CANARY WHARF
GROUP PLC

NQ.PA.24

North Quay
Aviation Safeguarding Assessment

Eddowes Aviation Safety
July 2020

Contents

Executive Summary

1. Canary Wharf (North Quay) Ltd is making an application for outline planning permission (all matters reserved) for the redevelopment of the North Quay site for mixed use, including the erection of tall buildings.

2. The Site lies beneath flight paths to and from London City 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. 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.

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

    - 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.

4. A detailed specification of the height limits that apply at the Site, according to international standards and recommended practices, has previously been developed in the form of a contour plot across the Site that was provided to the architects designing the scheme in order to inform the design process and ensure compliance with the relevant physical safeguarding requirements. In order to provide the Applicant with the greatest amount of flexibility, the Proposed Development is defined in terms of the maximum parameters under the outline planning application, together with an Indicative Scheme of one way development could be undertaken in accordance with the parameters. An assessment of the identified maximum parameters and Indicative Scheme against these aviation height limits has been undertaken to confirm that the Application complies with these requirements. In addition to determining the acceptable height of permanent buildings at the site, consideration has also been given to the acceptability of the use of cranes above the finished building heights during construction.

5. The maximum parameters are defined for a series of Development Plots across the Site in terms of the coordinates of the plot footprints and the heights AOD that provide for 8 buildings with varying maximum heights. The greatest maximum parameter height of 225 m AOD applies at plot NQ.A4, located on the western edge of the site, furthest from the Airport where the physical safeguarding height limits are least restrictive.

6. Assessment of the Proposed Development, as defined in terms of the maximum parameters, against the relevant physical safeguarding requirements at the Site associated with operations at London City Airport has confirmed that the proposed maximum permanent building heights identified comply with those requirements. Since the Indicative Scheme complies with the proposed maximum parameters, being slightly lower than them in all plots, it is evident that the Indicative Scheme will comply with the relevant aviation-related limits.

7. The Site is located beneath the approach surface of the OLS and the identified maximum parameters are close to the height limit defined by this surface. Use of cranes for construction above finished building height may require temporary infringement of this surface. Previously, London City Airport has permitted temporary infringements of the approach surface where the vertical margins associated with the relevant PANS-OPS criteria were met. The scope for temporary infringement of the OLS across the Site according to these principles has been assessed by determining the maximum permissible heights which avoid impacts upon existing flight procedures. The most limiting flight procedure height constraint is found to be associated with the Runway 27 ILS 3% climb gradient missed-approach operation. This procedure gives rise to height constraints of around 240 m AOD on the eastern side of the site rising to around 247 m AOD on the western site boundary.

8. However, the flexibility to allow temporary infringements at the Proposed Development has subsequently been limited under a ruling by Jon Round, Head of Airspace, Air Traffic Management and Aerodromes at the Civil Aviation Authority. The change followed a review of these practices, largely stimulated by development issues in the City of London and the change to regulatory oversight of airport licensing by the European Aviation Safety Agency (EASA). This ruling emphasises the importance of compliance with EASA regulatory requirements that there should be no new infringements of the approach surface by either permanent or temporary structures. On that basis, the OLS height limits and margins identified for the Proposed Development may now need to be applied to construction cranes as well as permanent buildings. In our view, these approach surface restrictions imposed by the CAA in relation to construction activities are unnecessary, particularly in the area of One Canada Square where this existing obstacle already represents an infringement of the approach surface.

9. A reasonable case may still be made that there is an element of flexibility in the relevant international regulations and that, at the discretion of the appropriate authority (i.e. London City Airport, having regard to the opinion of their regulator, the CAA), temporary infringements of the approach surface limits identified above could be permitted. If this case were to be accepted, the height of temporary infringements would be limited by the margins required to comply with existing flight procedures. Height limits of between 20.8 m and 22 m above the maximum parameter heights being proposed would apply which should be sufficient to allow for development of a viable crane plan to support construction above the maximum parameter heights. As things stand, however, it cannot be guaranteed that these operational crane

height limits would be accepted by the airport and lower margins would apply if crane heights were to be limited to the height of the approach surface. To ensure that a viable crane plan can be developed, it is therefore recommended that the required crane heights are taken into account during development of the detailed designs for the North Quay scheme, according to the future position adopted by London City Airport in this respect. These issues, including the potential development of special crane strategies to ensure compliance as necessary, can most effectively be addressed at the Reserved Matters Application stage, in consultation with London City Airport, as necessary.

10. In addition to the physical safeguarding assessment of normal operations by reference to the OLS and PANS-OPS criteria, consideration has also been given to reasonably foreseeable non-standard operations such as one engine inoperative scenarios. Due to the proximity of the Site to existing tall buildings, namely the Canary Wharf Tower at One Canada Square, it may be concluded that the development in accordance with the identified maximum parameters will have no material adverse impact on the safety and efficiency of operations at London City Airport.

11. NATS, the operators of the radar who are responsible for its technical safeguarding have recently identified potential impacts of proposed tall building developments in the Canary Wharf area. On that basis it is expected that tall building development at the Site may, in principle at least, give rise to potential impacts on the H10 radar. The extent of these impacts may be limited to some extent by the existing and consented tall building developments immediately adjacent to the Site. In the event that potential adverse impacts were identified, previous experience indicates that these can normally be addressed satisfactorily by a radar mitigation scheme, in agreement with NATS. NATS are statutory consultees under the planning process and will be able to advise during determination of the application if mitigation might be required.

1. Introduction

1.1 Canary Wharf (North Quay) Ltd is making an Outline Planning Application ("OPA") and associated application for Listed Building Consent ("LBC") in respect of the North Quay site. Canary Wharf (North Quay) Ltd is making an application for outline planning permission (all matters reserved) for the redevelopment of the North Quay site for mixed use, including the erection of tall buildings.

1.2 The Site lies beneath flight paths to and from London City 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. Specific height limits apply at the Site, according to the 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.

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

- 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.

1.4 A detailed specification of the height limits that apply at the Site, according to international standards and recommended practices, has previously been developed in the form of a contour plot across the Site that was provided to the architects designing the scheme in order to inform the design process and ensure compliance with the relevant physical safeguarding requirements. The Proposed Development is defined in terms of the maximum parameters under the outline planning application, together with an Indicative Scheme. An assessment of the identified maximum parameters and Indicative Scheme against these height limits has been undertaken to confirm that the application complies with these requirements. In addition to determining the acceptable height of permanent buildings at the Site, consideration has also been given to the acceptability of the use of cranes above the finished building heights during construction.

1.5 Permanent building heights are typically restricted to the heights specified by the OLS. However, recent studies of nearby development sites in the vicinity of London City Airport have highlighted the limitations of the OLS in some areas where maintaining the clearance margins associated with some flight procedures has required building height limits lower than those specified by the OLS. On the other hand, in some areas, the OLS are more restrictive than the

minimum requirements for instrument procedure design in accordance with PANS-OPS criteria. Under those circumstances, there may be scope for temporary penetrations of the OLS by construction cranes, for example.

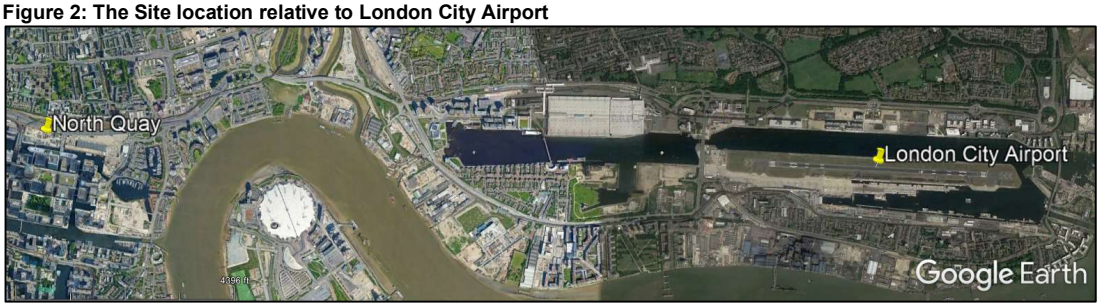
1.6 This report provides an account of the Aviation Safeguarding Assessment of the Proposed Development to demonstrate that it will not adversely affect the safety and efficiency of operations at London City Airport.

2. Site Description

2.1 The Site is bounded by Canary Wharf Crossrail Station to the south, Aspen Way (A1261) to the north, Hertsmere Road to the west and Billingsgate Market to the east. The West India Quay Docklands Light Railway (DLR) station and Delta Junction are located on the western side of the Site and the Site also incorporates parts of North Dock, Upper Bank Street and Aspen Way, as shown in Figure 1. The location of the Site relative to London City Airport is shown in Figure 2. The Site lies approximately 4,400 m to the west of the western end of the runway and is close to the runway extended centreline. The length of 1,650 m of the paved runway surface at London City Airport provides a reference point for the scale of the distances in Figure 2.

Figure 1: Site boundary

Figure 2: The Site location relative to London City Airport



2.2 The OPA identifies the maximum parameters for a series of Development Plots across the Site. These maximum parameters are defined in terms of the coordinates of the Development Plot footprints and the heights AOD that provide for 8 buildings with varying maximum heights. Figure 3 shows the layout of the proposed Development Plots and their maximum parameter heights AOD. Figure 4 shows that Indicative Scheme sitting within the maximum parameter envelope. The key characteristics of the Proposed Development are as follows:

- Development Plot NQ.A4, located at the south-west corner edge of the Site, has the largest maximum parameter height of 225 m AOD. The height of the building in this plot identified in the Indicative Scheme is 220.6 m AOD. The maximum parameter height for plot NQ.A1, located to the north of plot NQ.A4 is 150 m AOD and height of the building in this plot identified in the Indicative Scheme is 124.6 m AOD. A much lower block, NQ.A5, immediately adjacent and to the east of NQ.A4, has a maximum proposed height of 37 m AOD.
- Along the northern half of the Site and to the east of NQ.A1, three plots are defined; moving from east to west across the northern half of the Site, NQ.B1 with a maximum height of 180 m AOD, NQ.D1 with a maximum height of 190 m AOD and NQ.D2 with a maximum height of 150 m AOD. The heights of the three buildings in these plots identified in the Indicative Scheme are 168.25 m AOD, 140.6 m AOD and 104.95 m AOD, for NQ.B1, NQ.D1 and NG.D2, respectively.
- In the south-east quadrant of the Site, two further plots are defined; NQ.D3 with a maximum height of 85 m AOD and NQ.D4 adjacent to the eastern boundary of the Site with a maximum height of 190 m AOD. The heights of the buildings in these plots identified in the Indicative Scheme are 77.4 m AOD and 182.20 m AOD, for NQ.D3 and NQ.D4, respectively.

Figure 3: Proposed Development Plot Maximum Heights

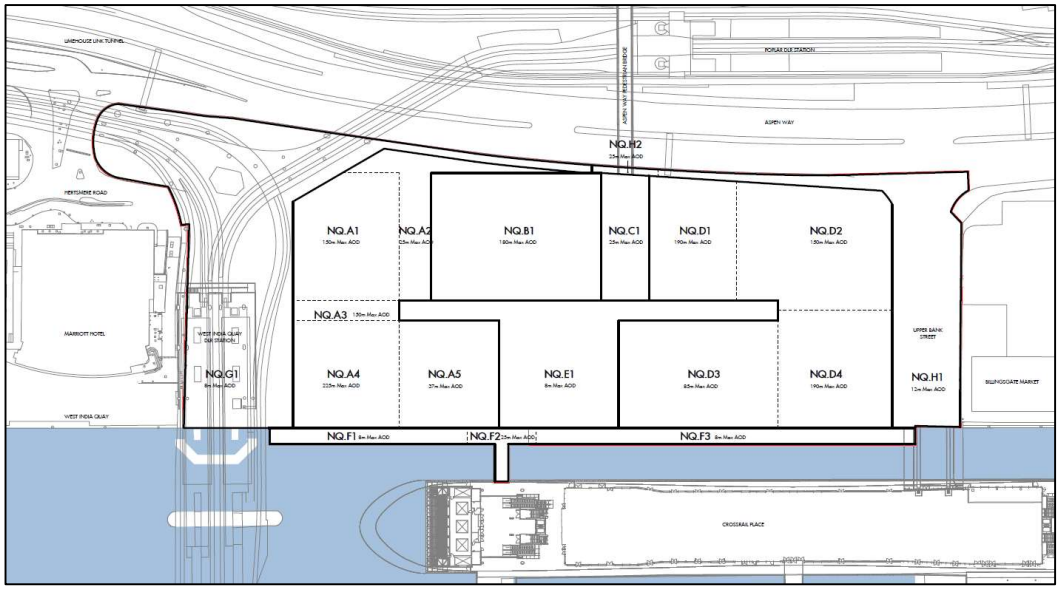
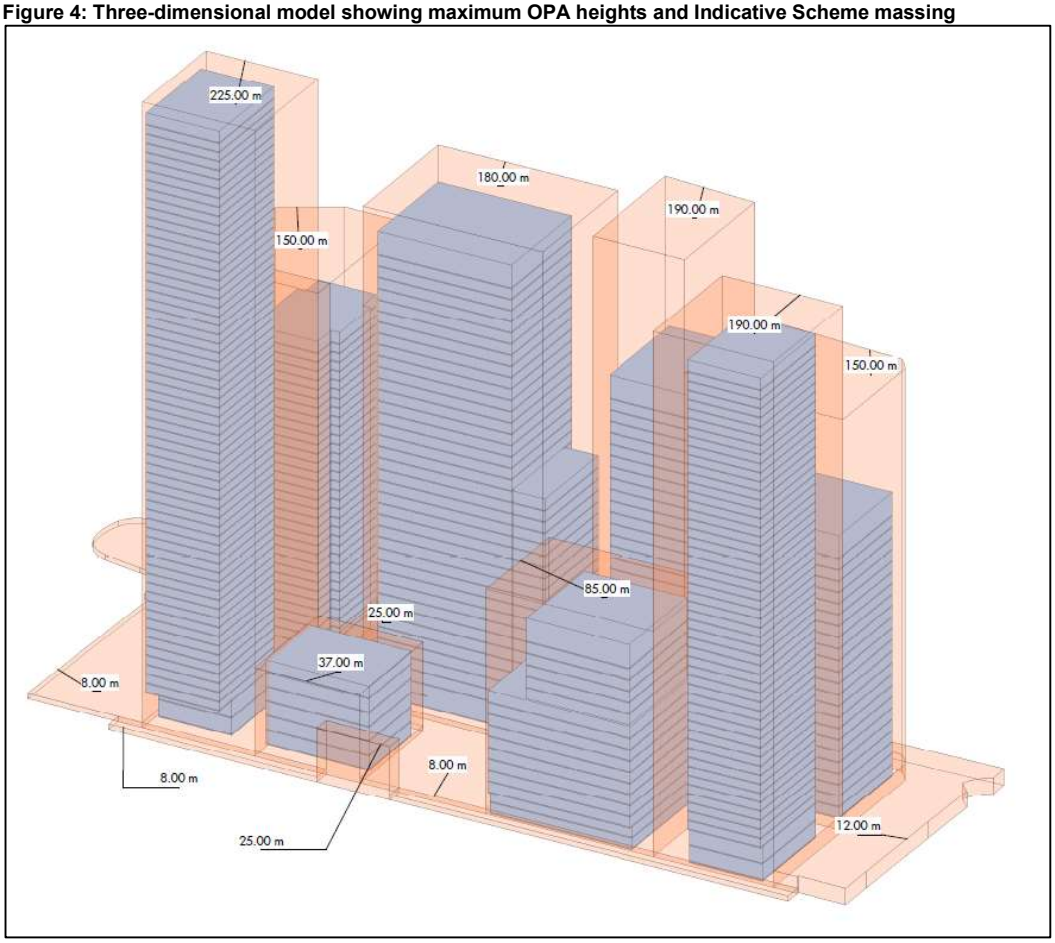


Figure 4: Three-dimensional model showing maximum OPA heights and Indicative Scheme massing



2.3 The Proposed Development has been assessed by reference to the proposed maximum parameter heights and the OS grid coordinates of the primary corners delineating the various

Development Plots with maximum parameter heights at or above 150 m AOD. It is readily seen that plots with lower heights are below the height of the outer horizontal surface applicable at the Site and therefore must comply with the OLS defined for London City Airport. These coordinates and heights are shown in Table 1.

2.4 For the purposes of this assessment, it is convenient to work in terms of runway-aligned coordinates in which locations are specified with respect to their longitudinal distance, X, from the runway threshold and lateral distance, Y, from the runway extended centreline. The runway threshold coordinates identified in the Aeronautical Information Publication for London City Airport, where Runway 09 refers to the western threshold employed in easterly approaches and Runway 27 refers to the eastern threshold employed for approaches in a westerly direction, are as follows:

- Runway 09: WGS84 51 30 19.9 N, 000 02 44.71 E; OSGB 542076.280, 180494.157
- Runway 27: WGS84 51 30 17.72 N, 000 03 53.83 E; OSGB 543410.592, 180464.247

2.5 The runway-aligned coordinates for the relevant assessment points are summarised in Table 1.

Table 1: Development site coordinates

Reference Point Name	OS Grid Coordinates		RWY 09 aligned		RWY 27 aligned		Maximum Parameter Building Height (m AOD)
	Easting	Northing	X (m)	Y (m)	X (m)	Y (m)	
NQ.A1-1	537551.9	180534.5	4524.1	61.1	-5858.8	-61.1	150
NQ.A1-2	537513.4	180547.8	4562.9	48.6	-5897.6	-48.6	150
NQ.A1-3	537518.9	180584.6	4558.3	11.7	-5892.9	-11.7	150
NQ.A1-4	537538.9	180592.5	4538.4	3.4	-5873.1	-3.4	150
NQ.A4-1	537545.9	180494.4	4529.2	101.3	-5863.9	-101.3	225
NQ.A4-2	537506.4	180500.3	4568.9	96.3	-5903.5	-96.3	225
NQ.A4-3	537512.3	180540.4	4563.9	56.0	-5898.5	-56.0	225
NQ.A4-4	537551.9	180534.5	4524.1	61.1	-5858.8	-61.1	225
NQ.B1-1	537678.6	180523.2	4397.2	69.5	-5731.9	-69.5	180
NQ.B1-2	537646.0	180528.1	4429.9	65.3	-5764.6	-65.3	180
NQ.B1-3	537652.9	180574.5	4424.1	18.8	-5758.7	-18.8	180
NQ.B1-4	537685.2	180567.5	4391.6	25.1	-5726.3	-25.1	180
NQ.D1-1	537678.6	180523.2	4397.2	69.5	-5731.9	-69.5	190
NQ.D1-2	537685.2	180567.5	4391.6	25.1	-5726.3	-25.1	190
NQ.D1-3	537738.6	180556.0	4338.0	35.4	-5672.6	-35.4	190
NQ.D1-4	537729.4	180467.1	4345.2	124.5	-5679.8	-124.5	190
NQ.D2-1	537686.9	180473.5	4387.8	119.0	-5722.5	-119.0	150
NQ.D2-2	537693.4	180517.2	4382.3	75.2	-5716.9	-75.2	150
NQ.D2-3	537735.9	180510.9	4339.7	80.5	-5674.3	-80.5	150
NQ.D4-1	537506.4	180500.3	4568.9	96.3	-5903.5	-96.3	150
NQ.D4-2	537512.3	180540.4	4563.9	56.0	-5898.5	-56.0	150
NQ.D4-3	537551.9	180534.5	4524.1	61.1	-5858.8	-61.1	150
NQ.D4-4	537628.2	180530.7	4447.8	63.1	-5782.4	-63.1	150

3. Safeguarding Criteria Assessment

Outline of Constraints and Method

3.1 A number of distinct aviation-related height constraints apply in respect of the Proposed Development, associated with the safeguarding of operations at London City Airport:

- General safeguarding criteria, prescribed by the CAA in the context of aerodrome licensing [1,2] and in accordance with ICAO standards [3], which are defined by a series of OLS. The OLS are a set of primarily 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, are defined in ICAO PANS-OPS [4]. These criteria, defined in terms of a set of obstacle assessment surfaces (OAS), take account of the existing obstacle environment during the design of specific instrument flight procedures at individual airports. These criteria may place some restrictions on operations, the safety of which might otherwise be compromised by the existing obstacle environment. It is important from the perspective of the airport operator that new buildings would not introduce any additional restrictions that might adversely affect operational efficiency or safety. On the other hand, where some restrictions already apply due to existing obstacles, this may allow some flexibility in respect of new developments, provided that these can be accommodated by those existing restrictions.

3.2 The maximum parameter heights identified in the OPA for the Proposed Development are designed to be below the limits identified by the London City Airport OLS. The maximum heights at primary corners of the Development Plots have been systematically assessed against the airport OLS to determine the potential effects of the Proposed Development on operations at London City Airport.

3.3 Assessment of the safeguarding requirements of specific flight operations in the case of the Proposed Development requires that three different operations are considered:

- Runway 09 approach operations, involving easterly approach over the west side of the airport along a flight path directly over the Site;
- Runway 27 missed-approach operations, involving westerly approach from the other direction when an approach must be discontinued, requiring aircraft to fly over the runway and climb to the west again along a flight path directly over the Site.
- Runway 27 departure, involving take-off initially to the west along a runway-aligned flight path towards the site and then a turn to the north, well before reaching the Site.

3.4 The primary approach procedures that require protection by reference to the PANS-OPS criteria are the precision approach operations which employ the instrument landing system (ILS) for both runway directions. In addition, there is a published non-precision approach procedure in each runway direction which may be employed when the glide path element of the ILS approach procedure is not serviceable. Accordingly, six different sets of surfaces may place overlapping and slightly different restrictions on building heights at the Site:

- the general OLS safeguarding criteria;
- the final approach segment OAS of the Runway 09 ILS approach procedure;
- the missed-approach segment OAS of the Runway 27 ILS approach procedure;
- the final approach segment OAS of the Runway 09 non-precision approach procedure;
- the missed-approach segment OAS of the Runway 27 non-precision approach procedure;
- the Runway 27 instrument departure.

3.5 The initial constraints assessment has considered the height limits across the Site in general associated with each of the sets of surfaces, to identify the most limiting surfaces that may apply. The OLS and OAS are defined in terms of rectilinear runway aligned coordinates: the longitudinal distance, X, from the runway end as measured along the runway extended centre line; the perpendicular lateral distance, Y, from the runway extended centre line; the height above appropriate aerodrome reference elevations. As noted earlier, the assessment is facilitated by expressing the Site location in terms of runway-aligned coordinates, as presented in Table 1, in common with the coordinate system by means of which the OLS and OAS are defined.

Assessment against OLS

3.6 The initial assessment against the OLS shows that the whole of the Site lies under the approach surface (APPS). This surface slopes upwards from east to west at a 5% angle with the direction of slope aligned with the runway axis. The most limiting restriction of around 219.2 m AOD that is associated with this surface applies at the north-east corner of Development Plot NQ.D2. Further to the west, a higher limit of up to 230.7 m AOD applies at the south-west corner of Development Plot NG.A4. Table 2 shows the OLS height limits at the north-east and south-west corners of each relevant plot. The analysis confirms that the Proposed Development, as defined by the identified maximum parameters, complies with the relevant OLS requirements. The maximum parameter and Indicative Scheme outlines are shown schematically against the height limit defined by the approach surface in Figure 5.

Figure 6: Schematic representation of obstacle assessment surfaces

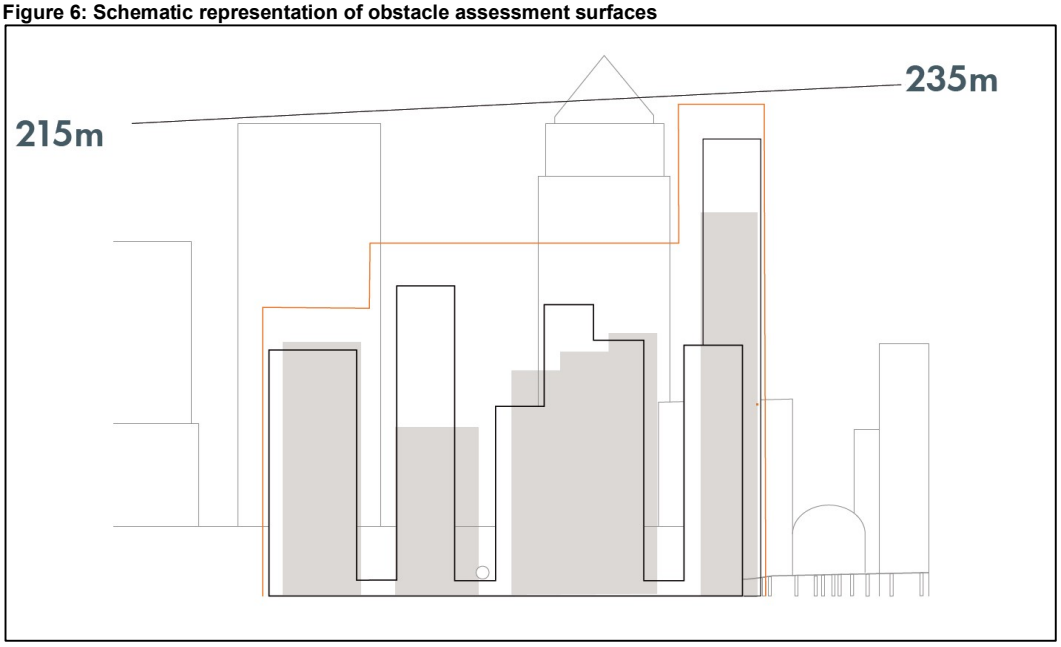


Table 2: OLS height limits

Reference point	OLS height limit (m AOD)	Maximum parameter building height (m AOD)	Vertical margin (m)
NQ.A1-4 (NE corner)	229.2	150	79.2
NQ.A1-2 (SW corner)	230.4	150	80.4
NQ.A4-4 (NE corner)	228.5	225	3.5
NQ.A4-2 (SW corner)	230.7	225	5.7
NQ.B1-4(NE corner)	224.4	180	44.4
NQ.B1-2 (SW corner)	227.9	180	47.9
NQ.D1-4 (NE corner)	221.9	190	31.9
NQ.D1-2 (SW corner)	223.8	190	33.8
NQ.D2-3 (NE corner)	219.2	150	69.2
NQ.D2-1 (SW corner)	222.2	150	72.2
NQ.D4-4 (NE corner)	219.3	190	29.3
NQ.D4-2 (SW corner)	221.7	190	31.7

Instrument Flight Procedure Margins

Runway 09 ILS Approach OAS

3.7 The precision approach OAS are shown schematically in Figure 6. For the approach phase, the relevant surfaces are the W, X and Y surfaces on the left hand side of the diagram. The Site is located in the area covered by the Runway 09 W surface. The height limits associated with this surface are 229.5 m AOD and 217.6 m AOD at the south-west and north-east corners of the Site, respectively. In practice, these limits are relaxed due to the step-down fix located along the approach path close to this point, in order to accommodate the tower at One Canada Square. Taking account of this step-down fix, the applicable height limits are shown in Table 3.

Figure 6: Schematic representation of obstacle assessment surfaces

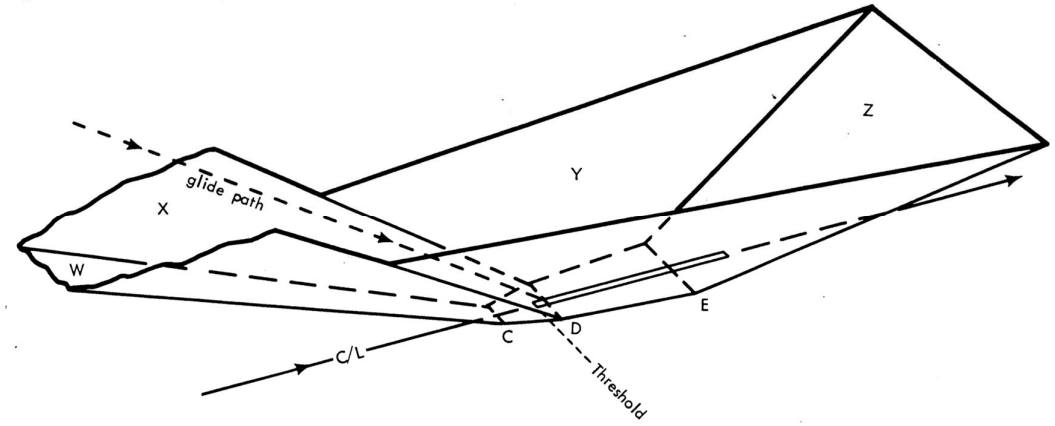


Table 3: Runway 09 ILS procedure OAS height limits

Reference point	Runway 09 ILS OAS height (m AOD)	Maximum parameter building height (m AOD)	Vertical margin (m)
NQ.A1-4 (NE corner)	289.5	150	139.5
NQ.A1-2 (SW corner)	293.2	150	143.2
NQ.A4-4 (NE corner)	287.4	225	62.4
NQ.A4-2 (SW corner)	294.1	225	69.1
NQ.D1-4 (NE corner)	267.5	180	77.5
NQ.D1-2 (SW corner)	273.3	180	83.3
NQ.D2-3 (NE corner)	259.5	190	109.5
NQ.D2-1 (SW corner)	268.4	190	118.4
NQ.D4-4 (NE corner)	259.7	150	69.7
NQ.D4-2 (SW corner)	266.9	150	76.9
NQ.A4-4 (NE corner)	287.4	190	62.4
NQ.A4-2 (SW corner)	294.1	190	69.1

3.8 It can be seen from the data in Table 3 that the heights of all elements of the Proposed Development, as defined by the maximum parameters under the OPA, are well below the limits applicable to this procedure and that there is a substantial vertical margin provided with respect to the PANS-OPS requirement.

Runway 27 ILS missed approach OAS

3.9 The whole of the Proposed Development is located in the area covered by the Z surface for this flight procedure. The Aeronautical Information Publication (AIP) for London City Airport identifies Runway 27 missed-approach procedures with climb gradients of 2.5%, 3.0% and 3.5%. The climb gradient determines the characteristics of the Z surface such that the height of the surface is lower at any given location during the climb sector of the instrument procedure for lower climb rates. The most limiting constraint of 100.0 m AOD applies at the most north-easterly corner of the Site for a 2.5% climb gradient. For a 3.5% climb gradient the corresponding value is around 137.8 m AOD.

3.10 In practice, the potential height restrictions at the Site associated with this procedure are reduced by the requirement to accommodate existing obstacles, including One Canada Square at a height of 245.75 m AOD. These existing obstacles limit the obstacle clearance altitude (OCA) of the approach procedure which is the minimum height to which aircraft may descend in conditions of limited visibility without gaining the visual reference to the runway that is required to allow the approach to be continued safely to landing. By limiting the minimum descent height, additional vertical clearance is provided in the missed approach. For the 2.5% and 3% missed approach climb gradient procedures, these operational restrictions within the current procedures that accommodate One Canada Square will accommodate a reduced height restriction at the Site. The extent to which the height restriction is reduced can be determined by reference to the adjustment required to accommodate the tower at One Canada Square. The assessment of the 3.5% climb gradient procedure indicates that another obstacle, one of the chimneys at the Tate and Lyle Factory located immediately to the south of the airport is more limiting than the tower at One Canada Square. On that basis, the applicable height limits associated with the Runway 27 ILS procedures are shown in Table 4.

Table 4: Runway 27 ILS procedure OAS height limits

Reference point	Runway 27 ILS procedure OAS height limits for different missed approach climb gradients (m AOD)			Maximum parameter building height (m)	Vertical clearance margin (m)
	2.5% CG	3% CG	3.5% CG		
NQ.A1-4 (NE corner)	246.2	246.3	260.0	150	96.2
NQ.A1-2 (SW corner)	246.8	247.0	260.8	150	96.8
NQ.A4-4 (NE corner)	245.8	245.9	259.5	225	20.8
NQ.A4-2 (SW corner)	247.0	247.2	261.0	225	22.0
NQ.B1-4(NE corner)	243.8	243.4	256.6	180	63.4
NQ.B1-2 (SW corner)	245.5	245.5	259.0	180	65.5
NQ.D1-4 (NE corner)	242.5	241.9	254.8	190	51.9
NQ.D1-2 (SW corner)	243.5	243.0	256.2	190	53.0
NQ.D2-3 (NE corner)	241.2	240.3	252.9	150	90.3
NQ.D2-1 (SW corner)	242.7	242.1	255.0	150	92.1
NQ.D4-4 (NE corner)	241.2	240.3	253.0	190	50.3
NQ.D4-2 (SW corner)	242.4	241.8	254.7	190	51.8

3.11 It can be seen from the data in Table 4 that the heights of all elements of the Proposed Development, as defined by the maximum parameters under the OPA, are below the limits applicable to this procedure and that there is a vertical margin of at least 20.8 m provided with respect to the PANS-OPS requirement.

Non-Precision Approach Criteria

3.12 In addition to the ILS precision approach procedures, there are published procedures for LOC/DME/NDB non-precision approaches in both runway directions at London City Airport. These procedures are very rarely used and would be required only when the glide path component of the ILS is not serviceable. These procedures will nevertheless require safeguarding.

3.13 For the Runway 09 LOC/DME/NDB approach procedure, the surfaces employed to determine whether or not an adjustment to the OCA is required to accommodate an obstacle are the same as those employed for the assessment of the Runway 09 ILS precision approach, as described earlier in Paragraph **Error! Reference source not found.**. For the Proposed Development, which is in the area protected by the step-down fix, the applicable height limits are those identified earlier for the Runway 09 ILS approach: i.e. approximately 259.5 m AOD at the north-east corner of Development Plot D2 and 294.1 m AOD at the south-west corner of Development Plot A4.

3.14 Runway 27 non-precision approach procedures are identified for Category A, B and C aircraft and with missed approach climb gradients of 2.5% and 3.5%. The Site is located after the start of climb in the climb phase of the missed approach. Different OCA are defined for these procedures and these different OCA will accommodate different temporary obstacle heights at the Site, according to the detail of the procedure specifications. The most limiting case is that for the Category C aircraft 2.5% climb gradient procedure. The applicable height limits associated with the Runway 27 non-precision approach procedures are shown in Table 5.

Table 5: Runway 27 non-precision approach procedure height limits

Reference point	Runway 27 non-Precision approach procedure height limits for different missed approach climb gradients (m AOD)		Maximum parameter building height (m AOD)	Vertical margin (m)
	2.5% CG	3.5% CG		
NQ.A1-4 (NE corner)	272.3	292.0	150	122.3
NQ.A1-2 (SW corner)	272.9	292.8	150	122.9
NQ.A4-4 (NE corner)	271.9	291.5	225	46.9
NQ.A4-2 (SW corner)	273.0	293.0	225	48.0
NQ.B1-4(NE corner)	269.9	288.6	180	89.9
NQ.B1-2 (SW corner)	271.6	291.0	180	91.6
NQ.D1-4 (NE corner)	268.6	286.8	190	78.6
NQ.D1-2 (SW corner)	269.6	288.2	190	79.6
NQ.D2-3 (NE corner)	267.3	285.0	150	117.3
NQ.D2-1 (SW corner)	268.7	287.0	150	118.7
NQ.D4-4 (NE corner)	267.3	285.0	190	77.3
NQ.D4-2 (SW corner)	268.5	286.7	190	78.5

3.15 It can be seen from the data in Table 5 that the heights of all elements of the Proposed Development, as defined by the maximum parameters under the outline application, are well below the limits applicable to this procedure and that there is a substantial vertical margin provided with respect to the PANS-OPS requirement.

Runway 27 Standard Instrument Departure

3.16 Generic PANS-OPS criteria for obstacle clearance during standard instrument departures are based on an obstacle identification surface (OIS) with an origin at the departure end of runway (DER), a width at origin of 150 m either side of the runway centreline and a divergence of 15°.

The whole of the Site is found to fall within the area covered by the OIS and the Proposed Development must therefore comply with the defined vertical clearance margin requirements.

3.17 The Runway 27 departure procedure involves flight initially aligned with the runway up to a fix located 1.5 nautical miles from the Runway 09 threshold (nominally coincident with the DER but displaced from it to the West by 23.85 m). That fix location that marks the start of the turn corresponds with approximately 2.8 km from the DER and therefore the Proposed Development is found to lie within the turning area. The PANS-OPS vertical clearance margin requirement for a departure procedure prior to a turn is 0.8% of the distance travelled from the DER and a minimum of 75 m within the turning area. The Runway 27 instrument departure procedure at London City Airport specifies a minimum climb gradient of 7.2% which is apparently set to accommodate the tower at One Canada Square. This existing building is within the turn area and the climb gradient of 7.2% provides a clearance margin of at least 75 m[1]. The same requirement applies at the Proposed Development. On that basis, the relevant limits associated with the Runway 27 standard instrument departure procedure are shown in Table 6.

Table 6: Runway 27 standard instrument departure height limits

Reference point	Runway 27 SID height limits (m AOD)	Maximum parameter building height (m AOD)	Vertical margin (m)
NQ.A1-4 (NE corner)	263.8	150	113.8
NQ.A1-2 (SW corner)	265.5	150	115.5
NQ.A4-4 (NE corner)	262.7	225	37.7
NQ.A4-2 (SW corner)	265.9	225	40.9
NQ.B1-4(NE corner)	256.8	180	76.8
NQ.B1-2 (SW corner)	261.8	180	81.8
NQ.D1-4 (NE corner)	253.2	190	63.2
NQ.D1-2 (SW corner)	255.9	190	65.9
NQ.D2-3 (NE corner)	249.3	150	99.3
NQ.D2-1 (SW corner)	253.6	150	103.6
NQ.D4-4 (NE corner)	249.4	190	59.4
NQ.D4-2 (SW corner)	252.9	190	62.9

3.18 It can be seen from the data in Table 6 that the heights of all elements of the Proposed Development, as defined by the maximum parameters under the OPA, are below the limits applicable to this procedure and that there is a vertical margin of at least 37.7 m provided with respect to the PANS-OPS requirement.

Assessment of the Proposed Development

3.19 The OLS height limits defined in Paragraph 3.6 define the permanent building limits which apply at the Site. The maximum parameter heights identified in the OPA have been shown to comply with these limits, in accordance with the clearance margins summarised in Table 2. Since the

[1] The earlier version of PANS-OPS that applied when this procedure was designed to accommodate the Canary Wharf Tower required a minimum vertical clearance margin of 90 m. This margin has been revised down to 75 m in the 6th edition of PANS-OPS.

Indicative Scheme complies with the proposed maximum parameters, being lower than them across all plots, it is evident that the Indicative Scheme will comply with the OLS limits. Compliance of the Proposed Development with the OLS limits and with the height limits associated with the flight procedures discussed in Paragraphs **Error! Reference source not found.**, 3.10, 3.14 and 3.16 is confirmed by the summary of the relevant limits in comparison to the maximum parameter building heights and the associated clearance margins shown in Table 7.

Table 7: Summary of height limits at the North Quay Site

Reference point	Maximum Parameter building height (m AOD)	Approach surface height limit (m AOD)	Approach surface margin (m)	Flight procedure height limit (m AOD)	Flight procedure margin (m)
NQ.A1-1	150.0	228.5	78.5	245.8	95.8
NQ.A1-2	150.0	230.4	80.4	246.8	96.8
NQ.A1-3	150.0	230.2	80.2	246.7	96.7
NQ.A1-4	150.0	229.2	79.2	246.2	96.2
NQ.A4-1	225.0	228.8	3.8	246.0	21.0
NQ.A4-2	225.0	230.7	5.7	247.0	22.0
NQ.A4-3	225.0	230.5	5.5	246.8	21.8
NQ.A4-4	225.0	228.5	3.5	245.8	20.8
NQ.B1-1	180.0	224.7	44.7	243.6	63.6
NQ.B1-2	180.0	227.9	47.9	245.5	65.5
NQ.B1-3	180.0	227.6	47.6	245.3	65.3
NQ.B1-4	180.0	224.4	44.4	243.4	63.4
NQ.D1-1	190.0	222.2	32.2	242.1	52.1
NQ.D1-2	190.0	223.8	33.8	243.0	53.0
NQ.D1-3	190.0	223.5	33.5	242.9	52.9
NQ.D1-4	190.0	221.9	31.9	241.9	51.9
NQ.D2-1	150.0	222.2	72.2	242.1	92.1
NQ.D2-2	150.0	221.9	71.9	241.9	91.9
NQ.D2-3	150.0	219.2	69.2	240.3	90.3
NQ.D4-1	190.0	219.6	29.6	240.5	50.5
NQ.D4-2	190.0	221.7	31.7	241.8	51.8
NQ.D4-3	190.0	221.4	31.4	241.6	51.6
NQ.D4-4	190.0	219.3	29.3	240.3	50.3

Construction crane assessment

3.20 Temporary infringements of some of the OLS by construction cranes may be permitted, provided that this is not in conflict with operational requirements, in accordance with PANS-OPS criteria. Where there are existing infringements of the OLS, such as the tower at One Canada Square which is an infringement of the approach surface by 17.44 m, operations must be conducted in a manner that ensures aircraft safety. Operational practices adopted to support the safety of aircraft with respect to existing infringements may allow other infringements to be permitted without any material impact on operational safety and efficiency. In the case of the obstacle along the approach presented by the tower at One Canada Square, a stepdown fix is

identified immediately before it. In accordance with PANS-OPS criteria, aircraft must not drop below a defined altitude until they have passed this fix which ensures an adequate vertical margin will be maintained with respect to this obstacle and similarly with respect to other obstacles of a comparable size in that vicinity.

3.21 Previously, London City Airport has permitted some temporary infringements of the approach surface where the vertical margins associated with the relevant PANS-OPS criteria were met. The scope for temporary infringement of the OLS across the Site according to these principles has been assessed by determining the maximum permissible heights which avoid impacts upon existing flight procedures. The findings of this assessment, based on the reference points associated with the maximum parameters, are summarised in Table 7. The most limiting height constraint associated with the flight procedures is found to be that associated with the Runway 27 ILS 3% climb gradient missed approach operation. This procedure gives rise to height constraints of around 240 m AOD on the eastern side of the Site, rising to around 247 m AOD on the western site boundary.

3.22 However, the flexibility to allow temporary infringements at the Proposed Development has subsequently been limited under a ruling by Jon Round, Head of Airspace, Air Traffic Management and Aerodromes at the CAA, following a review of these practices, largely stimulated by development issues in the City of London and the change to regulatory oversight of airport licensing by the European Aviation Safety Agency (EASA). This ruling emphasises the importance of compliance with EASA regulatory requirements that there should be no new infringements of the approach surface. On that basis, the OLS height limits summarised in Table 7 may need to be applied to construction cranes as well as permanent buildings. In our view, these approach surface restrictions imposed by the CAA in relation to construction activities are unnecessary, particularly in the area of One Canada Square where this existing obstacle already represents an infringement of the approach surface and operational measures are in place to manage impacts on operational safety and efficiency.

3.23 A reasonable case may still be made that there is an element of flexibility in the relevant international regulations and that, at the discretion of the appropriate authority (i.e. London City Airport, having regard to the opinion of their regulator, the CAA), temporary infringements of the approach surface limits identified above could be permitted. As can be seen from Figure 5, the existing Canary Wharf tower at One Canada Square is an existing infringement of the approach surface that is currently accommodated safely by operations at London City Airport. If this case were to be accepted, the height of temporary infringements would be limited by the margins required to comply with existing flight procedures. A height limit of between 20.8 m and 22 m above the maximum parameter heights of the tallest building in Development Plot A4 would apply which should be sufficient to allow for development of a viable crane plan to support construction above the maximum parameter heights. Headroom of between 50 m and 95 m would apply above lower elements of the Proposed Development if their maximum parameter building heights were adopted. As things stand, however, it cannot be guaranteed that these

operational crane height limits would be agreed by the airport. If temporary crane heights are limited to the approach surface, a margin of only 3.5 m is identified between the maximum parameter building height in Development Plot A4 and the approach surface height constraints. The Indicative Scheme height proposed for Development Plot A4 is 220.6 m AOD resulting in a margin of approximately 7.9 m between the top of the proposed building and the approach surface. To ensure that that a practical crane plan to support construction can be developed, it is therefore recommended that the required crane heights are taken into account during development of the detailed designs for the North Quay scheme, according to the future position adopted by London City Airport in this respect. These issues can most effectively be addressed at the Reserved Matters Application stage, in consultation with London City Airport, as necessary.

4. Operational Safety Assessment

4.1 Broadly speaking, it is to be expected that where new developments are located beneath the OLS that are intended to provide for the general protection of flight paths they will not give rise to any material impact on the safety of operations. Similarly, where temporary structures such as construction cranes do not lead to the erosion of the vertical and lateral margins according to instrument flight procedure design criteria, these can generally be expected not to lead to a material impact on operational safety or efficiency. Where instrument flight procedures are designed to meet the identified PANS-OPS vertical and lateral margin criteria with respect to the existing obstacle environment they are evidently considered to provide for an acceptable level of safety. It would therefore seem to follow that where those criteria are met with respect to a new, temporary structure no material impact on operational safety or efficiency will arise.

4.2 Notwithstanding these general observations, some further operational safety assessment is appropriate to ensure that there are no adverse impacts on some operations that may not necessarily be adequately covered by the specifications for the OLS and the OAS. For example, there are other operational criteria in respect of the one engine operative condition which merits specific consideration.

4.3 In addition, it should be noted that PANS-OPS cautions against the use of the precision approach criteria for the assessment of the potential safety impacts of penetrations of the standard OLS. The PANS-OPS criteria for defining the OCA that are employed in precision approach procedures were designed against an identified safety target. The OCA set by reference to these criteria are regarded to ensure clearance of obstacles from the start of the final approach to the end of the intermediate missed-approach segment of the ILS precision approach. The criteria are based on normal operations and PANS-OPS states that they shall therefore not be applied for assessing the safety of penetrations of the Annex 14 OLS. Such a statement would appear not to be entirely consistent with the evident presumption that adherence to PANS-OPS criteria provides for an adequate level of operational safety in the design of instrument flight procedures. It is understood that the primary concern in respect of the use of criteria based on normal operations alone to assess OLS penetrations is that they do not explicitly take account of the one-engine inoperative condition. In practice, this scenario will be accommodated by various operational factors, as is demonstrated by this assessment.

4.4 In addition to the one-engine inoperative scenario, go-around initiation below the OCA or “baulked landing” is a relatively common “non-standard” operation. Go-arounds may be initiated if the approach is not adequately stabilised or perhaps in the event of a runway incursion. Experience across a number of airports indicates a go-around rate of the order of 1 in 300 approaches. A proportion of these go-around events may be initiated below the OCA. For the late go-around, executed below the normal OCA, aircraft will have dropped below the level at which it can be guaranteed, on the basis of normal PANS-OPS criteria, that a safe

vertical margin can be maintained with respect to all obstacles in the go-around path. There is a possibility during these operations that aircraft may drift from the runway aligned path into locations where obstacles are located. It is therefore important to establish if new obstacles will have any significant impact on these operations.

4.5 In the case of new obstacles at the Proposed Development, which is located very close to One Canada Square, it is reasonable to expect that in the event of single engine failure in the missed approach or during departure operations, aircraft would need to turn and follow a path to the north of Canary Wharf to avoid collision with the existing obstacle environment. Therefore, it is reasonable to expect that tall buildings located at the Proposed Development will not have any significant additional impact on the safety of these operations over and above the impacts of the existing obstacle environment. A sufficient lateral safety margin is expected to be achieved under these circumstances. The lateral margins achieved in practice will be dependent upon the details of the departure procedures adopted by airlines operating at London City Airport. It is anticipated that the airport will consult with the airlines as part of the statutory consultation process adopted as part of the determination of the application in order to confirm the acceptability of the Proposed Development in this respect.

4.6 In principle, in addition to one-engine inoperative conditions, a wide range of abnormal operational scenarios involving more major fault conditions or errors may be envisaged. Such events have a diverse range of causes and are not amenable to detailed individual assessment. Based on the recent historical accident rate, significant near-miss events may be considered to occur with a rate of the order of perhaps 10^{-6} to 10^{-7} per approach. Where they do occur, they may arise anywhere and a small fraction only might be expected to involve flight in the vicinity of the Site. In the event that operations that have been compromised by major failure or errors were to involve flight in that area these can generally be expected not to be compromised more than they are by the existing obstacle environment. It can be concluded that there would be no grounds for additional control of development to take account of these sorts of scenarios beyond the limits associated with the OLS and PANS-OPS criteria.

4.7 Therefore, on the basis of these findings, it can be concluded that, having regard to the rate of occurrence and other characteristics of the reasonably foreseeable off-normal operational scenarios of engine failure and late go-around below the OCA, the Proposed Development at North Quay will not have any material impact on the safety or efficiency of operations at London City Airport.

5. Technical Safeguarding

5.1 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.

5.2 The technical safeguarding of navigational aids such as instrument landing systems and other equipment providing guidance directly to aircraft is achieved by reference to defined geometrical frames, representing the volumes of space around any given navigational aid that may need to be kept free of obstacles to avoid potential interference with effective operation. Guidance [5] on the dimensions of geometrical frames associated with specific types of equipment is provided by the CAA. The geometrical frames identified in CAA guidance are understood to be cautious and represent the volumes of space in which there may be some potential for adverse impacts from new objects but where, in practice, according to the details of the object and equipment concerned, no significant impact may arise. These frames are initially applied as screening criteria to identify those circumstances where some further assessment may be required to determine whether or not any impacts will occur in practice.

5.3 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 London City Airport. Furthermore, the Site is located over 4.4 km from the airport and well outside the geometrical frames that apply to equipment at London City Airport.

5.4 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 on 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.

5.5 NATS, the operators of the radar who are responsible for its technical safeguarding have recently identified potential impacts of proposed tall building developments in the Canary Wharf area. On that basis it is expected that tall building development at the Site may, in principle at least, give rise to potential impacts on the H10 radar. The extent of these impacts may be limited to some extent by the existing and consented tall building developments immediately

adjacent to the Site. In the event that potential adverse impacts were identified, previous experience indicates that these can normally be addressed satisfactorily by a radar mitigation scheme, in agreement with NATS. NATS are statutory consultees under the planning process and will be able to advise during determination of the application if mitigation might be required.

6. Bird Hazard Management

6.1 Under international standards, safeguarding in respect of bird hazards applies out to a defined radial distance of 13 km around airports. The Site is within this safeguarded area. In our experience, the operators of London City Airport have often given limited attention to this issue when considering developments of the type being proposed at the Site but now appear to be increasingly focusing attention on bird hazard management when responding to some applications during statutory consultation. The scale of development and proximity to the airport appear to be factors determining the importance now being attached to this safeguarding issue during the consideration of any given application. For some larger developments close to the airport, the airport operators have identified specific requirements for landscaping plans to be unattractive to birds so as to avoid adverse effect on the safety of operations at London City Airport and for submission of bird management strategies for approval by the airport as a condition on permissions.

6.2 Taking account of its distance from the airport and the scale and nature of the Proposed Development, bird hazard management would seem to be of limited importance in this instance. Some preliminary guidance on bird hazard management is provided below.

6.3 ICAO guidance [6] identifies bird attractants falling within three general categories that should be minimised in development at or near airports, as follows:

- Food
- Water
- Shelter

6.4 Guidance provided by the UK CAA [7] identifies the same broad issues as primary considerations in bird hazard management near airports.

6.5 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."

6.6 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."*

6.7 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.

6.8 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.

6.9 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.

6.10 In practice, it would appear unlikely that bird hazard management is likely to be a major issue in the design of the Proposed Development. 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.

6.11 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. The nature and scale of the Proposed Development is such that it would seem

unlikely to give rise to a significant increase in the likelihood of occurrence of these sorts of events. It is nevertheless recommended that the general guidance in respect of the avoidance of potential nest sites that may attract these species is followed during building design. There is potential concern about the increasing use of urban areas by gulls, in particular the establishment of nesting colonies making use of flat roofs on buildings. If flat roofs form part of the design, some active management to deter nesting of these species may be appropriate during the life of the development.

7. References

1 CAP 168: Licensing of Aerodromes, UK Civil Aviation Authority (CAA) Safety Regulation Group, Edition 11, January 2019
2 Safeguarded and Obstacle Limitation Surfaces – London City Airport, Aerodrome Standards Department, Safety Regulation Group, UK Civil Aviation Authority, August 2004
3 Annex 14 to the Convention on International Civil Aviation: Aerodromes Volume 1, Aerodrome Design and Operations Eighth Edition, International Civil Aviation Authority July 2018
4 Procedures for Air Navigation Services: Aircraft Operations (Doc 8168), International Civil Aviation Organisation.
5 CAP 670 Air Traffic Services Safety Requirements, Issue 3, UK Civil Aviation Authority, 2019
6 Airport Services Manual Part 3: Wildlife Control and Reduction, Fourth Edition, 2012, International Civil Aviation Organization
7 Wildlife Hazard Management at Aerodromes CAP 772 Version 2, Civil Aviation Authority, October 2017

Appendix 1 Abbreviations

AIP	Aeronautical Information Publication
AOD	Above Ordnance Datum
APPS	Approach Surface
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CG	Climb Gradient
DER	Departure End of Runway
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
OAS	Obstacle Assessment Surface
OCA	Obstacle Clearance Altitude
OIS	Obstacle Identification Surface
OLS	Obstacle Limitation Surface
OS	Ordnance Survey
RWY	Runway