

55 VASTERN ROAD

READING, UK

PEDESTRIAN LEVEL WIND MICROCLIMATE ASSESSMENT

RWDI #1901994

MAY 19TH, 2020

SUBMITTED TO

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VERSION HISTORY

RWDI Project #1901994		55 Vastern Road, Reading, UK	
Report	Releases	Dated	
Reports	Rev A	April 27 th , 2020	
	Final	May 19 th , 2020	
Project Team	Matthew Rodwell	Project Engineer	
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1 INTRODUCTION

RWDI was retained to conduct an additional pedestrian level wind assessment of the proposed Vastern Road development in Reading, UK in the context of two additional cumulative schemes from those assessed in RWDI Technical Report 1901994 55 Vastern Road, 20th January 2020. This technical addendum presents the results of one configuration tested using Computational Fluid Dynamics (CFD) simulations, namely:

- Configuration 4: Proposed Development with Cumulative Surrounding Buildings (including 182252 – 80 Cavesham Road and 200328 – Vastern Court Schemes).

As in the previous assessment, this configuration was assessed devoid of existing or proposed landscaping, or wind mitigation measures in order to present a worst-case (i.e. windy) scenario. Results are presented in terms of the Lawson Comfort Criteria with the main focus on the windiest (generally winter) season and the summer season, when amenity spaces are expected to be most frequently used.

Meteorological data representative of Reading indicates prevailing winds from the south-west throughout the year with a secondary peak from the north-east (typically during the spring season).

Wind conditions at the Proposed Development with the inclusion of nearby cumulative schemes would range from suitable for sitting to strolling use during the windiest season. All measured thoroughfare, entrance, terrace and balcony locations would have suitable conditions, requiring no mitigation measures. The fixed seating area situated outside the podium café east of Building E would have an isolated area suitable for standing use during the summer season, one category windier than suitable. With the implementation of the proposed landscaping scheme wind conditions would be expected to be suitable. No strong wind exceedances would be expected to occur.

However, mitigation would remain necessary as discussed in the previous report (RWDI Technical Report 1901994 55 Vastern Road, 20th January 2020) in the event the cumulative schemes do not come forward as assessed.

In conclusion, the wind conditions around the Proposed Development with the inclusion of nearby cumulative schemes would have acceptable conditions, requiring no mitigation. Wind conditions without the cumulative schemes (tested previously) would result in several areas being windier than suitable with the potential for strong wind exceedances to occur. Mitigation measures have been suggested to compliment the proposed landscaping scheme, and it is recommended that these measures are assessed through additional simulations to ensure a suitable wind environment at the Proposed Development in the context of existing surrounding buildings.

2 BACKGROUND AND APPROACH

A Computational Fluid Dynamics (CFD) simulation was conducted on the Proposed 55 Vastern Road Development, (referred to as the “Proposed Development” hereafter in this report), in Reading, UK. The assessment quantifies the wind conditions within and around the Site, by comparing the measured wind speed and frequency of occurrence with the Lawson Comfort Criteria. Meteorological data for Reading has been analysed and adjusted to the Site conditions by modelling the effect of terrain roughness in the computational domain.

One configuration was simulated, as follows:

- Configuration 1: Proposed Development with Cumulative Surrounding Buildings (including 182252 80 Cavesham Road and 200328 Vastern Court Schemes).

2.1 Site Description and Surroundings

The development Site is located in Reading, UK, approximately 300m north of Reading train station. The OS Landranger grid reference is SU715741.

The Site is bound by the A739 Vastern Road to the south, two to three storey residential developments on Lynmouth Road to the west, the River Thames, Thames Path and the Christchurch Bridge pedestrian route to the north, and the four to five storey office developments on Norman Place to the east. The existing substation would be retained. The surrounding area is a mix of low-rise suburban development and the more open areas of the Christchurch Meadows, King's Meadows and the River Thames to the north and the east of the Site. Reading town centre is located to the south of the Site and consists of predominantly low- to mid-rise developments punctuated by occasional high-rise buildings. The general openness from the northern and eastern regions, and low-rise buildings from the southern and western regions results in a higher mean wind speed approaching the Site and relatively low turbulence when compared to a site surrounded by more urban terrain.

Figure 1 below shows an aerial view of the Site and surroundings, with the approximate Site location highlighted in yellow.



Figure 1: Aerial view of the Existing Site (Approximate extent of the Site highlighted in yellow)

2.2 The Proposed Development

Demolition of existing structures and erection of a series of buildings ranging in height from two to 11 storeys, comprising residential units, parking spaces and amenity areas, together with a new north-south pedestrian link, connecting Christchurch Bridge to Vastern Road.

Buildings A and B, located along Vastern Road, would be six storeys and part four, nine, and 11 storeys in height respectively. Building C would be a four-storey terraced block located along the eastern Site boundary between Building B and Building C. Buildings D and E, located to the north of the Site, would be part six and 11 storeys and part four and eight storeys in height respectively. Building F, adjoining to the south of Building E, would be three storeys with the two storey Building G adjoining to the south. A raised podium level would be located between Building D and E with a single storey café and associated spill out seating as well as a link bridge to the Christchurch Bridge to the north.

There are terrace level amenity spaces at the sixth and seventh floors of Building E, and at the eighth and ninth floors of Building D. Additionally, there are balconies located on Buildings A – F of the Proposed Development, Building A and E would have balconies from the first floor to the fifth floor; Building B would have balconies from the first to the eighth floor; Building C would have balconies from the first to the fourth floor; Building D would have balconies from the first to the ninth floor; and Building F would have balconies on the first and second floors.

A 3D view of the Proposed Development is shown in Figure 2 below.

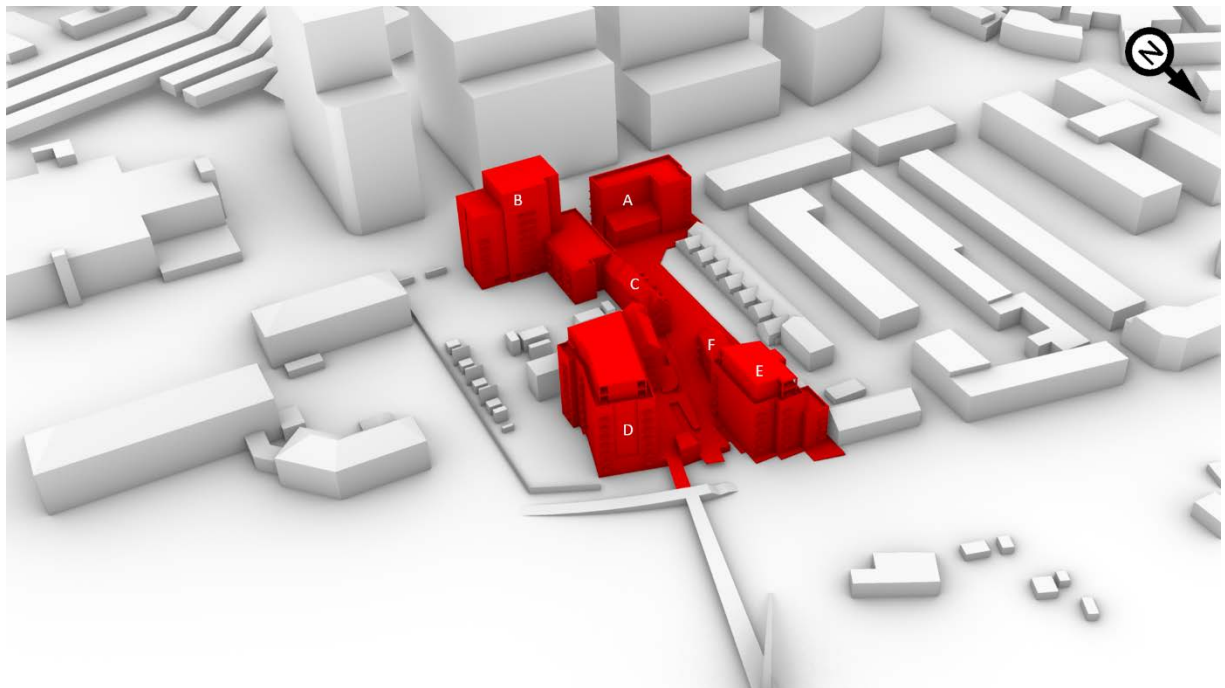


Figure 2: 3D model of the Proposed Development (in the context of the cumulative surrounding buildings) used for CFD simulation (view from north-east)

3 METHODOLOGY AND ASSESSMENT CRITERIA

The computational model of the Proposed Development in the context of the cumulative surrounding buildings used for the CFD simulation of Configuration 1 is shown in Figure 2. In the assessed scenario, surrounding buildings within a 400m radius of the centre of the Site were included on the model.

The 'Results' section, shows the windiest season (typically winter) and the summer season (June to August) comfort plots. The comfort results are assessed at a height of 1.5m above the ground or building surface to represent conditions around people. The colours correspond to the Lawson Comfort Criteria described below in 3.2 'Pedestrian Comfort'.

CFD is a computer modelling technique for numerically simulating wind flow in complex environments. For this study, computational modelling was undertaken using OpenFOAM version 4.1 with 18 wind angles tested, equally spaced out around the compass (equal 20 degrees intervals). Although the strongest winds originate from the south-westerly sector, this quantity of wind angles will provide sufficient coverage of all aerodynamic interactions from winds from all angles.

The individual case of the Proposed Development was solved using RANS approach with an RNG k- ϵ turbulence model. The steady state RANS type model with the RNG k- ϵ turbulence model is chosen over other turbulence models or transient type schemes for wind microclimate studies by RWDI for its ability to approximate highly complex flows within urban environments to a high level of accuracy against a practical computational time. The statistically steady solution obtained by RANS simulations does not have the ability to predict the fluctuating or gusty nature of wind. As comfort is predominantly a function of average conditions, this model is more suited to help analyse this.

The potential for strong winds leading to potential safety issues is assessed using informed engineering judgement.

The computational model was discretized into approximately 20 million hexahedral cells with refinement close to the areas of expected high velocity gradients.

The assessment was simulated in the absence of any landscaping elements in order to provide a worst-case wind environment.

3.1 Meteorological Data

Figure 3 shows the seasonal wind roses (meteorological data) for Reading area which are based on data obtained from the meteorological station at London Heathrow airport. 0 Degrees represents wind blowing from the north and 90 degrees represents wind blowing from the east.

Approximately 30 years of meteorological data for London Heathrow was used in this report, presented in the seasonal wind roses with the wind speed divided into wind speed thresholds (Figure 3). The radial axis indicates the cumulative number of hours per season that the wind speed exceeds the wind speed threshold as a percentage. The seasons are defined as spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February).

The meteorological data indicate that the prevailing wind direction throughout the year is from the south-west. This is typical for many areas of southern England. There is a secondary peak from the north-westerly winds, especially during the spring; however, these tend to be colder winds.

The combination of meteorological data and velocity ratios permits the percentage of time that wind speeds are exceeded on the site to be evaluated. The locations can then be assessed using 'comfort criteria', as described below.



Figure 3: Seasonal Wind Roses for London Heathrow airport (in m/s) (Radial axis indicated the percentage time for which the stated wind speed threshold is exceeded)

3.2 Pedestrian Comfort

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the Lawson Comfort Criteria, which have been established for over thirty years. The Criteria, which seek to define the reaction of an average pedestrian to the wind, are described in Table 1. If the measured wind conditions exceed the threshold wind speed for more than 5% of the time, then they are unacceptable for the stated pedestrian activity and the expectation is that there may be complaints of nuisance or people will not use the area for its intended purpose.

The Criteria sets out four pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The four categories are sitting, standing, strolling and walking, in ascending order of activity level, with a fifth category for conditions that are uncomfortable for all uses. In other words, the wind conditions in an area for sitting need to be calmer than a location that people merely walk past.

The distinction between strolling and walking is that in the strolling scenario pedestrians are more likely to take on a leisurely pace, with the intention of taking time to move through the area, whereas in the walking scenario pedestrians are intending to move through the area quickly and are therefore expected to be more tolerant of stronger winds.

The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. Thermal comfort is discussed with reference to acceptable wind environments but not evaluated as part of the assessment.

The coloured key in Table 1 corresponds to the presentation of simulation results described later in this report.

Table 1: Lawson Comfort Criteria

Key	Comfort Category	Threshold	Description
	Sitting	0-4 m/s	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or comfortably sit for long periods
	Standing	4-6 m/s	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops
	Strolling	6-8 m/s	Moderate breezes that would be appropriate for window shopping and strolling along a city/town centre street, plaza or park
	Walking	8-10 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
	Uncomfortable	>10 m/s	Winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended

3.3 Strong Winds

Lawson¹ also specified a lower limit strong wind threshold when winds exceed 15m/s for more than 0.025% of the time (approximately two hours per year). When winds exceed this threshold remedial measures or a careful assessment of the expected use of that location would be required; e.g. is it reasonable to expect elderly or very young pedestrians to be present at the location on the windiest day of the year?

Wind speeds that exceed 20m/s for more than approximately two hours per year represent a safety issue for all members of the population, which would require mitigation to provide an appropriate wind environment.

¹ Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press



Strong winds are generally associated with areas which would be classified as acceptable for walking or as uncomfortable. In a mixed-use urban development scheme, walking and uncomfortable conditions would not usually form part of the 'target' wind environment and would usually require mitigation due to pedestrian comfort considerations. This mitigation would also reduce the frequency of, or even eliminate, any strong winds.

It should be noted that the CFD simulations will provide an average expected wind speed for the windiest (typically the winter months - December to February) and summer season in regard to pedestrian comfort. Areas which would have wind conditions suitable for walking use would be likely to have instances of strong winds. As such, professional judgement incorporating RWDI's experience of a large number of similar projects both within the UK and internationally has been applied, informed by the CFD results to identify areas of the Proposed Development likely to have instances of strong winds and wind conditions heavily influenced by gusts.

4 RESULTS

4.1 Details of Analysis

To account for the difference in height and terrain roughness between meteorological conditions at the airports and the Site, which is taken into account during the CFD simulations. For the Proposed Development, a suburban roughness factor was used to adjust the meteorological data due to the relatively built up surroundings of the Site.

4.2 Desired Pedestrian Activity around the Development

Generally, for the Development, the target conditions are:

1. Strolling during the windiest season on pedestrian thoroughfares;
2. Standing conditions at main entrances, drop off areas or taxi ranks, and bus stops throughout the year; and
3. Sitting conditions at outdoor seating and amenity areas during the summer season when these areas are more likely to be frequently used by pedestrians.

The walking and uncomfortable classifications are usually avoided because of their association with occasional strong winds, unless they are on a minor pedestrian route or a route where pedestrian access could be controlled in the event of strong winds.

Achieving a sitting classification in the summer usually means that the same receptor would be acceptable for standing in the windiest season because winds are stronger at this time.

This is considered an acceptable occurrence for the majority of external amenity spaces because other factors such as air temperature and precipitation influence people's perceptions about the 'need' to use seating in the windiest season.

It should be noted that a mixture of sitting use and standing use is acceptable for larger amenity spaces, should designated seating not be located at the windier locations suitable for standing use. Furthermore, standing use conditions are also considered tolerable at private amenity areas (such as balconies) where the occupant has control over the use of the space.

4.3 Performance against the Lawson Comfort Criteria

The wind microclimate within and around the site has been assessed and classified using the Lawson Comfort Criteria defined in Table 1. The results of the assessment for each configuration are described below and presented graphically in Figures 4 – 7.



4.3.1 Configuration 4 – Proposed Development with the Cumulative Surrounding Buildings (including 182252 80 Cavesham Road and 200328 Vastern Court Schemes)

The wind microclimate results for Configuration 4 are shown in the following figures:

- Figure 4: Windiest Season: Ground Level;
- Figure 5: Summer Season: Ground Level;
- Figure 6: Summer Season: Terrace/Balcony Levels (view from south-west); and
- Figure 7: Summer Season: Terrace/Balcony Levels (view from north-west).

This configuration includes the Proposed Development in the context of cumulative surrounding buildings devoid of landscaping or wind mitigation measures in order to assess a worst-case (i.e. windy) scenario.

5 DISCUSSION

This discussion compares the measured wind conditions (shown in the contour plots) to the anticipated use of the Site, to provide an assessment of whether the conditions would be suitable or too windy for the intended use.

Any areas not specifically mentioned would be suitable, or calmer than required, for the desired pedestrian use. Areas that are windier than suitable for the intended pedestrian use would require mitigation.

No landscaping was included in any tested configuration, in order to present a worst-case (i.e. windy) scenario.

5.1 Configuration 4: Proposed Development with the Cumulative Surrounding Buildings (including 182252 80 Cavesham Road and 200328 Vastern Court Schemes)

The Proposed Development was assessed with the known cumulative schemes as well as two new cumulative schemes in the surrounding context. The following cumulative schemes were within 400m of the Site and included within the assessment:

- Station Hill Development (Refs. 190466 and 190465);
- Former Cooper Reading BMW scheme (Ref. 162166)
- 80 Cavesham Road (Ref. 182252); and
- Vastern Court (Ref. 200328).

Results for the Proposed Development with the cumulative surrounding buildings are presented in Figure 4 for ground and podium level during the windiest season. Figure 5 presents results for ground and podium level for the summer season and Figures 6 and 7 present results for the terrace and balcony levels during the summer season, when amenity spaces are expected to be most frequently used.

5.1.1 Pedestrian Comfort

Wind conditions around the Proposed Development with the addition of nearby cumulative schemes would overall be calmer when compared to those in Configuration 2, ranging from suitable for sitting to strolling use during the windiest season. This is likely due to the shelter provided by the 80 Cavesham Road and Vastern Court schemes from prevailing south-westerly winds.

5.1.1.1 Thoroughfares (Figure 4)

Wind conditions along pedestrian thoroughfares around the Proposed Development would range from suitable for sitting to strolling use during the windiest season, acceptable for the intended usage.

5.1.1.2 Entrances (Figure 4)

Entrances to the Proposed Development would now have suitable wind conditions, ranging from suitable for sitting to standing use during the windiest season.

All other entrance locations around the Proposed Development and to existing buildings would have standing use or calmer wind conditions throughout the year. As such, these areas would have conditions be suitable for the intended pedestrian use and require no wind mitigation measures.

5.1.1.3 Podium Level Amenity Space (Figure 5)

The podium café seating area located to the east of Building E would mainly be suitable for sitting use during the summer season, with a small isolated area of standing conditions. Standing use wind conditions would be one category windier than suitable for seating areas requiring mitigation. With the implementation of the proposed landscaping scheme standing conditions in the café seating area would be expected to become suitable.

5.1.1.4 Upper Level Amenity Spaces (Figures 6 and 7)

Terraces would mainly be suitable for sitting use during the summer season, with isolated areas around the corners of Buildings D and E being suitable for standing use. Sitting and standing conditions would be suitable for private terraces.

Likewise, balconies would also mainly be suitable for sitting use during the summer season, with balconies situated on the southern façade of Building A, eastern façade of Building E, and the upper balconies situated on the northern facades of Buildings D and E being suitable for standing use. Sitting and standing conditions would be suitable for private balconies.

5.1.2 Strong Winds

Winds exceeding 15m/s for more than 0.025% of the time (approximately 2 hours per year) would be expected to occur where wind conditions would be suitable for walking use during the windiest season. As there are no areas that would have walking use conditions, it is anticipated that there would not be any strong wind exceedances.

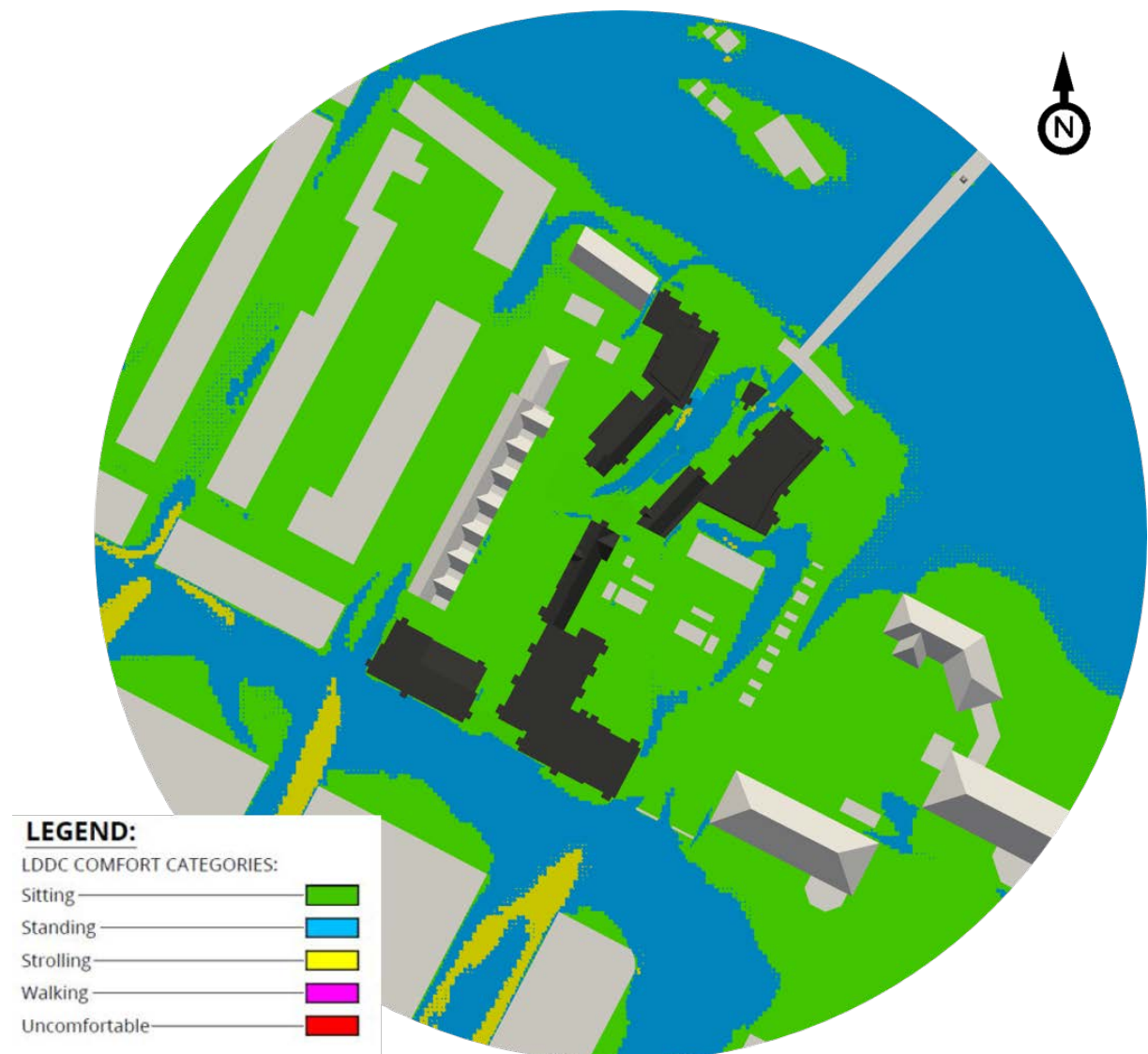


Figure 4: Configuration 4 – Proposed Development with the Cumulative Surrounding Buildings – Ground and Podium Level, Windiest Season

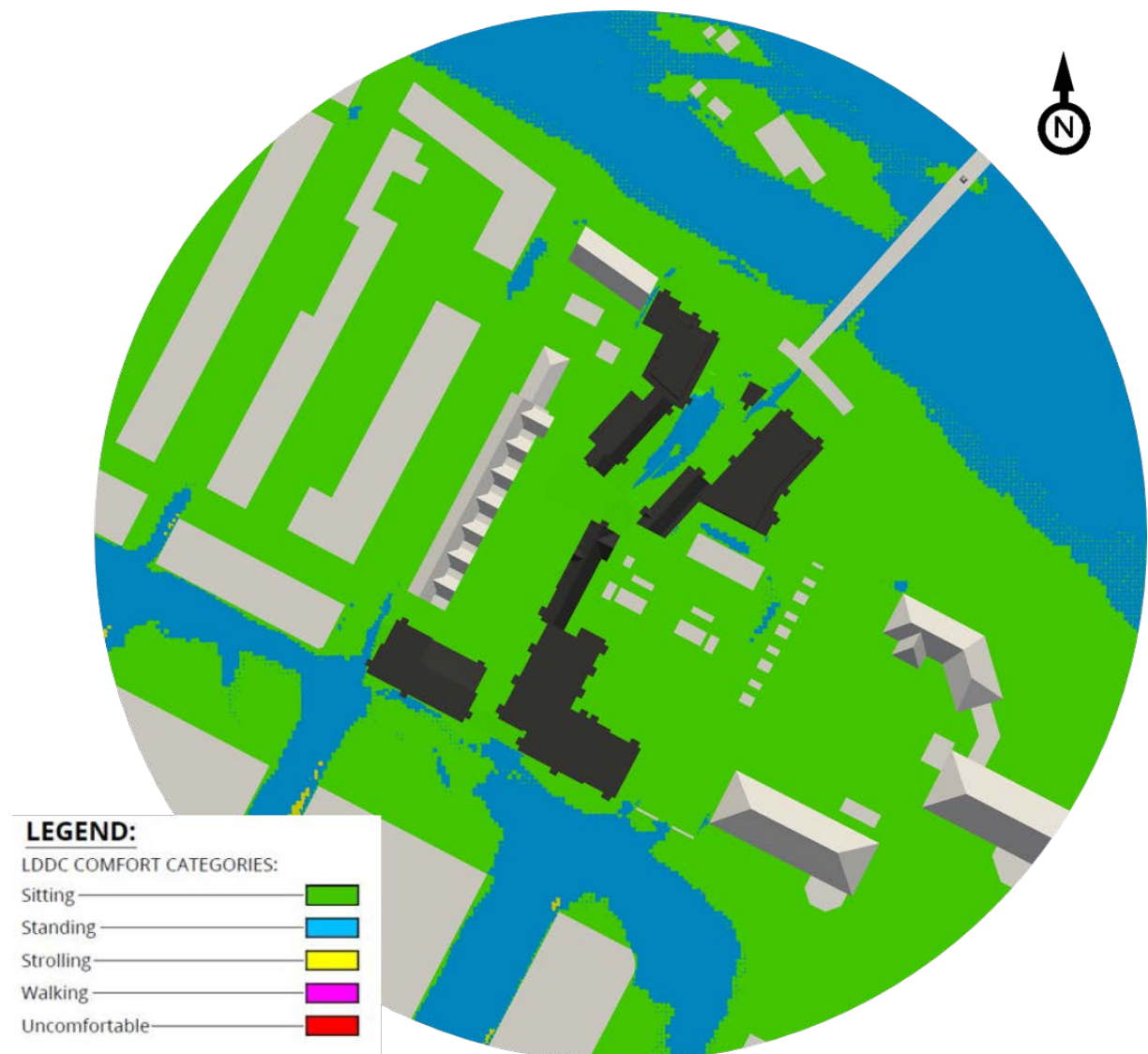


Figure 5: Configuration 4 – Proposed Development with the Cumulative Surrounding Buildings – Ground and Podium Level, Summer Season

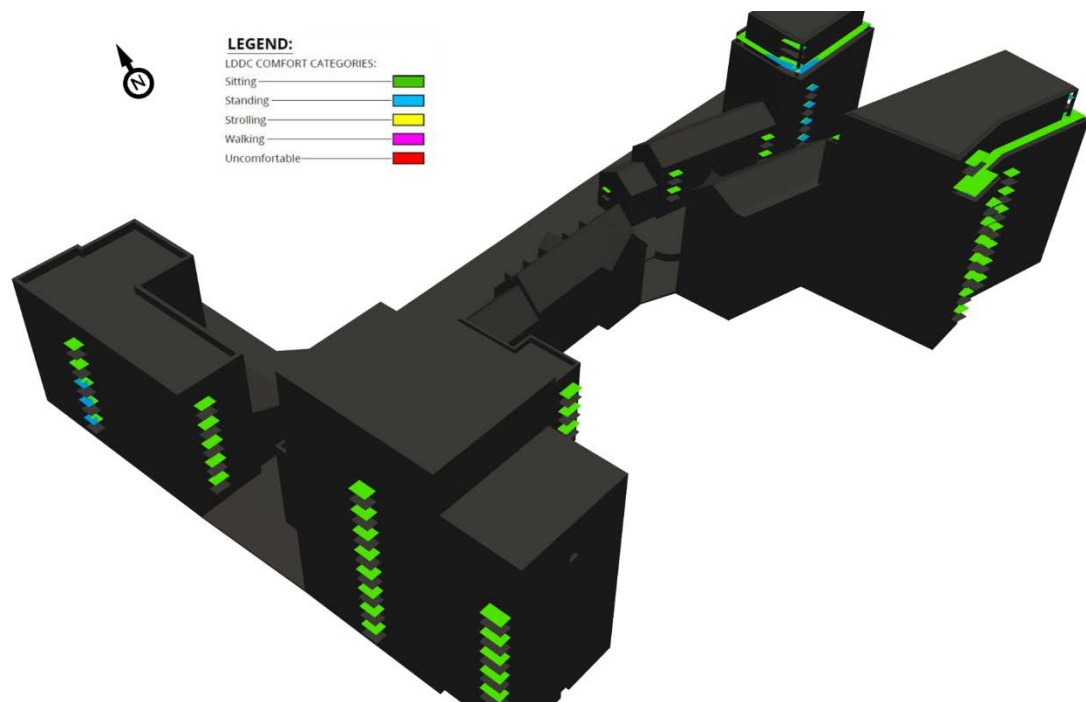


Figure 6: Configuration 4 – Proposed Development with the Cumulative Surrounding Buildings – Terrace/Balcony Levels (view from the north-west), Summer Season

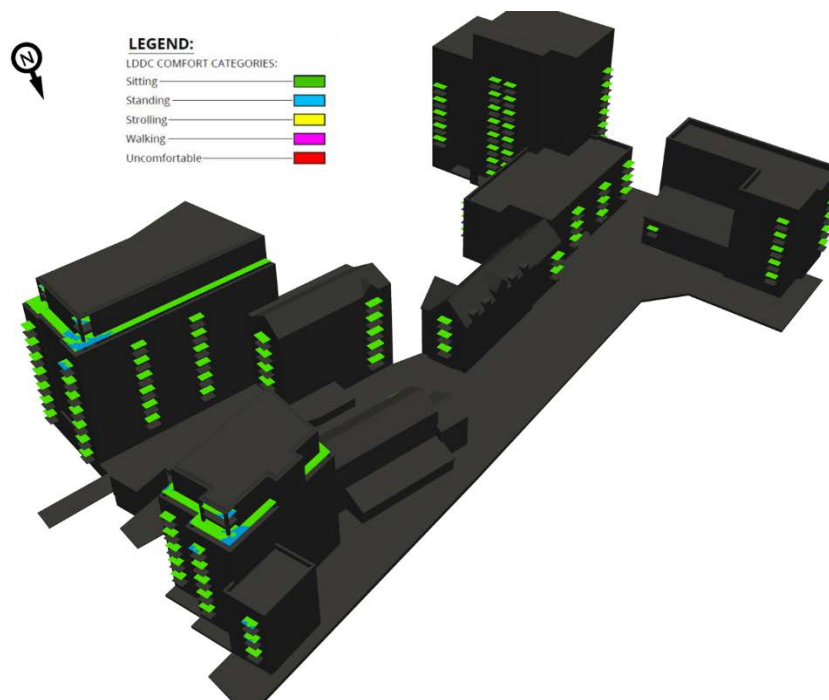


Figure 7: Configuration 4 – Proposed Development with the Cumulative Surrounding Buildings – Terrace/Balcony Levels (view from the south-east), Summer Season

6 MITIGATION MEASURES

Wind conditions around the Proposed Development were assessed devoid of landscaping or wind mitigation measures in order to assess a worst-case (i.e. windy) scenario.

No mitigation measures would be required for this scenario. However, mitigation would remain necessary as discussed in the previous report (RWDI Technical Report 1901994 55 Vastern Road, 20th January 2020) in the event the cumulative schemes do not come forward as assessed.

7 CONCLUDING REMARKS

This report has identified the wind microclimate effects on the Proposed Development, based on an assessment conducted using a Computational Fluid Dynamics (CFD) simulation. The following is a summary of the key points described in the report:

- The meteorological data for the Site indicates prevailing winds blowing from the south-west throughout the year. There is a secondary wind from the north-east most common during the late spring season.
- Wind conditions with the addition of nearby cumulative schemes would range from suitable for sitting to strolling use on-Site and in the nearby surrounding area during the windiest season. All thoroughfares, entrances, terraces and balconies would have suitable wind conditions.
- The fixed seating area situated outside the podium café east of Building E would have an isolated area suitable for standing use during the summer season, one category windier than suitable. With the implementation of the proposed landscaping scheme wind conditions would be expected to be suitable.
- No strong wind exceedances would be expected to occur.
- However, mitigation would remain necessary as discussed in the previous report (RWDI Technical Report 1901994 55 Vastern Road, 20th January 2020) in the event the cumulative schemes do not come forward.
- In conclusion, the wind conditions around the Proposed Development with the inclusion of nearby cumulative schemes would have acceptable conditions, requiring no mitigation. Wind conditions without the cumulative schemes (tested previously) would result in several areas being windier than suitable with the potential for strong wind exceedances to occur (as discussed in RWDI Technical Report 1901994 55 Vastern Road, 20th January 2020). Mitigation measures have been suggested, and it is recommended that these measures are assessed through additional simulations to ensure a suitable wind environment at the Proposed Development in the context of existing surrounding buildings.



8 REFERENCES

1. Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press

APPENDIX A



APPENDIX A: 3D MODEL IMAGES

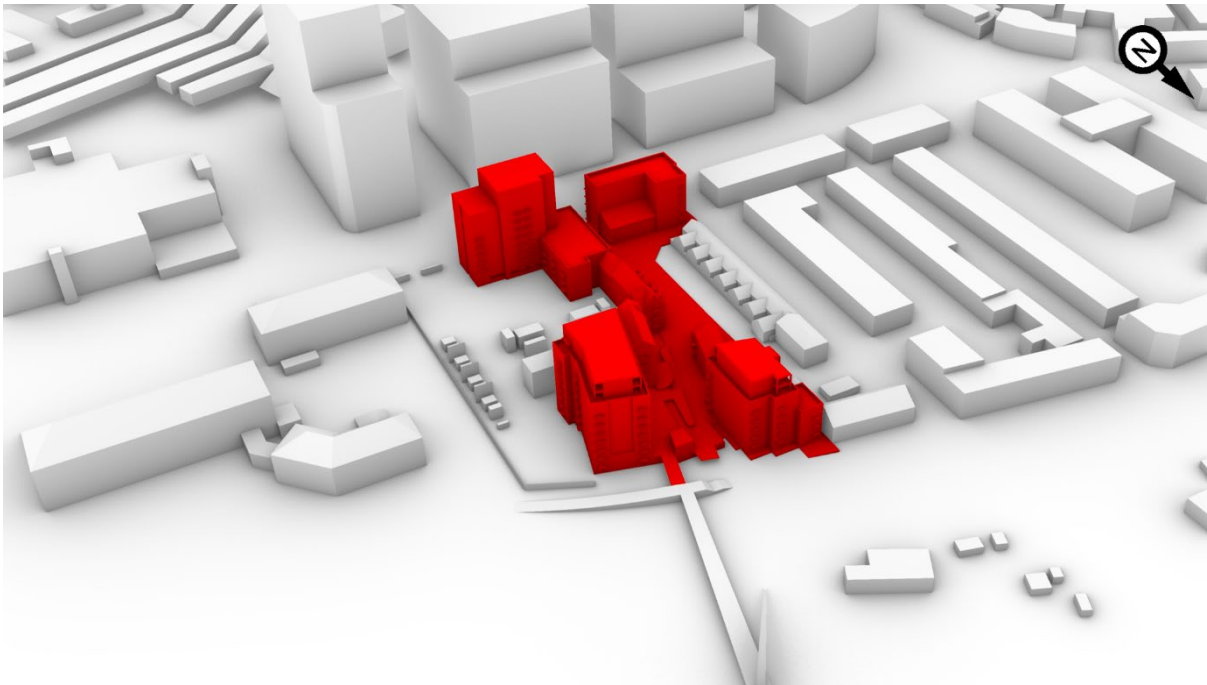


Figure 8 Proposed Development with Cumulative Surrounding Buildings (Configuration 4) – View of the 3D model from the north-east

APPENDIX B



APPENDIX B: PROPOSED LANDSCAPING SCHEME



Figure 9 Proposed Landscaping scheme (BHOC.448_Landscape General Arrangement DRAFT.pdf)