



WIND MICROCLIMATE ASSESSMENT REPORT

Waterfront Square

16 July 2024

GIA No: 19977

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1 INTRODUCTION

This report outlines the results of a wind microclimate analysis for the proposed development at Waterfront Square, Reading.

1.1 SUMMARY

Wind microclimate conditions for the proposed development at Waterfront Square were assessed using high resolution Computational Fluid Dynamics (CFD).

There are no wind safety risks associated with the proposed development.

Wind comfort conditions will be suitable for the intended use for all thoroughfares, existing building entrances, proposed building entrances, bus stops, the Thames Path, existing amenity spaces, and proposed amenity at ground level, level 1, level 5 and level 8.

The cumulative impact of future committed developments would be negligible on the wind environment around the site.

1.2 GUIDANCE

Planning Practice Guidance

The Planning Practice Guidance (2021) identifies the potential for tall and large buildings to affect wind microclimate. The National Design Guide (2021) states in Paragraph 71 that:

“Proposals for tall buildings (and other buildings with a significantly larger scale or bulk than their surroundings) require special consideration. This includes their [...] environmental impacts, such as [...] wind. These need to be resolved satisfactorily”

2 METHOD

To identify the likely effect of the proposed development on the pedestrian level wind environment, a 3D CFD model of the development and surrounding site was created. This section describes the methodology for the creation of this model and the inputs used.

2.1 ASSESSMENT METHODOLOGY

The assessment was performed using GIA’s high-resolution Computational Fluid Dynamics (CFD) modelling.

CFD is a digital modelling technique, which simulates the effect of wind for the built environment. The air is divided into hundreds of millions of “cells”, within which the equations of motion are solved. GIA uses cloud computing from Amazon Web Services (AWS) to run the simulations, to ensure vast scalability and appropriate resource availability for any project.

A full description of the test methodology is included in Appendix 01.

2.2 ESTABLISHING MICROCLIMATE CONDITIONS

Microclimate conditions were established using a high resolution CFD model, extending 400m radius from the Site.

A model of the development was included within the CFD model and tested to determine the conditions at and around the Site. The model used is shown in Figure 1, Figure 2 and Figure 3.

The model was run at full scale from 18 wind angles, spaced using 10° or 30° increments such that no sector contributes more than 10% of the annual wind. The wind angles which were run are indicated in Appendix 01.

Wind speeds were measured at 1.5m above any surfaces expected to be used for pedestrian activity.

On-site and local wind speeds were combined with wind statistics from 30 years of data recorded at London Heathrow and City airports for variations in terrain between the airports and the site, to obtain annual and seasonal frequency and magnitude of wind speeds across the model. This allows the ‘grading’ of the pedestrian level winds according to the Lawson Comfort Criteria, which are explained later in this report.

The mean correction factors between the site and the airport are shown in Table 1.

The wind microclimate effects are assessed annually, for the winter months (December, January and February) and for the summer months (June, July, August). Winter conditions are reported as this is the season when the strongest winds are expected, summer conditions are reported as this is the season when pedestrian usage of outdoor spaces is expected to be highest.

2.3 LIMITATIONS AND ASSUMPTIONS

The accuracy of the results is dependent upon the accuracy of the CAD used to construct the model.

The assessment herein is valid to the design as supplied to GIA at the time of the assessment, and does not cover future variations in the design.

There is an inherent assumption that on-site wind speeds will scale linearly with the measured wind speeds at the airport.

There is an inherent assumption that the wind speed statistics for the past 30 years will remain applicable for the foreseeable future.

Table 01: Site Wind Correction Factors

DIRECTION (°N)	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
Corr. Factor	1.41	1.42	1.44	1.43	1.39	1.45	1.46	1.51	1.46	1.41	1.41	1.4

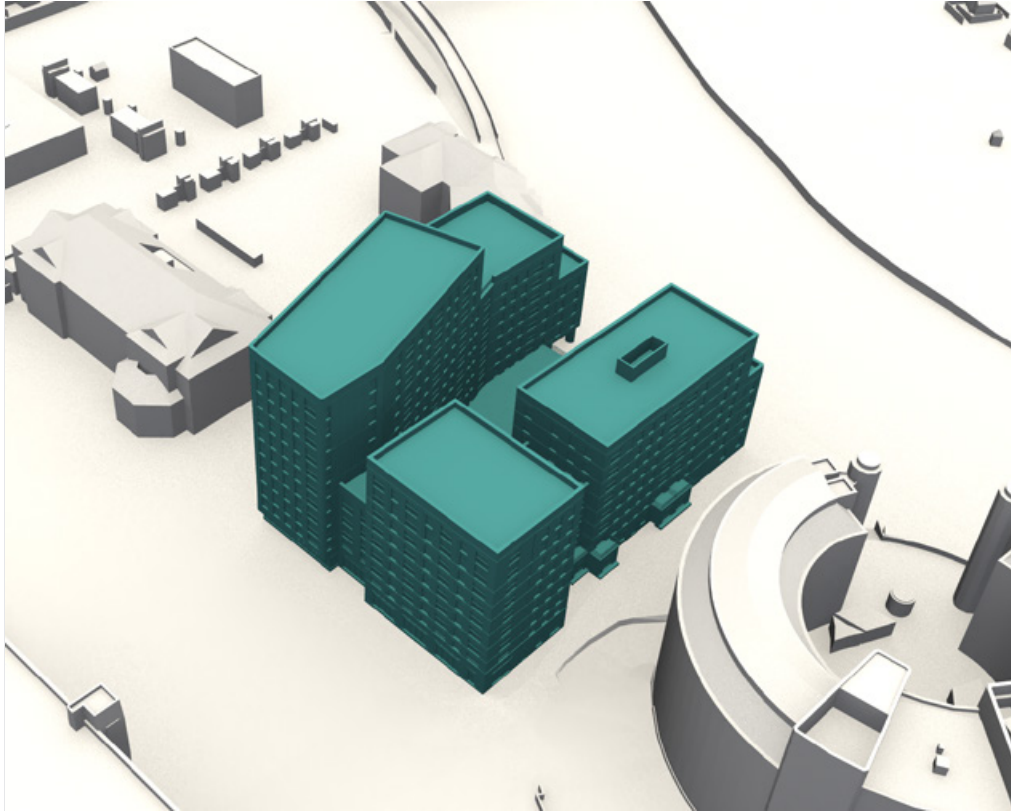


Fig. 01: 3D View of proposed Development



Fig. 02: Proposed Development with Existing Surrounds



Fig. 04: Proposed Development with Cumulative Surrounds

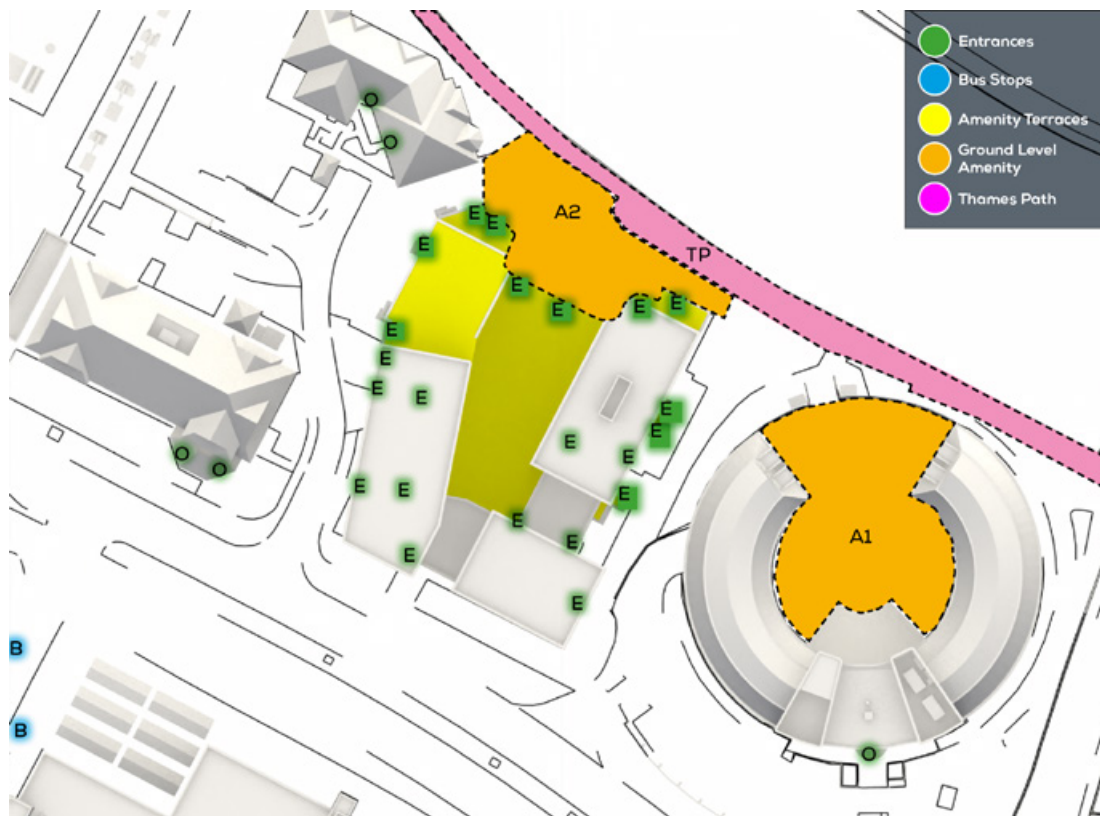


Fig. 03: Sensitive Wind Receptors

2.4 LAWSON COMFORT AND SAFETY CRITERIA

The assessment was graded against the Lawson Comfort and Safety Criteria.

Table 2 and Table 3 show the banding of the various categories within the Lawson Comfort and Safety criteria.

Comfort categories are based on the level of wind speed exceedance for 5% of each season, and safety categories are based on the level of wind speed exceedance for ~2 hours per year.

The assessment was performed using the London Docklands Development Corporation (LDDC) variant of the Lawson Comfort Criteria. The Lawson Criteria are well-established in the UK for quantifying wind conditions in relation to build developments and, although not a UK 'standard', the criteria are recognised by local authorities as a suitable benchmark for wind assessments. The Lawson Criteria have been adopted for this assessment.

Table 02: Lawson Comfort Criteria (LDDC variant)

KEY	COMFORT CATEGORY	MEAN WIND SPEED (5% EXCEEDANCE)	DESCRIPTION
	Sitting	4 m/s	Acceptable for outdoor sitting use (e.g. cafés, benches, balconies and terraces)
	Standing	6 m/s	Acceptable for main building entrances, pick-up / drop-off points and bus stops
	Walking (leisure)	8 m/s	Acceptable for strolling
	Walking (business)	10 m/s	Acceptable for external pavements, walking purposefully without lingering
	Uncomfortable	>10 m/s	Not comfortable for regular pedestrian access

Table 03: Lawson Safety Criteria (LDDC variant)

KEY	SAFETY CATEGORY	MEAN WIND SPEED (0.025% EXCEEDANCE)	DESCRIPTION
	No Safety Exceedance	<15 m/s	
	S15 (Distress)	>15 m/s	Unsafe for frail individuals, or cyclists
	S20 (Safety)	>20m/s	Wind conditions considered unsafe for all users

2.5 TARGET CONDITIONS

Any areas which show up as either unsafe (annually) or uncomfortable (for winter) will require mitigation, unless they are in locations where pedestrian access can be controlled in the event of strong winds. This applies to all thoroughfares (for pedestrians) and roads (for cyclists) around the Development.

The areas immediately outside any building entrances should be suitable for standing use during winter to provide a “buffer” between the still conditions in interior spaces and the general thoroughfare. The principal entrances to the proposed development are marked “E” on Figure 4, and principal off-site entrances are marked “O”.

The Reading North interchange bus stops are targeted to be suitable for standing at worst.

Mixed amenity spaces are targeted to be suitable for a mixture of sitting and standing in summer. There is existing amenity within the courtyard of the Thames Water building (marked “A1” on Figure 4). There is proposed communal amenity spaces at ground floor (marked “A2”) as well as communal terraces at levels 1 and 8 and private terraces at level 5.

The Thames Path is targeted to be suitable for standing in summer.

The locations of sensitive receptors are shown in Figure 4.

2.6 TEST SCENARIOS

The purpose of these tests was to compare conditions with and without the proposed development.

The following scenarios were tested:

- Baseline: The existing building on site, with the existing surrounds (including any planning consented schemes which are under construction at the time of writing);
- Proposed Development with Existing Surrounds: The completed and operational development with the existing surrounds; and
- Proposed Development with Cumulative Surrounds: The completed and operational development with the existing surrounds plus local planning consented schemes.

A review of planning consented schemes in the local area was undertaken. The following consented scheme was identified as sufficient to influence the wind environment and was included as a cumulative scheme in Scenario 3:

- 55 Vastern Road (planning ref. 231673)

Trees and soft landscaping were not included in the model, to ensure conservative results.

3 RESULTS

3.1 BASELINE CONDITIONS

Ground Level Conditions

Annual safety at ground level for the baseline scenario is shown in Figure 5. Winter comfort at ground level for the baseline scenario is shown in Figure 6. Summer comfort at ground level for the baseline scenario is shown in Figure 7.

There are no wind safety risks identified within the study area.

Conditions range between suitable for sitting, standing and leisure walking. The region which is only suitable for walking is less extensive in summer than in winter.

All principal off-site entrances (marked "O" in results figures) are suitable for either sitting or standing in all seasons. This is suitable for the intended use.

The Reading North Interchange bus stops (marked "B" in results figures) are suitable for standing in winter and sitting in summer. This is suitable for the intended use.

The Thames Path (marked "TP" in results figures) is suitable for a mix of sitting and standing in all seasons. This is suitable for the intended use.

The Thames Water building courtyard amenity (marked "A1" in results figures) is suitable for a mix of sitting and standing in winter and for sitting in summer. This is suitable for the intended use,

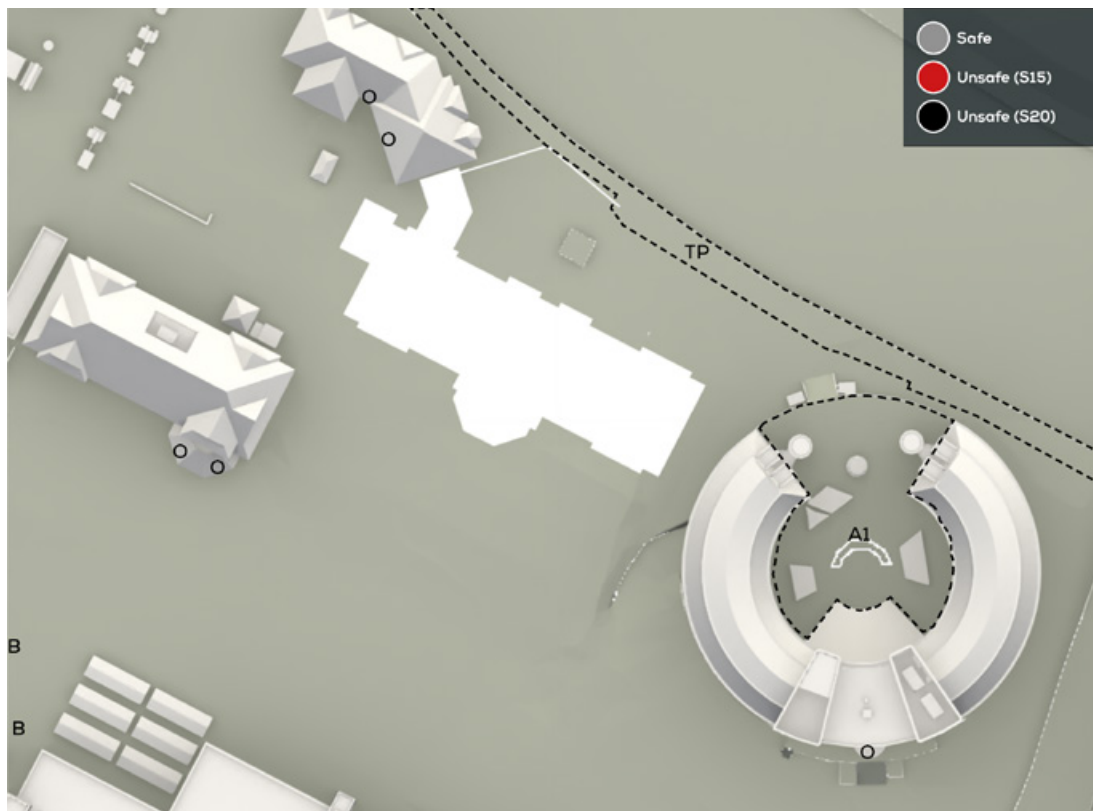


Fig. 05: Annual Safety, Baseline

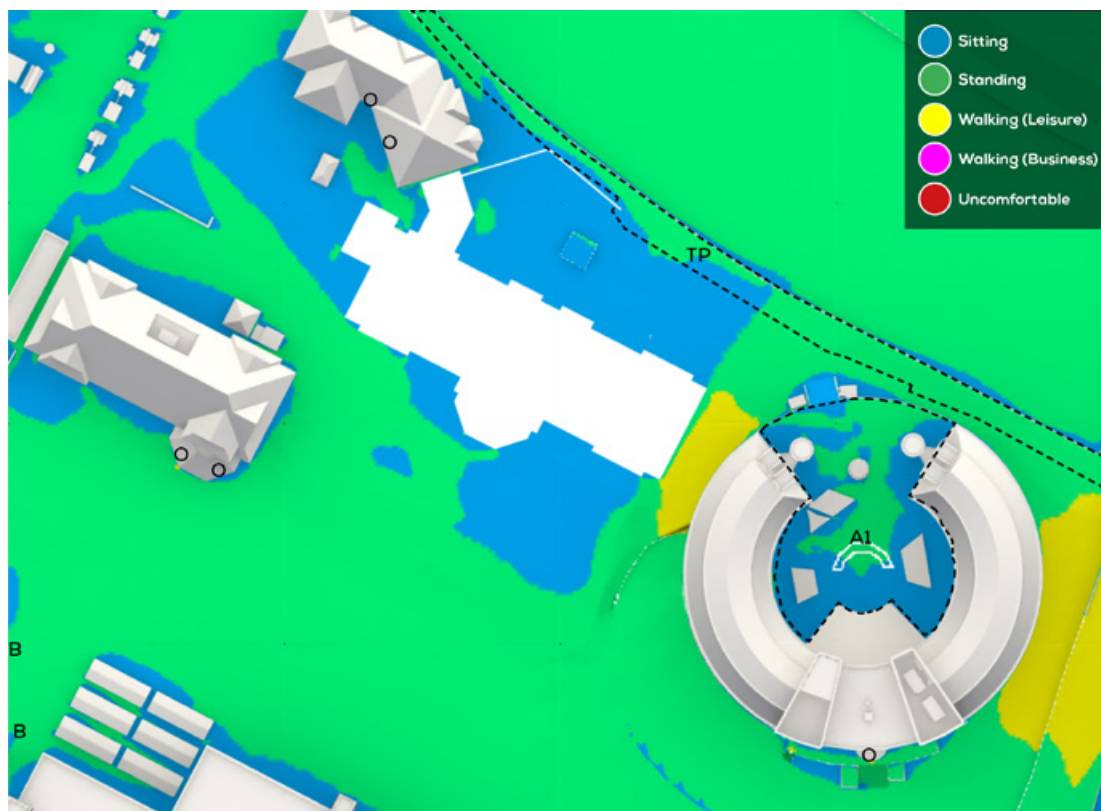


Fig. 06: Winter Comfort, Baseline

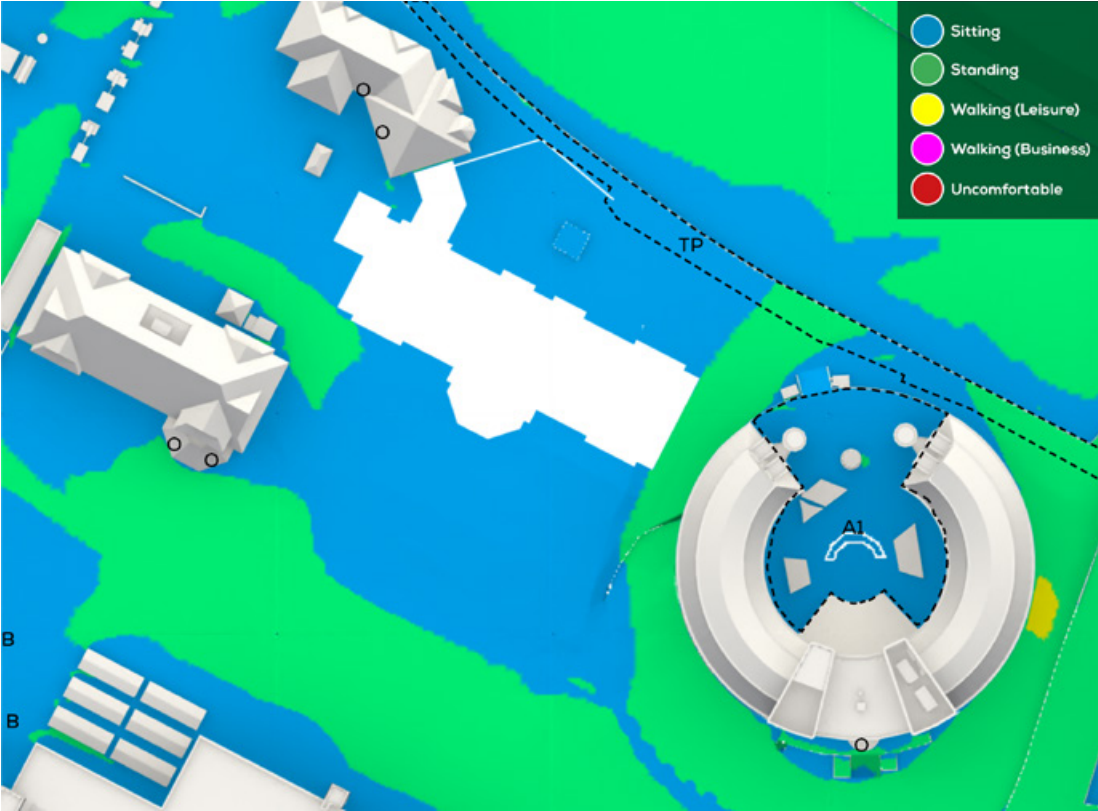


Fig. 07: Summer Comfort, Baseline

3.2 CONDITIONS FOR PROPOSED DEVELOPMENT WITH EXISTING SURROUNDS

Ground Level Conditions

Annual safety at ground level for the proposed development with existing surrounds is shown in Figure 8. Winter comfort at ground level for the proposed development with existing surrounds is shown in Figure 9. Summer comfort at ground level for the proposed development with existing surrounds is shown in Figure 10.

There are no wind safety risks identified within the study area.

Conditions range between suitable for sitting, standing and leisure walking. The region which is only suitable for walking is less extensive in summer than in winter.

Conditions for the proposed entrances (marked "E" in results figures) are suitable for either sitting or standing in all seasons. This is suitable for the intended use,

All principal off-site entrances (marked "O" in results figures) are suitable for either sitting or standing in all seasons. This is suitable for the intended use.

The Reading North Interchange bus stops (marked "B" in results figures) are suitable for sitting or standing in winter and sitting in summer. This is suitable for the intended use.

The Thames Path (marked "TP" in results figures) is suitable for a mix of sitting, standing and leisure walking in winter and a mix of sitting and standing in summer. This is suitable for the intended use.

The Thames Water building courtyard amenity (marked "A1" in results figures) is suitable for a mix of sitting and standing in winter and for sitting in summer. This is suitable for the intended use,

The proposed ground floor amenity in the form of the public square to the north of the

site (marked "A2" in results figures) would be suitable for a mix of sitting, standing and leisure walking in winter and for a mix of sitting and standing in summer (with the majority of the space suitable for sitting). This is suitable for the intended use.

Terrace Level Conditions

Annual safety at elevated levels for the proposed development with existing surrounds is shown in Figure 11. Winter comfort at elevated levels for the proposed development with existing surrounds is shown in Figure 12. Summer comfort at elevated levels for the proposed development with existing surrounds is shown in Figure 13.

There is one highly localised region of S15 exceedance at the south west of the level 8 communal terrace. Access to this region is inhibited by the landscaped terrace edge, and also the open railing (which was adjacent to this region in the model used for wind testing) has been replaced by a solid parapet for the final design of the proposed development, which would reduce speed of winds which enter the terrace from the south west corner. As such, this will not cause a wind safety risk to terrace users.

Conditions for the proposed communal level 1 terrace would be suitable for sitting in all seasons. This is suitable for the intended use.

Conditions for the proposed private level 5 terraces would be suitable for sitting in all seasons. This is suitable for the intended use.

Conditions for the proposed communal level 8 terrace would be suitable for a mix of sitting and standing in all seasons. This is suitable for the intended use.

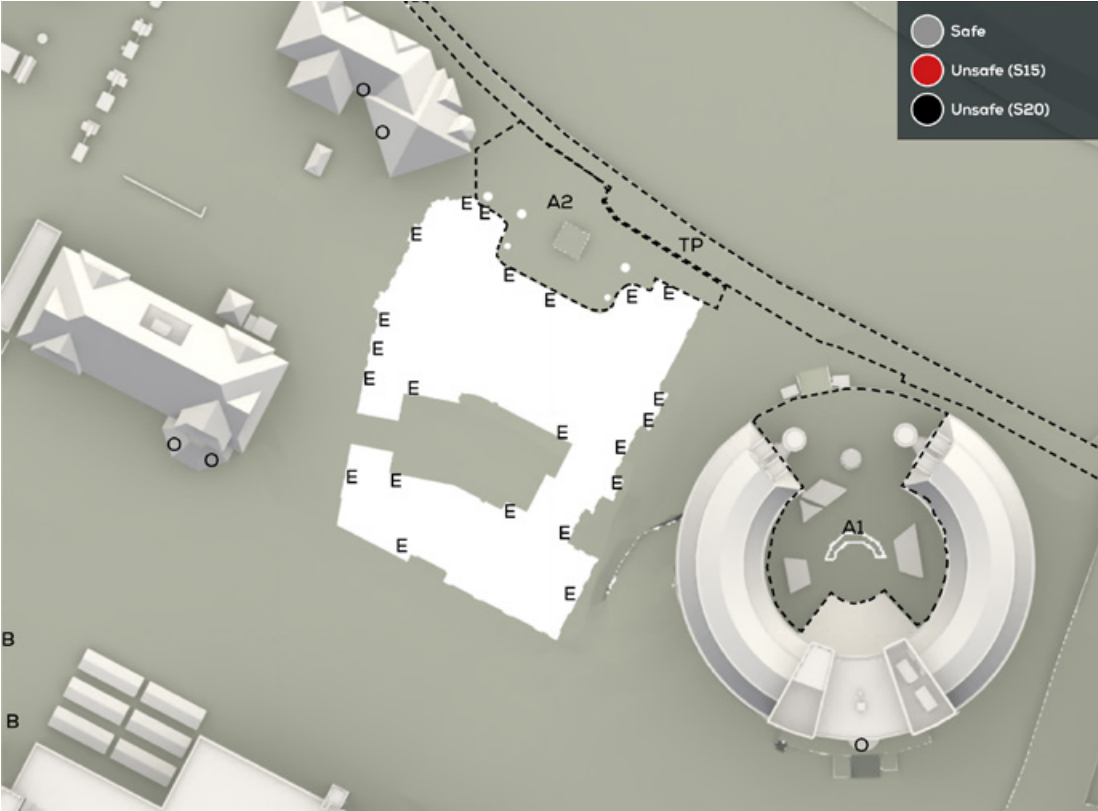


Fig. 08: Annual Safety, Proposed Development with Existing Surrounds

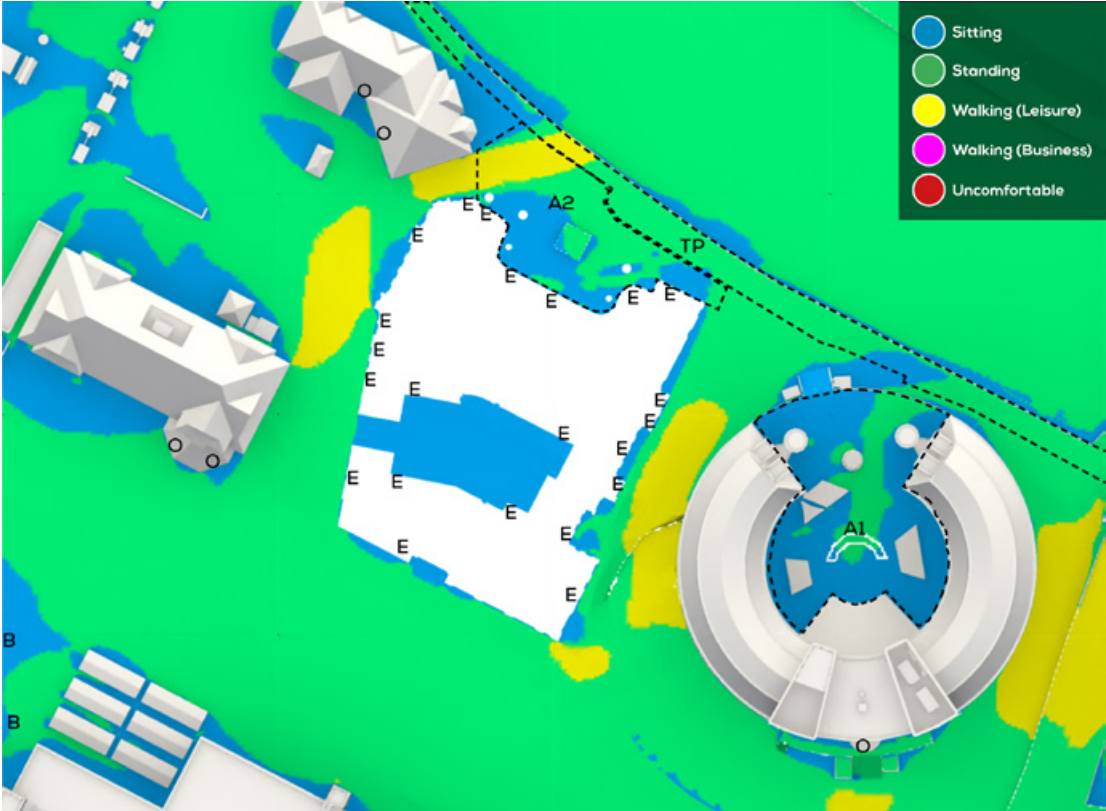


Fig. 09: Winter Comfort, Proposed Development with Existing Surrounds

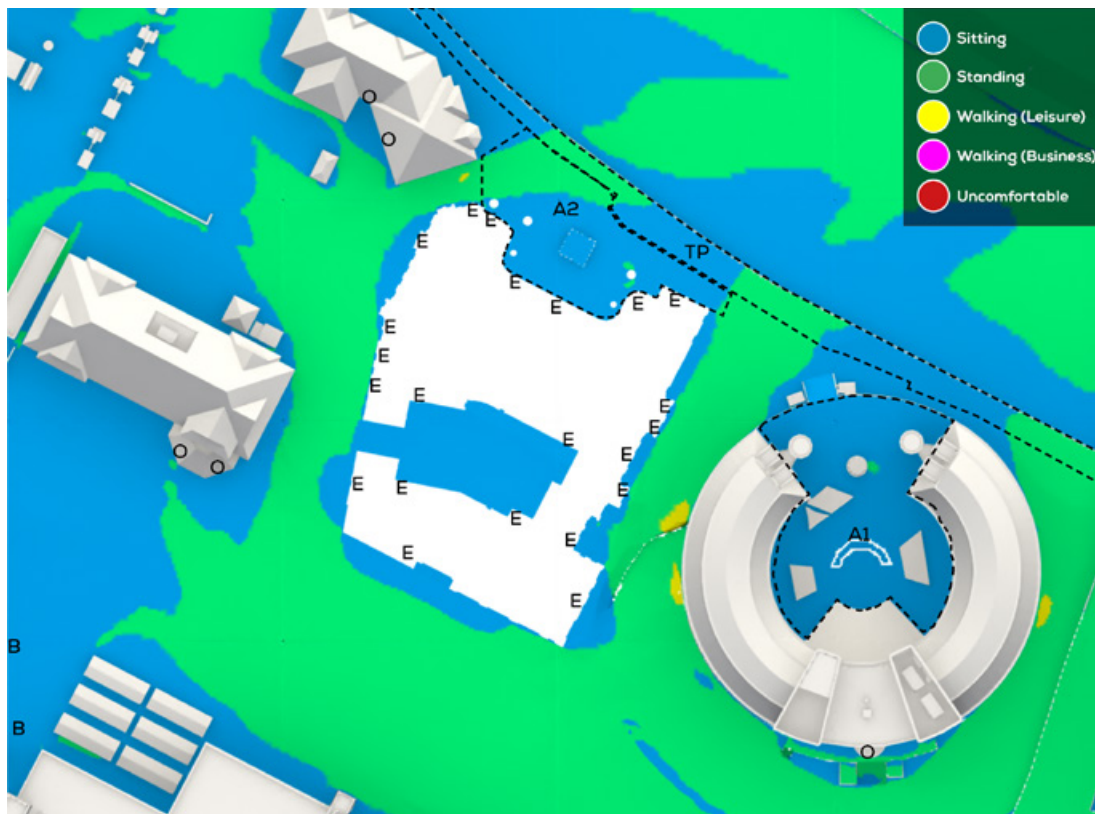


Fig. 10: Summer Comfort, Proposed Development with Existing Surrounds

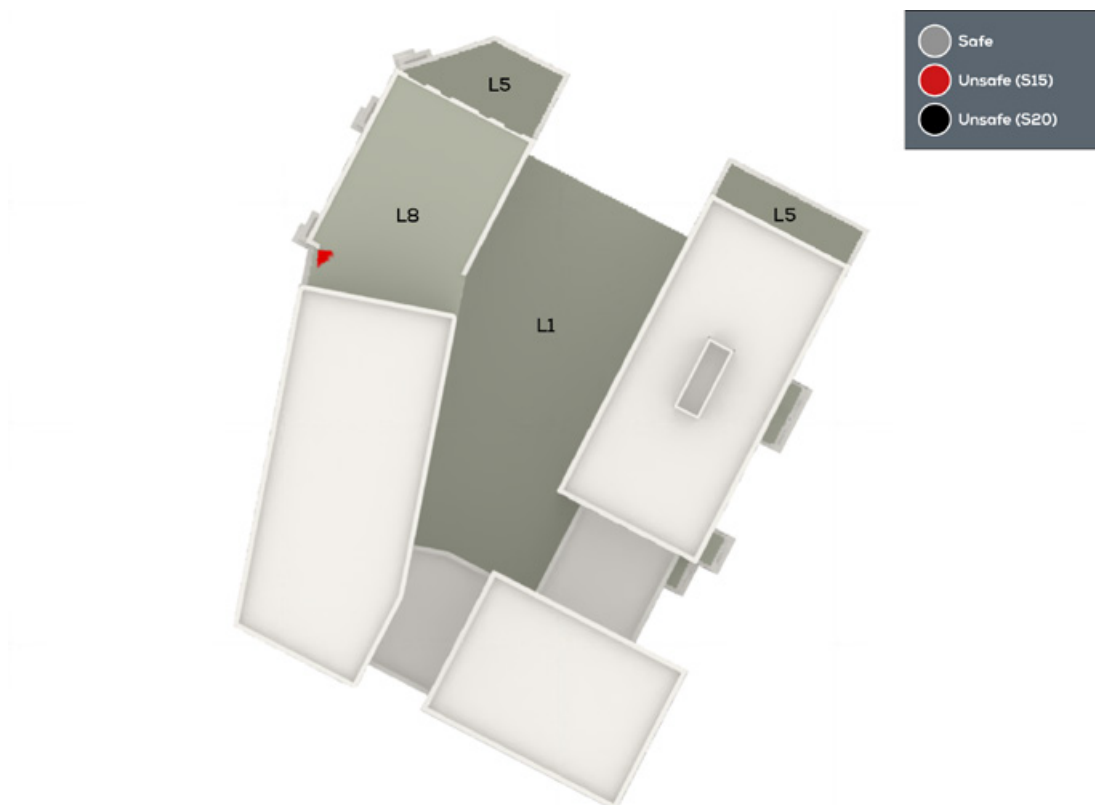


Fig. 11: Annual Safety at Elevated Levels, Proposed Development with Existing Surrounds

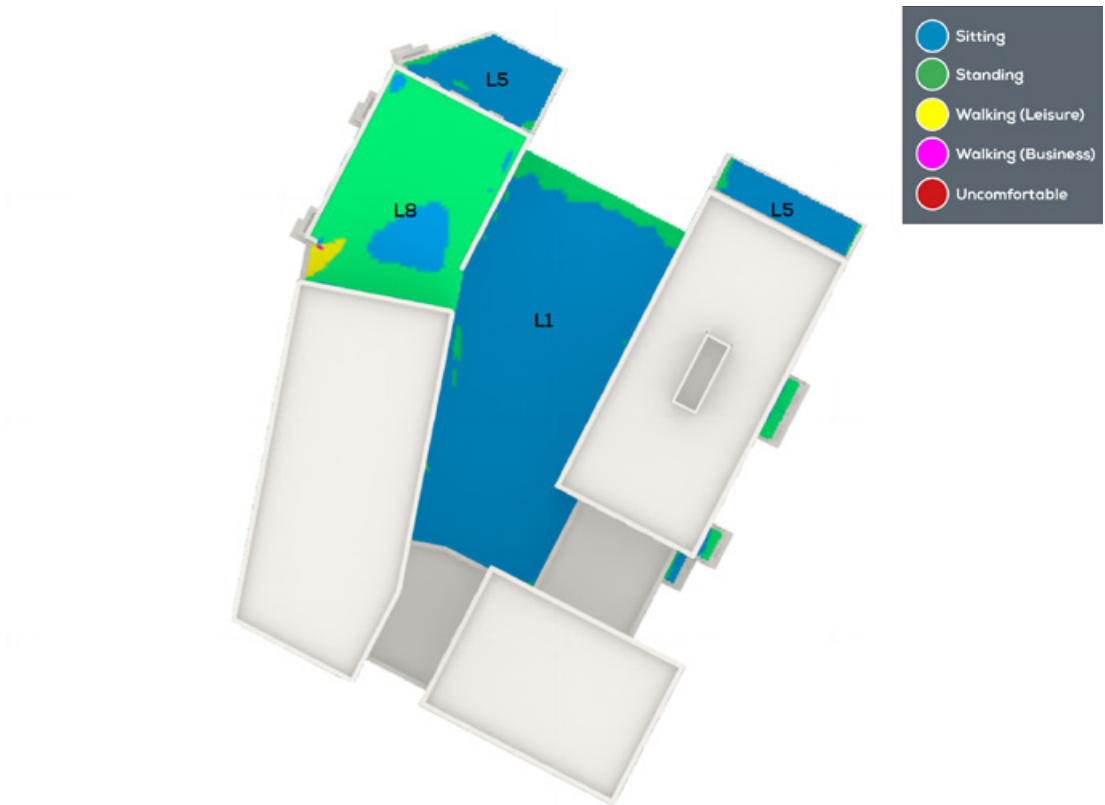


Fig. 12: Winter Comfort at Elevated Levels, Proposed Development with Existing Surrounds

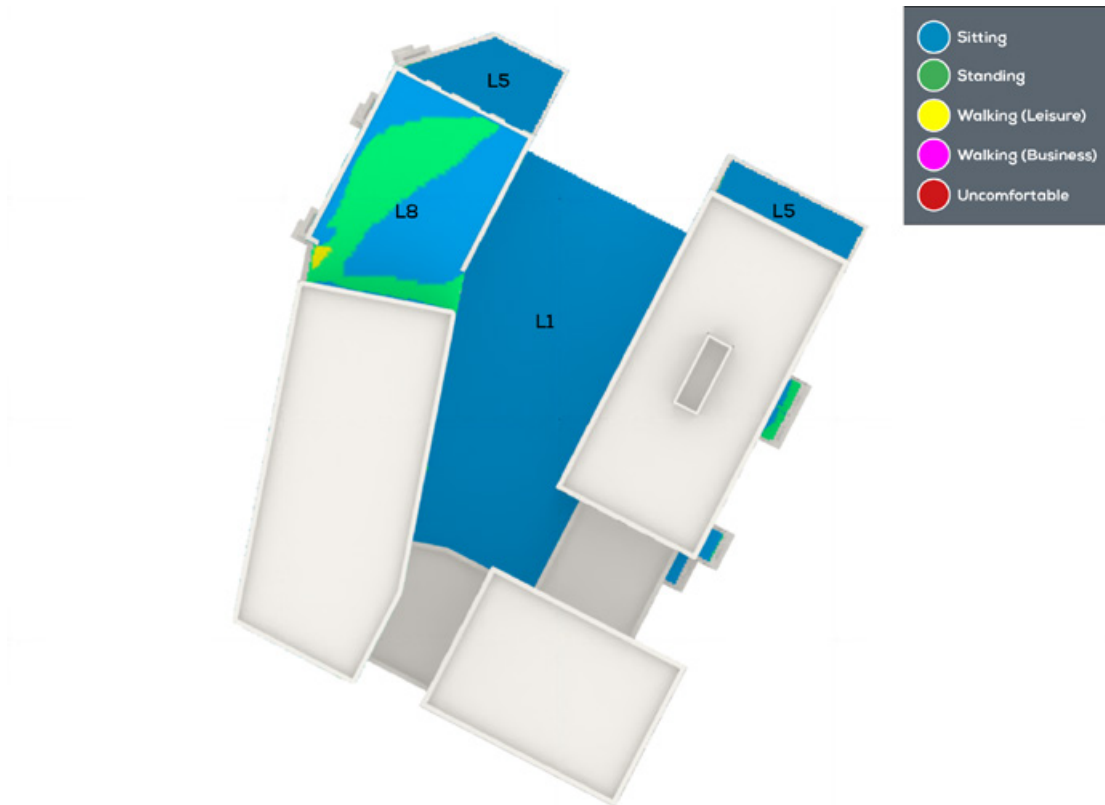


Fig. 13: Summer Comfort at Elevated Levels, Proposed Development with Existing Surrounds

3.3 **CONDITIONS FOR PROPOSED DEVELOPMENT WITH CUMULATIVE SURROUNDS**

Annual safety at ground level for the proposed development with cumulative surrounds is shown in Figure 14. Winter comfort at ground level for the proposed development with cumulative surrounds is shown in Figure 15. Summer comfort at ground level for the proposed development with cumulative surrounds is shown in Figure 16.

Annual safety at elevated levels for the proposed development with cumulative surrounds is shown in Figure 17. Winter comfort at elevated levels for the proposed development with cumulative surrounds is shown in Figure 18. Summer comfort at elevated levels for the proposed development with cumulative surrounds is shown in Figure 19.

There are no material differences in wind conditions when compared to those reported for the proposed development in existing surrounds in Section 3.2.

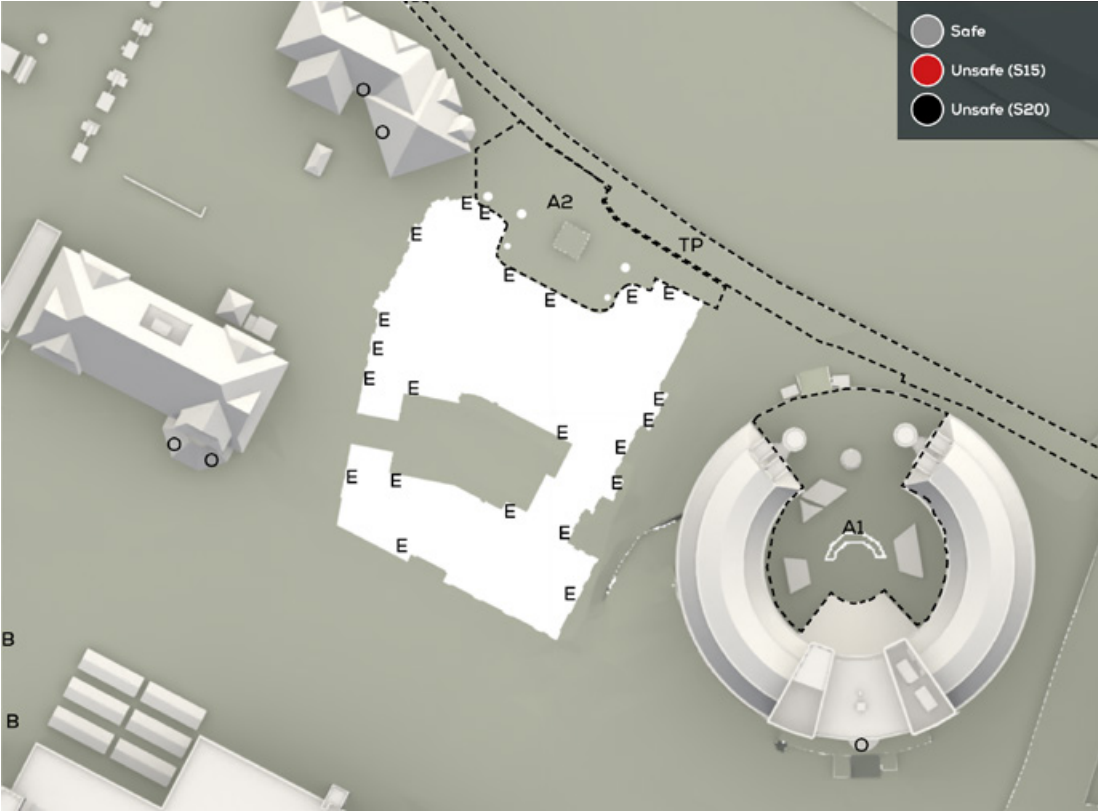


Fig. 14: Annual Safety, Proposed Development with Cumulative Surrounds

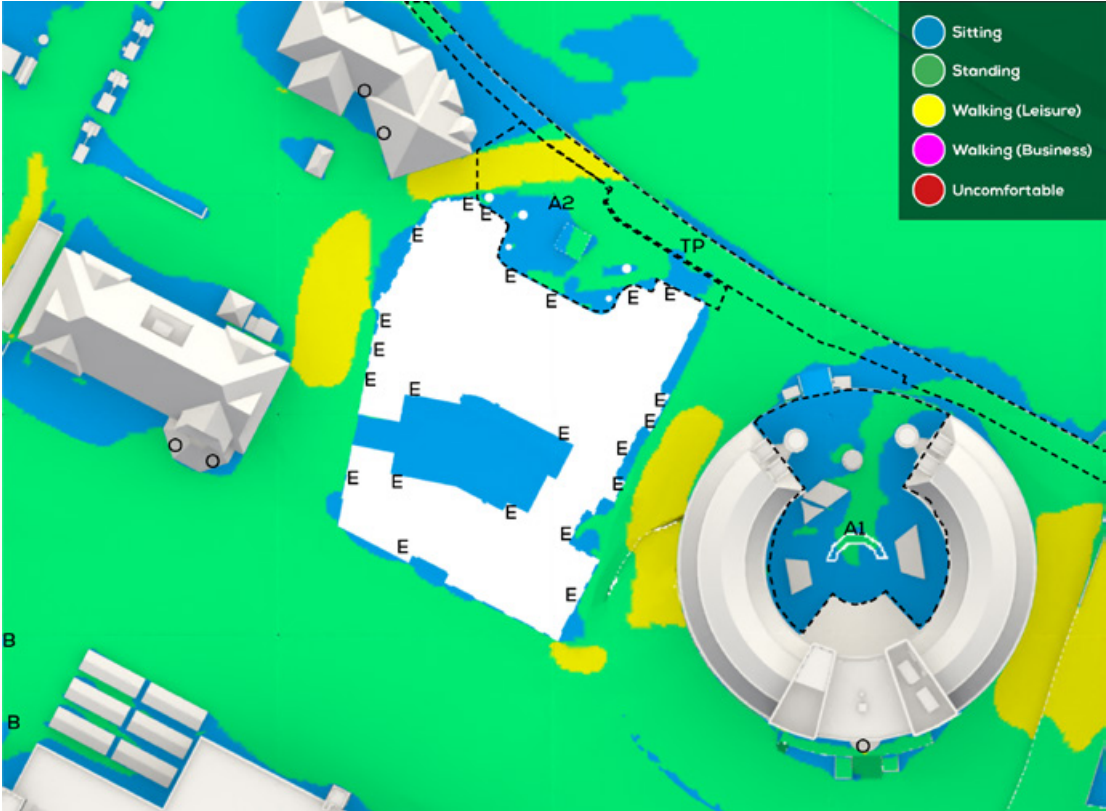


Fig. 15: Winter Comfort, Proposed Development with Cumulative Surrounds

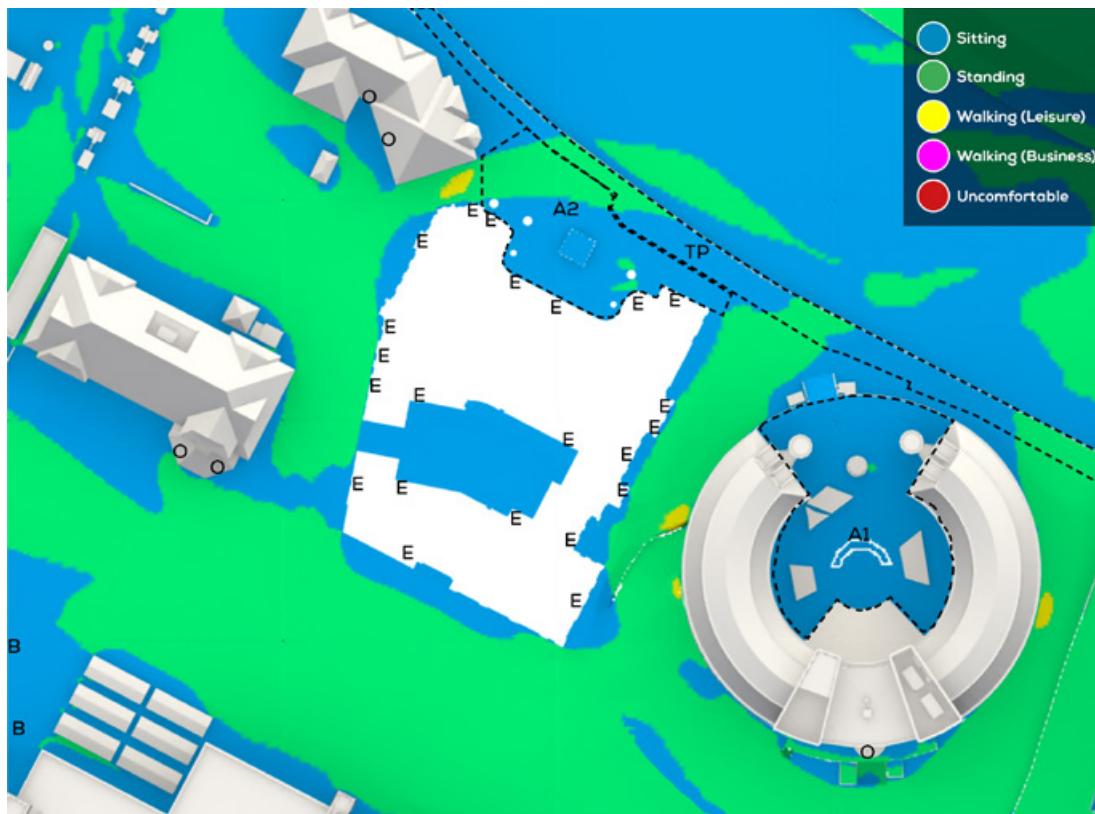


Fig. 16: Summer Comfort, Proposed Development with Cumulative Surrounds

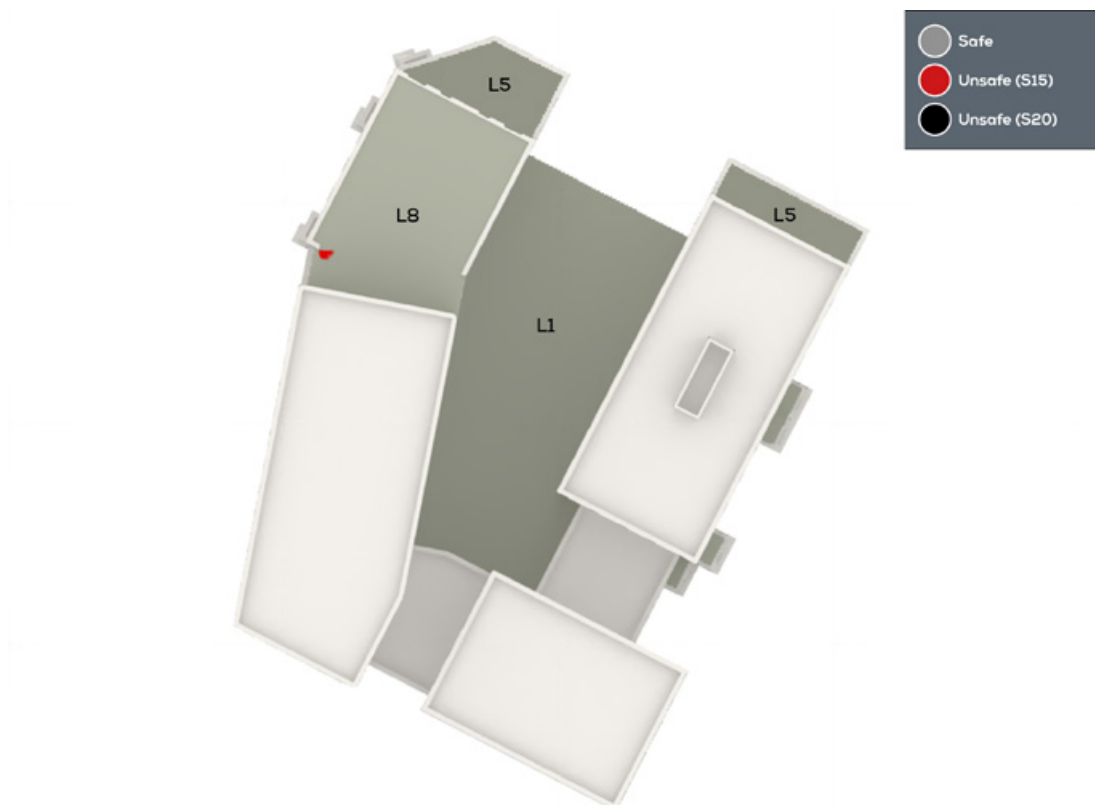


Fig. 17: Annual Safety at Elevated Levels, Proposed Development with Cumulative Surrounds

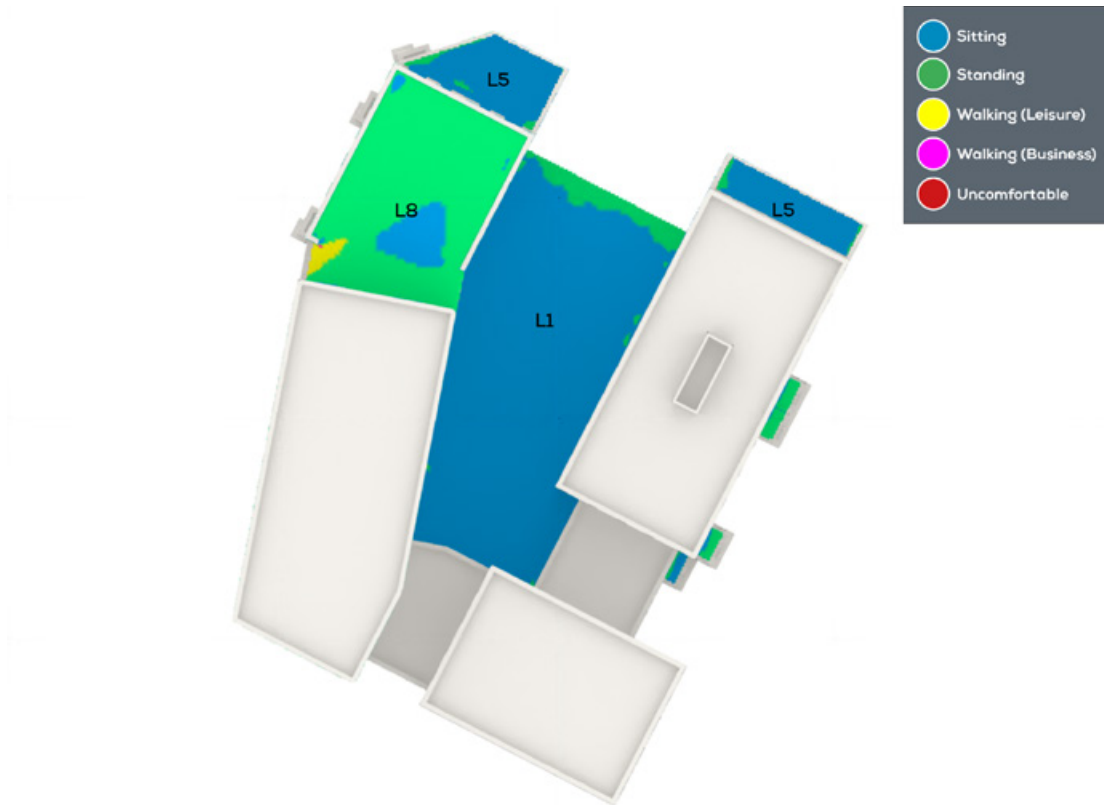


Fig. 18: Winter Comfort at Elevated Levels, Proposed Development with Cumulative Surrounds

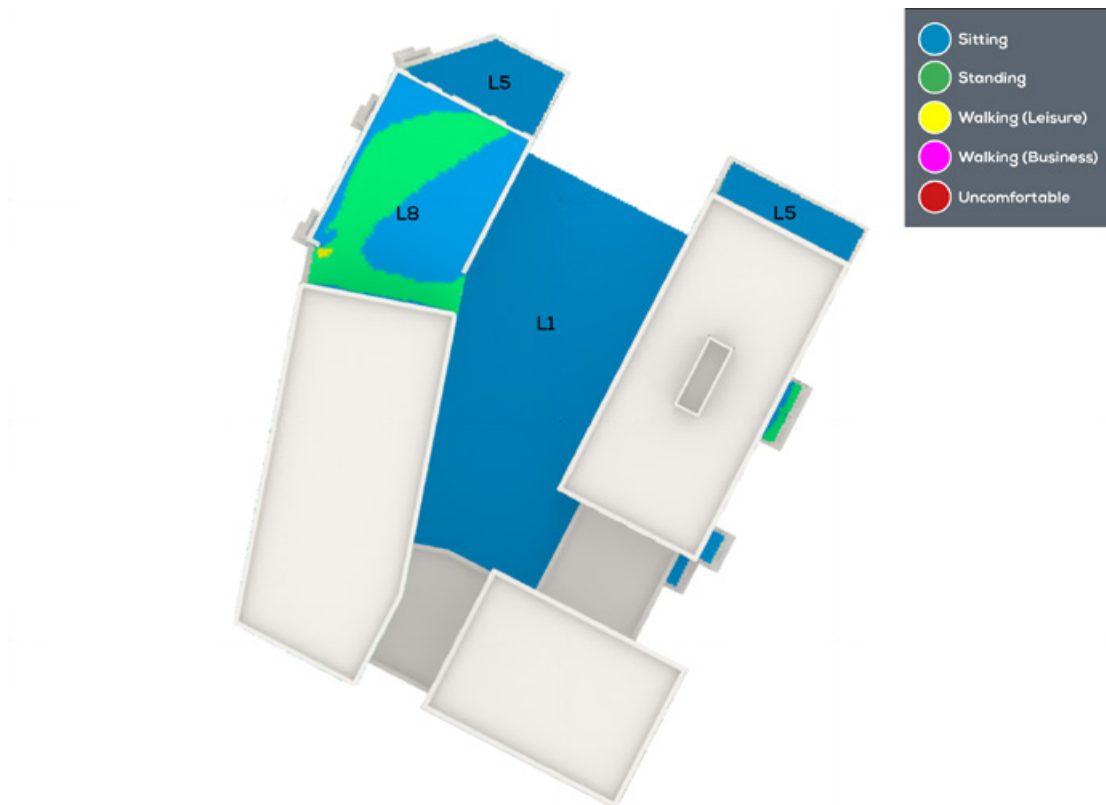


Fig. 19: Summer Comfort at Elevated Levels, Proposed Development with Cumulative Surrounds

4 CONCLUSIONS

Wind microclimate conditions for the proposed development at Waterfront Square were assessed using high resolution Computational Fluid Dynamics (CFD).

There are no wind safety risks associated with the proposed development.

Wind comfort conditions will be suitable for the intended use for all thoroughfares, existing building entrances, proposed building entrances, bus stops, the Thames Path, existing amenity spaces, and proposed amenity at ground level, level 1, level 5 and level 8.

The cumulative impact of future committed developments would be negligible on the wind environment around the site.

APPENDIX 01 DETAILED METHODOLOGY

CFD METHODOLOGY

The CFD was performed using OpenFOAM.

Meshed using a hybrid mesh of hexahedral, polyhedral, tetrahedral and prismatic elements:

- On site building edge length: 0.05m – 0.25m
- Surrounding context edge length: 0.25m – 1m

Prismatic cells were used in the boundary layer region, with 4 layers of cells growing with an expansion ratio of 1.15 and aspect ratios between 0.1 and 0.4.

The total mesh size was between 55 and 61million cells. Mesh detail is shown in Figure 20 and Figure 21.

Buildings within 400m of the site were included.

The domain was 5000mx5000m, with a blockage ratio of 0.5%

The blockage ratio uses a “test section” of 600mx200m (within which detail is captured).

Run using the SST turbulence model with high Re wall functions to ensure mesh suitability.

The simulations were steady state and isothermal.

2nd order discretisation schemes were used.

Convergence was measured as the residuals of the continuity, x-velocity, y-velocity, z-velocity, k and omega equations all falling by at least 2 orders of magnitude, and by measured static pressure on the site buildings varying by less than 1% over the final 100 iterations.

The wind speed is corrected into a “gust-equivalent” mean. The gust-equivalent mean is calculated using an empirical relationship between the gust and mean ratios recorded at over 13,000 data points from wind tunnel tests. This method is found to give a significant correlation improvement over the more traditional methods based on the CFD turbulent kinetic energy field.

WIND CLIMATE METHODOLOGY

The simulations were performed from 18 wind directions, spaced such that no single direction contributed more than 10% of the annual winds.

The directions simulated were 0°,30°,60°,90°,120°,150°,180°,200°,210°,220°,230°,240°,250°,260°,270°,280°,300°,330°.

Seasonal wind roses for London Heathrow and City airports combined are shown in Figure 22.

Target wind profiles for the site, from each wind direction, were generated using sectoral analysis of the terrain surrounding the site and the local weather stations with ESDU 2010 Item01008 ‘Computer program for wind speeds and turbulent properties: flat or hilly sites in terrain with roughness changes’. The target wind profiles, compared to the wind speeds measured from the CFD model are shown in Figure 23.

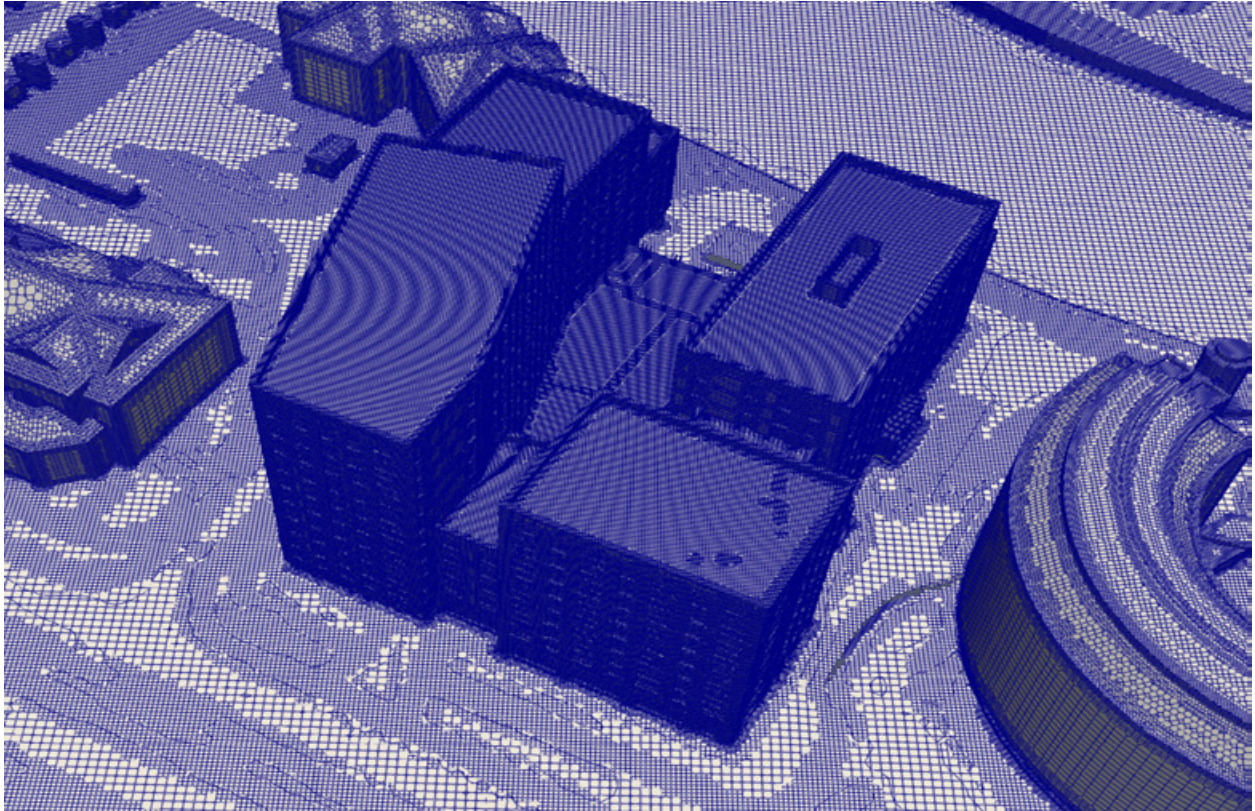


Fig. 20: Mesh Detail on Site Buildings

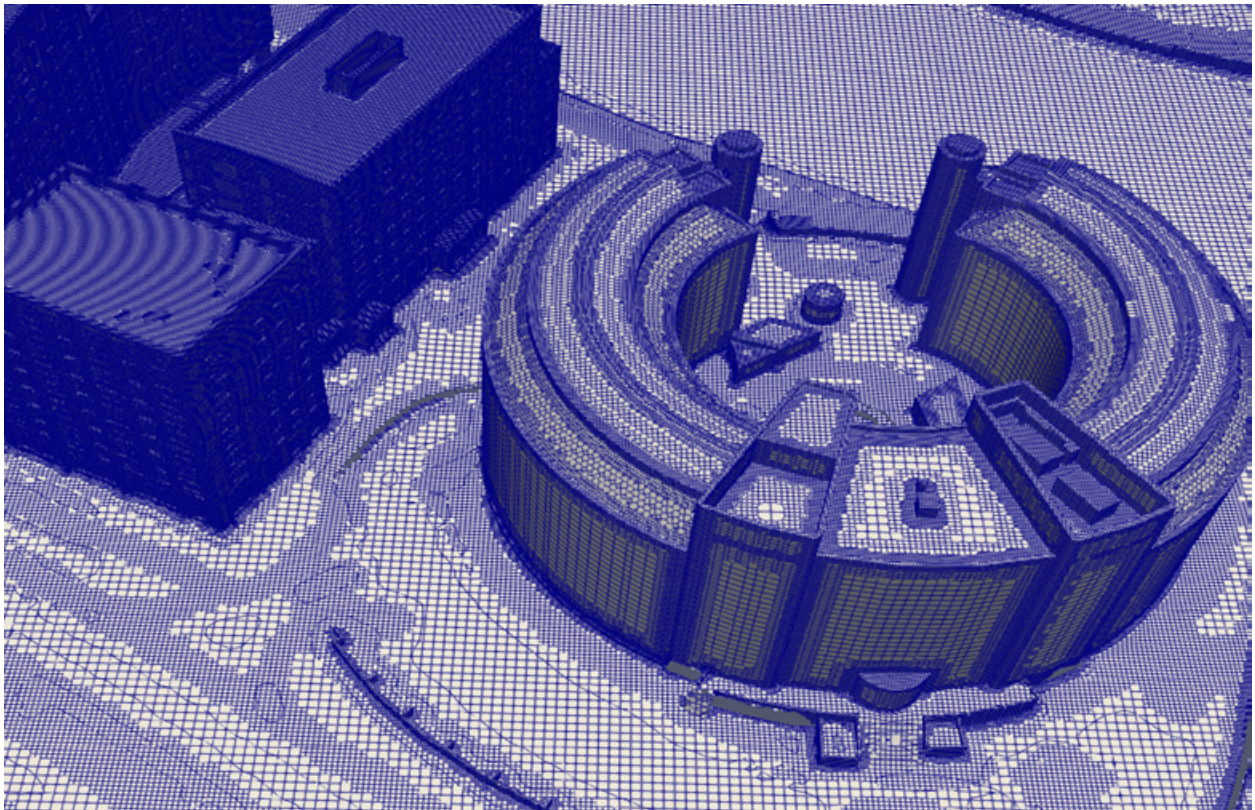


Fig. 21: Mesh Detail on Surrounds

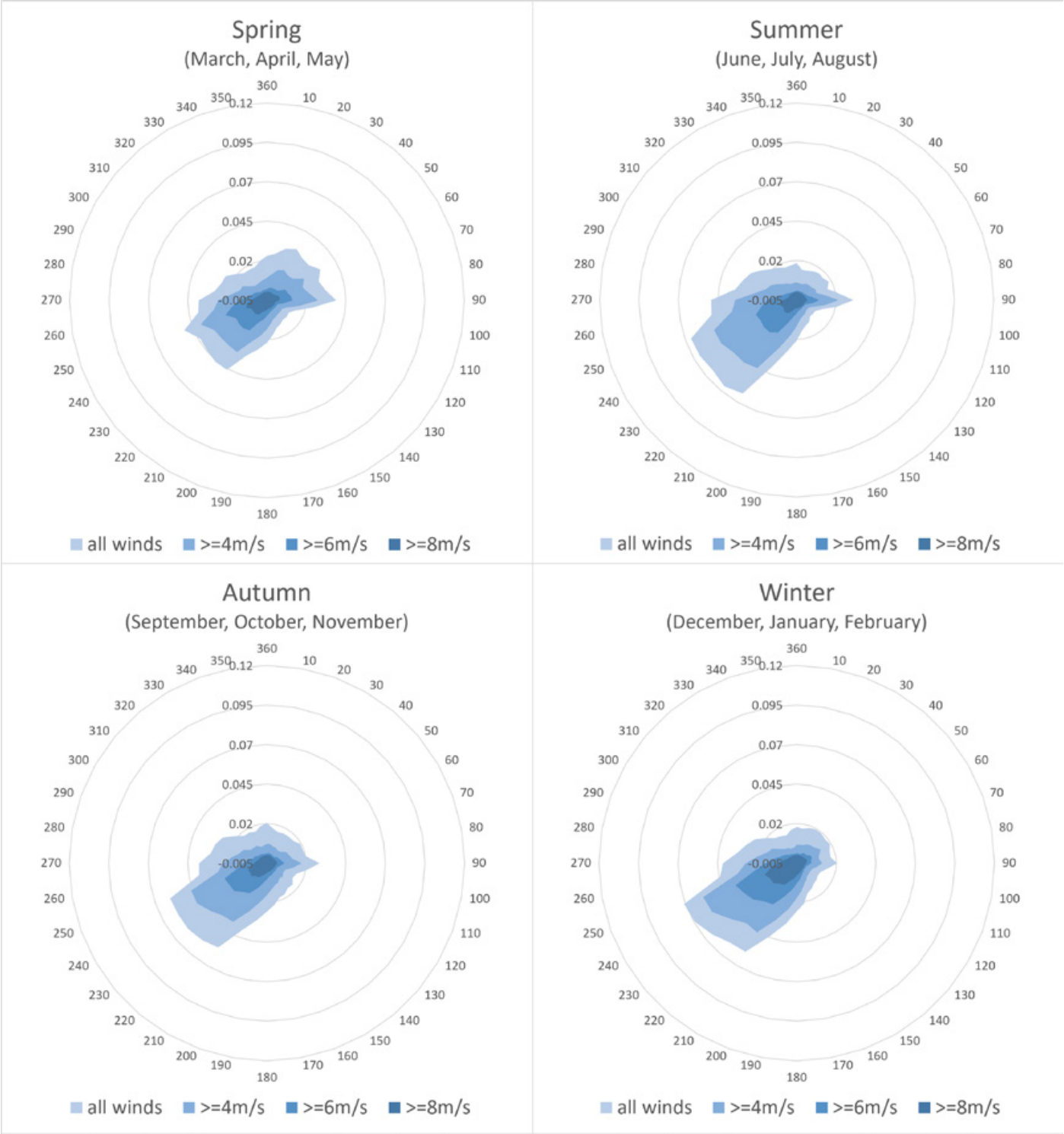


Fig. 22: Seasonal Wind Roses for London Combined (1990-2020)

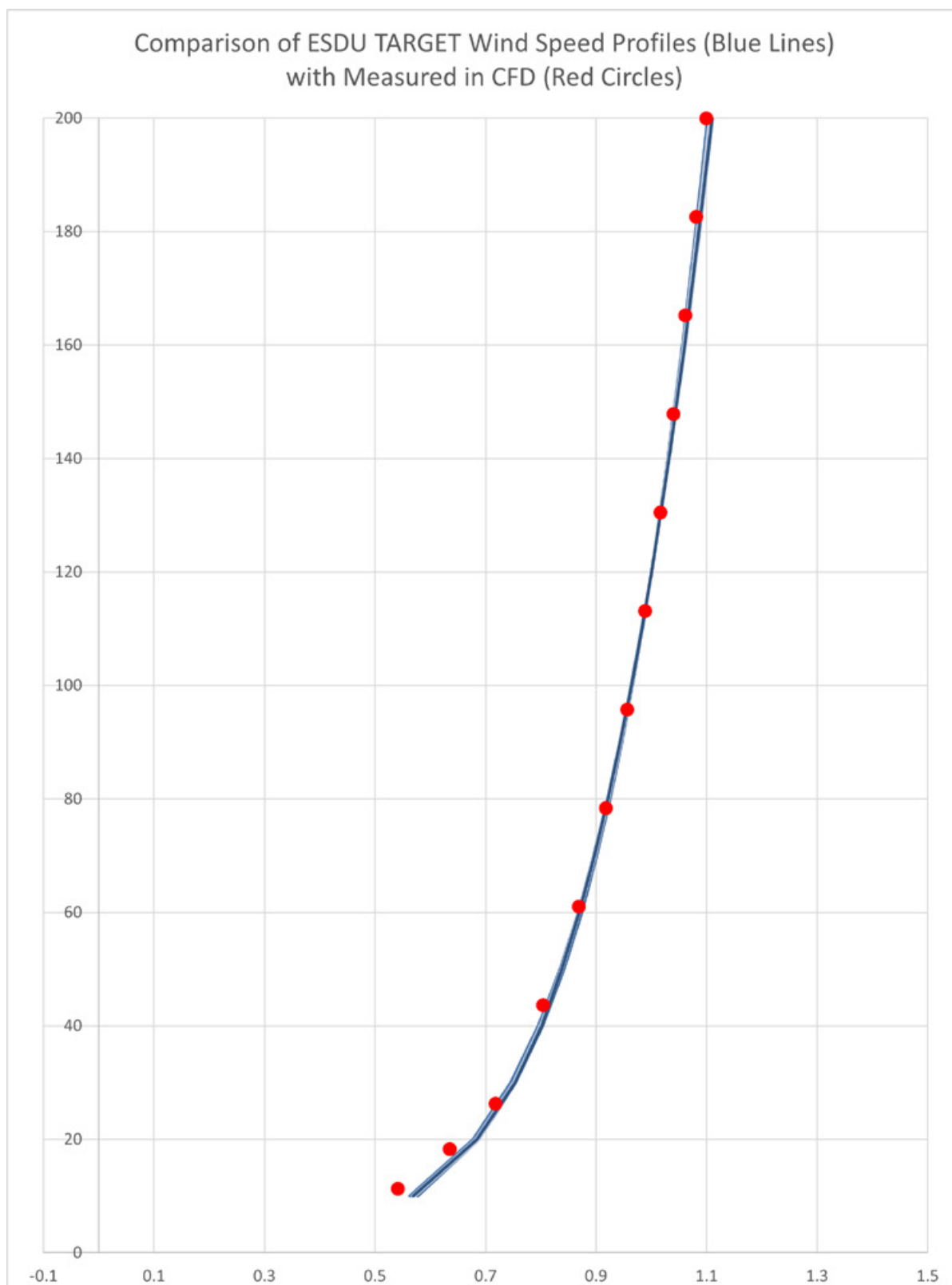


Fig. 23: Wind Profile for Reading



What we do:

Building Surveying
Daylight & Sunlight
Light Obstruction Notices
Measured Surveys
Neighbourly Matters
Rights of Light
Solar Photovoltaics
Wind

Where we are:

Belfast
Birmingham
Bristol
Dublin
London
Manchester