. Therefore, preliminary review of the potential bird hazard associated with the proposed development indicate that it is unlikely to result in any significant impacts and any issues that might arise can be addressed by the adoption of well-established management measures, if considered appropriate.
- The external lighting strategy for the proposed development has been developed to be in keeping with the surrounding context and aims to strike a balance between security requirements and environmental impacts. The proposed lighting scheme has been designed *'taking the local context, Client needs, aviation requirements, and ecology concerns into consideration'*. The lighting strategy specifies column down lights with '*negligible upward light spill'* to meet light pollution requirements; these constraints will also ensure that there will be no direct glare towards aircraft on approach or taking off from Heathrow airport.

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