
One Medlock Street
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APPENDIX E: WIND MICROCLIMATE



One Medlock Street

For

Premier Inn Hotels and Dominvs Group

Wind Microclimate Report

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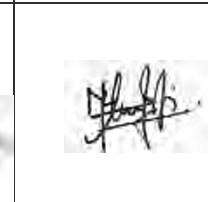
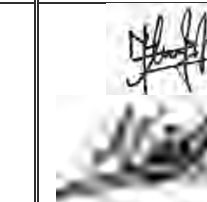
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Executive Summary

Background

A study has been carried out by Architectural Aerodynamics Ltd. (ArcAero) to assess the wind microclimate for the proposed One Medlock Street development in Manchester, UK.

The study has adopted wind tunnel testing to predict the strength of winds. Then using the industry standard Lawson criteria, it has established the suitability of wind conditions and the impact on the surrounding area, following the introduction of the proposed development.

Conclusions

The following conclusions have been drawn:

- Following the introduction of the proposed development, wind conditions are substantially suitable for designated pedestrian and occupant activities.
- Minor localised exceptions are predicted to occur to the main entrance on the western façade of Block B, thoroughfares across Medlock Street and within the southern balconies of Block A which are still expected to be comfortable for use.
- The modest exceedances observed to the main entrance to the western façade of Block B. The introduction of robust landscaping to the south of this entrance has been implemented, as shown in Figure 2.2, and conditions are therefore expected to be suitable for use.
- With the introduction of the cumulative developments, wind conditions do not materially differ from wind conditions in the proposed development in existing scenario.

1 Introduction

A microclimate is defined as the distinctive climate of a small-scale area. The weather variables in a microclimate, such as wind, may be different to the conditions prevailing over the area as a whole. Wind microclimate assessments consider the wind conditions that would result upon the introduction of a new development into an existing space.

Such assessments predict the proportion of time an area will experience wind speeds in excess of threshold values associated with safe and comfortable use by pedestrians and occupants once the development is introduced. It can therefore be shown within the various parts of a new proposal and neighbouring properties whether wind conditions are suitable or unsuitable, and whether design adjustment or mitigation measures are required. It is for this purpose that wind microclimate assessments are undertaken.

This report summarises the results wind tunnel studies commissioned by Premier Inn Hotels and Dominvs Group, to assess the wind microclimate for the proposed One Medlock Street development in Manchester, UK.

2 The Proposed Development

2.1 Site Location and Surrounding Area

The One Medlock Street development is bounded by River Street to the northwest, Medlock Street to the northeast, The Mancunian Way Ring Road to the southeast; and student accommodation to the southwest.

Further afield to the south, the terrain is typical of suburban residential areas. To the north lies Manchester City Centre, with mid-to high-rise office and residential developments and buildings typical of a UK city centre.

The proposed development will comprise the demolition of the existing hotel building and structures and the development of the Site for commercial (Use Class E) and purpose-built student accommodation (Sui Generis), comprising two separate buildings, along with associated ancillary internal and external amenity space, hard and soft landscaping and associated highway works. The proposed development will deliver approximately 1,014 student accommodation units and 36,500m² of office floorspace. The proposed development will be formed of two buildings: a block for the student accommodation (Block B) and a block of the office floorspace (Block A). The student accommodation block will be up to 37 storeys in height and the office block will be up to 13 storeys in height.

2.2 Drawing Information Describing the Proposed Development

Assessment models have been constructed on the basis of the following drawing received from Jon Matthews Architects on 26th August 2022:

- 100_One Medlock Street Massing Model 220826.dwg

The modelling of the gates to the south of the service yard for One Medlock Street are based on the following drawings received from Jon Matthews Architects on 23rd September 2022:

- 100_One Medlock Street Massing Model 220923.skp
- 100_MP_02_2200.dwg
- 100_MP_02_2202.dwg

The existing surrounding area was based upon information supplied John Matthews Architects and supplemented by Ordnance Survey details for the area. Cumulative surrounds were based upon information contained within the Manchester City Council planning portal.

2.3 Soft Landscaping

The wind microclimate has been assessed for the proposed development with soft landscaping proposals as shown in Figure 2.1 and surrounding landscaping.

The landscaping proposals were updated to respond to wind conditions, with the updated version presented in Figure 2.2, “2072-PLA-XX-XX-DR-L-0003” Revision P04 dated 11th October 2022.

2.4 Surrounding Contexts

The proposed development was assessed in two surrounding contexts, namely existing surrounds and cumulative surrounds. A number of significant developments are substantially under construction to the eastern sector of the proposed development. These have been included within all assessment scenarios and are listed in Table 2-1.

Table 2-1 – Developments Already Under Construction

Development Name	Planning Reference
Plot 9 First St	132600/FO/2021
Plot 11 First St	125573/FO/2019
John Dalton West	125799/FO/2019
Birley Plot E, Stretford Road	120896/FO/2018
Former Bauer Millet Site	115871/FO/2017
Land Bound by Silvercroft Street, Crown Street, And the Mancunian Way	126668/FO/2020

Consented developments that have been additionally considered within the cumulative surrounds scenario are listed in Table 2-2.

Table 2-2 – Cumulative Schemes

Development Name	Planning Reference
One City Road	128002/FO/2020
Great Jackson Street	116850/FO/2017
10-12 Whitworth Street	111003/FO/2016/C1
Hotspur Press 2	120635/FO/2018
Land Bounded by Trumpet Street, Albion Street & Great Bridgewater Street (Apex Tower)	133172/FO/2022
34 Great Jackson Street	129273/FO/2021
Land At Deansgate South	129406/FO/2021
Plot F Great Jackson Street	132199/FO/2021

3 Assessment Methodology

3.1 Overview

Wind tunnel modelling was undertaken in the Imperial College 10x5 atmospheric boundary layer wind tunnel in London. The blockage ratio was within the 5% level recommended by the ASCE SEI (1) and AWES QAM (2) guidelines. Full details of the wind tunnel testing conducted for the study are presented in Appendix A of this report.

Modelling via wind tunnel testing has derived mean and gust equivalent mean wind speeds, in accordance with best industry practice. In doing so 16 wind directions were assessed, in 22.5° increments.

The industry standard criteria for wind microclimate assessments, the LDDC variant of the Lawson criteria (3), has been employed for the study.

3.2 Wind Climate Analysis

Wind microclimate studies require that meteorological data is transposed from a nearby weather station with sufficient wind data to produce accurate wind frequency statistics. The current study uses data from Manchester International Airport.

Full details of the wind climate relevant to the site, the wind properties approaching the site and the modelling of those wind properties in the wind tunnel models are provided in Appendix B of this report. All analysis of wind data and the atmospheric boundary layer has employed the methods of ESDU item 01008 (4), in accordance with best industry practice.

3.3 Assessment Scenarios

The wind tunnel model covered a radius of 450 metres from the site. All features which are likely to impact the wind flow within the study area have been replicated. The assessment considered a full range of directions in 22.5° intervals, and considered the following configurations:

1. Existing site, existing surrounding conditions
2. Proposed development, existing surrounding conditions
3. Proposed development, cumulative surrounding conditions

Details of the tunnel and model used for the wind tunnel study are presented in Appendix A of this report.

3.4 The LDDC Lawson Criteria

The industry standard criteria for wind microclimate assessments are commonly referred to in the UK as the Lawson criteria after one of their main authors. As with most other leading practitioners, ArcAero use the 'LDDC' variant of the Lawson Criteria (London Docklands Development Corporation (3)).

The LDDC variant applies a single percentage probability of exceedance of a range of wind speeds and associates different wind speeds to different types of usage. This offers a relatively simple and practical manner for the assessment of wind comfort and safety.

3.4.1 Safety

A wind speed of 15 m/s occurring once per year is rated as unsuitable, in terms of safety, with the potential to de-stabilise the less able members of the public including the elderly, cyclists and children.

3.4.2 Comfort

The LDDC variant of the Lawson criteria (3) prescribes that wind conditions are suitable for a given activity when the threshold is exceeded no more than 5% of the time. The value of 5% has been established as giving a reasonable allowance for extreme and relatively infrequent winds that are tolerable within each category.

Where certain activities are year-round, such as walking, entrance use or for waiting areas, comfort ratings are required to be met in all seasons. For more seasonal activities, such as outdoor recreation or for sitting spaces, the assessment focuses on relevant seasons where the expectation will exist for conditions to be suitable. The LDDC comfort threshold wind speed values are presented in Table 3-1.

Table 3-1 – LDDC Wind Comfort Thresholds

Threshold Wind Speed [m/s]	Comfort Rating / Activity	
4	C4	Long-term sitting
6	C3	Short-term sitting / standing
8	C2	Strolling
10	C1	Walking
> 10	C0	Uncomfortable

3.5 Pedestrian / Occupant Uses

In using the Lawson criteria to consider the suitability of spaces, in terms of comfort, it is necessary to identify the anticipated usage of the various areas and assign that usage to an assessment receptor. Each measurement location is assigned a pedestrian / occupant use, for each assessment scenario. This is presented in Figure C.1 and Figure C.2 in Appendix C.

3.6 EIA Scoping

The assessment meets the requirements of the One Medlock Street EIA Scoping Report.

Identification of Effects which are Not Significant:

- Temporary Exceedance of LLDC Wind Safety and Comfort Criteria during Construction

Identification of Likely Significant Effects and Receptors:

- Exceedance of the LLDC wind safety criteria, for pedestrians within the proposed development and surrounding areas
- Exceedance of the LLDC wind comfort criteria, for pedestrians within the proposed development and surrounding areas

The assessment methodology and criteria (3.4) are also consistent with the requirements of the scoping.

4 Results

4.1 Existing Site within Existing Surrounds

The existing site wind conditions are dominated by the built-up nature of the area. Surrounding buildings particularly River Street Tower development that is located to the west of the site, have the potential to cause some downdraughts and accelerations at corners.

The results for the existing site conditions are presented graphically within Figure 4.2 and Figure 4.2 for worst-seasonal and summer conditions respectively.

4.1.1 Safety

All areas within the site and the surrounding areas satisfy the safety criteria for pedestrian safety.

4.1.2 Comfort

Wind conditions within the site and the surrounding areas are substantially suitable for their existing uses with conditions suitable for short periods of standing at entrances and at least strolling on thoroughfares and carpark areas.

Minor exceedances are observed to the northeast corner of the River Street Tower development (Locations 48 and 49) where conditions are only suitable for walking in winter. Conditions are still suitable for strolling in excess of 92% of the time in winter and thus are considered tolerable for pedestrian thoroughfares.

Wind conditions to the southern terraces of City Apartment building are suitable for standing or better in summer and thus for their intended uses.

4.2 Proposed Development within Existing Surrounds

The results for the proposed development within existing surrounds are presented graphically within Figure 4.3 and Figure 4.4 for worst-seasonal and Figure 4.5 and Figure 4.6 for summer conditions respectively.

4.2.1 Safety

Upon the introduction of the proposed development, areas within the site and immediate surrounds satisfy the safety criteria for wind.

4.2.2 Comfort

4.2.2.1 Thoroughfares

Wind conditions at thoroughfares within the site are suitable for at least strolling and thus for comfortable pedestrian access to and passage through the site.

4.2.2.2 Entrances

Wind conditions at entrances to the proposed development are generally suitable for short-term standing and thus for comfortable pedestrian ingress / egress.

An exception is observed to the main entrance to the western façade of Block B (Location 5) where conditions are only suitable for strolling from autumn to spring months and thus too windy for comfortable ingress / egress. The introduction of robust landscaping to the south of this entrance and the introduction of an entrance screen, as shown in Figure 2.2, is expected to mitigate these modest exceedances and create conditions suitable for use.

A further exception is observed to the main entrance to the northern façade of Block B (Location 91). This would be considered marginal, with conditions suitable for standing ~94% of the time in winter. Therefore, wind conditions would still be considered to be suitable for entrance use.

4.2.2.3 *Recreational Spaces*

Wind conditions to the rooftop terraces of Block B and Block A are suitable for short-term sitting or better in summer and are thus comfortable for general recreational spaces.

Similarly at the smaller terraces of Block A, wind conditions would be suitable for short periods of sitting in summer and thus for their intended uses. Marginal exceedances are observed in autumn at the southern terraces but these spaces would be still considered tolerable for use.

4.2.2.4 *Surrounding Area*

Upon the introduction of the proposed development, the wind conditions to the surrounding area remain substantially suitable for strolling and thus for comfortable pedestrian access to and passage through the site. Conditions also remain comfortable for pedestrian ingress / egress at surrounding entrances.

A single exception occurs to the west of Block A, across Medlock Street (Location 23), where wind conditions are only suitable for strolling for 93% of the time in winter rather than the 95% criteria. Since the exceedances are marginal, wind conditions are still considered tolerable for pedestrian thoroughfares.

The wind conditions remain suitable for standing or better in summer at the southern terraces of City Apartment building and thus for their intended uses.

4.3 Proposed Development within Cumulative Surrounds

The results for the proposed development within cumulative surrounds are presented graphically within Figure 4.7 and Figure 4.8 for worst-seasonal and Figure 4.9 and Figure 4.10 for summer conditions respectively.

The majority of the cumulative developments lie to the north and to the west of the site and these developments do not coincide with the direction of the main prevailing winds. Correspondingly, wind conditions remain similar to those for the proposed development in existing surroundings.

Exceptions exist however, where minor exceedances are found upon the introduction of cumulative surrounds. These are the thoroughfares to the north of Block B (Location 48) and to the north of Plot 11 (Location 87). The exceedances here are marginal, suitable for strolling ~94% of the time in winter, rather than the required 95%, and would still be considered to be acceptable for their intended use.

Additionally, marginal exceedances are observed at the southern terrace of Level 12 of Block A (Location 34), with wind conditions being marginally windy for short-term sitting during autumn, suitable ~94% of the time, rather than the required 95% of the time. However, wind conditions would still be considered to be comfortable for recreational use particularly during the summertime.

The wind conditions to the main entrance on the western façade of Block B remain unsuitable for ingress / egress from autumn to spring months.

Elsewhere, conditions within the site and surrounding areas remain suitable for the planned and existing pedestrian uses.

5 Conclusions

The following conclusions have been drawn:

- Following the introduction of the proposed development, wind conditions are substantially suitable for designated pedestrian and occupant activities.
- Minor localised exceptions are predicted to occur to the main entrance on the western façade of Block B, thoroughfares across Medlock Street and within the southern balconies of Block A which are still expected to be comfortable for use.
- The modest exceedances observed to the main entrance to the western façade of Block B. The introduction of robust landscaping to the south of this entrance has been implemented, as shown in Figure 2.2, and conditions are therefore expected to be suitable for use.
- With the introduction of the cumulative developments, wind conditions do not materially differ from wind conditions in the proposed development in existing scenario.

6 References

1. **Quality Assurance Manual - Wind Engineering Studies of Buildings. 2001. AWES-QAM-1-2001.**
2. **The American Society of Civil Engineers (ASCE) Manual of Practice No.67 for Wind Tunnel Studies. ASCE SEI 49/12.**
3. **Lawson, T.V. *The determination of the wind environment of a building complex before construction*. Bristol : University of Bristol, Department of Aeronautical Engineering, 1990.**
4. **ESDU (Engineering Science Data Unit). *Item 01008. Computer Program for wind speeds and turbulence properties: flat or hilly sites in terrain with roughness*. 2001.**

7 Figures

Figure 2.1 – Soft landscaping scheme



Figure 2.2 – Soft landscaping scheme with additional wind mitigation

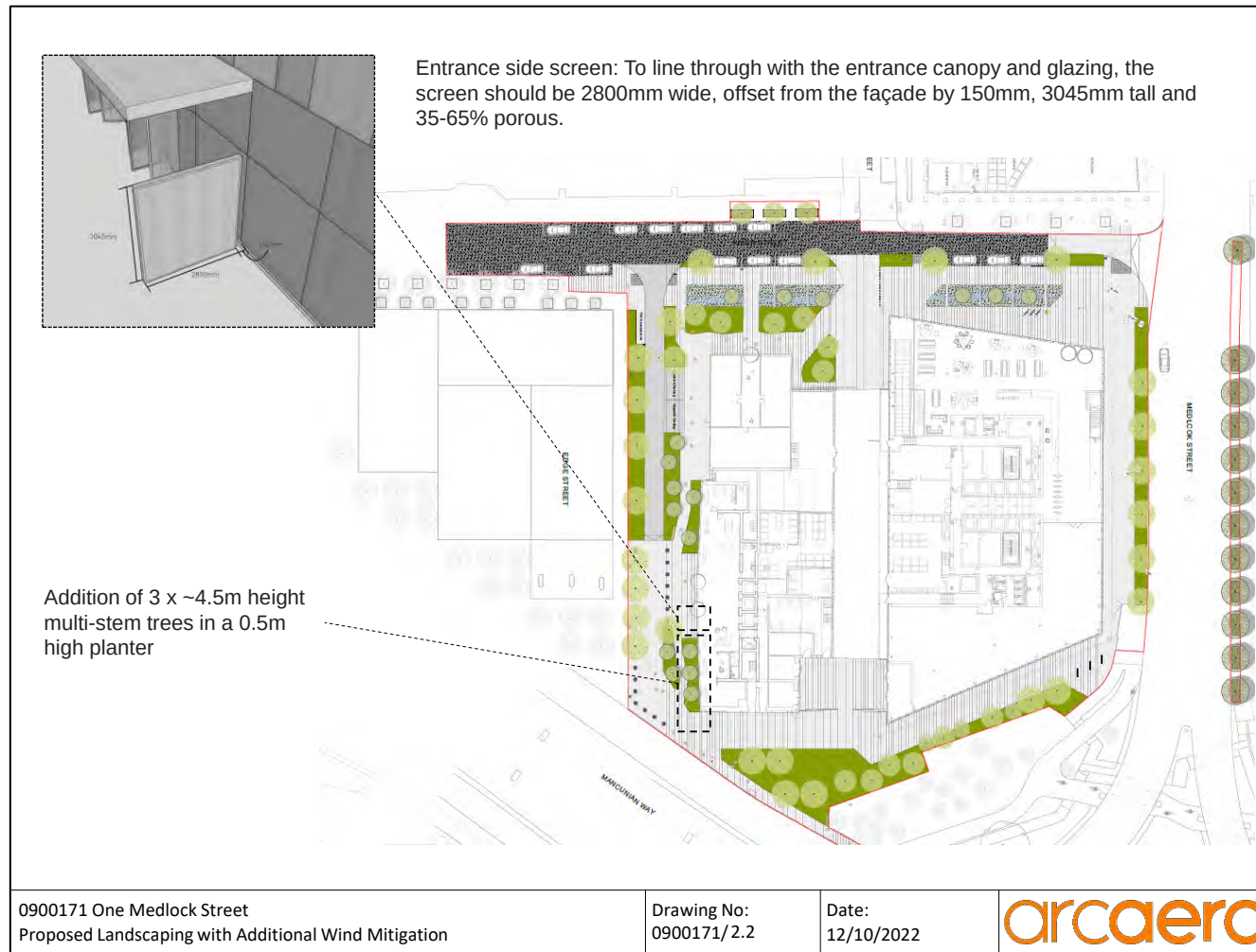


Figure 4.1 - Pedestrian wind conditions, existing site within existing surrounds, 'worst' season

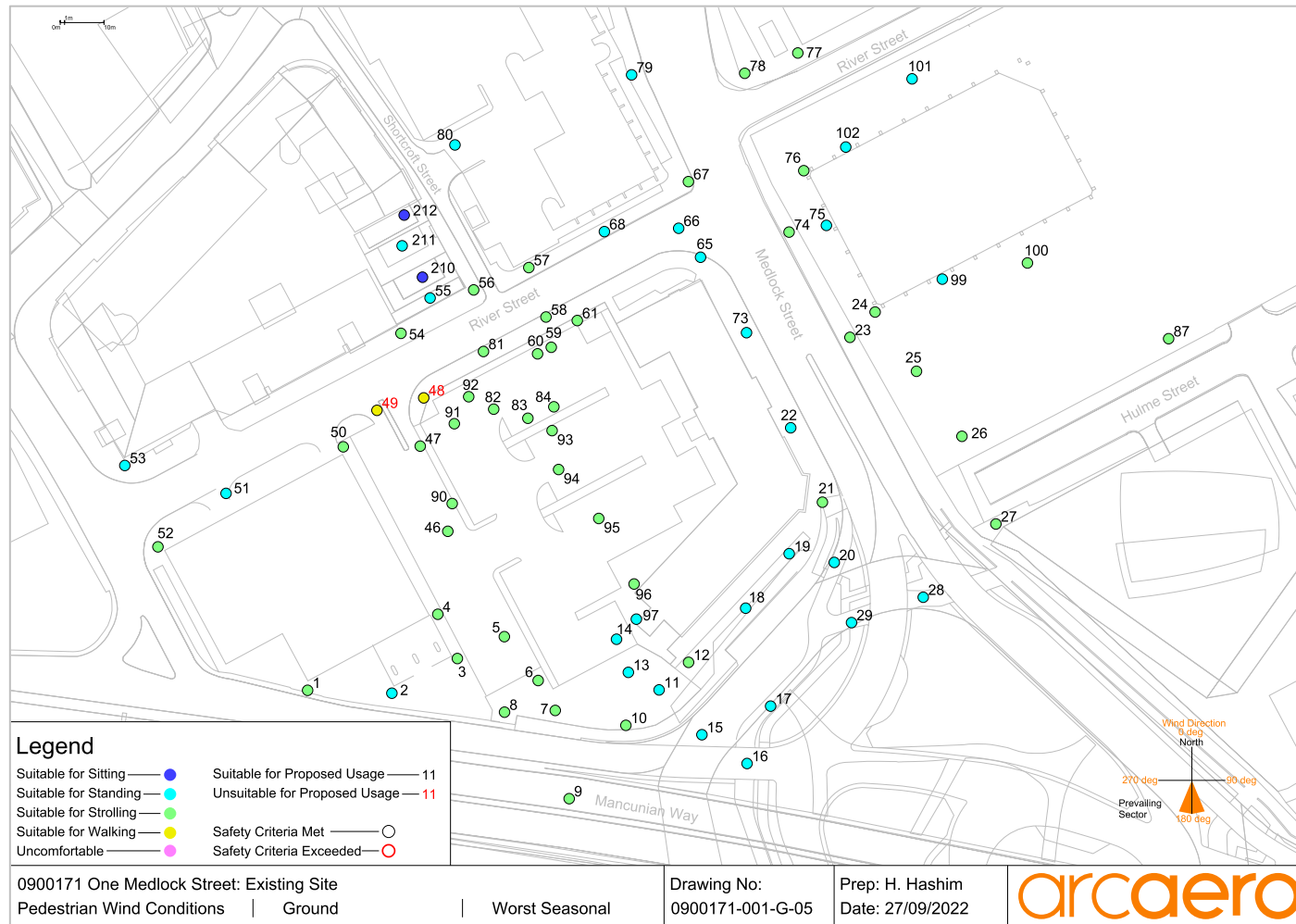


Figure 4.2 - Pedestrian wind conditions, existing site within existing surrounds, summer

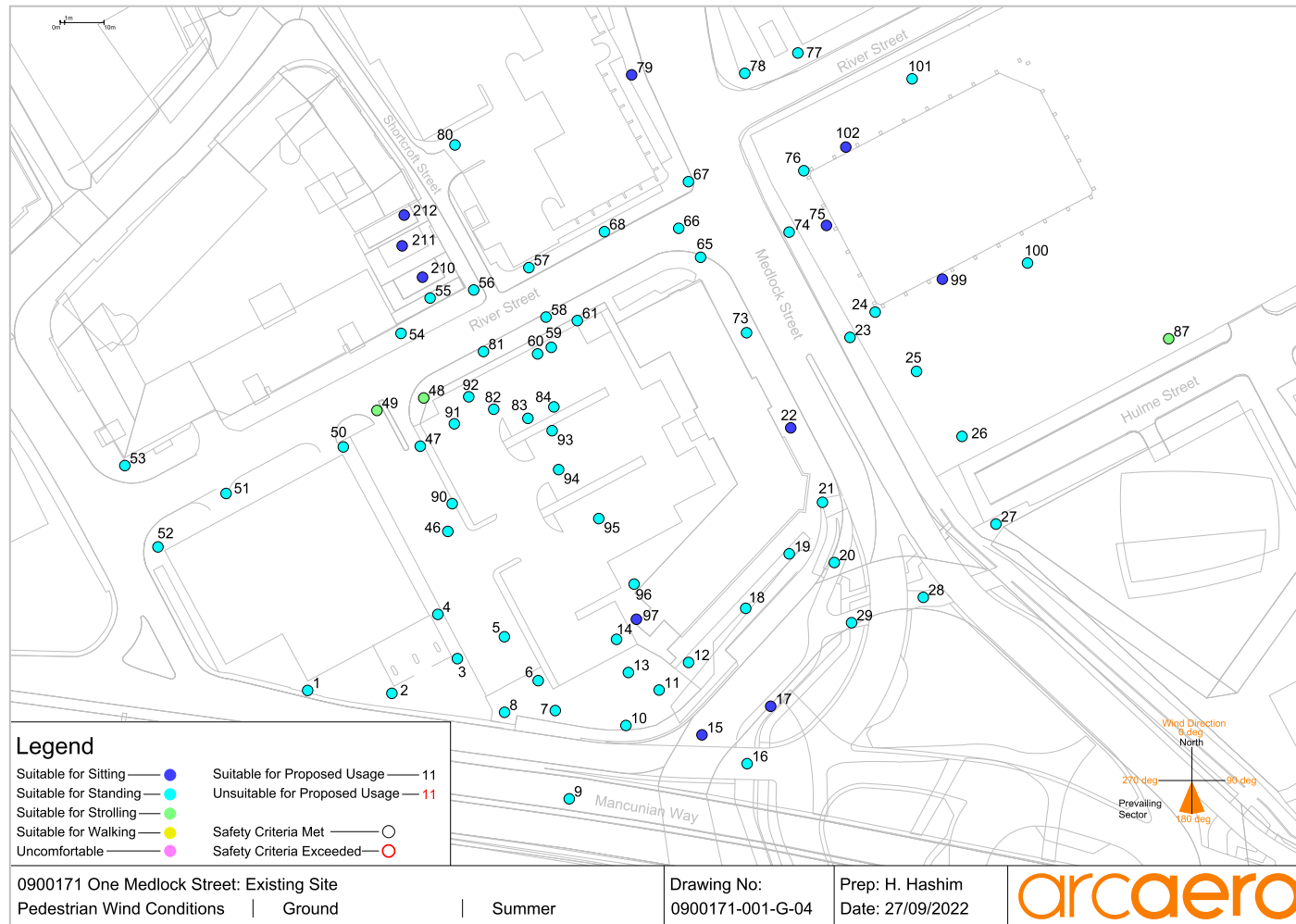


Figure 4.3 - Pedestrian wind conditions, proposed development within existing surrounds, 'worst' season – ground level

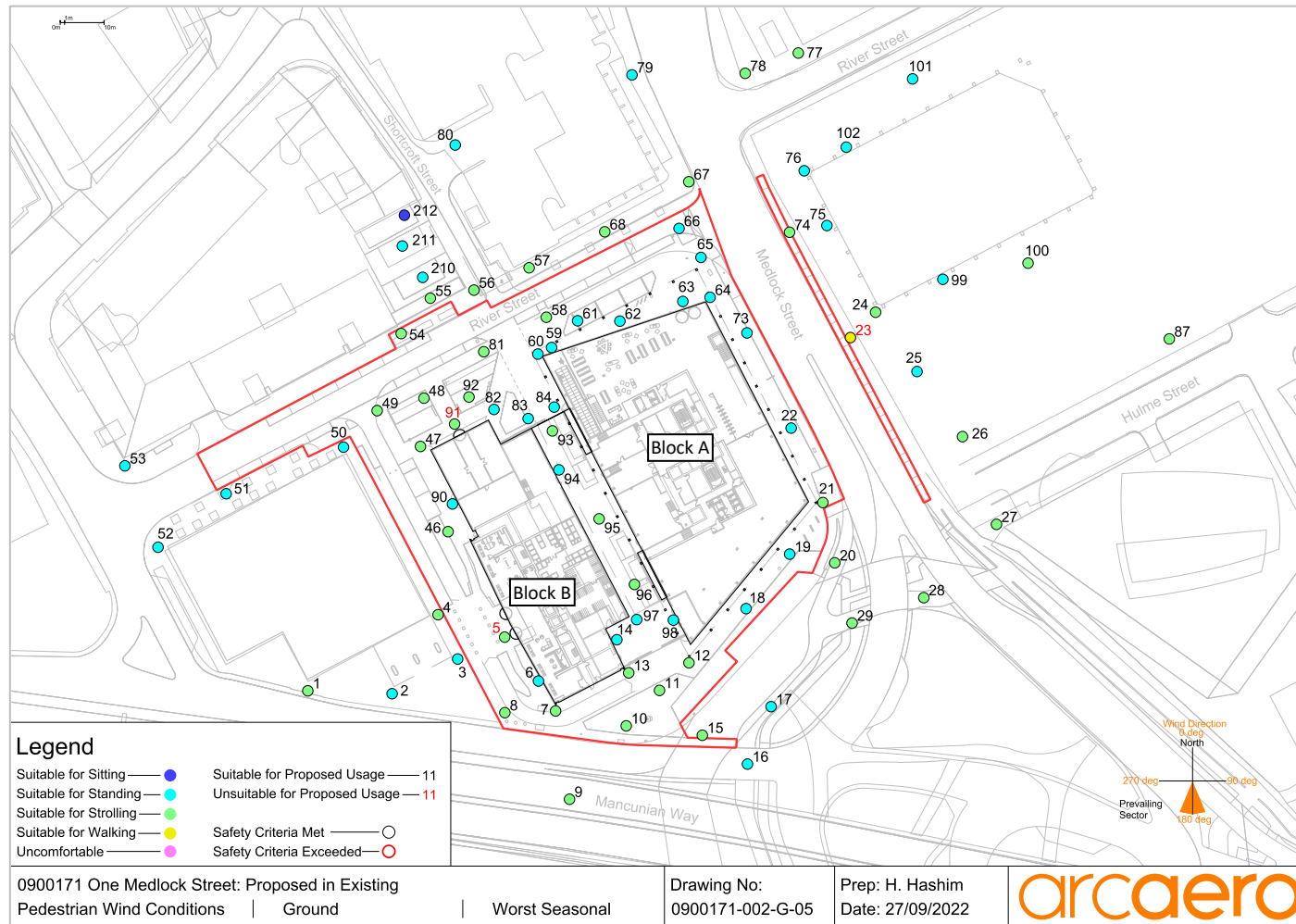


Figure 4.4 – Pedestrian wind conditions, proposed development within existing surrounds, 'worst' season – terrace / balcony level

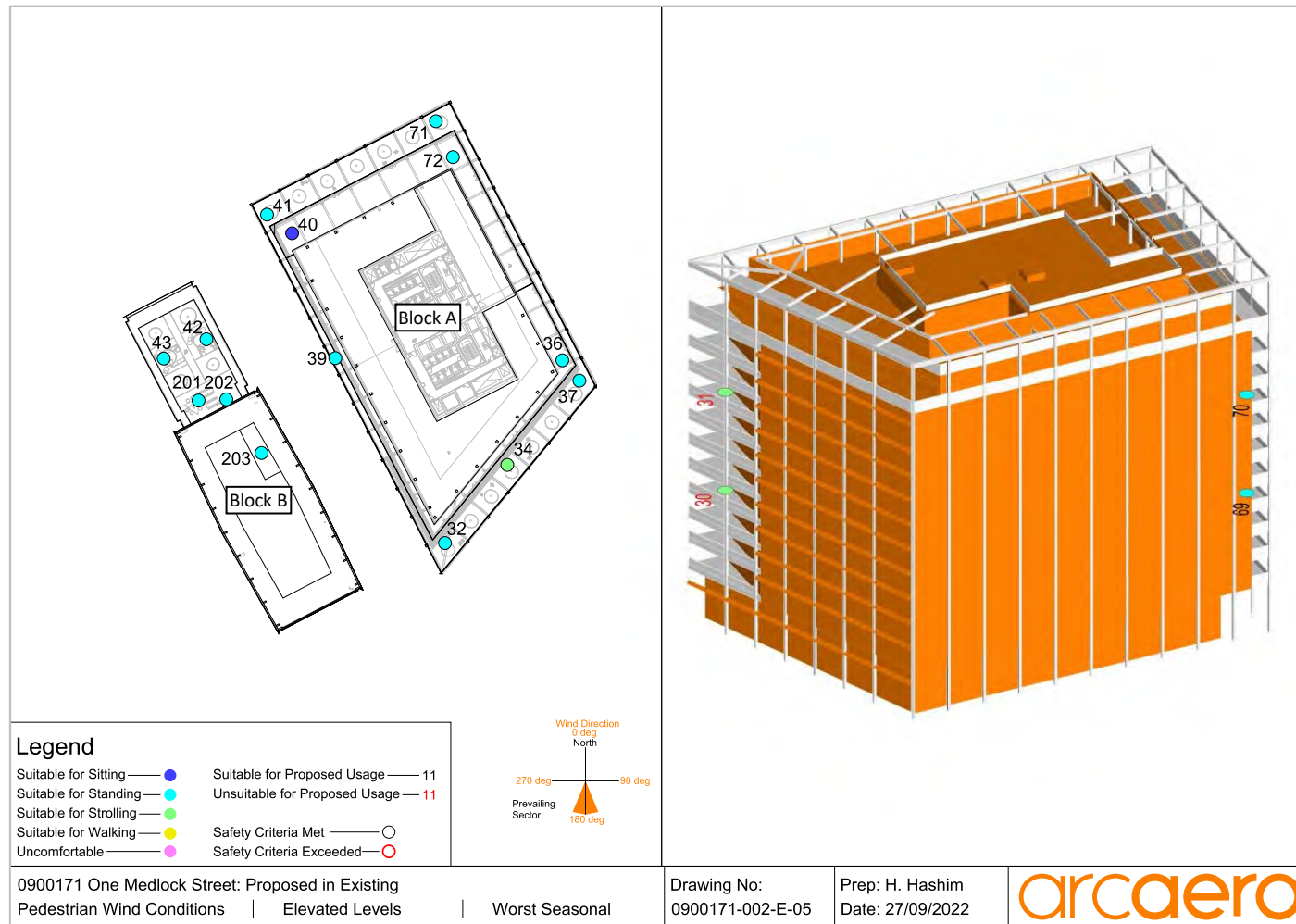


Figure 4.5 - Pedestrian wind conditions, proposed development within existing surrounds, summer – ground level

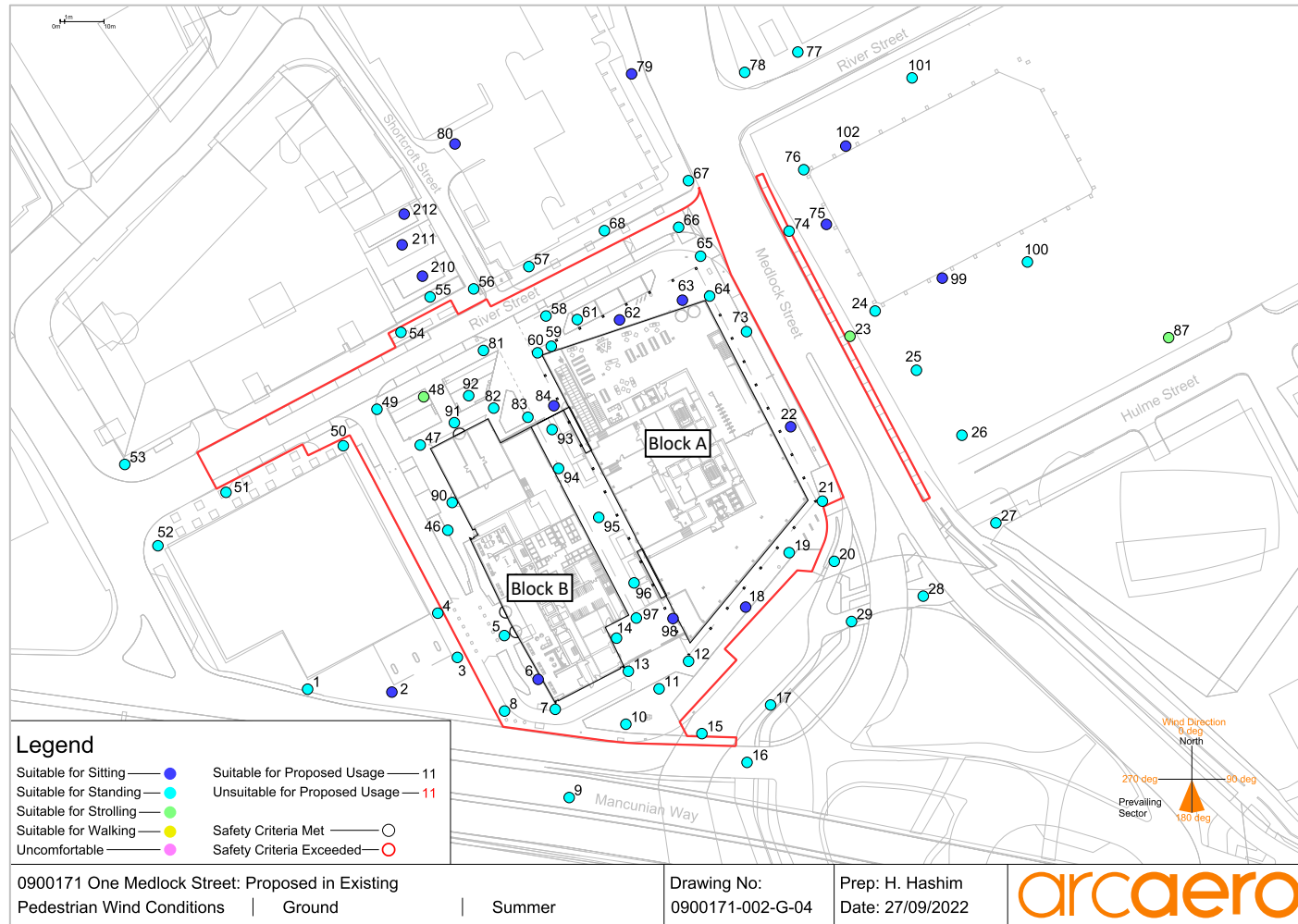


Figure 4.6 – Pedestrian wind conditions, proposed development within existing surrounds, summer – terrace / balcony level

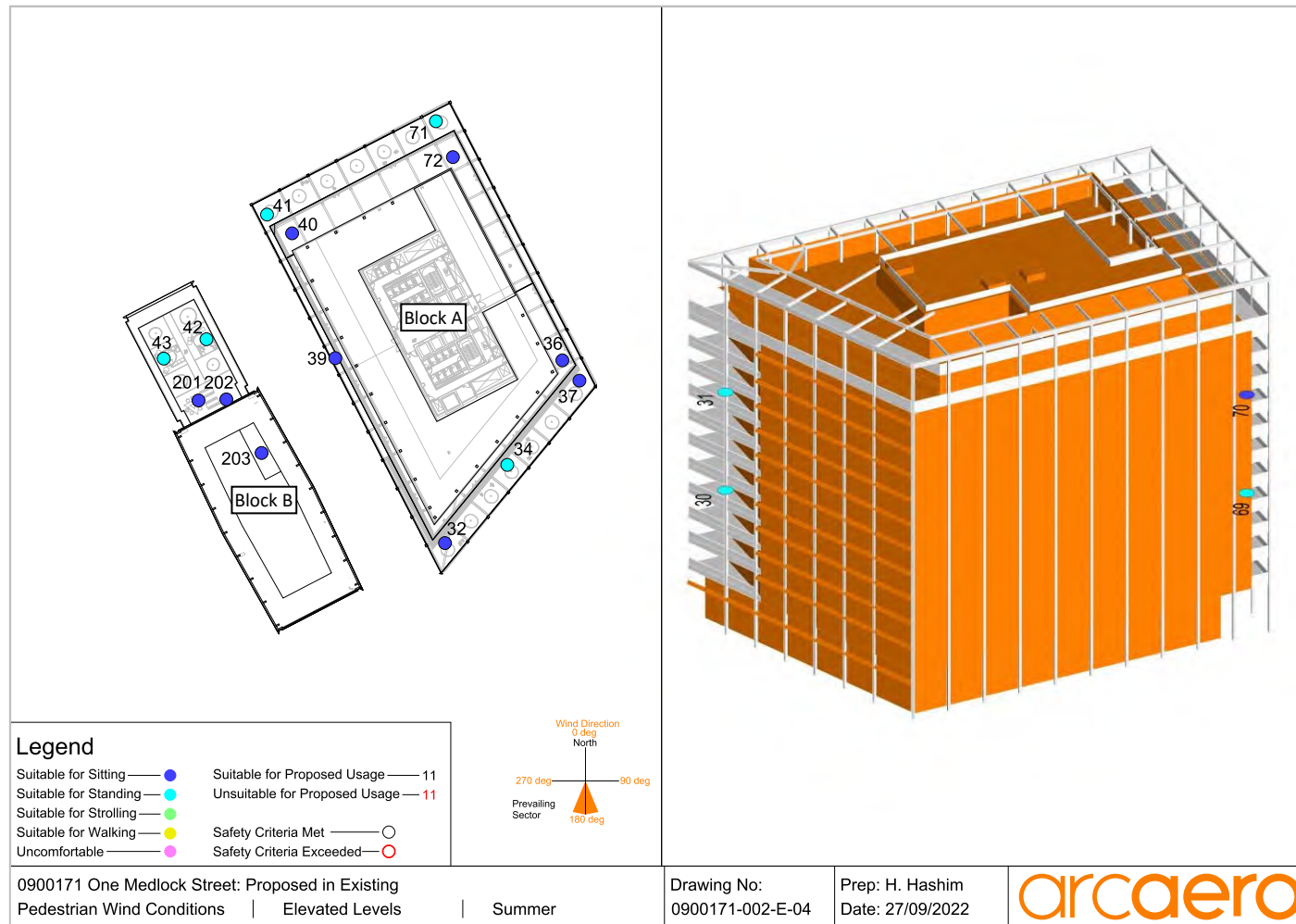


Figure 4.7 - Pedestrian wind conditions, proposed development within cumulative surrounds, 'worst' season – ground level

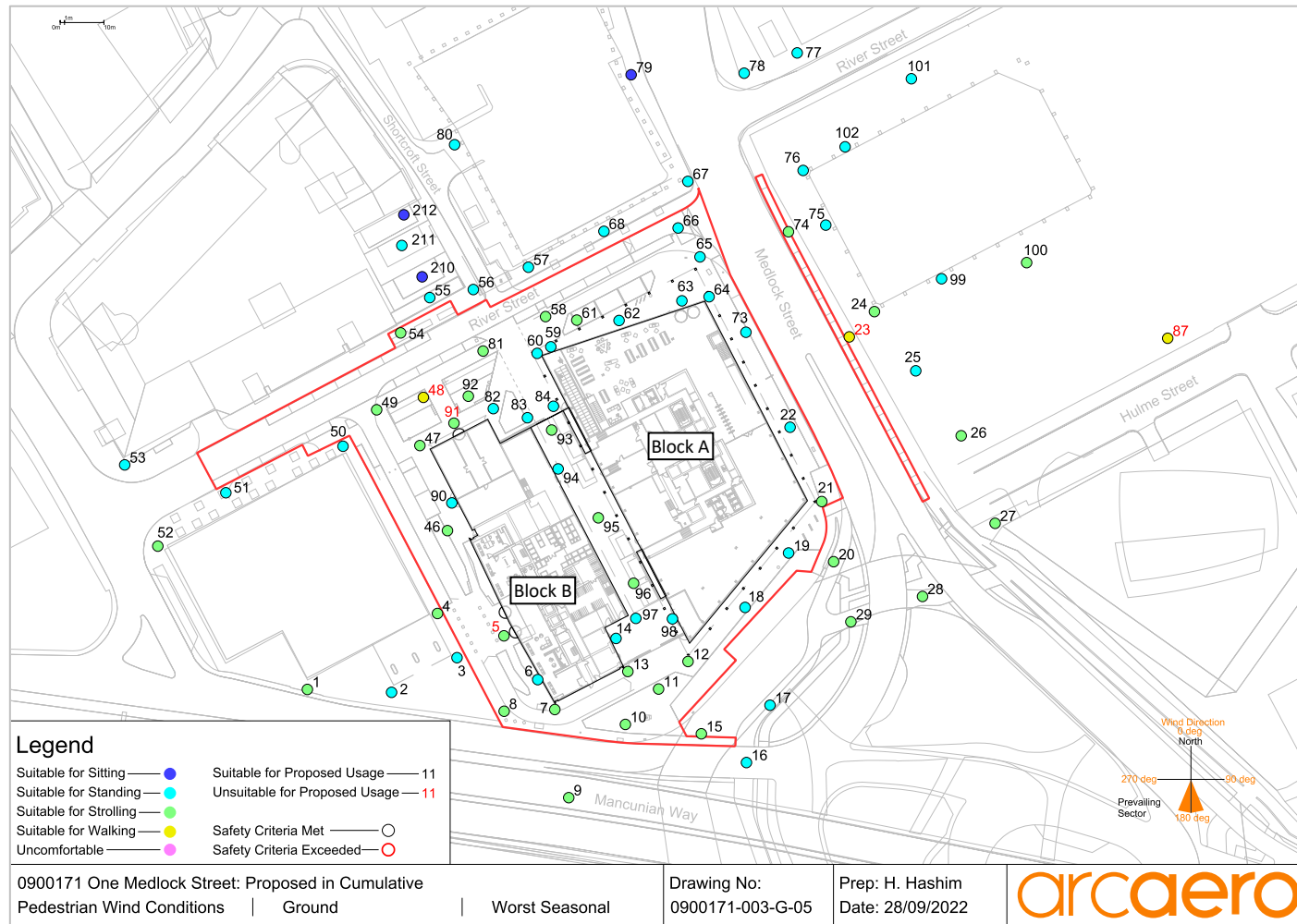


Figure 4.8 – Pedestrian wind conditions, proposed development within cumulative surrounds, 'worst' season – terrace / balcony level

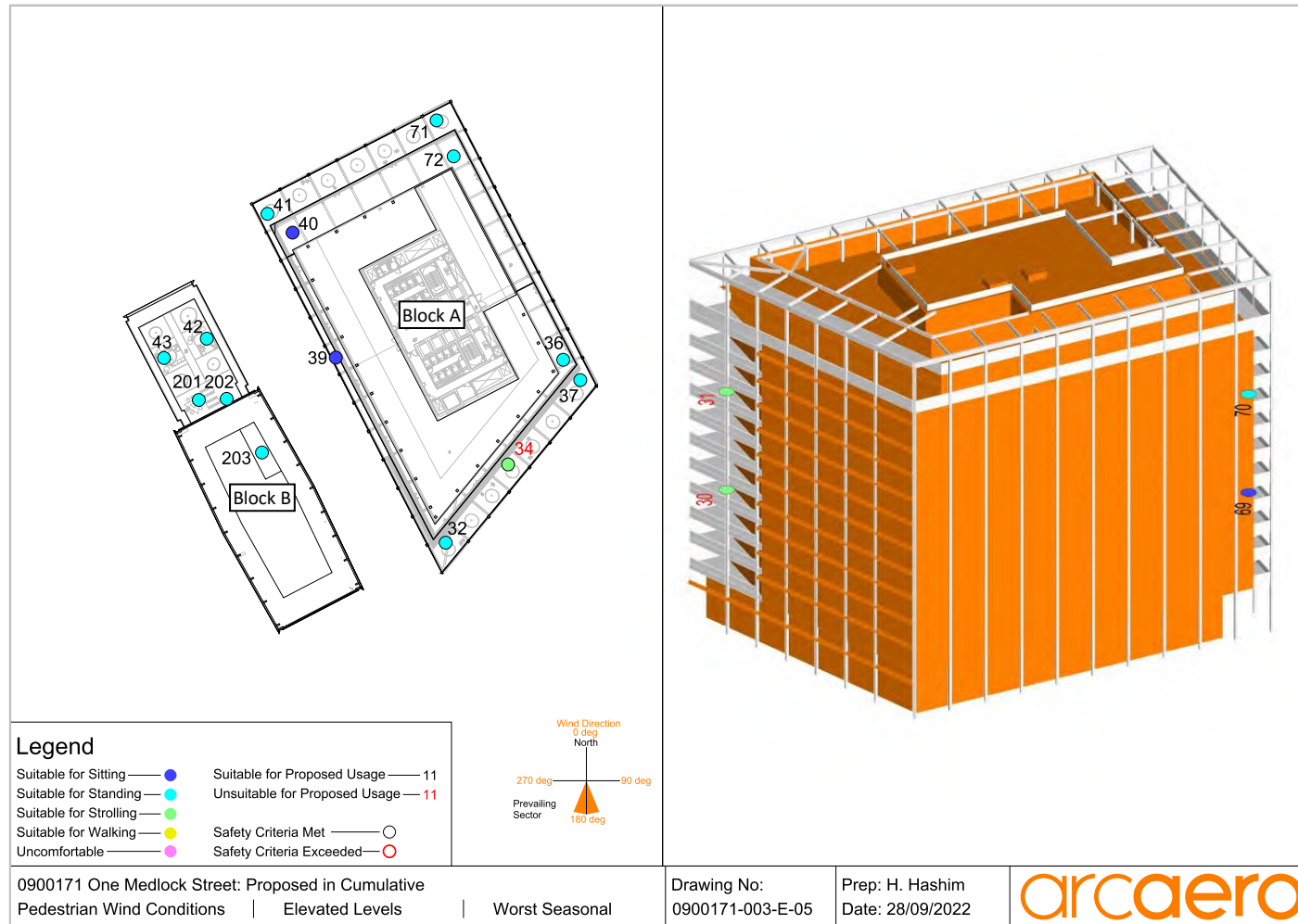


Figure 4.9 - Pedestrian wind conditions, proposed development within cumulative surrounds, summer – ground level

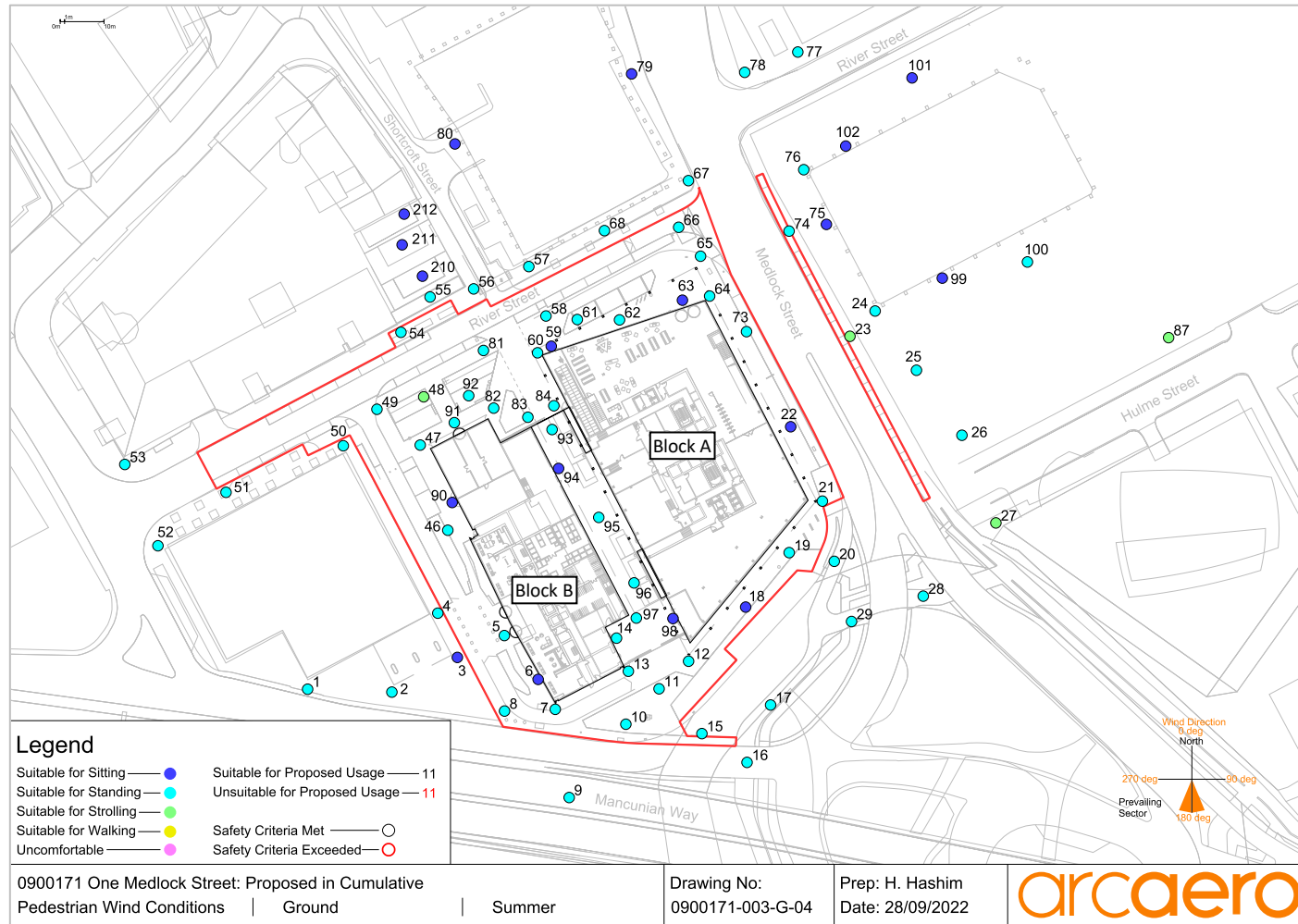
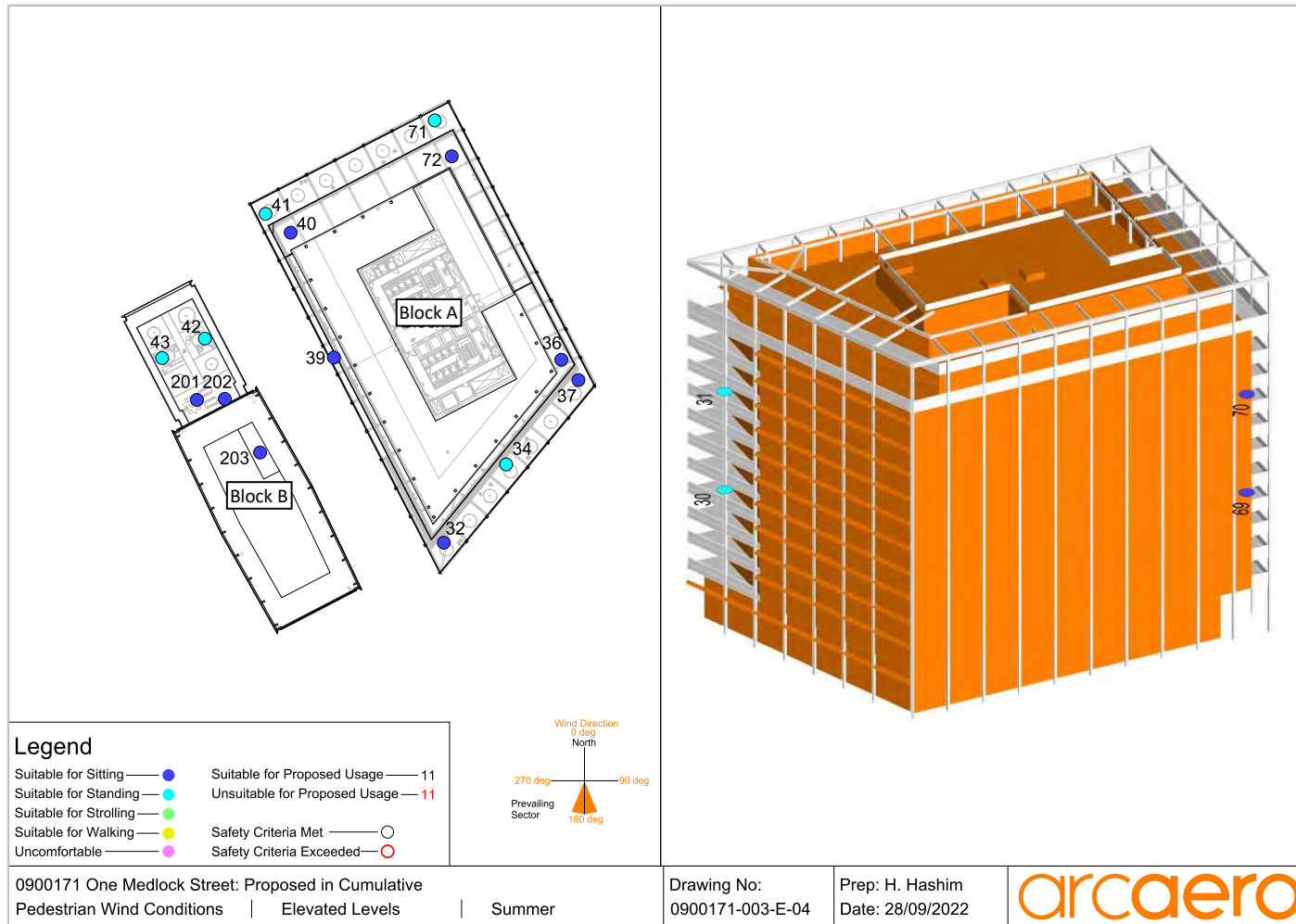


Figure 4.10 – Pedestrian wind conditions, proposed development within cumulative surrounds, summer – terrace / balcony level



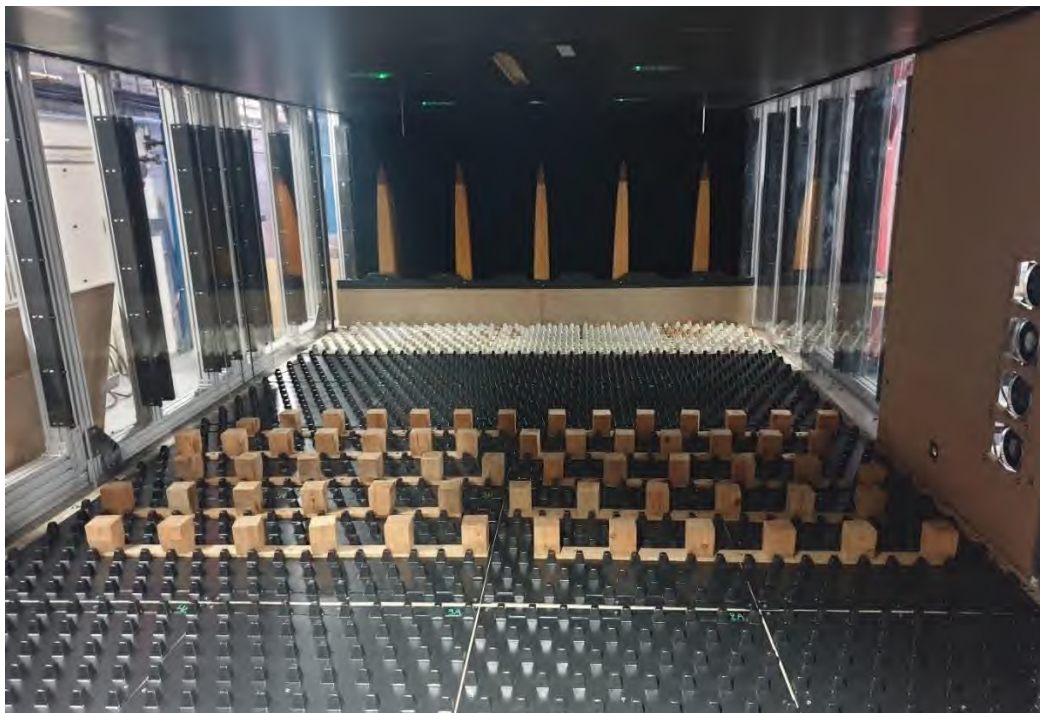
Appendix A Wind Tunnel and Model

A.1 Atmospheric Boundary Layer Modelling

The study was conducted at the Imperial College 10' x 5' atmospheric boundary layer wind tunnel in London. This closed-loop facility provides a 20m long boundary layer test section and a 3.0 m x 1.5 m test section. The wind speed operating range is 0-40 m/s.

'Roughness blocks', a 2D fence and 3D posts were used to replicate the boundary layer. These elements are presented Figure A.1.

Figure A.1 - Boundary layer creation, Imperial College boundary layer wind tunnel, London.



A.2 Wind Tunnel Models

A 1:300 scale wind tunnel was constructed from materials such as dense foam, wood and plastic. The wind microclimate was assessed at a total of 99 locations for the proposed development.

Photos of the wind tunnel model are presented as follows:

- Figure A.2 and Figure A.3: existing site conditions
- Figure A.4 and Figure A.5: proposed development within existing surrounds
- Figure A.6 and Figure A.7: proposed development within cumulative surrounds
- Figure A.8 and Figure A.9: close-ups of proposed development

Figure A.2 – Existing site conditions, viewed from north



Figure A.3 - Existing site conditions, viewed from south



Figure A.4 - Proposed development within existing surrounds, viewed from north

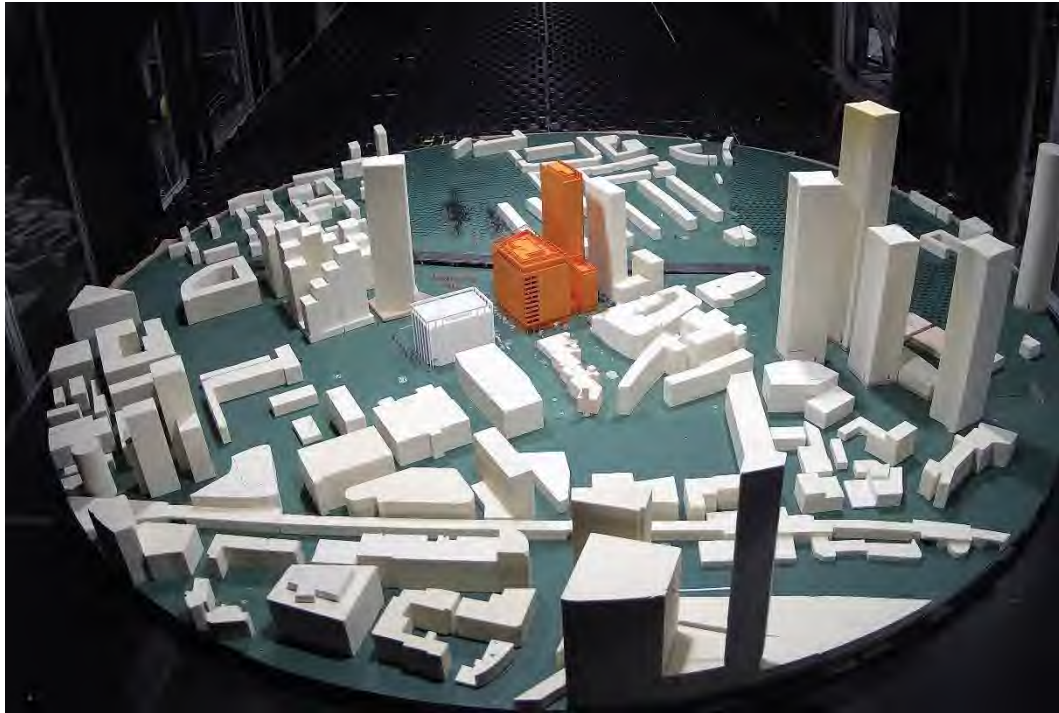


Figure A.5 - Proposed development within existing surrounds, viewed from south



Figure A.6 – Proposed development within cumulative surrounds, viewed from north

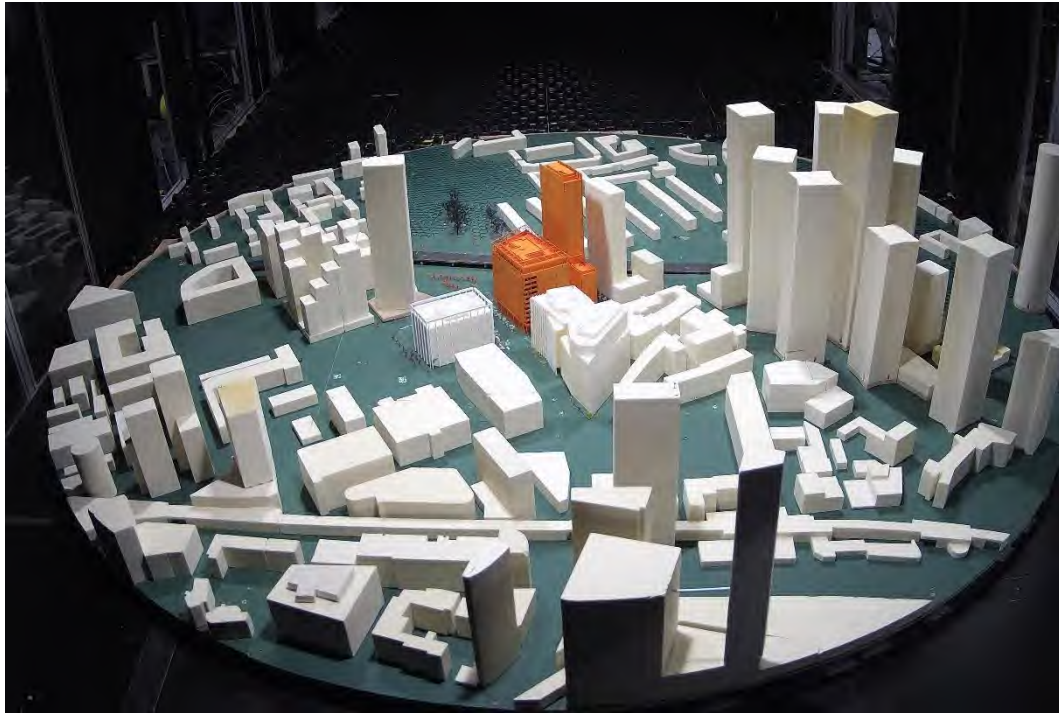


Figure A.7 – Proposed development within cumulative surrounds, viewed from south



Figure A.8 – Close-up of the proposed development within existing surrounds, viewed from southeast



Figure A.9 – Close-up of the proposed development within existing surrounds, viewed from north



A.3 Data Acquisition

Wind speed measurements were made using 'Irwin probes', capable of measuring fluctuating pressure differences that are calibrated against wind speed. A system of probes running simultaneously was used to obtain results from 99 locations at a height corresponding to 1.5m at full scale.

Data was recorded for a sufficient length of time to determine the mean and 3-second gust wind speeds.

The gust wind speed is translated to an equivalent mean wind speed, the Gust Equivalent Mean or GEM, according to the following equation:

$$U_{GEM} = \frac{U_{GUST}}{1.85}$$

The results at each location were combined with wind statistics transposed to the site to assess the exceedance of threshold wind speeds that relate to comfort and safety in accordance with the Lawson criteria.

Appendix B Wind Climate Analysis

B.1 Wind Frequency Data, Manchester International Airport

Wind microclimate studies require that wind speed data obtained from a measurement station be transposed to the site of interest. The current study employs wind data from Manchester International airport.

The wind speed history has been reformatted into the number of observations of mean-hourly wind speeds within each of several wind speed ranges, for each wind direction and for each month of the year. To facilitate the transposition of the wind data, the months are grouped into the seasons and a Weibull distribution is fitted to the wind speed distribution for each wind direction, for each season.

From the Weibull cumulative distribution, the probability that, for a given wind direction, a wind speed, V , will be exceeded is given by:

$$P(>V) = e^{-\left(\frac{V}{c}\right)^k}$$

where c is the dispersion parameter and k is the shape parameter.

To these parameters is further added the probability, p , of each wind direction occurring. Thus, for each month of the year the probability that a specified wind speed is exceeded for a specified wind direction may be calculated.

The resulting weather centre wind data is transposed to a standard reference terrain category, 'open country terrain', at sea-level, accounting for upwind terrain, topography and altitude for the weather centre. The open country wind data is then transposed to the reference height at the site of the proposed development, accounting for upwind terrain, topography and altitude for the target site.

For the transposition of wind speed data from the weather station to open country, and from open country to the site, the methods set out in ESDU item 01008 (4) (the industry standard) have been employed.

The resulting annual and seasonal directional and wind speed probability distributions at the reference height of 120m, at the proposed site, are given in Figures B.2 to B.6, respectively.

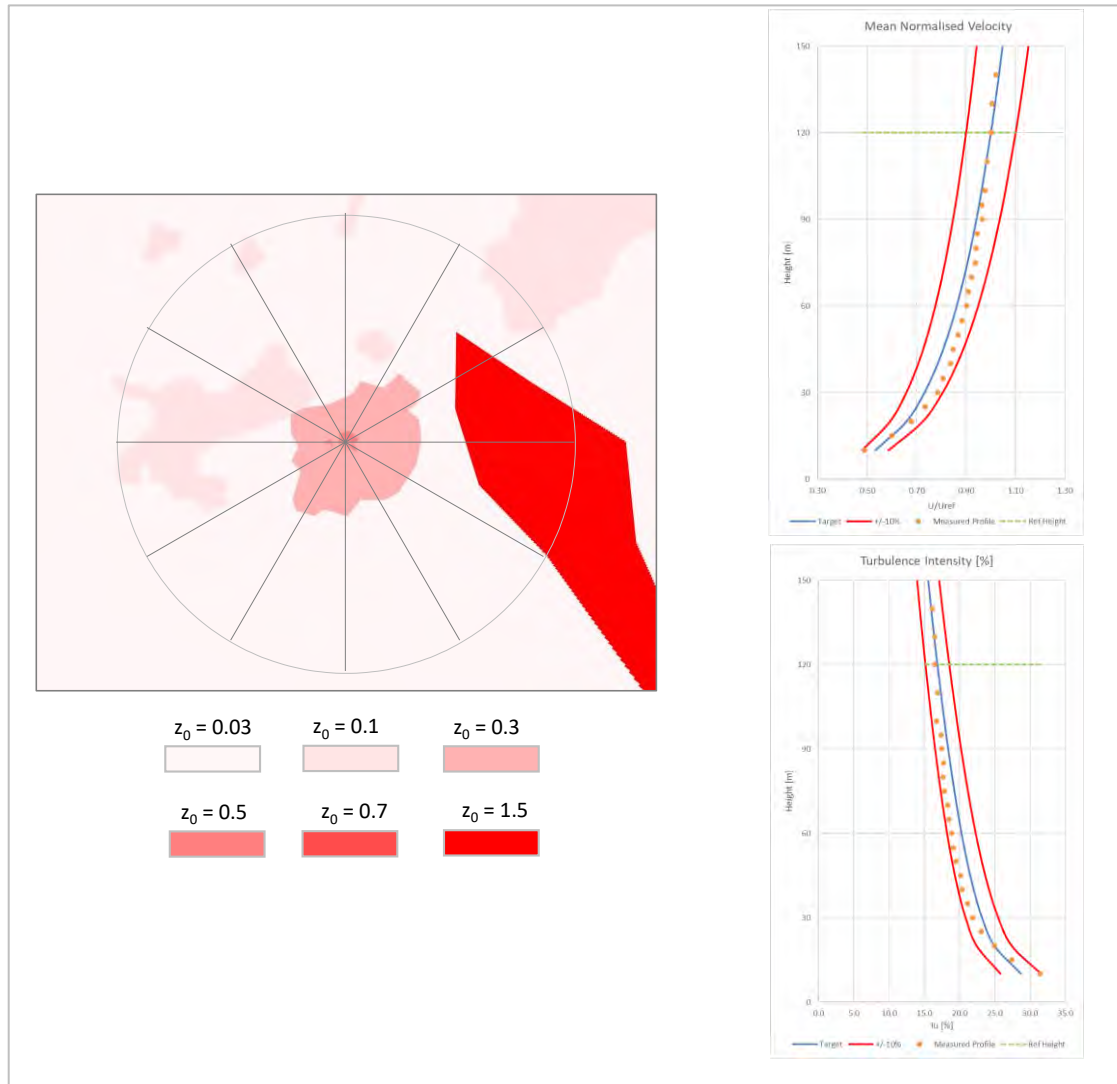
B.2 Wind Properties at the Site

A detailed analysis, based on the widely accepted Deaves and Harris model of the atmospheric boundary layer (ABL), as defined in ESDU Item 01008 (4), has been carried out to determine the wind properties at the site. From this analysis a representative profile was defined as a target for the ABL simulation in the wind tunnel.

Upon conducting the ESDU analysis, one wind profile was replicated in the wind tunnel to adequately account for wind blowing from all angles.

ArcAero's terrain analysis and resulting mean wind speed and turbulence intensity profiles are presented within Figure B.1.

Figure B.1 – Target mean wind speed and turbulence intensity profiles and wind tunnel profile



B.3 Wind Frequency Data

Wind microclimate studies require that meteorological data is transposed from a nearby weather station with sufficient wind data to produce accurate wind frequency statistics. The current study uses data from Manchester International Airport. The cumulative wind speed probability distributions, transposed to building height at site are provided in Figure B.2 to Figure B.5.

Figure B.2 – Cumulative wind speed probability distribution at site, annual

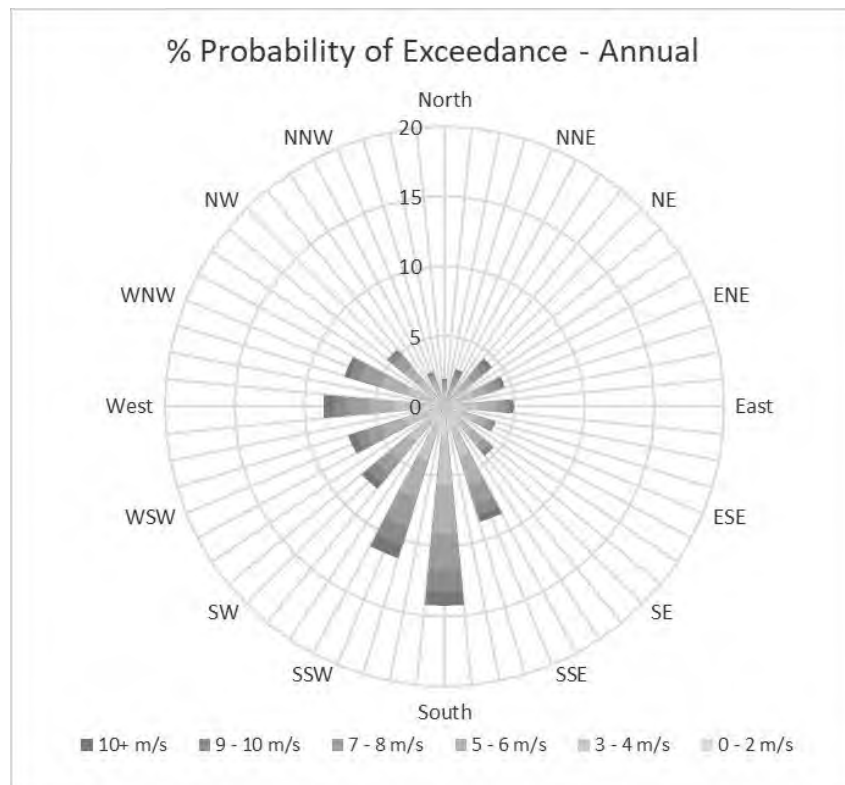


Figure B.3 – Cumulative wind speed probability distribution at site, spring

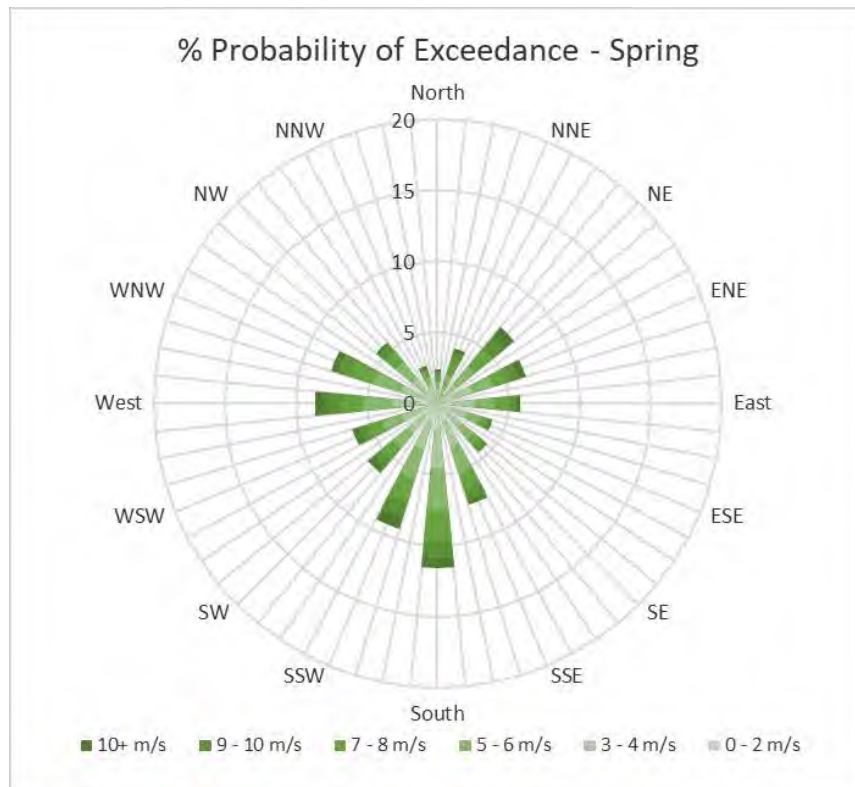


Figure B.4 – Cumulative wind speed probability distribution at site, summer

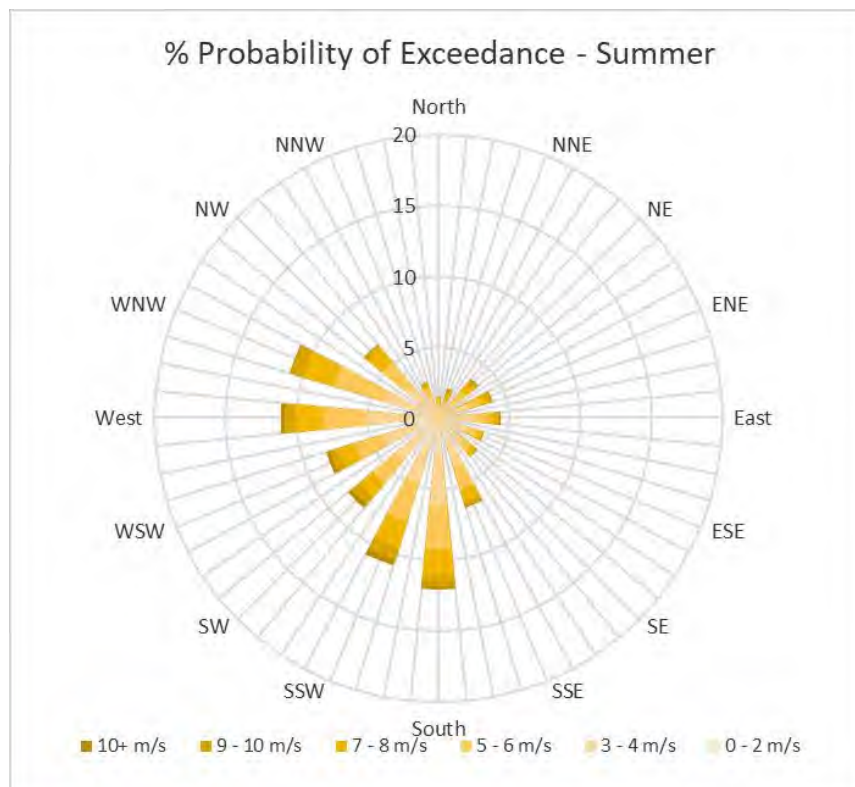


Figure B.5 – Cumulative wind speed probability distribution at site, autumn

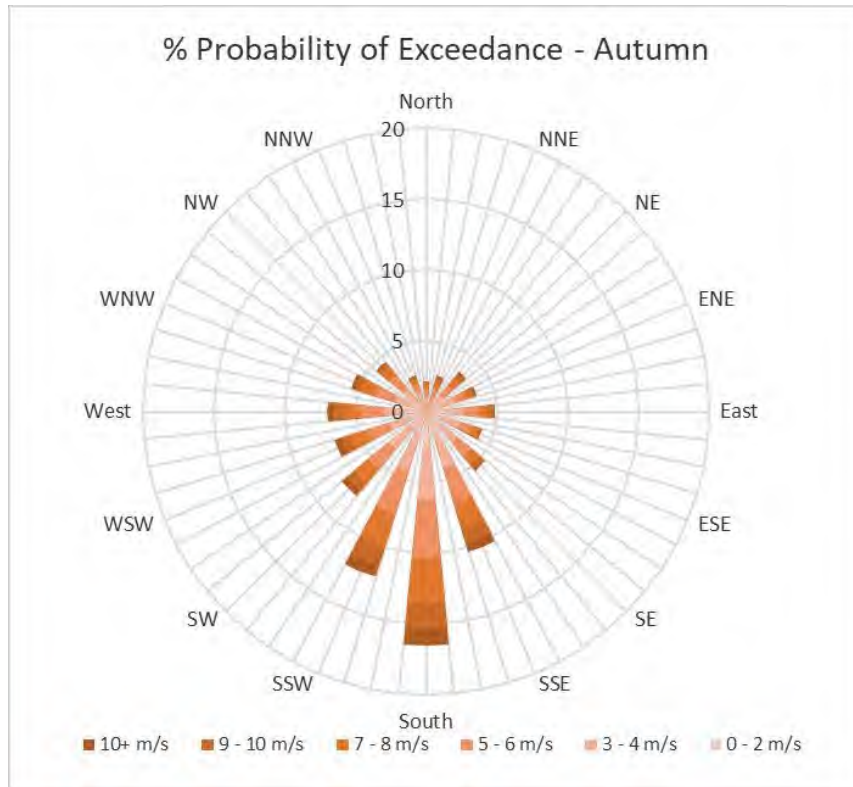
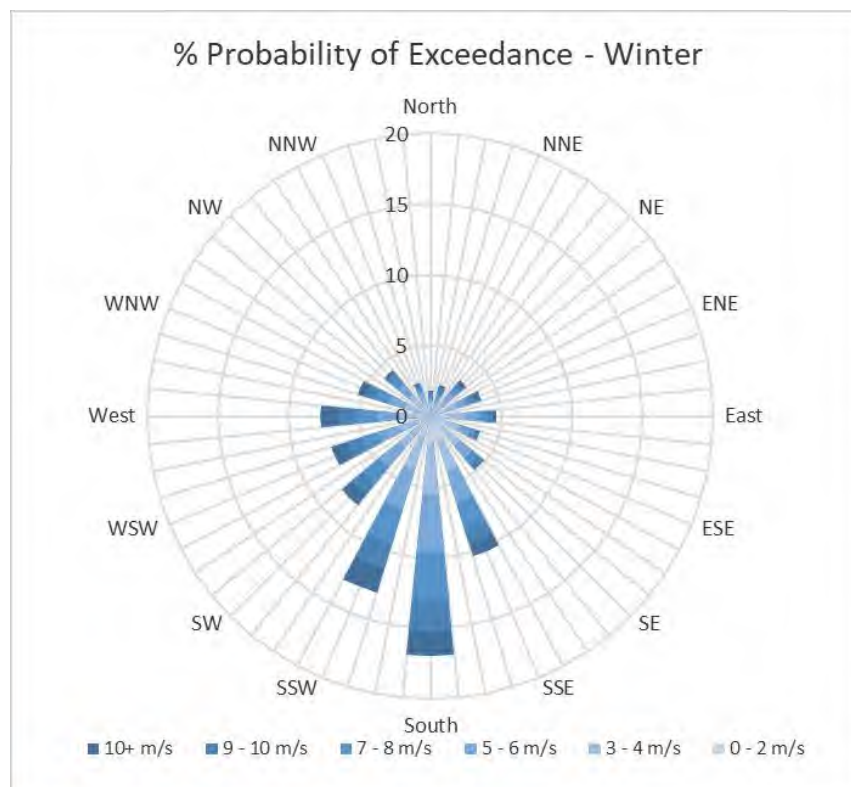


Figure B.6 – Cumulative wind speed probability distribution at site, winter



Appendix C Pedestrian / Occupant Uses

Figure C.1 – Assumed pedestrian uses, proposed development – ground level

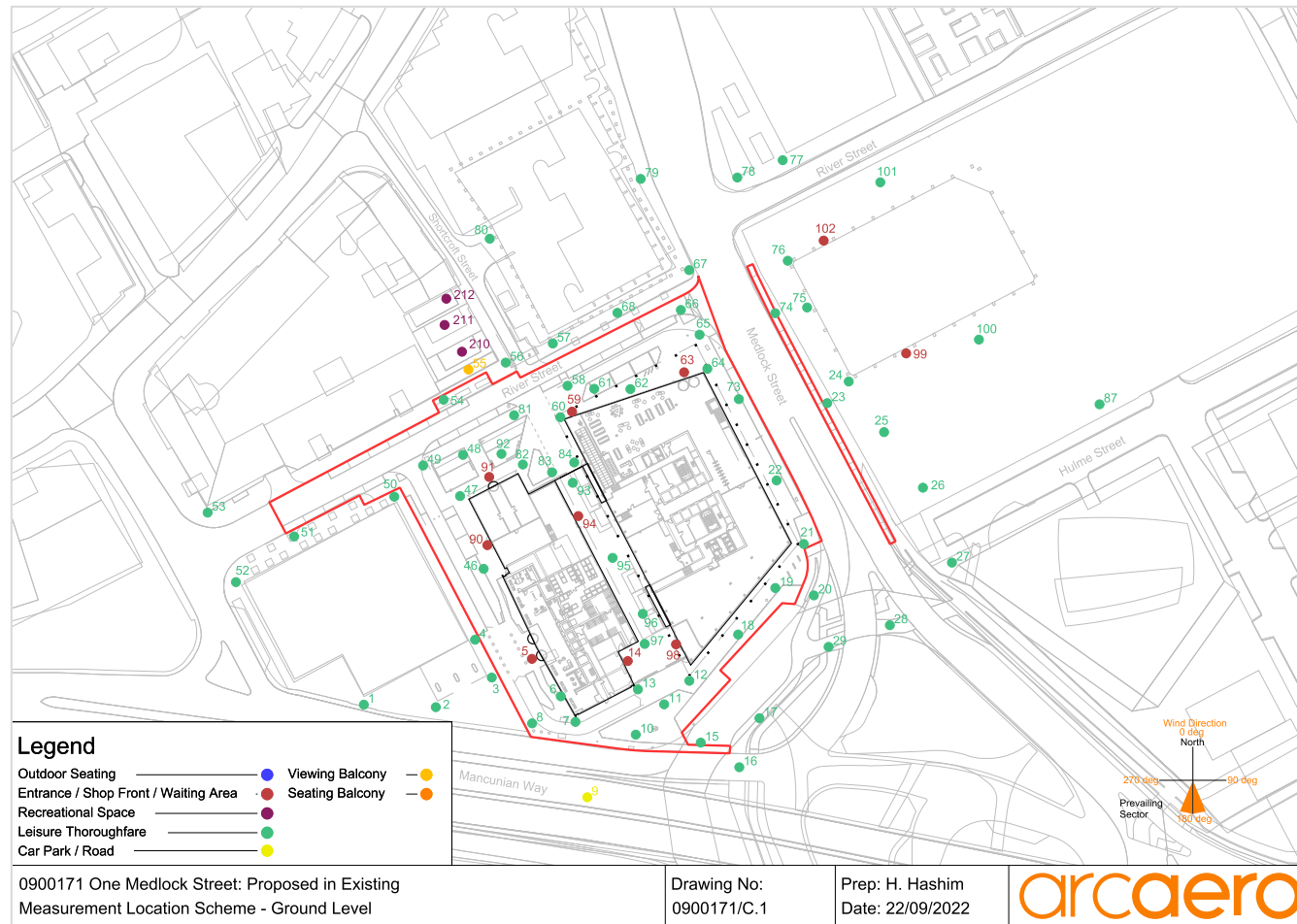


Figure C.2 – Assumed pedestrian uses, proposed development – elevated levels

