

Technical Aerodrome Safeguarding Assessment

Crown Street, Phase 3

Renaker Build Ltd

March 2023

PLANNING SOLUTIONS FOR:

- Solar
- Defence
- Airports
- Telecoms
- Buildings
- Radar
- Railways
- Wind
- Mitigation

www.pagerpower.com



ADMINISTRATION PAGE

Job Reference:	11610A
Date:	March 2023
Author:	Michael Sutton
Telephone:	01787 319001
Email:	michael@pagerpower.com

First Reviewer:	Aaron Williams; Kai Frolic
Email:	aaron@pagerpower.com; kai@pagerpower.com

Issue	Date	Detail of Changes
1	08 March 2023	Initial issue
2	23 March 2023	Comments from client

Confidential: The contents of this document may not be disclosed to others without permission.

Copyright © 2023 Pager Power Limited

Stour Valley Business Centre, Brundon Lane, Sudbury, Suffolk, CO10 7GB

T: 01787 319001 E: info@pagerpower.com W: www.pagerpower.com

All aerial imagery (unless otherwise stated) is taken from Google Earth. Copyright © 2023 Google.

EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to investigate the potential impact of a proposed building development (Phase 3) located on Crown Street, Manchester city centre, upon aviation infrastructure in the surrounding area, predominantly operations at Manchester Airport.

Building developments have the potential to affect aviation operations in numerous ways. The most common impacts relate to building developments as physical obstructions both to aircraft and wireless signals used for radar and radio systems. This assessment has identified and assessed the relevant aviation constraints for the proposed development.

The Proposed Development

The Proposed Development includes four residential towers. Two of the residential towers will have a maximum height of 151.8m above ground level (agl) and a maximum altitude of 184.3m above ordnance datum (AOD), and two of the residential towers will have a maximum height of 140.4m agl and a maximum altitude of 172.9m AOD.

Overall Conclusions

The proposed development is clear of the Outer Horizontal Surface (OHS) at Manchester Airport; however, it is likely that cranes used in construction will infringe as they will extend above the proposed development. Aviation lighting is a mandatory requirement for Towers C7 and C8 due to their height, and infringement of an OHS by cranes can normally be operationally accommodated through appropriate aviation lighting and a crane operations scheme.

Technical mitigation for impacts on the Secondary Surveillance Radar (SSR) at Manchester Airport has been agreed and will be implemented by NATS. The solution is a technical fix, which is applied to the radar.

No significant impacts upon surrounding Helicopter Landing Sites (HLS) and Manchester Barton Airport are predicted.

Consultation with Manchester Airport and Manchester Royal Infirmary Hospital is recommended to discuss the results of this report.

Analysis Results

Manchester Airport's Obstacle Limitation Surfaces

The proposed development is clear of the OHS at Manchester Airport with a clearance margin of 22.48m.

Crane usage will need to be considered due to the close proximity to the OLS. It is likely a Crane Operations Scheme will be required.

Consultation with the safeguarding team at Manchester Airport is recommended to confirm the analysis results and to identify any other safeguarding issues.

Manchester Airport SSR

The proposed development is located approximately 14.7km from the SSR at Manchester Airport and is predicted to be visible to the radar considering the existing environment.

Technical mitigation in the form of a technical fix applied to the radar has been agreed and will be implemented by NATS.

Instrument Flight Procedures (IFPs) at Manchester Airport – High-Level

No impacts upon the published Standard Instrument Departures or Standard Arrival Charts and Instrument Approach Procedures are predicted, following consideration of the appropriate vertical and horizontal clearance margins. There are also taller existing buildings in the immediate surrounding area that already co-exist with the current IFPs.

Whilst no detailed IFP assessment is recommended, it is possible that a full assessment is requested by Manchester Airport.

Aviation Lighting Requirement

Towers C7 and C8, as well as any cranes used during construction, that are 150m agl or taller should be lit with medium intensity aviation lighting. The specific lighting arrangement has not yet been decided.

Helicopter Operations and Other Aerodromes – High-Level

Concerns relating to helicopter use are not predicted because the proposed development is located within the city centre where there is already significant urbanisation with many similar types of building development and is in this vicinity to tall building developments such as Beetham Tower and the Owen Street Towers.

It is recommended that the Manchester Royal Infirmary is made aware of the proposed development as it is the closest HLS to the proposed development.

Manchester Barton is a licenced aerodrome located approximately 8.7km west of the proposed development. None of the published charts cover areas extending over the proposed development or the city centre itself and therefore no significant impacts are predicted.

LIST OF CONTENTS

Administration Page	2
Executive Summary	3
Report Purpose.....	3
The Proposed Development	3
Overall Conclusions.....	3
Analysis Results.....	3
List of Contents	5
List of Figures.....	7
List of Tables.....	7
1 Background	9
1.1 Introduction.....	9
2 Proposed Development Details	10
2.1 Description of Development	10
2.2 Proposed Development General Arrangement.....	10
2.3 Assessment Parameters	10
2.4 3D Building Representation	12
3 Radar Data and Interference Mechanisms.....	13
3.1 Overview.....	13
3.1 Radar Details.....	13
3.2 Interference Mechanisms	13
3.3 SSR Capabilities.....	14
4 Radar Line of Sight and Interference Analysis.....	17
4.1 Methodology.....	17
4.2 Line of Sight Analysis.....	17
4.3 Interference Assessment	19
4.4 Assessment Conclusions.....	20
5 Obstacle Limitation Surfaces	20
5.1 Obstacle Limitation Surfaces	21

	5.2	Crane Usage Overview.....	22
6		High-Level Instrument Flight Analysis.....	23
	6.1	Overview.....	23
	6.2	Area Minimum Altitude	23
	6.3	Surveillance Minimum Altitude Chart (SMAC)	23
	6.4	High-level IFP Assessment – Obstacle Clearance Margins.....	24
	6.5	Standard Instrument Departures (SIDs)	25
	6.6	Standard Arrival Charts (STARs)	26
	6.7	Instrument Approach Charts.....	27
	6.8	High-level IFP Assessment – Obstacle Clearance Margins Conclusions	29
7		Helicopter Operations and Other Aerodromes (High-Level Commentary)	30
	7.1	Helicopter Operations	30
	7.2	Other Aerodromes	30
8		High-level Aviation Lighting Considerations.....	31
	8.1	Overview.....	31
	8.2	Lighting Requirements.....	31
9		Conclusions	32
	9.1	Analysis Results.....	32
	9.2	Overall Conclusions	33
		Appendix A - Tower Footprint Coordinates.....	34
		Tower C7	34
		Tower C8	35
		Tower E1.....	36
		Tower E2.....	37

LIST OF FIGURES

Figure 1 Proposed development general arrangement plan.....	10
Figure 2 Proposed development roof level general arrangement.....	11
Figure 3 3D building representation.....	12
Figure 4 Manchester Airport SSR visibility	18
Figure 5 OLS chart	21
Figure 6 Manchester Airport ATC Surveillance Minimum Altitude Chart.....	24

LIST OF TABLES

Table 1 Tower heights and altitudes	11
Table 2 Manchester Airport SSR radar location details	13
Table 3 Radar features for reducing interference	16
Table 4 OLS assessment results	22
Table 5 Standard Instrument Departure (SID) Charts assessment results	26
Table 6 Standard Arrival Charts (STARs) assessment results	26
Table 7 Instrument Approach Chart assessment results	29

ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 56 countries within Europe, Africa, America, Asia and Australasia.

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

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

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

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

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

1 BACKGROUND

1.1 Introduction

Pager Power has been commissioned to investigate the potential impact of a proposed building development (Phase 3) located on Crown Street, Manchester city centre, upon aviation infrastructure in the surrounding area, predominantly operations at Manchester Airport.

Building developments have the potential to affect aviation operations in numerous ways. The most common impacts relate to building developments as physical obstructions both to aircraft and wireless signals used for radar and radio systems. This assessment has identified and assessed all of the aviation constraints for the proposed development.

In detail the report includes:

- Proposed development details.
- Radar impact assessment for the Manchester Airport Secondary Surveillance Radar (SSR).
- Obstacle limitation surfaces (OLS) assessment for Manchester Airport.
- High-level assessment of Instrument Flight Procedures (IFPs).
- Commentary on crane usage and lighting requirements.
- High-level assessment of helicopter operations and other aerodromes.
- Overall conclusions and recommendations.

Following the results of the analysis, conclusions and recommendations are made.

2 PROPOSED DEVELOPMENT DETAILS

2.1 Description of Development

The description of the development is as follows¹:

The Proposed Development includes four residential towers. These sit on top of a podium providing ground floor flexible commercial uses. A central area of significant public realm is provided spanning Great Jackson Street, with traffic calming measures proposed to Great Jackson Street. Basement car parking is also proposed.

2.2 Proposed Development General Arrangement

The general arrangement plan for the proposed development is shown in Figure 1 below².

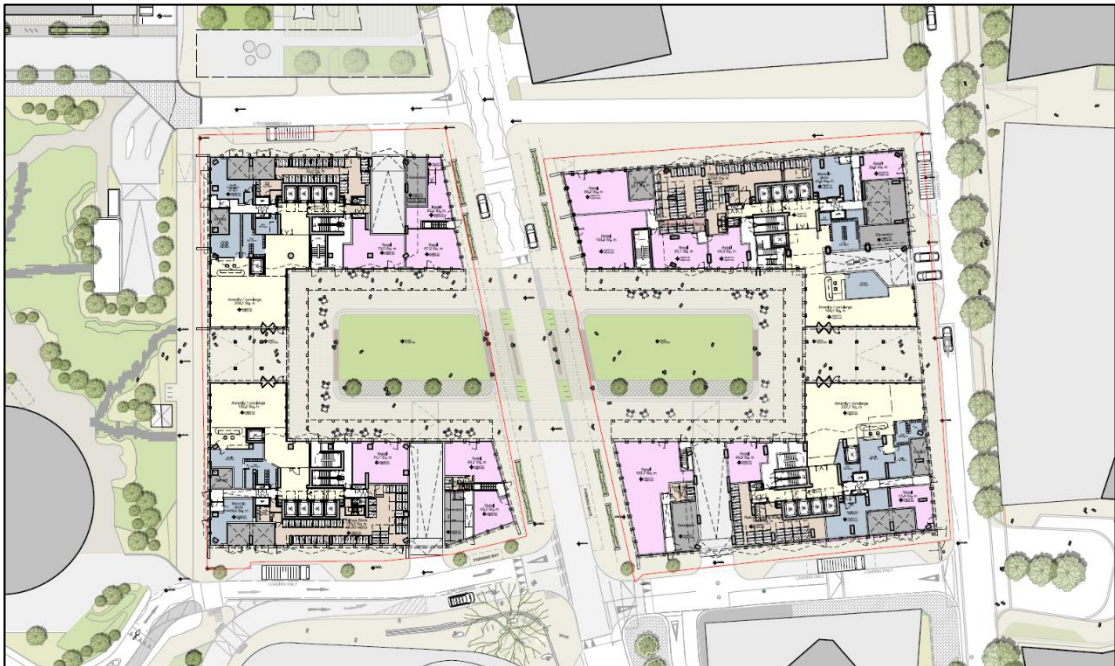


Figure 1 Proposed development general arrangement plan

2.3 Assessment Parameters

The four residential towers are assessed within this report due to their height and potential to cause a significant impact upon aviation infrastructure. The roof level general arrangement, identifying the towers and their shapes, is shown in Figure 2 on the following page³.

¹ CS Phase 3 and Plot D - Key Information Table.

² Plot D - General Arrangement [cropped]. The landscaping and floorplan shown are indicative only.

³ Z1-SHP-G200-PL-RF-001_Ver1 [edited].

The corner coordinates for the residential tower have been extrapolated from the site drawing and are presented in Appendix A.

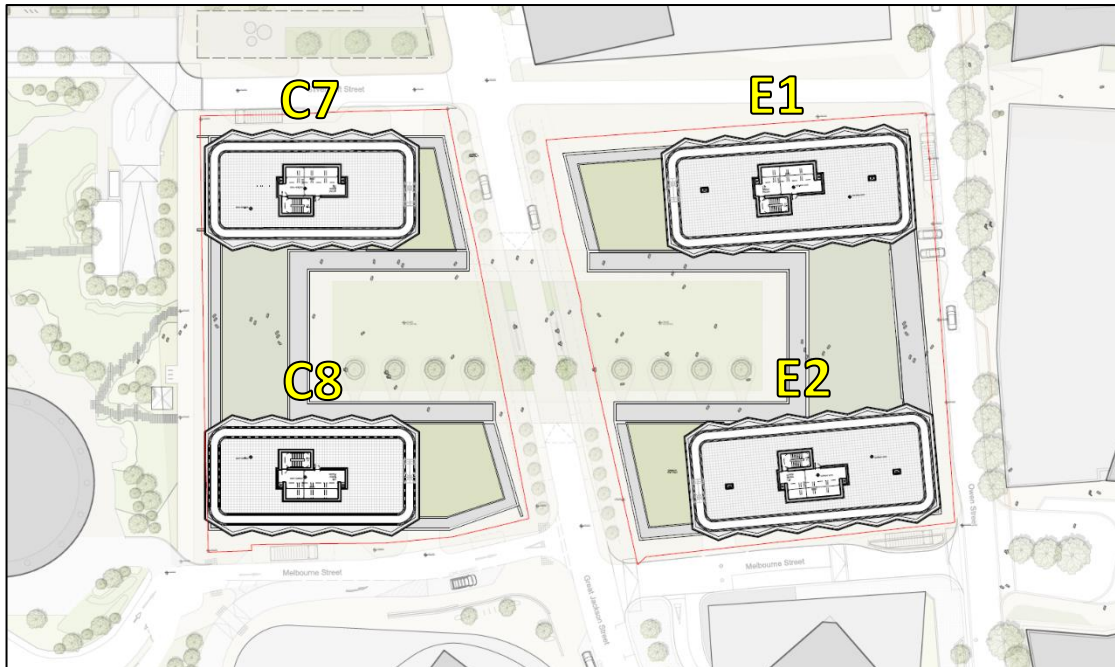


Figure 2 Proposed development roof level general arrangement

The tower height and altitude information is presented in Table 1 below.

Tower	Height (m agl)	Altitude (m AOD)
C7	151.8	184.3
C8		
E1	140.4	172.9
E2		

Table 1 Tower heights and altitudes

The podium sections of the proposed development are in keeping with other low-rise buildings in the area and are therefore not predicted to have a significant impact upon aviation infrastructure. The podiums have not been mentioned further within this report.

2.4 3D Building Representation

A representative 3D aerial image of the proposed development is shown in Figure 3 below.

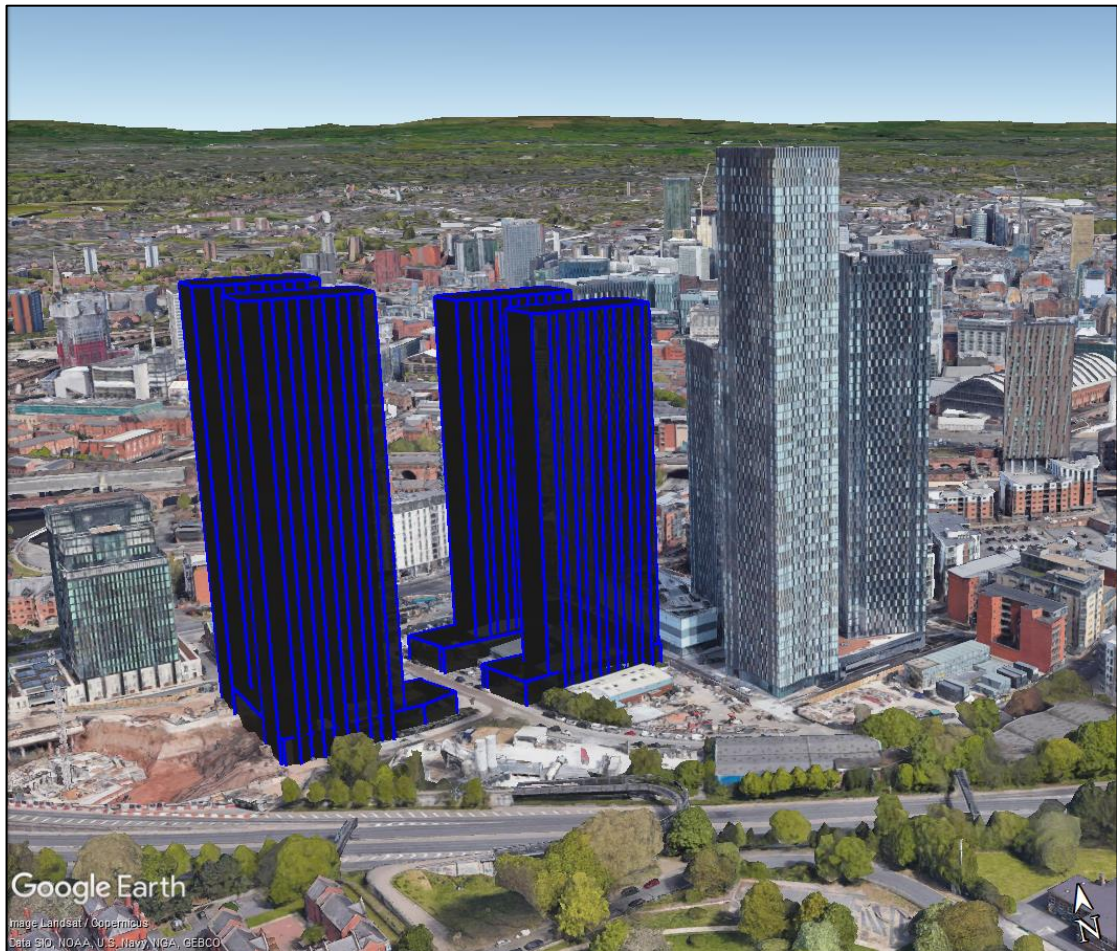


Figure 3 3D building representation

3 RADAR DATA AND INTERFERENCE MECHANISMS

3.1 Overview

An overview of the radar details and primary interference mechanisms are presented in the following subsections.

3.1 Radar Details

Table 2 below provides the details for the assessed Manchester Airport SSR radar. All data has been provided by NATS.

Radar	Secondary Surveillance Radar (SSR)
Overall radar altitude above mean sea level	97 m
Distance between the proposed development and radar	14.7km
Average grid bearing from radar to proposed development	7.6°

Table 2 Manchester Airport SSR radar location details

3.1.1 Radar Types and Usage

SSR broadcast interrogating radio signals that are detected by aircraft with on-board transponders. The transponder responds by broadcasting a radio reply which normally contains identification and altitude information. The SSR determines the aircraft's horizontal position from the direction the antenna is orientated and the time taken to receive a response from the interrogation.

Both radar will be used by air traffic controllers to provide approach services to aircraft landing at and departing Manchester Airport. Both radar will also be used by air traffic controllers at national air traffic control centres to provide services to en-route aircraft.

The radar of significance with respect to the predicted impact is the SSR. The PSR is not expected to be significantly affected.

3.2 Interference Mechanisms

Buildings, structures and terrain can interfere with SSR. The level of interference normally depends on the size of the interfering structure and its distance from the radar. A larger structure closer to the radar is more likely to interfere than a smaller structure which is further away. The two predominant forms of interference are reflections and shadowing.

3.2.1 Reflections

Reflections from a structure can potentially result in genuine aircraft returns being plotted in the wrong place as a result of the structure reflecting signals in a specular (mirror-like) way. This means that an air traffic controller could mis-manage aircraft, leading to safety implications.

Both in-bound and out-bound signals are weakened due to reflections because they are reflected by a structure in both directions.

3.2.2 Shadowing

Radar signals are weakened by physical obstacles. The most significant signal blocking is often caused by terrain. Large obstructions within a radar's area of coverage can have a 'shadowing' effect, reducing the signal strength immediately behind them.

This effect is most pronounced immediately behind the structure and becomes less pronounced with distance. This is important because it means a structure's 'shadow' does not block radar coverage indefinitely, and the areas with the highest losses should be considered in an operational context.

Both in-bound and out-bound signals are weakened by shadowing because signals are attenuated by a structure in both directions.

3.3 SSR Capabilities

The radar is an SSR fitted with a Large Vertical Aperture (LVA) antenna. The radar is located to the south of Manchester Airport. It is a Mode S monopulse SSR supplied by Raytheon Systems Limited as part of a nationwide contract to upgrade NATS' national network of twenty sites.

The radar is understood to be a Condor 300 dual channel system with Mode S capabilities. This radar has a range of advanced built-in capabilities for increasing its reliability and performance. Specific features that reduce the radar's susceptibility to interference from buildings are listed in Table 3 below and on the following pages.

Feature	Form of interference	How feature reduces interference	Additional Information
Integral Tracking Function	Reflections	More likely to determine return is genuine if it moves as an aircraft return is expected to.	Ensures good false target suppression.
Refined Algorithms	Reflections and Shadowing	Experience on many sites used to enhance performance.	Ensures good performance in complex environments.

Feature	Form of interference	How feature reduces interference	Additional Information
Identification and rejection of false replies	Reflections	False returns are rejected	If two or more replies are identified from the same source all but the first is rejected.
Side Lobe Suppression	Reflections	False returns arising from antenna sidelobes are rejected	P1 and P2 pulses are used. This is an encoding system which enables sidelobe signals to be detected by comparing pulse sizes.
Sensitivity Time Control (STC)	Reflections	Removes reflections	Removes relatively low amplitude replies
Minimum Detection Signal Level (MDS)	Shadowing	Maximises radar coverage whilst minimising noise detections	-
Dynamic Threshold	Shadowing	Weak signals stronger than any interference signals are detected.	-
Reply to Reply Correlation	Reflections	Multiple replies required for target processing	Single reply reports are rejected.
FRUIT ⁴ Rejection	Reflections	Track initiation only allowed if report contains two or more correlating replies in the same SSR mode	e.g. two or more Mode A replies
Track Processing	Reflections and Shadowing	Improvements are made in target location using history of target position.	Improvements made when confidence in location information is low

⁴ FRUIT – False Replies Unsynchronized in Time

Feature	Form of interference	How feature reduces interference	Additional Information
False Target Processing	Reflections	Advanced processing that applies a series of tests to identify and reject false returns	Techniques include: 1: Check whether Mode A code is unique 2: Check “known” reflection zones 3: Use geometric analysis for checking reflection zones 4: Self adaptive processing

Table 3 Radar features for reducing interference

4 RADAR LINE OF SIGHT AND INTERFERENCE ANALYSIS

4.1 Methodology

The approach taken within this report is presented in the following section.

4.1.1 Technical Assessment

- Radar line of sight assessment based on the tower co-ordinates assessed at their relative height above ground level;
- Screening assessment to determine whether existing buildings and/or landscape features would hide/shield the proposed development from the SSR;
- Consideration of the distance from the SSR.

4.1.2 Cumulative Assessment

Assessment of the predicted impact in the context of the existing environment has been undertaken.

4.2 Line of Sight Analysis

A radar line of sight assessment was completed for the proposed development – considering the footprint coordinates of the four towers presented in Appendix A. Figure 44 on the following page show the line of sight chart from Manchester Airport SSR to the closest corner of the proposed development.

The box labelled ‘certainty’ in Figure 44 provides the distance (in metres) by which the specific tower is within line of sight to the assessed radar (rounded to one decimal place).

The chart shows that the proposed development will be significantly visible to the radar.

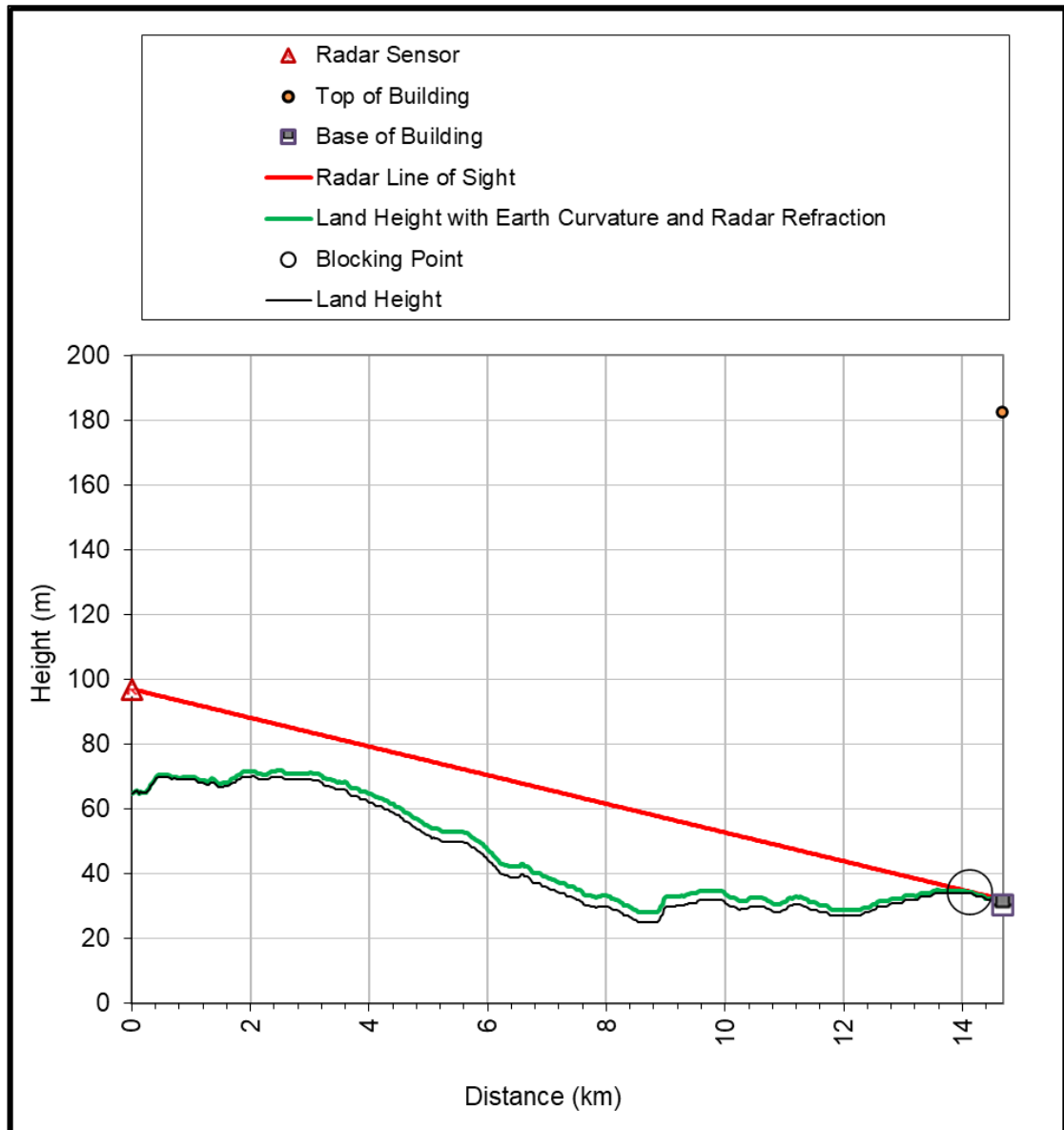


Figure 4 Manchester Airport SSR visibility

4.2.1 Additional Screening

A review of the line of sight profiles was undertaken to identify any potential additional screening that may significantly reduce the visibility of the towers to the SSR.

Towers C7 and E1 would benefit from partial screening by the C8 and E2 towers; however, towers C8 and E2 do not benefit from screening by other existing, under construction or consented developments. There is therefore no further significant additional screening that warrants incorporation to the line of sight profiles.

4.2.2 Radar Line of Sight Conclusions

The results show that the four residential towers would be significantly visible to the SSR at Manchester Airport and therefore technical and subsequent operational impacts upon the radar are possible. These are discussed further in the following subsection.

4.3 Interference Assessment

SSR radar broadcast interrogating radio signals that are detected by aircraft with on-board transponders. The transponder responds by broadcasting a radio reply which normally contains identification and altitude information. The SSR determines the aircraft's horizontal position from the orientation of the antenna and the time taken to receive a response from the interrogation.

Buildings, structures and terrain can interfere with SSR. The level of interference normally depends on the size of the interfering structure and its distance from the radar. A larger structure closer to the radar is more likely to interfere than a smaller structure which is further away. Two forms of interference have been considered. These are:

1. Reflections – Either in-bound or out-bound signals are reflected off a structure;
2. Shadowing – Either in-bound or out-bound signals are weakened because they are attenuated by a structure.

The proposed development's location, height and orientation has been reviewed and the reflection and shadow zones considered at a high level.

4.3.1 Reflection Effects

The proposed development can be considered a flat façade acting as a uniform reflector. Reflection effects caused by static structures have the potential to create false targets, azimuth errors and target fading issues. These could occur when an obstruction reflects the outgoing and/or incoming radar signals between the SSR and an aircraft. To be received by the radar the signals also have to be strong enough to be detected. A radar return that is reflected via a building will be significantly weaker than a return received directly from an aircraft. Furthermore, a radar antenna is also designed to have reduced gain at very low angles to reduce ground clutter returns. Overall, radar returns that are reflected via buildings are significantly weaker than those that are received directly from aircraft.

Towers C7 and E1 are positioned partially behind Towers C8 and E2 relative to the radar, such that some façades will be hidden from the radar. The remaining façades will be exposed to the radar, where reflections would be geometrically possible, and therefore concerns due to reflections are possible.

In practice, the effects from the proposed development are likely to be small. The radar is understood to be a Condor 300 dual channel system with Mode S capabilities. This radar has a range of specific features that reduce the radar's susceptibility to interference from buildings are shown in Section 3.3.

Whilst the impact is predicted to be small, due to the advanced built-in capabilities for increasing its reliability and performance, the potential for some adverse effects on the radar cannot be conclusively ruled out.

4.3.2 Shadowing Effects

Shadowing effects will be extremely limited. This is because the development is already within a built up area of Manchester city centre, including the Owen Street Development that consists of four towers, two of which are taller than the proposed development. One of these towers is on the same bearing as the proposed development relative to the SSR.

4.4 Assessment Conclusions

The modelling has revealed that the proposed development will be significantly visible to the SSR at Manchester Airport.

Mitigation in the form technical fix applied to the radar has been agreed with and will be implemented by NATS.

5 OBSTACLE LIMITATION SURFACES

5.1 Obstacle Limitation Surfaces

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

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

5.1.1 Obstacle Limitation Surfaces at Manchester Airport

The OLS for Manchester Airport have been modelled with respect to the representative tower corner points. The OLS chart is shown in Figure 5 below. The assessed points are shown by the red crosses – due to the scale they appear as a single icon.

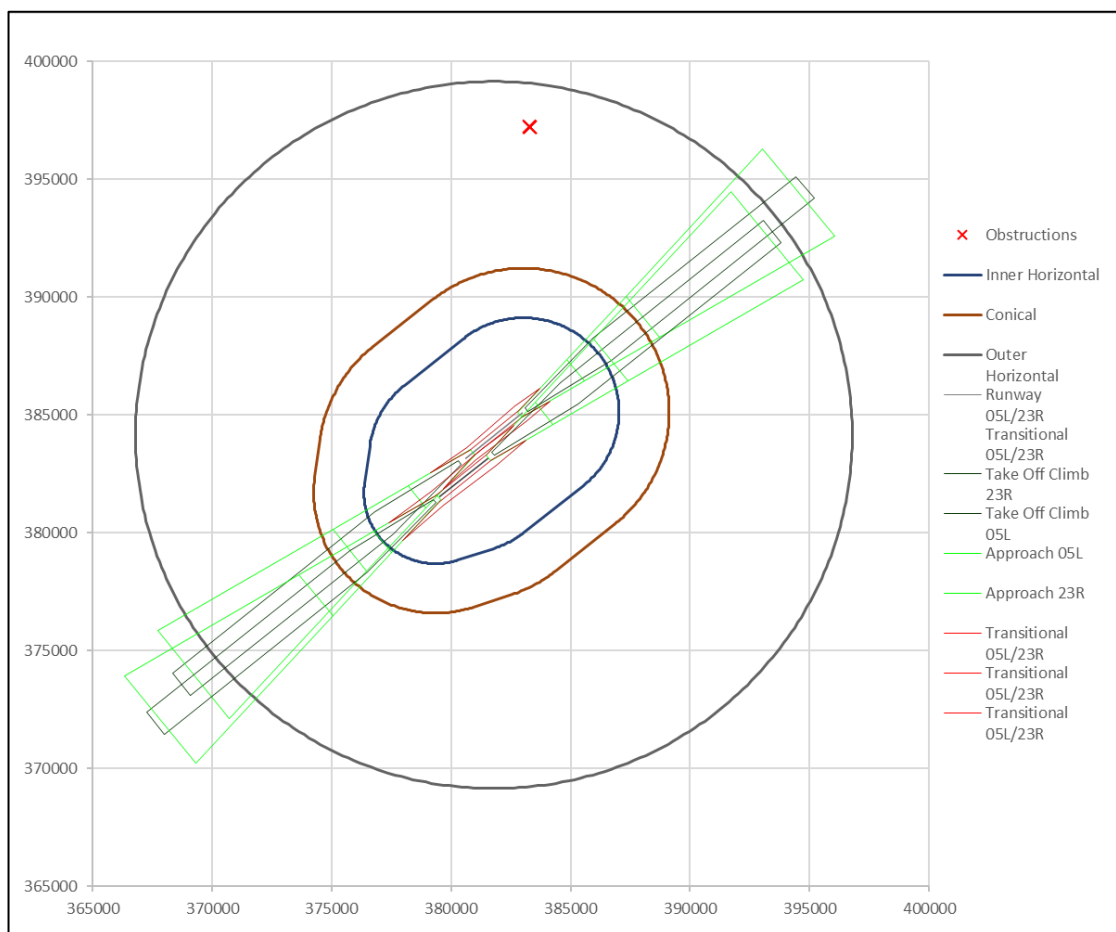


Figure 5 OLS chart

Table 4 below presents a summary of the OLS assessment results.

Surface	Towers C7 and C8	Towers E1 and E2
Outer Horizontal Surface ⁵	<u>Clear</u> by 22.48 metres	<u>Clear</u> by 33.88 metres

Table 4 OLS assessment results

5.2 Crane Usage Overview

During the construction phase, cranes will be present at the site that will reach elevations greater than the final building height, which could breach the OHS if they extend 22.48 metres above Towers C7 and C8. In principle, safeguarding concerns for cranes are the same as for building developments.

It is likely that a crane operation scheme will need to be agreed with Manchester Airport and steady red medium intensity aviation lighting will be required for cranes. Lighting will be a mandatory requirement for any crane breaching the OLS or are 150m agl or taller.

Consultation with Manchester Airport is recommended to confirm their position in relation to crane usage during construction.

⁵ The OHS is a flat surface with an altitude of 206.78m AOD.

6 HIGH-LEVEL INSTRUMENT FLIGHT ANALYSIS

6.1 Overview

Aircraft flying Instrument Flight Rules (IFR) have been assessed at a high-level by considering:

- Impact on Maximum Elevation Figures (MEF) shown on national aeronautical charts;
- Impact on Manchester Airport Surveillance Minimum Altitude Chart (SMAC);
- Impact on current Manchester Airport Standard Instrument Departures (SIDs);
- Impact on current Manchester Airport Standard Arrival Charts (STARs);
- Impact on current Manchester Airport Instrument Approach Charts.

This has been undertaken to determine whether an impact upon Instrument Flight Procedures (IFP) is likely or whether further, more detailed, analysis is required.

6.2 Area Minimum Altitude

The Area Minimum Altitude provides the minimum obstacle clearance above all obstacles (terrain and structures) in a particular quadrangle of an aeronautical chart. The Area Minimum Altitude shown for the quadrangle in which the development is located is 2,200 feet amsl. The proposed development has a maximum altitude of 604.7 feet which is 1,595.3 feet below the Area Minimum Altitude.

The proposed development will therefore not affect the current Area Minimum Altitude.

6.3 Surveillance Minimum Altitude Chart (SMAC)

Surveillance Minimum Altitude Charts (SMAC)⁶ are published to show the lowest altitude a pilot will be instructed to fly whilst receiving an air traffic control service. The Manchester Airport SMAC shows that the minimum altitude for the sector above is 2,400 feet amsl. The proposed development has a maximum altitude of 604.7 feet. The vertical clearance between aircraft subject to a radar control service and the residential tower will be at least 1,795.3 feet. This is 811.3 feet greater than the specified clearance of 984 feet⁷ in the CAA publication (CAP 777) for designing SMACs. This means that published SMAC will not be impacted by the proposed development.

Figure 6 on the following page shows the ATC Surveillance Minimum Altitude Chart for Manchester Airport. It presents the approximate location of the proposed development (blue outlined dot) as well as the area of tall buildings present in the surrounding city centre.

⁶ AD 2.EGCC-5-1.

⁷ 300 metres

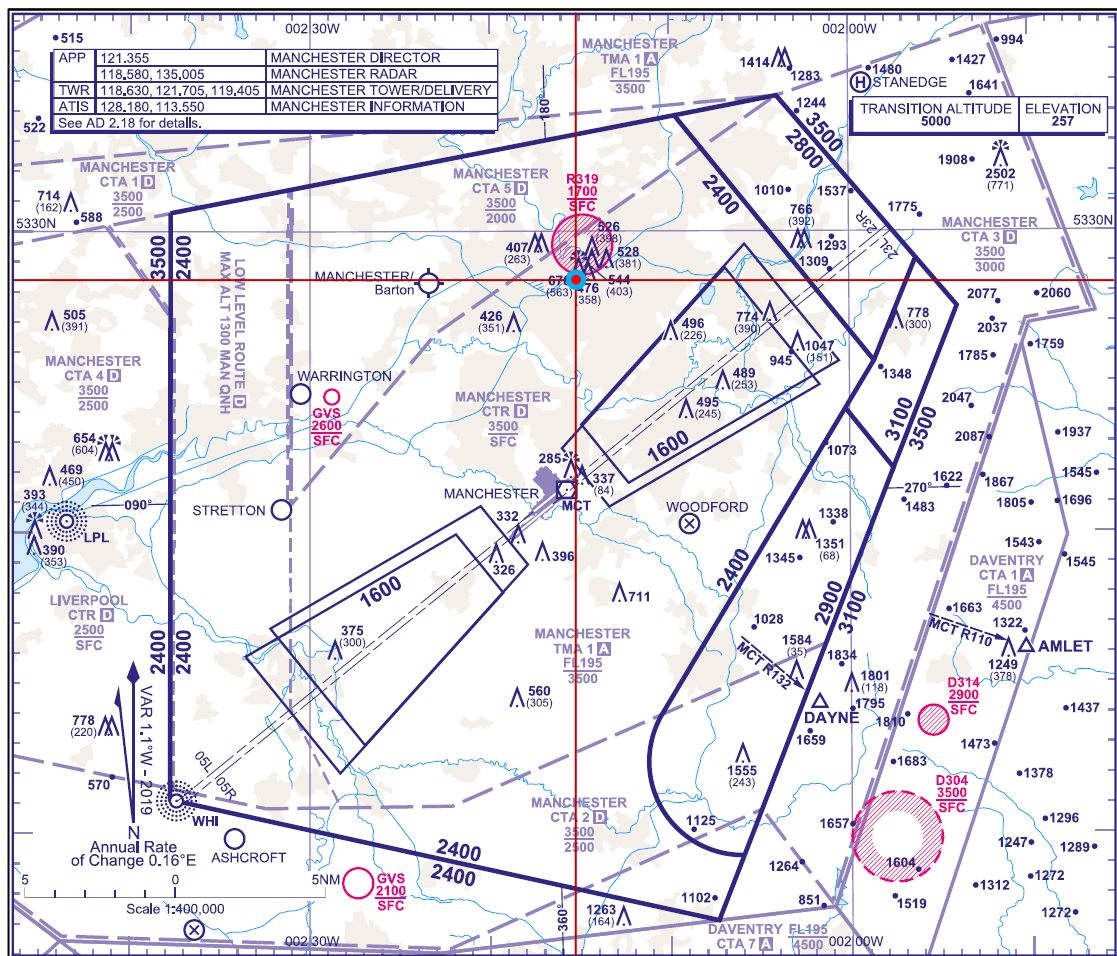


Figure 6 Manchester Airport ATC Surveillance Minimum Altitude Chart

6.4 High-level IFP Assessment – Obstacle Clearance Margins

As a general rule Instrument Flight Procedures (IFPs) are designed so that there are vertical and horizontal safety margins between the specified trajectory and surrounding terrain and obstacles. These margins vary depending on the phase of flight and whether UK, European or International rules are being considered. Nevertheless, the vertical margins are always 1,000 feet or less (except in particularly mountainous regions which Manchester is not). This means that if the vertical clearance between an IFP route and the top of the proposed development exceeds 1,000 feet then it will not have a significant safety impact on aircraft flying the route. The maximum altitude of the proposed development is 605 feet.

This means that aircraft subject to any IFP route or limit which is more than 1,605 feet will not be impacted by the proposed development⁸.

⁸ This is a worst-case vertical clearance – the required vertical clearance also reduces the closer the aircraft is to the aerodrome.

6.5 Standard Instrument Departures (SIDs)

Manchester Airport has seven published Standard Instrument Departure procedures (SIDs). Each of these has been assessed with respect to the proposed development. Results of the assessment are shown in Table 5 below.

SID Name	Observations	Assessed Impact	Recommendation
MONTY 1R 1S 1Y 1Z	The proposed development is approximately 2.7 nautical miles from the nearest section of the procedure	No impact due to vertical clearance	No further action
ASMIM 1S 1Z/KUXEM 1R 1Y/EKLAD 1R 1Y	An aircraft will be at an altitude of approx. 1,963 feet at this point		
LISTO 2S 2Z	The proposed development is approximately 5.9 nautical miles from the nearest section of the procedure	No impact due to horizontal clearance	No further action
LISTO 2R 2Y	The proposed development is approximately 7.7 nautical miles from the nearest section of the procedure	No impact due to horizontal clearance	No further action
POL 5R 4S 1Y 1Z	The proposed development is approximately 5.2 nautical miles from the nearest section of the procedure	No impact due to horizontal clearance	No further action

SID Name	Observations	Assessed Impact	Recommendation
SONEX 1R 1Y/DESIG 1S 1Z	The proposed development is approximately 1 nautical mile from the nearest section of the procedure An aircraft will be at an altitude of approx. 4.762 feet at this point	No impact due to vertical clearance	No further action
SANBA 1R 1Y	The proposed development is approximately 7.7 nautical miles from the nearest section of the procedure	No impact due to horizontal clearance	No further action

Table 5 Standard Instrument Departure (SID) Charts assessment results

The proposed development and any associated crane are likely to present an acceptably low collision risk to aircraft flying all Standard Instrument Departure routes.

6.6 Standard Arrival Charts (STARs)

Manchester Airport has four published Standard Arrival (STARs) Charts. Each of these has been assessed with respect to the proposed development. Results of the assessment are shown in Table 6 below.

STAR Name	Observations	Assessed Impact	Recommendation
LAKEY 1M SETEL 1M TILNI 1M	Minimum Altitude FL70	No impact due to vertical clearance	No further action
LIBSO 1M OTBED 1M			
MAKUX 1M MALUD 1M OKTEM 1M PENIL 1M	Minimum Altitude FL60	No impact due to vertical clearance	No further action
ELVOS 1M LESTA 1M	Minimum Altitude FL70	No impact due to vertical clearance	No further action

Table 6 Standard Arrival Charts (STARs) assessment results

Aircraft flying Manchester Airport's Standard Arrival Routes will be at least 5,395 feet vertically clear of the towers. This means that such aircraft will have an acceptably low collision risk.

6.7 Instrument Approach Charts

Manchester Airport has fourteen published Instrument Approach Charts. Each of these has been assessed with respect to the proposed development. Results of the assessment are shown in Table 7 below.

Name	Observations	Assessed Impact	Recommended Action
ILS/DME (I-MC) RWY 05R	The proposed development is approximately 5.6 nautical miles from the nearest section of the procedure	No impact due to horizontal clearance	No further action
ILS/DME (MCT) RWY 05R			
LOC/DME (I-MC) RWY 05R			
VOR/DME RWY 05R			
ILS/DME (I-MM) RWY 05L	The proposed development is approximately 4.9 nautical miles from the nearest section of the procedure	No impact due to vertical clearance	No further action
ILS/DME (MCT) RWY 05L	An aircraft will be at an altitude of approx. 1,653 feet at this point		
LOC/DME RWY 05L	The proposed development is approximately 4.9 nautical miles from the nearest section of the procedure An aircraft will be at an altitude of approx. 1,980 feet at this point	No impact due to vertical clearance	No further action

Name	Observations	Assessed Impact	Recommended Action
VOR/DME RWY 05L	The proposed development is approximately 5.3 nautical miles from the nearest section of the procedure	No impact due to horizontal clearance	No further action
ILS/DME (I-NN) RWY 23R	The proposed development is approximately 4.4 nautical miles from the nearest section of the procedure	No impact due to vertical clearance	No further action
ILS/DME (MCT) RWY 23R	An aircraft will be at an altitude of approx. 1,956 feet at this point		
LOC/DME RWY 23R	The proposed development is approximately 4.4 nautical miles from the nearest section of the procedure An aircraft will be at an altitude of approx. 1,948 feet at this point	No impact due to vertical clearance	No further action
VOR/DME RWY 23R	The proposed development is approximately 4.6 nautical miles from the nearest section of the procedure An aircraft will be at an altitude of approx. 1,718 feet at this point	No impact due to vertical clearance	No further action

Name	Observations	Assessed Impact	Recommended Action
VOR/DME RWY 23L	The proposed development is approximately 5.1 nautical miles from the nearest section of the procedure	No impact due to horizontal clearance	No further action
RNP RWY 23L	The proposed development is approximately 5.2 nautical miles from the nearest section of the procedure	No impact due to horizontal clearance	No further action

Table 7 Instrument Approach Chart assessment results

The proposed development is likely to present an acceptably low collision risk to aircraft flying all Instrument Approach Procedures. No further assessment is recommended.

6.8 High-level IFP Assessment – Obstacle Clearance Margins Conclusions

As a general rule, IFPs are designed so that there are vertical and horizontal safety margins between the specified trajectory and surrounding terrain and obstacles. It is likely that if an obstacle does not infringe the OLS it will not adversely affect the IFP. The OLS will not be affected by the proposed development.

No impacts upon the published SIDs or STARs and Instrument Approach Procedures are predicted, following consideration of the appropriate vertical and horizontal clearance margins. There are also taller existing buildings in the immediate surrounding area that already co-exist with the current IFPs.

Whilst no detailed IFP assessment is recommended, it is possible that a full assessment is requested by Manchester Airport.

7 HELICOPTER OPERATIONS AND OTHER AERODROMES (HIGH-LEVEL COMMENTARY)

7.1 Helicopter Operations

Helicopter use in and around the city centre is most likely to be associated with the emergency services. Any tall building in principle has the potential to present a hazard to helicopters, particularly if they were to be operating at low-level. There are several helicopter landing site (HLS) surrounding Manchester.

Manchester Royal Infirmary Hospital is the closest HLS to the proposed development, which is located approximately 1.9km to the southeast.

The development is unlikely to present a significant risk to helicopter operations because:

- The proposed development is located within the city centre where there is already significant urbanisation with many similar types of building development.
- The proposed development is in this vicinity to tall building developments such as Beetham Tower and the Owen Street Towers, which have a greater altitude than the proposed development.

The greatest risk to helicopters related to the proposed development is likely to be the use of cranes, because they will be at a greater altitude and are in general harder to see from the air than buildings are. Cranes have been discussed in Section 5.2.

Concerns relating to helicopter use are not predicted. It is recommended that the Manchester Royal Infirmary is made aware of the proposed development.

7.2 Other Aerodromes

Generally speaking, Manchester Airport is the aerodrome that presents the most significant restrictions with regard to building developments in Manchester's city centre.

Manchester Barton is a licenced aerodrome located approximately 8.7km west of the proposed development.

The aerodrome has multiple grass runways. Published charts associated with the aerodrome include an 'aerodrome chart' and an 'ATZ, Helicopter Entry/Exit Points and Circuits'.

These charts do not cover areas extending over the proposed development or the city centre itself. Furthermore, existing buildings at a greater altitude than the proposed development that are located closer to Manchester Barton Aerodrome.

Significant impacts on Manchester Barton Aerodrome are not predicted.

8 HIGH-LEVEL AVIATION LIGHTING CONSIDERATIONS

8.1 Overview

Aviation lighting is required where an object becomes a collision risk. This is most likely where there is an infringement of the OLS. It also becomes mandatory to have lighting where an object extends to 150m above ground level or more⁹. The following section explores the requirement for aviation lighting at a high-level.

8.2 Lighting Requirements

Towers C7 and C8 extend to 151.8m agl whereas Towers E1 and E2 extend to 140.4m agl. On this basis aviation lighting is mandatory for Towers C7 and C8 only, as per the associated CAA guidance and will be requested by Manchester Airport.

The following lighting arrangements are therefore recommended:

- Towers C7 and C8 will be lit with medium intensity lights.
- Intermediate lights on Towers C7 and C8 will be included, as appropriate.
- The top of any associated crane that breaches the OHS or is 150m or taller will be lit with medium intensity lights.
- The towers will be marked on CAA Aeronautical Charts.
- Any associated crane will be marked on CAA Aeronautical charts or a Notice to Airmen (NOTAM) will have been issued advising of the crane's height and location.

The specific aviation lighting scheme for each tower is to be decided.

⁹ CAP 168 Licensing of Aerodromes, Edition 12, January 2022. Last accessed 07.03.23.

9 CONCLUSIONS

9.1 Analysis Results

The results of the analysis for the key identified aviation risks are presented below.

9.1.1 Manchester Airport's Obstacle Limitation Surfaces

The proposed development is clear of the OHS at Manchester Airport with a clearance margin of 22.48m.

Crane usage will need to be considered due to the close proximity to the OLS. It is likely a Crane Operations Scheme will be required.

Consultation with the safeguarding team at Manchester Airport is recommended to confirm the analysis results and to identify any other safeguarding issues.

9.1.2 Manchester Airport SSR

The proposed development is located approximately 14.7km from the SSR at Manchester Airport and is predicted to be visible to the radar considering the existing environment.

Mitigation in the form technical fix applied to the radar has been agreed with and will be implemented by NATS.

9.1.3 Instrument Flight Procedures at Manchester Airport – High-Level

No impacts upon the published SIDs or STARs and Instrument Approach Procedures are predicted, following consideration of the appropriate vertical and horizontal clearance margins. There are also taller existing buildings in the immediate surrounding area that already co-exist with the current IFPs.

Whilst no detailed IFP assessment is recommended, it is possible that a full assessment is requested by Manchester Airport.

9.1.4 Aviation Lighting Requirement

Towers C7 and C8, as well as any cranes used during construction, that are 150m agl or taller should be lit with medium intensity aviation lighting. The specific lighting arrangement has not yet been decided.

9.1.5 Helicopter Operations and Other Aerodromes – High-Level

Concerns relating to helicopter use are not predicted because the proposed development is located within the city centre where there is already significant urbanisation with many similar types of building development and is in this vicinity to tall building developments such as Beetham Tower and the Owen Street Towers.

It is recommended that the Manchester Royal Infirmary is made aware of the proposed development as it is the closest HLS to the proposed development.

Manchester Barton is a licenced aerodrome located approximately 8.7km west of the proposed development. None of the published charts cover areas extending over the proposed development or the city centre itself and therefore no significant impacts are predicted.

9.2 Overall Conclusions

The proposed development is clear of the Outer Horizontal Surface (OHS) at Manchester Airport; however, it is likely that cranes used in construction will infringe as they will extend above the proposed development. Aviation lighting is a mandatory requirement for Towers C7 and C8 due to their height, and infringement of an OHS by cranes can normally be operationally accommodated through appropriate aviation lighting and a crane operations scheme.

Technical mitigation for impacts on the SSR at Manchester Airport has been agreed and will be implemented by NATS. The solution is a technical fix, which is applied to the radar.

No significant impacts upon surrounding HLS and Manchester Barton Airport are predicted.

Consultation with Manchester Airport and Manchester Royal Infirmary Hospital is recommended to discuss the results of this report.

APPENDIX A - TOWER FOOTPRINT COORDINATES

Tower C7

Easting	Northing
383275	397202
383306	397196
383313	397226
383282	397232
383275	397202
383306	397196
383313	397226
383282	397232
383275	397202
383306	397196
383313	397226
383282	397232
383275	397202
383306	397196
383313	397226
383282	397232
383275	397202
383306	397196
383313	397226
383282	397232
383275	397202

Easting	Northing
383306	397196

Tower C7 footprint coordinates

Tower C8

Easting	Northing
383231	397309
383224	397310
383221	397307
383217	397306
383214	397304
383210	397303
383207	397300
383203	397300
383200	397297
383196	397296
383193	397291
383200	397276
383206	397276
383209	397278
383213	397279
383216	397282
383221	397283
383223	397285
383227	397286
383230	397289

Easting	Northing
383234	397290
383238	397295

Tower C8 footprint coordinates

Tower E1

Easting	Northing
383317	397353
383311	397353
383309	397350
383305	397349
383302	397346
383298	397345
383295	397342
383291	397341
383288	397338
383284	397337
383281	397334
383277	397333
383274	397329
383283	397314
383288	397314
383291	397317
383295	397318
383298	397321
383302	397322

Easting	Northing
383305	397325
383309	397326
383312	397329
383316	397330
383319	397332
383323	397333
383326	397338

Tower E1 footprint coordinates

Tower E2

Easting	Northing
383310	397269
383316	397269
383318	397272
383322	397273
383325	397276
383329	397277
383332	397280
383336	397281
383339	397284
383343	397285
383346	397288
383349	397289
383352	397294
383344	397308

Easting	Northing
383338	397308
383335	397305
383331	397304
383328	397301
383324	397300
383322	397297
383318	397296
383315	397293
383311	397292
383308	397289
383304	397288
383301	397283

Tower E2 footprint coordinates



Pager Power Limited
Stour Valley Business Centre
Sudbury
Suffolk
CO10 7GB

Tel: +44 1787 319001 **Email:** info@pagerpower.com **Web:** www.pagerpower.com