



BEROL QUARTER

Wind Microclimate Assessment

WSP

BEROL QUARTER LIMITED

December 2022



Berol Quarter Limited

BEROL QUARTER

Wind Microclimate Report





Berol Quarter Limited

Berol Quarter

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70094918

OUR REF. NO. 020

DATE: NOVEMBER 2022

WSP

4th Floor

6 Devonshire Square

London

EC2M 4YE

Phone: +44 20 7337 1700

Fax: +44 20 7337 1701

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3	Revision 4
Remarks	Draft Report V1	Draft Report V2	Final	Final	
Date	21 October 2022	28 October 2022	7 November 2022	8 November 2022	
Prepared by	E. Chatzistefanou	E. Chatzistefanou	E. Chatzistefanou	E. Chatzistefanou	
Signature					
Checked by	Camilo Diaz	Camilo Diaz	Camilo Diaz	Camilo Diaz	
Signature					
Authorised by	Camilo Diaz	Camilo Diaz	Camilo Diaz	Camilo Diaz	
Signature					
Project number	70094918	70094918	70094918	70094918	
Reference number	70094918-020	70094918-020	70094918-020	70094918-020	
Issue number	v1	v2	v3	v4	

CONTENTS

QUALITY CONTROL	3
CONTENTS	4
1 INTRODUCTION	6
2 PLANNING POLICY AND LEGISLATIVE CONTEXT	6
2.1 LEGISLATIVE FRAMEWORK	6
2.2 NATIONAL PLANNING POLICY	7
2.3 REGIONAL PLANNING POLICY	7
2.4 LOCAL PLANNING POLICY	8
2.5 GUIDANCE	9
3 METHODOLOGY	9
3.1 ASSESSMENT METHODOLOGY	9
3.2 SITE AND STUDY AREA	10
ASSESSMENT MODELLING	11
3.3 ASSESSMENT CRITERIA	13
3.4 GENERAL TARGET WIND CONDITIONS	14
3.5 SENSITIVE RECEPTORS FOR WIND ASSESSMENT	14
3.6 WIND CLIMATE ANALYSIS	17
3.7 SIMULATION DETAILS AND ASSUMPTIONS	20
4 ASSESSMENT RESULTS	21
4.2 EXISTING BASELINE CONDITIONS	22
PEDESTRIAN SAFETY – BASELINE	22
PEDESTRIAN COMFORT – BASELINE	23
4.3 ASSESSMENT OF PROPOSED SCENARIO	24
PEDESTRIAN SAFETY – PROPOSED	25



PEDESTRIAN COMFORT – PROPOSED – WINTER	28
PEDESTRIAN COMFORT – PROPOSED – SUMMER	29
4.4 ASSESSMENT OF CUMULATIVE SCENARIO	31
PEDESTRIAN SAFETY – CUMULATIVE	32
PEDESTRIAN COMFORT – CUMULATIVE – WINTER	34
5 MITIGATION	37
6 CONCLUSIONS	37
7 REFERENCES	40

1 INTRODUCTION

- 1.1.1. WSP UK Ltd has been appointed by Berol Quarter Limited to undertake a wind microclimate assessment for the Proposed Development of the Berol Quarter, comprising the Berol House and 2 Berol Yard buildings.
- 1.1.2. This report provides an assessment of the pedestrian street-level wind environment within and around the Proposed Development site against wind comfort and wind safety criteria. The study pays particular attention to pedestrian access routes, amenity spaces, outdoor seating areas, bus stops and building entrances. Additionally, an assessment of the proposed upper levels (balconies and terraces) has been included in the study.
- 1.1.3. The site is located in the London Borough of Haringey, and it is bounded by Ashley Road to the west, Watermead Way to the east and Cannon Factory to the north (Figure 1-1).

Figure 1-1 – Proposed Development site



2 PLANNING POLICY AND LEGISLATIVE CONTEXT

2.1 LEGISLATIVE FRAMEWORK

- 2.1.1. There is no specific national legislation or planning policy guidance dealing with wind microclimate in terms of pedestrian comfort. However, the Lawson Criteria (Ref. 1) are used to benchmark the pedestrian wind microclimate as they are well-established in the UK.

2.2 NATIONAL PLANNING POLICY

National Planning Policy Framework (2021)

2.2.1. The National Planning Policy Framework was revised in July 2021 by the Department of Communities and Local Government (Ref. 2).

2.2.2. Paragraph 130 of the National Planning Policy Framework states that:

“Planning policies and decisions should ensure that developments:

a) will function well and add to the overall quality of the area, not just for the short term but over the lifetime of the development;

b) are visually attractive as a result of good architecture, layout and appropriate and effective landscaping;

c) are sympathetic to local character and history, including the surrounding built environment and landscape setting, while not preventing or discouraging appropriate innovation or change (such as increased densities);

d) establish or maintain a strong sense of place, using the arrangement of streets, spaces, building types and materials to create attractive, welcoming and distinctive places to live, work and visit;

e) optimise the potential of the site to accommodate and sustain an appropriate amount and mix of development (including green and other public space) and support local facilities and transport networks; and

f) create places that are safe, inclusive and accessible and which promote health and well-being, with a high standard of amenity for existing and future users; and where crime and disorder, and the fear of crime, do not undermine the quality of life or community cohesion and resilience.”

2.3 REGIONAL PLANNING POLICY

2.3.1. The London Plan 2021 (Ref. 3) outlines that:

The middle of a tall building has an important effect on how much sky is visible from surrounding streets and buildings, as well as on wind flow, privacy and the amount of sunlight and shadowing there is in the public realm and by surrounding properties (Paragraph 3.9.7).

Buildings should be of high quality and enhance, activate and appropriately frame the public realm. Their massing, scale and layout should help make public spaces coherent and should complement the existing streetscape and surrounding area. Particular attention should be paid to the design of the parts of a building or public realm that people most frequently see or interact with in terms of its legibility, use, detailing, materials and location of entrances. Creating a comfortable pedestrian environment with regard to levels of sunlight, shade, wind, and shelter from precipitation is important (Paragraph 3.3.8)

2.3.2. Development Plans and development proposals should (Policy D8 Public Realm) (Ref. 3):

G) ensure buildings are of a design that activates and defines the public realm and provides natural surveillance. Consideration should also be given to the local microclimate created by buildings, and the impact of service entrances and facades on the public realm.

J) ensure that appropriate shade, shelter, seating and, where possible, areas of direct sunlight are provided, with other microclimatic considerations, including temperature and wind, taken into account in order to encourage people to spend time in a place.

2.3.3. Development proposals should address the following environmental impact (Policy D9 Tall Buildings) (Ref. 3):

A) wind, daylight, sunlight penetration and temperature conditions around the building(s) and neighbourhood must be carefully considered and not compromise comfort and the enjoyment of open spaces, including water spaces, around the building.

2.4 LOCAL PLANNING POLICY

Haringey's Local Plan Strategic Policies 2013-2026 (2017 edition)

2.4.1. Paragraph 3.1.5 (Ref. 4) states:

The Council will expect development in the growth areas to maximise site opportunities and the opportunities and benefits for the borough and the local area within the context of the full range of Haringey's planning policies and objectives, including those relating to amenity, sustainability, heritage/built environment, open space, community safety and sustainable transport.

Tottenham Area Action Plan, London Borough of Haringey (Adopted July 2017)

2.4.2. Page 127 (Ref. 5) mentions:

Ashley road itself should be pedestrian and cycle friendly, and provide a legible route to the new district Centre to the south.

Development Management DPD, London Borough of Haringey (Adopted July 2017)

2.4.3. Policy DM20: Open Space and Green Grid on page 41 (Ref. 6) states:

The reconfiguration of open space will be supported where: (...)

c It would achieve enhancements to address identified deficiencies in the capacity, quality and accessibility of open space, and it would secure a viable future for the open space; and

d It would not be detrimental to any environmental function performed by the existing open space.

2.4.4. Also, paragraph 6.17 states:

All proposals will need to consider impacts on amenity at an early stage and demonstrate that new uses will not prejudice the continuation of industrial and commercial activities. In considering proposals, the Council will also take into account the cumulative impact of non-employment uses.

2.5 GUIDANCE

The Lawson Criteria

- 2.5.1. The Lawson Criteria (Ref. 1) have been adopted for this assessment. 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.

Best Practice Guidelines for Computational Fluid Dynamics Simulation of Flows in the Urban Environment

- 2.5.2. The Best Practice Guidelines for Computational Fluids Dynamics (CFD) Simulation of Flows in the Urban Environment (Ref. 7) have been used as a technical reference for this assessment. This is the most comprehensive set of technical guidance for the application of computer fluid dynamics for wind flows in the urban environment.

3 METHODOLOGY

3.1 ASSESSMENT METHODOLOGY

- 3.1.1. A detailed Computational Fluid Dynamics (CFD) study was used to provide a quantification of the pedestrian level wind environment at locations such as pedestrian access routes, building entrances, bus stops and amenity areas. The study combines numerically obtained pedestrian level wind speeds at key areas within and around the Site of the Proposed Development with long-term wind frequency statistics transposed from the weather station (see Wind Climate Analysis section for more detail) to determine the probability of local wind speeds exceeding comfort and safety thresholds for a range of common pedestrian activities.
- 3.1.2. The pedestrian-level wind environment in an urban setting will depend on the general wind conditions, as well as on the effects of the urban environment itself. Therefore, the assessment consists of three main parts: calculation of the aerodynamic effect of the Proposed Development within the surrounding context (expressed as speed-up ratios); which is then combined with historical wind data; and, finally, compared against criteria to quantify the discomfort and/or level of safety caused by the wind.
- 3.1.3. All schemes that were identified as under construction at the time of this assessment have been considered to be completed and therefore, treated as existing context.
- 3.1.4. The assessment comprises the following three scenarios:
- Baseline scenario: The existing condition of the site within the existing surrounding context;
 - Proposed scenario: The Proposed Development on the site within the existing surrounding context; and
 - Cumulative scenario: The Proposed Development on the site within the existing surrounding context and consented schemes.

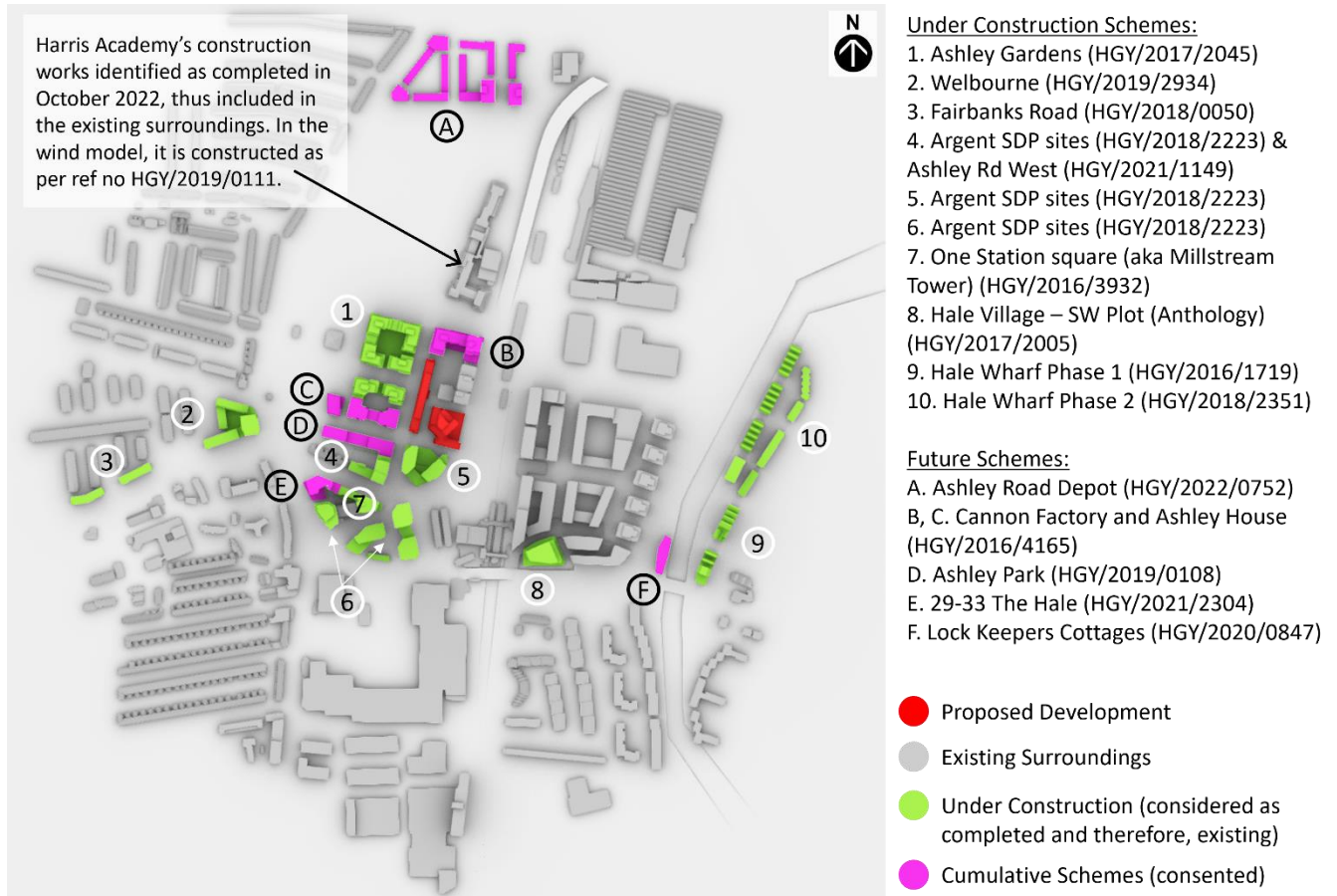
3.2 SITE AND STUDY AREA

- 3.2.1. The 3D model constructed for the study includes the built area within a radius of approximately 500 meters from the site (Figure 3-1) to account for the influence of the surrounding context on the incoming winds as they reach the site. Buildings beyond this radius are only explicitly included in the model if their distance from the site is less than 6 times their height, in line with best practice guidelines.
- 3.2.2. The model of the Proposed Development was based on the 3d model provided by Allies and Morrison on 28 September 2022, as well as on additional information and plans received on 29 September 2022 and 13 October 2022 respectively. The information used is fully presented on Table 3-1. The wind model was supplemented with information from mapping data and aerial photographic data for the area, as well as available information from the planning portal (Figure 3-2).

Figure 3-1 – Extent of the wind study area



Figure 3-2 – 3D model of the Proposed Development with future schemes – Top view



ASSESSMENT MODELLING

- 3.2.3. A three-dimensional CAD model of the site and surrounding buildings has been constructed using the information listed in Table 3-1.

Table 3-1 - Information used to construct the model

Date received	Type	Filename	Use in the wind assessment
28/09/22	3d Model	22049_02 Berol Yard_220928.dwg (based on: 22049_02 Berol Yard_220928.skp).	Construction of the Proposed Development.
29/09/22	Email	Re: 22049_2 BEROL YARD: Latest Model.	Construction of the Proposed Development.
29/09/22	JPG/PNG	22049_06_130_P1_Level 30_roof, Berol_Block E_Garden_north elevation, Berol_Level 6 windows, Berol_Level 17 windows, Berol_Level 25 windows.	Construction of the Proposed Development.

13/10/22	PDF	22049_06_102_P04, 22049_06_106_P05.	Construction of the Proposed Development.
17/10/22	PDF	626-CTF-XX-RP-DR-L-10001, 626-CTF-XX-XX-DR-L-10001, 626-CTF-XX-XX-DR-L-LUGF.	Roof Level General Arrangement, Landscape General Arrangement, London Urban Greening Factor.
04/10/22	Email	RE: Berol Yard - initial schedule of applications [NLP-DMS.FID272014] [LICH-DMS.FID272014].	Cumulative schemes within 1km of Berol Quarter application site.
13/10/22	Email	RE: Wind Microclimate Model Configurations [LICH-DMS.FID272014].	Instruction to include the 29-33 The Hale (ref no HGY/2021/2304) as consented.
October 2022	PDF	Various drawings obtained from Haringey Council's planning portal.	Construction of the schemes under construction and consented.

- 3.2.4. The model includes the site and all buildings within the extent of the study area as shown in Figure 3-3. The wind flow around these buildings and terrain is explicitly modelled within this radius, whilst outside this region obstructions to wind are accounted for using mathematical models which assign a 'roughness' depending on the terrain type.
- 3.2.1. The detail of the CAD model increases from approximately 1m for the surrounding buildings to 0.2m around the site, as shown in Figure 3-4. The differences of the terrain elevation are illustrated in Figure 3-5.

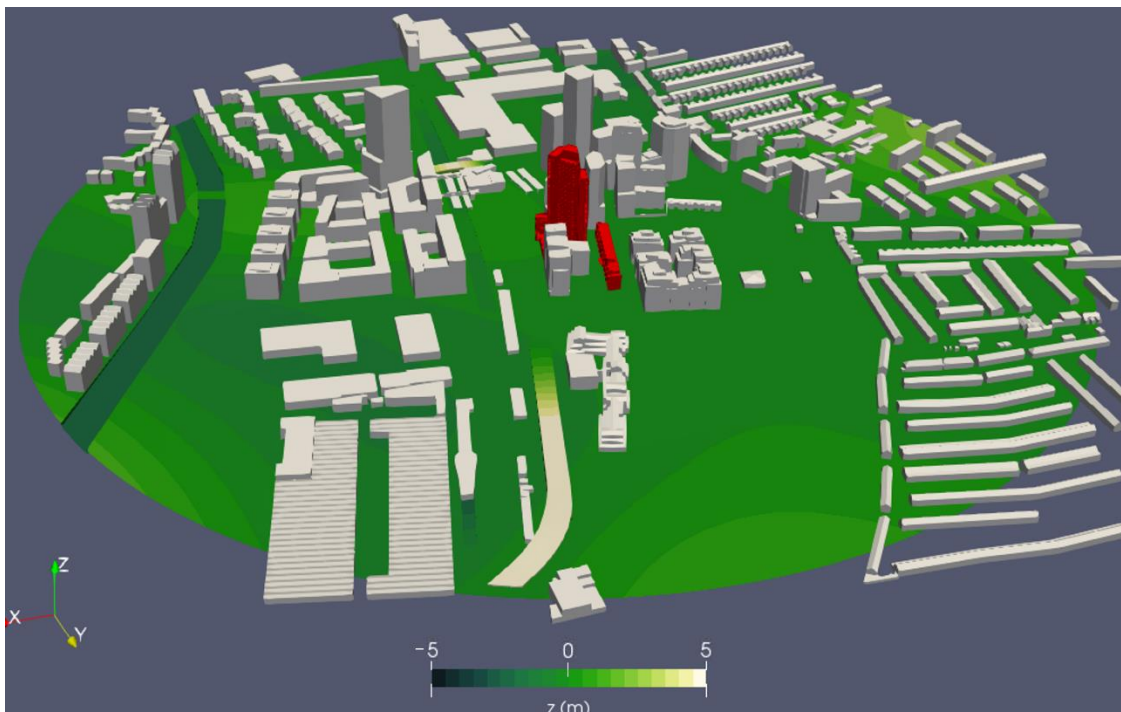
Figure 3-3 – 3D Model for the assessment



Figure 3-4 – Screenshot of the CAD model showing the level of detail in the model



Figure 3-5 – The 3D CAD model of the Proposed scenario, showing the explicitly modelled surrounding buildings and terrain. The terrain is coloured by its relative elevation, with the building of interest at $z=0$



3.3 ASSESSMENT CRITERIA

3.3.1. The Lawson Criteria (Ref.1) have been reproduced in Table 3-2. The criteria relate a threshold wind speed and a threshold frequency to the suitability of an activity.

- 3.3.2. The frequency threshold for each comfort criterion is 5% - about three weeks per year. It is also useful to assess frequency on a seasonal basis. This is particularly useful for summer and winter. For example, an outdoor seating area may require wind conditions suitable for sitting or standing in summer, but not in winter when the seating is unlikely to be used. For season-specific results, the criteria are based on 5% of hours across the months in that season.

Table 3-2 - Comfort Criteria

Criteria	Suitability	Threshold mean wind for 5% of hours [m/s]
Pedestrian sitting	Outdoor seating and areas one can occupy comfortably for long periods	4
Pedestrian standing	Main building entrances, pickup/drop-off points	6
Leisure walking	Appropriate for strolling	8
Business Walking	Can be tolerated if one's objective is to walk, run or cycle without lingering	10
Unsuitable	Nuisance for most pedestrian activities	>10

Additionally, the criteria for safety are defined based on 2.2 hours' exceedance per year (0.025% of the time). These are areas where someone could find walking difficult or even lose their footing. These criteria are reproduced in Table 3-3.

Table 3-3 - Safety Criteria

Criteria	Description	Threshold mean wind speed for 2.2hr/year [m/s]
S15	General public especially less able pedestrians and cyclists find conditions physically difficult or even dangerous.	15
S20	Unsuitable for all pedestrians	20

3.4 GENERAL TARGET WIND CONDITIONS

- 3.4.1. The wind assessment for each of these criteria has been carried out considering the season and expected activity on the site based on the following general target wind conditions:
- Pedestrian Thoroughfares: Business / Leisure walking during all seasons;
 - Pedestrian Walkways: Leisure walking during all seasons;
 - Building entrances, bus stops, drop-off areas: Standing during all seasons; and
 - Outdoor amenity and seating areas: Sitting during the summer season.

3.5 SENSITIVE RECEPTORS FOR WIND ASSESSMENT

- 3.5.1. Sensitive receptors for the wind assessment are all pedestrian circulation routes, building entrances, bust stops, leisure outdoor areas within the site and its surroundings, as well as the proposed terraces and balconies that are accessible to occupants. Any proposed upper levels that are not accessible to

occupants are not identified as sensitive receptors and therefore, are excluded from the assessment.

3.5.2. Specifically, the receptors identified for this assessment are shown Figure 3-6 and are listed in Table 3-4.

Figure 3-6 – Sensitive receptors

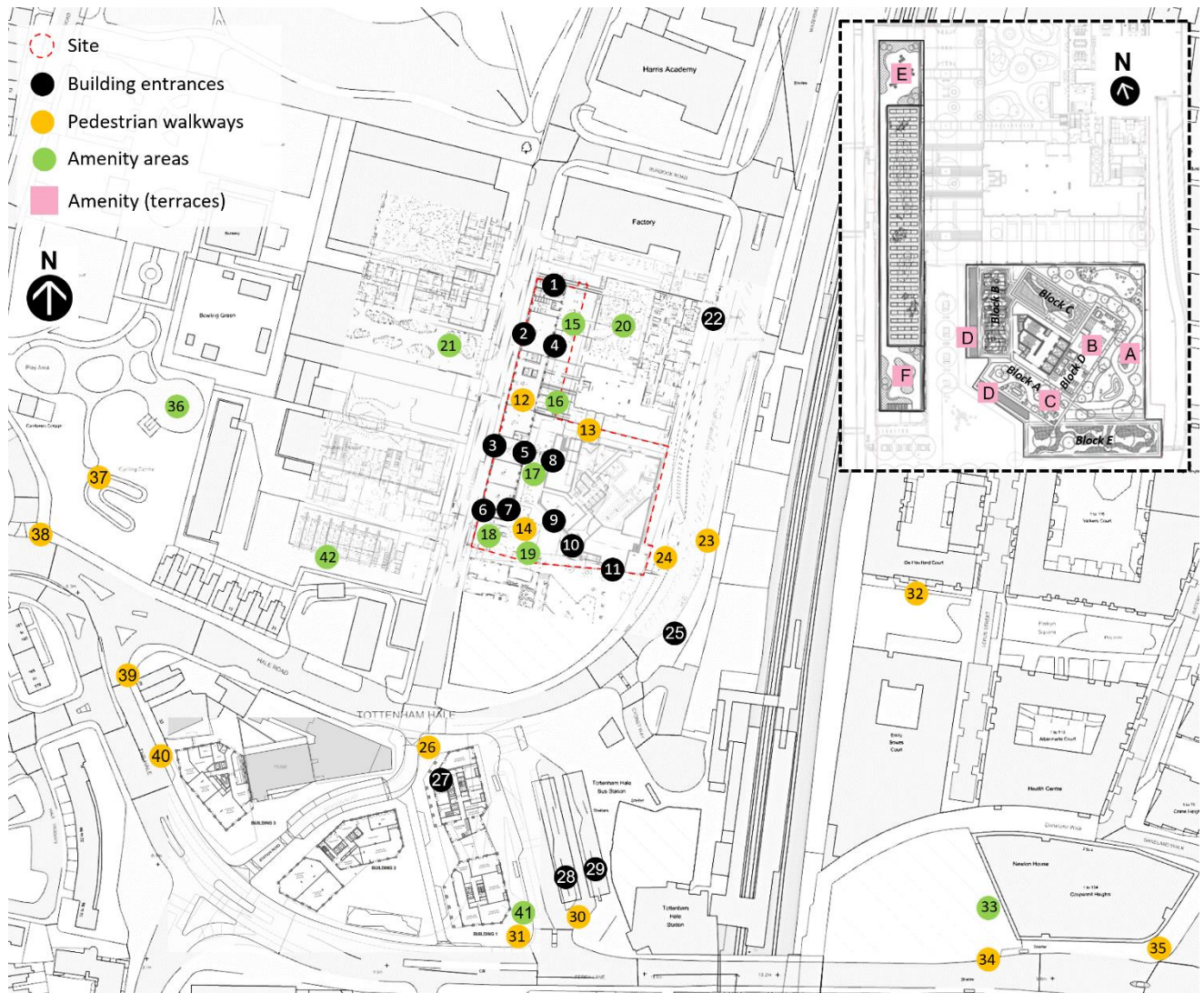


Table 3-4 - List of sensitive receptors

Recept or Number	Description	Use	Target Conditions
Existing Receptors			
20	Gessner Gardens	Outdoor Amenity Area	Sitting during the summer season
21	Berol Link	Outdoor Amenity Area	Sitting during the summer season
22	Burdock Road Lea Valley Technopark (Stop G)	Bus Stop	Standing during all seasons

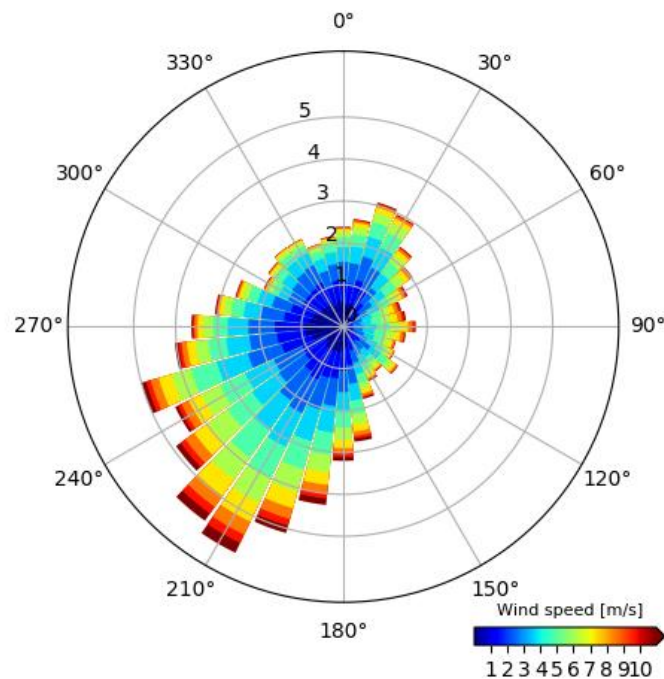
23, 24	Watermead Way	Pedestrian Walkway	Leisure walking during all seasons
25	Tottenham Hale Bus Station (Stop F)	Bus Stop	Standing during all seasons
26	Watermead Way & Station Rd corner	Pedestrian Walkway	Leisure walking during all seasons
27	Argent SDP sites, Building 1, NW entrance	Building Entrance	Standing during all seasons
28, 29	Tottenham Hale Bus Station (Stop A, B)	Bus Stop	Standing during all seasons
30	Pedestrian crossing south of Tottenham Hale Bus Station	Pedestrian Walkway	Leisure walking during all seasons
31	Ferry Lane	Pedestrian Walkway	Leisure walking during all seasons
32	De Havilland Court	Pedestrian Walkway	Leisure walking during all seasons
33	Outdoor seating between Hale Village SW & SE Plots	Outdoor Amenity Area	Sitting during the summer season
34	Hale Village SW Plot, Anthology	Pedestrian Walkway	Leisure walking during all seasons
35	Ferry Ln & Mill Mead Rd corner	Pedestrian Walkway	Leisure walking during all seasons
36	Park View Rd playground	Outdoor Amenity Area	Sitting during the summer season
37, 38	Park View Rd	Pedestrian Walkway	Leisure walking during all seasons
39, 40	The Hale	Pedestrian Walkway	Leisure walking during all seasons
41	Argent SDP sites, Building 1, SE benches	Outdoor Amenity Area	Sitting during the summer season
Future Receptors (On-site)			
1-7	Berol House entrances	Building Entrance	Standing during all seasons
8-11	2 Berol Yard entrances	Building Entrance	Standing during all seasons
12	Berol Passage	Pedestrian Walkway	Leisure walking during all seasons
13	2 Berol Yard north facade	Pedestrian Walkway	Leisure walking during all seasons
14	SE corner of Berol House	Pedestrian Walkway	Leisure walking during all seasons
15-17	Berol Walk amenity areas	Outdoor Amenity Area	Sitting during the summer season
18, 19	SW corner of the site	Outdoor Amenity Area	Sitting during the summer season
A	Level 0 podium	Outdoor Amenity Area	Sitting during the summer season
B	Level 30 roof terrace	Outdoor Amenity Area	Sitting during the summer season
C	Level 17 roof terrace	Outdoor Amenity Area	Sitting during the summer season
D	Level 0 terrace	Outdoor Amenity Area	Sitting during the summer season

E, F	Level 5 roof terrace	Outdoor Amenity Area	Sitting during the summer season
Future Receptors (Off-site)			
42	South of Ashley Park scheme	Outdoor Amenity Area	Sitting during the summer season

3.6 WIND CLIMATE ANALYSIS

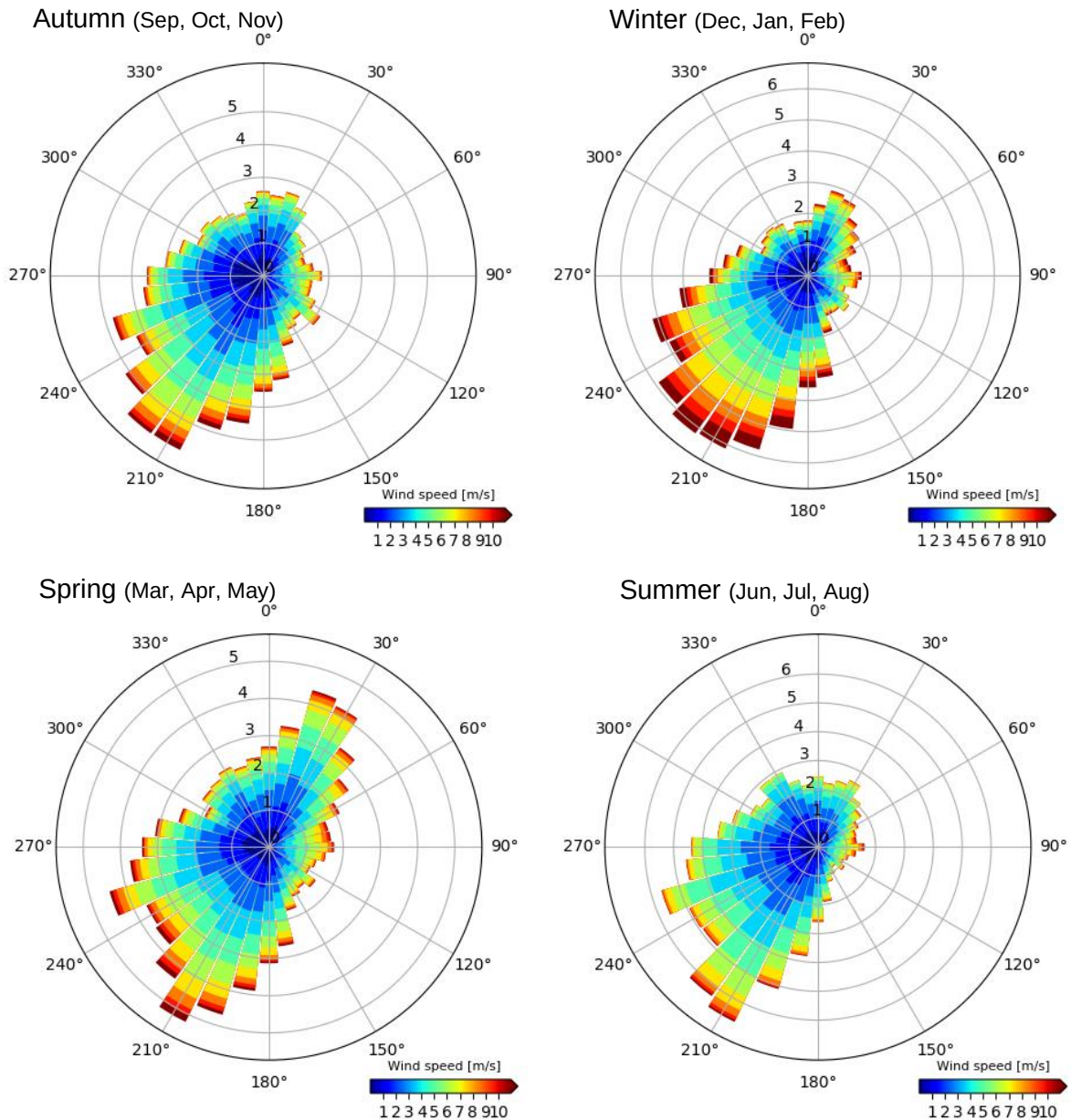
- 3.6.1. Wind data was collected from the Heathrow Airport weather station and transposed to the project site has been used for the assessment. The data was discretised into 36 bins, representing 10° sectors. The nomenclature adopted in this report assigns 0° to winds coming from North and increases clockwise such that 90° refers to winds blowing from East, 180° from South and 270° from West.
- 3.6.2. Figure 3-7 shows a summary of the wind data at the Weather Station for the whole year in the form of a wind rose. Wind direction is shown on the angular axes, with percentage of hours on the radial axes. From this plot, it is possible to observe that south-westerly winds are the prevailing wind direction, with these winds also representing the largest proportion of higher wind speeds.

Figure 3-7 – Annual wind rose at the Weather Station (Heathrow Airport), showing the frequency and magnitude of mean-hourly wind speeds



- 3.6.3. Figure 3-8 shows similar wind roses split into three-month seasons. It shows some variation in directionality, with spring showing an increase in north-easterly winds. The winter months are windier than other months, which is heavily weighted to the south-westerly winds.

Figure 3-8 – Wind roses for each season



3.6.4. Linear regression methods were used to fit the data to a Weibull probability distribution, i.e.:

$$P(U) = pe^{-\left(\frac{U}{c}\right)^k}$$

where the p , c and k coefficients are the probability of the wind direction occurring, the dispersion parameter and the shape parameter respectively.

3.6.5. To account for the differences in terrain surrounding the site, adjustments were made using the wind model proposed by ESDU, an engineering advisory organisation based in the UK (Ref. 8). This method assigns transposition factors to the c term in the Weibull distribution of the data at the meteorological site, based on upwind roughness factors which are assigned to various terrain types. The weather centre data was initially transposed to open country terrain and subsequently transposed to a reference height of 108 m at the Proposed Development site, accounting for upwind terrain and

topographical features which are shown in Figure 3-9. This terrain analysis resulted in the transposition factors shown in Table 3-5.

Figure 3-9 – Categorisation of the terrain surrounding the site

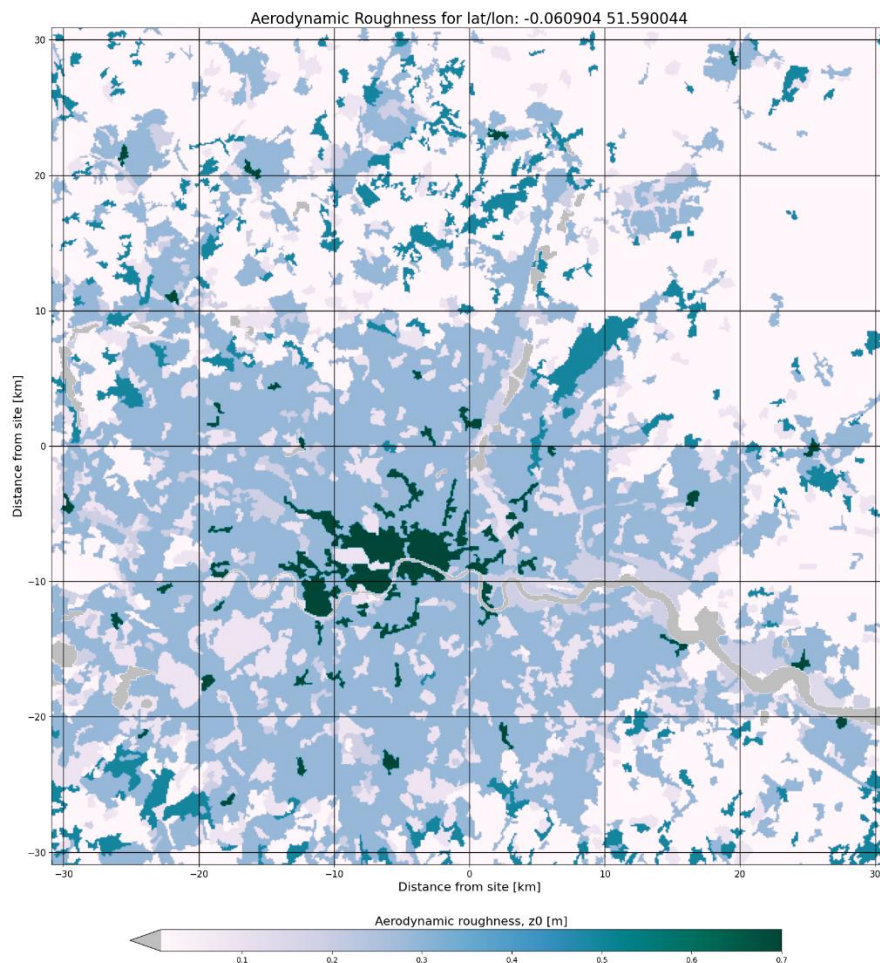


Table 3-5 - Transposition factors 10m open country to reference height (108m) at project site

0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
1.25	1.28	1.27	1.25	1.25	1.31	1.25	1.23	1.25	1.24	1.26	1.26

3.6.18. The aerodynamic effect from all wind directions must be accounted for and, as the weather data has an azimuthal resolution of 10°, 36 simulated directions will provide the best possible resolution. However, this can be computationally onerous and infrequent wind directions will not contribute significantly to the final outcome. Therefore, some adjacent infrequent directions have been grouped together such that each simulated direction has a similar frequency of occurrence. The grouping methodology is such that the frequency of grouped wind directions should generally not exceed that of the most frequent (prevailing) wind directions.

3.6.19. In this case, 22 wind directions were explicitly simulated, and are shown in Table 3-6.

Table 3-6 - Wind directions simulated

Simulated direction [°]	Bins included [°]	Combined frequency [%]
0	0, 10, 350	7.131
20	20	3.075
35	30, 40	5.305
55	50, 60	3.738
80	70, 80, 90	4.672
110	100, 110, 120	4.162
140	130, 140, 150	4.355
165	160, 170	4.546
180	180	3.201
190	190	4.271
200	200	5.108
210	210	5.976
220	220	5.688
230	230	4.904
240	240	4.446
250	250	4.998
260	260	4.038
270	270	3.624
280	280	3.079
295	290, 300	4.777
315	310, 320	4.529
335	330, 340	4.378

3.7 SIMULATION DETAILS AND ASSUMPTIONS

- 3.7.1. A CFD numerical simulation has been performed for each of the directions shown in Table 3-6. Relative wind speeds were sampled at a plane 1.5m from the ground. These values were then combined with the weather data shown in section 'Wind Climate Analysis' and compared against criteria discussed in section 3.3.
- 3.7.2. Each simulation uses numerical methods to solve the governing equations of fluid mechanics around the site of interest. The site of interest in this case is the geometry discussed in section 3.2, surrounded by a volume which extends 3km in the horizontal directions and 400m in the vertical direction. The CFD method employed requires this volume to be split into smaller volumes or 'cells'. These cells are nominally hexahedral and reduce in size from approximately 25m in the far field to 0.1m near the building in order to sufficiently resolve the fluid flow. Thin prismatic layers of cells were added to the ground and buildings to resolve the large gradients in the flow near the solid obstructions. In this case, the total number of cells was around 25 million for the Baseline scenario, 39 million for the Proposed and 39 million for the Cumulative.

3.7.3. As time-averaged results are of interest, the equations in the model have been time-averaged using Reynolds averaging to produce the Reynolds-Averaged Navier-Stokes (RANS) equations. The realizable version of the $k - \epsilon$ model (Ref. 9) has been used to describe the statistical effect of turbulence by solving transport equations for the turbulent kinetic energy (k) and turbulent dissipation rate (ϵ).

3.7.4. The velocity magnitude output from the CFD is a mean velocity defined as

$$\bar{U} = (\bar{u}^2 + \bar{v}^2 + \bar{w}^2)^{\frac{1}{2}}$$

where the overbar represents a time-averaged quantity and u, v, w are the velocity components in the x, y, z directions, respectively. However, a pedestrian's perception to the wind does not depend on direction; a wind from any direction is equally as uncomfortable. Therefore, the velocity of interest is actually

$$\bar{U} = \overline{(u^2 + v^2 + w^2)^{\frac{1}{2}}}$$

these scalar values are different because $u = \bar{u} + u'$ and $\bar{u'^2} = 0$ but $\overline{u'^2} \neq 0$, where u' is the fluctuating part of the instantaneous velocity, u . Using the fact that $k = \frac{1}{2}(\overline{u'^2} + \overline{v'^2} + \overline{w'^2})$, the velocity used of interest from the RANS equations is

$$\bar{U}_{scalar} = (\bar{U}^2 + 2k)^{\frac{1}{2}}$$

3.7.5. A non-slip condition was applied to the ground and buildings. Buildings and ground within the 500m radius had a rough wall function with an assigned roughness of $z_0 = 0.02m$; the far-field (>500m radius) ground and heavily forested areas had a rough wall function with varying depending on their terrain classification (ESDU). The outlet had a zero-gradient boundary condition, side and top walls had free slip conditions. A logarithmic velocity profile was applied to the inlet whereby the velocity varies with height through:

$$U(z) = \frac{u_\tau}{\kappa} \ln\left(\frac{z + z_0}{z_0}\right)$$

where

$$u_\tau = \frac{\kappa U_{ref}}{\ln\left(\frac{z_{ref} + z_0}{z_0}\right)}$$

and $\kappa = 0.41$ is the Von Karman constant, z is the height above the ground, $z_{ref} = 108m$, z_0 is the upstream roughness which varies by direction and $U_{ref} = 10m/s$.

3.7.6. The SIMPLE algorithm as implemented in OpenFOAM (Engys version HelyxCORE-3.0.0) was used to iteratively solve the equations. The solution was considered to be converged when the residuals (i.e. the relative change from one iteration to the next) were 10^{-5} for momentum and 10^{-4} for pressure.

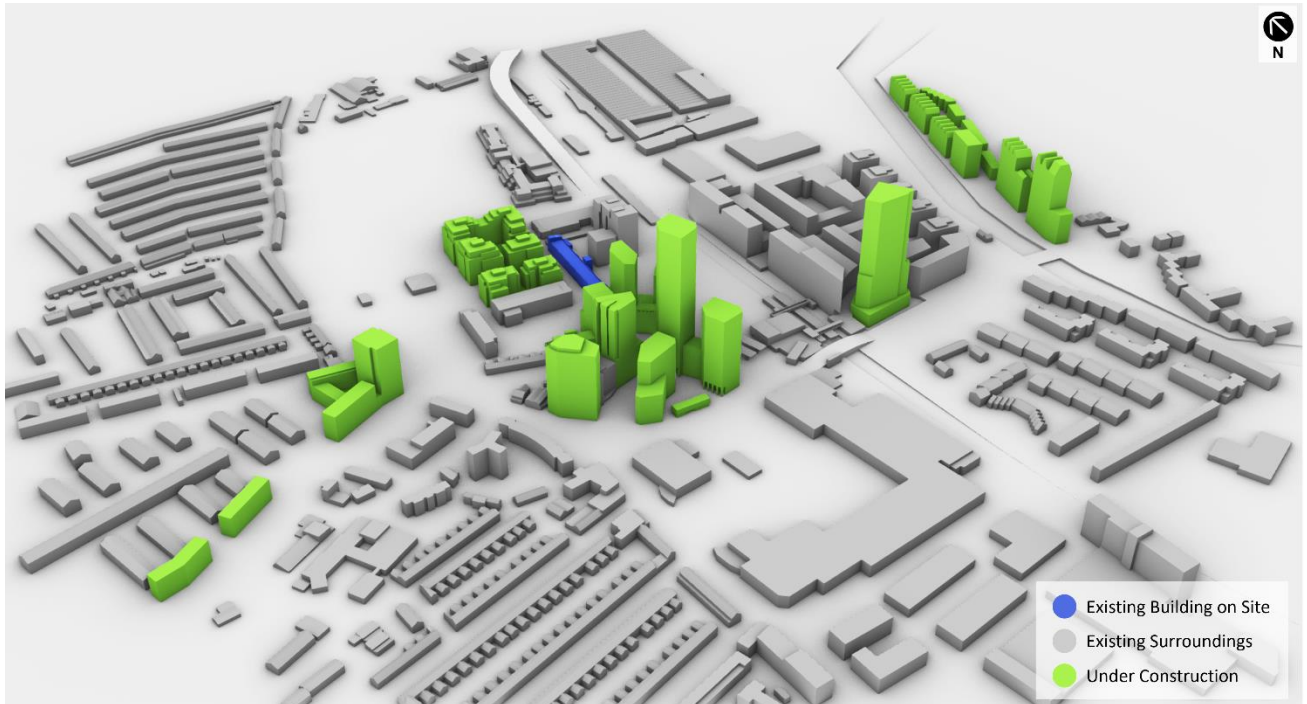
4 ASSESSMENT RESULTS

4.1.1. This section presents the safety and comfort results of the assessment. Conditions are assessed against the Lawson Criteria and comparisons are made between the Baseline, Proposed and Cumulative scenarios. The results are presented in the form of colour coded wind frequency plots taken at 1.5m plane above ground which is the industry standard height to represent pedestrian level.

4.2 EXISTING BASELINE CONDITIONS

- 4.2.1. The Baseline scenario has been modelled to represent the conditions around the site prior to the introduction of the Proposed Development (Figure 4-1). This scenario assumes the existing building on the site within the existing surrounding context. Any developments identified as under construction at the time of the assessment have been considered as completed and therefore part of the existing context.

Figure 4-1 – 3D Model of the Baseline scenario



PEDESTRIAN SAFETY – BASELINE

- 4.2.2. Figure 4-2 shows contours of annual safety criteria for the Baseline scenario. The results indicate that the recommended criteria for safety are met at most of the areas, with the only exception being the area near receptor 35 where the recommended safety criteria are exceeded.

Figure 4-2 – Safety Criteria for the Baseline scenario



PEDESTRIAN COMFORT – BASELINE

- 4.2.3. Figure 4-3 illustrates contours of the winter and summer comfort criteria at pedestrian street level for the Baseline scenario.

Street Level – On Site

- 4.2.1. The results indicate that the wind environment at all the areas within the site is suitable for the existing uses during winter and summer and therefore, no mitigation is required.

Street Level – Off Site (Winter)

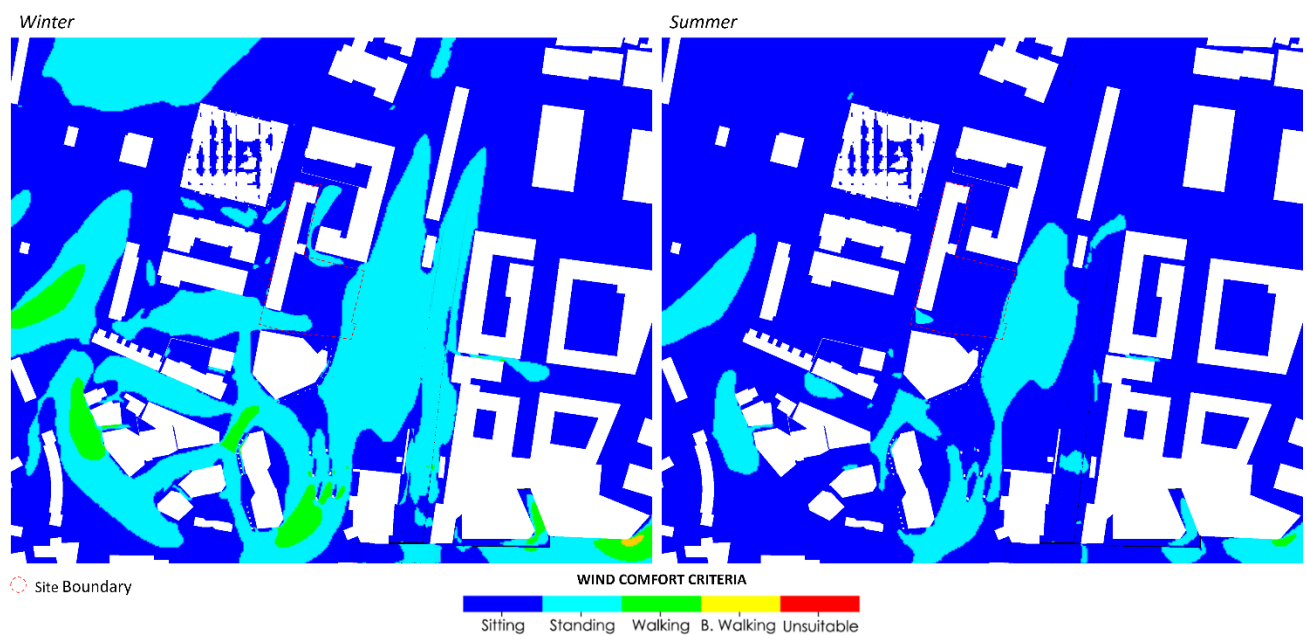
- 4.2.2. The results indicate that the wind conditions at the Tottenham Hale Bus Station are suitable for sitting, standing and leisure walking (near receptors 28, 29) with some parts exceeding the standing criteria typically required for bus stops.
- 4.2.3. The results also indicate that the wind environment at the NW building entrance of Building 1 - Argent SDP sites (receptor 27) is suitable for leisure walking around the entrance area, exceeding the standing criteria typically required for building entrances.
- 4.2.4. The results show that the wind conditions at the pedestrian walkway, on the corner of Ferry Lane and Mill Mead Road (receptor 35), are suitable for business and leisure walking exceeding the standing criteria typically required for building entrances.
- 4.2.5. The results show that the wind conditions at all remaining off-site receptors are suitable for the existing uses.

Street Level - Off Site (Summer)

- 4.2.6. The results show that the wind conditions at receptors 20 and 21 are suitable for sitting and therefore, suitable for the existing use. Also, the wind conditions near receptor 36 are mostly suitable for sitting with some areas suitable for standing and therefore, suitable for the existing use.

- 4.2.7. The results indicate that the wind environment around the outdoor seating area between Hale Village's SW and SE Plots (receptor 33) is suitable for standing. It is expected that the existing trees and landscape which have not been considered in the assessment, would help improve the local wind conditions in this area.
- 4.2.8. The results also indicate that the wind environment around the outdoor seating area near the SE corner of Building 1 - Argent SDP sites (receptor 41) is suitable for standing exceeding the sitting criteria, however it is expected that the existing trees and landscape which have not been considered in the assessment, would help improve the local wind conditions in this area.
- 4.2.9. The results indicate that the wind conditions at the remaining off-site receptors are suitable for the existing uses.

Figure 4-3 – Comfort Criteria for the Baseline scenario



4.3 ASSESSMENT OF PROPOSED SCENARIO

- 4.3.1. In order to assess the effect of the Proposed Development, the proposed scheme was introduced into the CFD model to represent the Proposed scenario (Figure 4-5). The Proposed scenario comprises the Proposed Development on the site within the existing surrounding context. The model of the Proposed scenario was simulated under the same wind conditions as the Baseline scenario to enable a direct comparison.

Figure 4-4 – 3D Model of the Proposed scenario



PEDESTRIAN SAFETY – PROPOSED

- 4.3.2. Figure 4-5 shows contours of annual safety criteria on a plane 1.5m above the ground at the pedestrian street level and terraces for the Proposed scenario.

Street Level – On Site

- 4.3.3. The results indicate that all the street-level areas on-site are within the safety criteria with wind speeds not exceeding 15m/s for 0.025% of the year. Thus, no mitigation is required at these areas.

Street Level – Off Site

- 4.3.4. The results indicate that the recommended criteria for safety are met at most of the areas surrounding the site. The only exception is the area near receptor 35 where the recommended safety criteria are exceeded, however this exceedance remains present from the Baseline scenario and it is not caused by the Proposed Development thus, no mitigation is required.

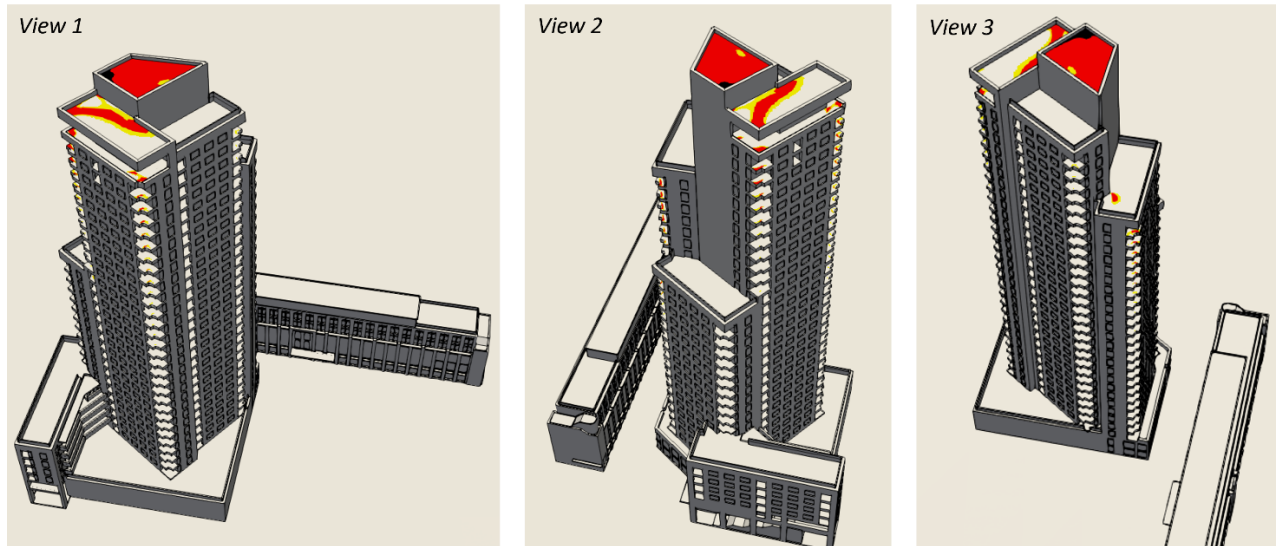
Elevated Levels – On Site

- 4.3.5. The results indicate that the wind conditions at the podium (receptor A), lower levels terraces (receptors C, D) and Berol House's terraces (receptors E, F) are within the recommended criteria for safety for all pedestrians with wind speeds not exceeding 15m/s for 0.025% of the year. Thus, no mitigation is required at these areas.
- 4.3.6. The results indicate that the recommended criteria for safety are exceeded at the level 30 terrace (receptor B), as the wind speeds near the corners and at some parts of the perimeter of the terrace exceed 15m/s for 0.025% of the year. Mitigation is required to prevent unsafe wind conditions. Mitigation options include the introduction of solid or porous balustrades (usually 1.1m – 1.5m tall), and landscape; these are further discussed in the Mitigation section.

- 4.3.7. The results indicate that the wind conditions at the majority of balconies are within the recommended criteria for safety. However, the assessment identified a number of balconies at the upper levels of the tower exceeding the safety criteria, near corners. More specifically, at the top two west-facing balconies of Block A; at the top six north and south-facing balconies of Block B; and at the top 8 north-facing and top five south-facing balconies of Block D. This indicates that mitigation would be required to improve wind conditions and achieve the recommended criteria for safety. Mitigation options include the introduction of solid or porous balustrades (usually 1.1m – 1.5m tall); these are further discussed in the Mitigation section.
- 4.3.8. The remaining terraces are not considered in the assessment as they are not accessible to occupants.

Figure 4-5 – Safety Criteria for the Proposed scenario

Street Level



WIND SAFETY CRITERIA



PEDESTRIAN COMFORT – PROPOSED – WINTER

- 4.3.9. Figure 4-6 illustrates contours of the winter comfort criteria at pedestrian street level for the Proposed scenario to illustrate the worst-case scenario to assess the spaces which are used all year round such as building entrances and key pedestrian circulation areas.

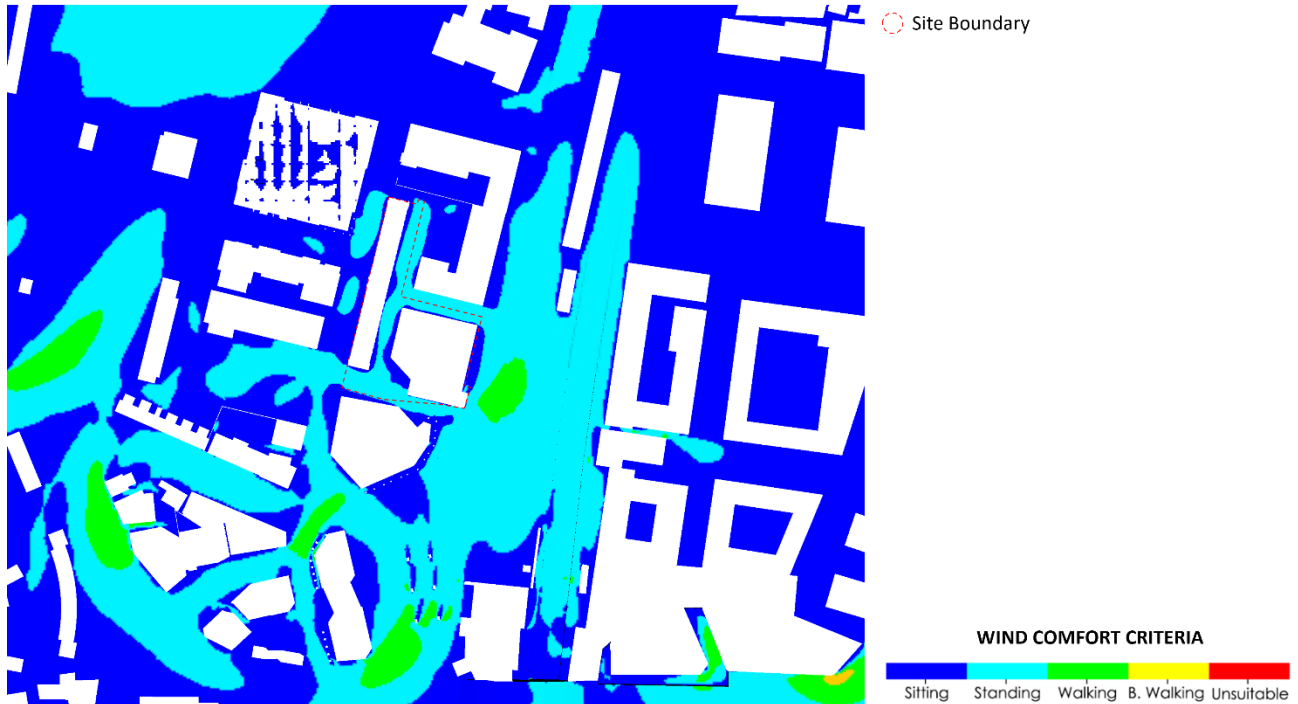
Street Level – On Site

- 4.3.10. With the introduction of the Proposed Development, the results indicate that the wind environment at all the areas within the site is suitable for the intended uses and therefore, no mitigation is required.

Street Level – Off Site

- 4.3.11. The results show some wind acceleration near receptors 23 and 24, where the wind conditions change from suitable to standing in the Baseline scenario to suitable for leisure walking in the Proposed scenario. However, the use of these areas is for pedestrian circulation and the wind conditions remain suitable for the existing use and therefore, no mitigation is required.
- 4.3.12. The results indicate that the wind conditions at the Tottenham Hale Bus Station remain suitable for sitting, standing and leisure walking (near receptors 28, 29). This shows no change from the Baseline scenario and therefore, no mitigation is required.
- 4.3.13. The results also indicate that the wind environment at the NW building entrance of Building 1 - Argent SDP sites (receptor 27) remains suitable for leisure walking and standing. This shows no change from the Baseline scenario and therefore, no mitigation is required.
- 4.3.14. The results show that the wind conditions at the pedestrian walkway on the corner of Ferry Lane and Mill Mead Road (receptor 35) remains suitable for business and leisure walking. This shows no change from the Baseline scenario and therefore, no mitigation is required.
- 4.3.15. The results show that the wind conditions at all remaining receptors are suitable for the existing uses, and therefore at these areas no mitigation is required.

Figure 4-6 – Winter Comfort Criteria for the Proposed scenario



PEDESTRIAN COMFORT – PROPOSED – SUMMER

- 4.3.16. Figure 4-7 shows contours of the summer comfort criteria at pedestrian street level and terraces for the Proposed scenario to assess the outdoor leisure areas during their higher occupancy period.

Street-level – On Site

- 4.3.17. The results indicate that the wind environment at all the areas within the site is suitable for sitting and standing, and therefore suitable for the intended uses, thus no mitigation is required. More particularly, the wind conditions at the amenity areas (receptors 15, 16, 17, 18, 19) are suitable for sitting and therefore, no mitigation is required.

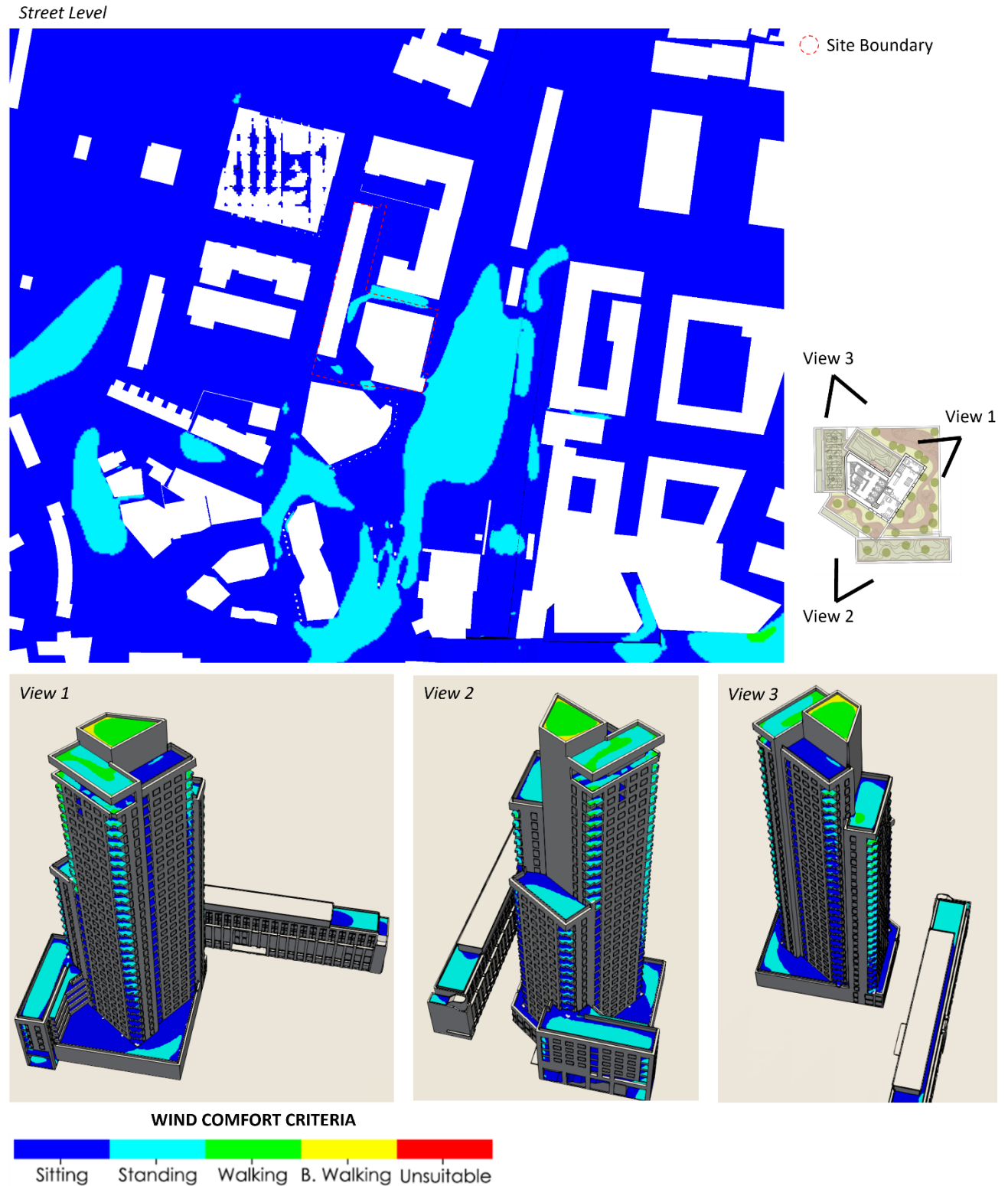
Street-level – Off Site

- 4.3.18. The results show that the wind conditions at receptors 20 and 21 remain suitable for sitting and therefore, suitable for the existing use, thus no mitigation is required. Also, the wind conditions near receptor 36 remain mostly suitable for sitting with some area suitable for standing and therefore, suitable for the existing use, thus no mitigation is required.
- 4.3.19. The results indicate that the wind environment around the outdoor seating area between Hale Village's SW and SE Plots (receptor 33) remains suitable for standing showing no change from the Baseline scenario and therefore, no mitigation is required.
- 4.3.20. The results also indicate that the wind environment around the outdoor seating area near the SE corner of Building 1 - Argent SDP sites (receptor 41) is suitable for standing, showing no change from the Baseline scenario and therefore, no mitigation is required.
- 4.3.21. The results indicate that the wind conditions at the remaining off-site receptors are suitable for the existing uses and therefore, at these areas no mitigation is required.

Elevated Levels – On Site

- 4.3.22. The results indicate that the wind conditions at receptors A, C, E and F are suitable for sitting and standing. Should any outdoor seating arrangements be allocated within the areas identified in this report as suitable for 'sitting', then no mitigation will be required at these areas.
- 4.3.23. The results show that the wind conditions at receptor D are suitable for sitting and therefore, suitable for the intended use, thus at this area no mitigation is required.
- 4.3.24. The results also indicate that the wind environment at level 30 terrace (receptor B) is suitable for sitting and standing, with some localised areas near corners that are suitable for leisure walking. Also, the wind conditions at a number of localised areas at the balconies are also suitable for leisure walking. The mitigation proposed to address the safety exceedances is likely to provide shelter and improve the wind conditions for comfort. This is further discussed in the Mitigation section.

Figure 4-7 – Summer Comfort Criteria for the Proposed scenario



4.4 ASSESSMENT OF CUMULATIVE SCENARIO

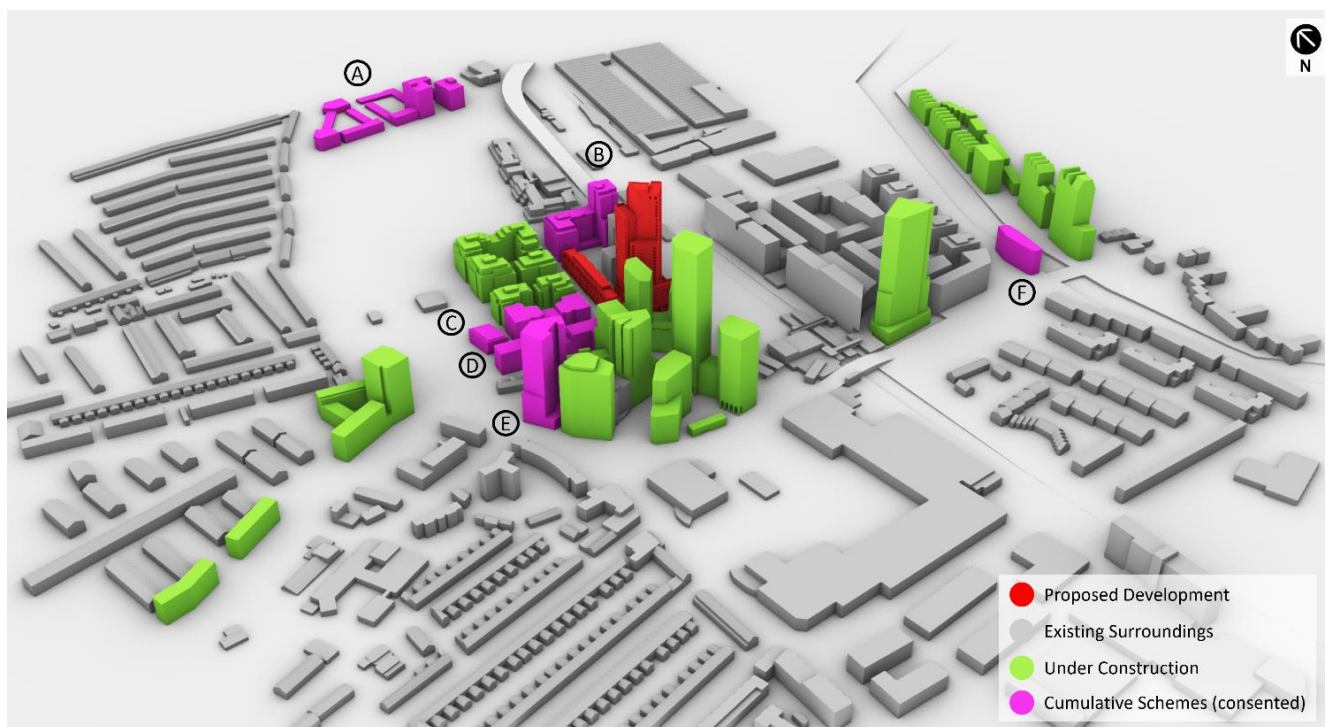
- 4.4.1. The Proposed Development and the future schemes around the site were introduced into the CFD model to represent the Cumulative scenario (Figure 4-8). The model of the Cumulative scenario was

simulated under the same wind conditions as the Baseline and Proposed scenarios, for consistency and to enable a direct comparison.

4.4.2. The future (consented) schemes considered in the assessment are presented in detail in Figure 3-2 and Figure 4-8 in this report, and is listed below:

- A. Ashley Road Depot (HGY/2022/0752)
- B, C. Cannon Factory and Ashley House (HGY/2016/4165)
- D. Ashley Park (HGY/2019/0108)
- E. 29-33 The Hale (HGY/2021/2304)
- F. Lock Keepers Cottages (HGY/2020/0847)

Figure 4-8 – 3D Model of the Cumulative scenario



PEDESTRIAN SAFETY – CUMULATIVE

4.4.3. Figure 4-9 shows contours of annual safety criteria on a plane 1.5m above the ground at the pedestrian street level and terraces for the Cumulative scenario.

Street Level – On Site

4.4.4. The results indicate that all the street-level areas on-site are within the recommended criteria for safety with wind speeds not exceeding 15m/s for 0.025% of the year. Thus, no mitigation is required at these areas.

Street Level – Off Site

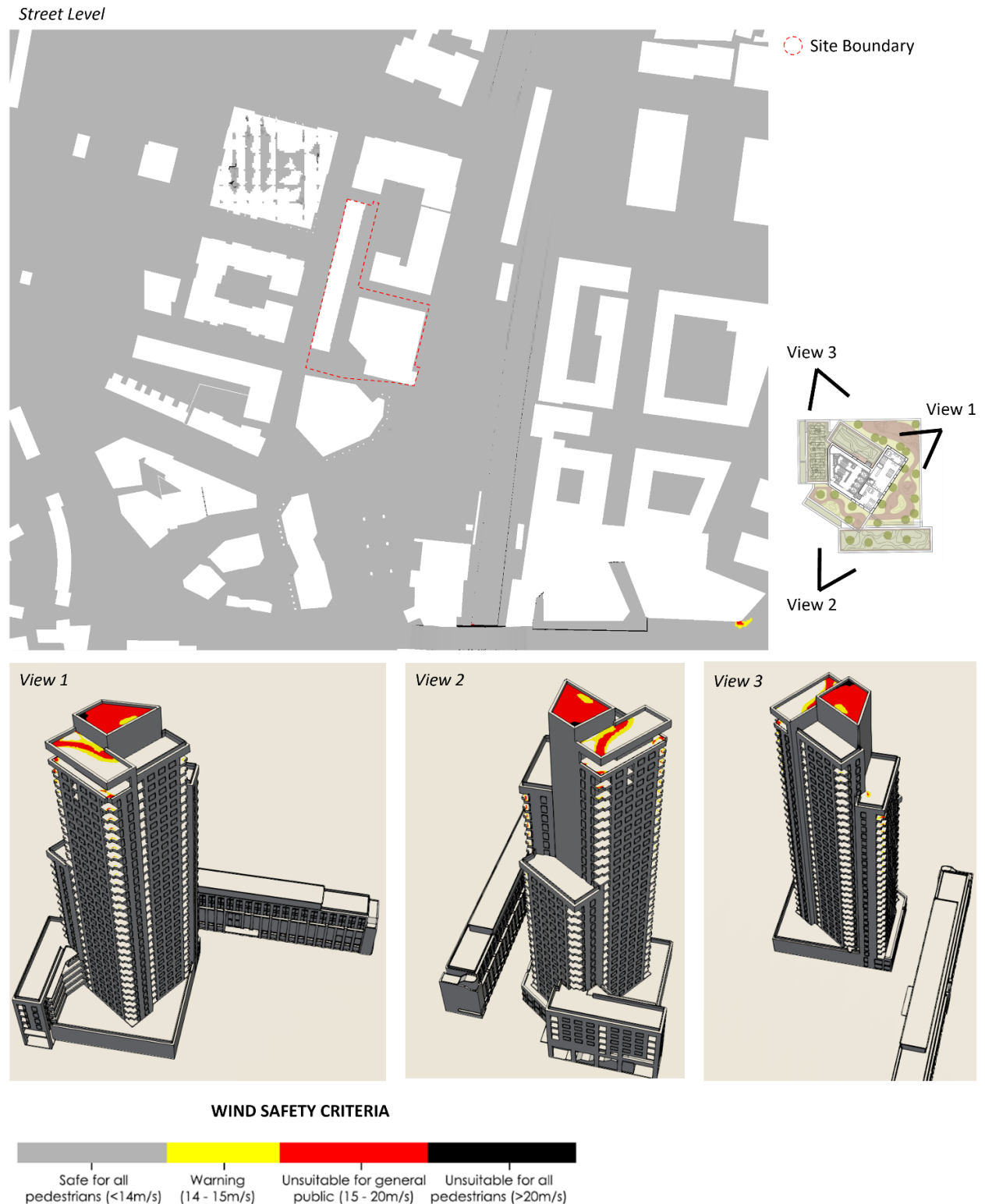
4.4.5. The results indicate that the recommended criteria for safety are met at most of the areas surrounding the site. The only exception is the area near receptor 35 where the recommended safety criteria are

exceeded. However, this exceedance remains present from the Baseline scenario and therefore, it is not caused by the Proposed Development thus, no mitigation is required.

Elevated Levels – On Site

- 4.4.6. Overall, the Cumulative scenario results of the elevated levels are similar to the Proposed scenario results. The results indicate that the wind conditions remain within the recommended criteria for safety at the podium (receptor A), lower levels terraces (receptors C, D) and Berol House's terraces (receptors E, F) and therefore, no mitigation is required at these areas.
- 4.4.7. Also, the results indicate that wind conditions at the level 30 terrace (receptor B) exceeds recommended criteria for safety remain and mitigation would be required. This is further discussed in the Mitigation section.
- 4.4.8. Regarding the wind conditions at the balconies, these have slightly improved compared to the Proposed scenario, however the recommended criteria for safety are still exceeded at a number of localised areas, as discussed Proposed section. Mitigation options are discussed in the Mitigation section.

Figure 4-9 – Safety Criteria for the Cumulative scenario

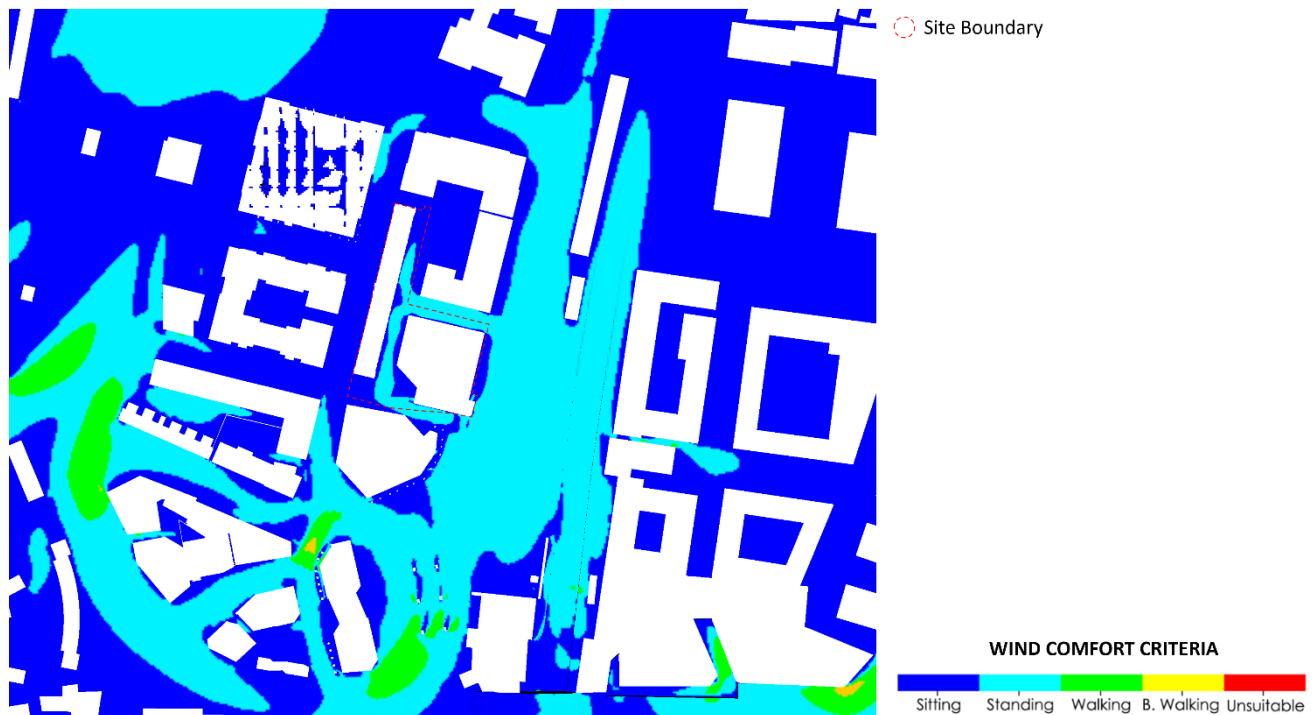


PEDESTRIAN COMFORT – CUMULATIVE – WINTER

4.4.9. Figure 4-10 illustrates contours of the winter comfort criteria at pedestrian street level for the Cumulative scenario.

- 4.4.10. The results show that, with the introduction of the future schemes, the areas immediately adjacent to the site are slightly less windy compared to the Proposed scenario and therefore, the wind environment within the site remains suitable for the intended uses. Thus, no mitigation is required.
- 4.4.11. Overall, for the areas outside the site, the Cumulative scenario results remain largely similar to the Proposed scenario results. The only changes are at the areas near receptors 23 and 24, where the wind conditions are improved in comparison to the Proposed scenario; near receptor 26, where the wind environment changes locally from suitable for leisure walking to suitable for business walking; and near receptor 39, where the wind pattern changes moderately, with the windiness moved further to the north of The Hale/A503 compared to the Proposed scenario. However, the wind conditions in these areas remain within the recommended comfort criteria and therefore, no mitigation is required.

Figure 4-10 – Winter Comfort Criteria for the Cumulative scenario



Pedestrian Comfort - CUMULATIVE - SUMMER

- 4.4.12. Figure 4-11 illustrates contours of the summer comfort criteria at pedestrian street level and terraces for the Cumulative scenario.

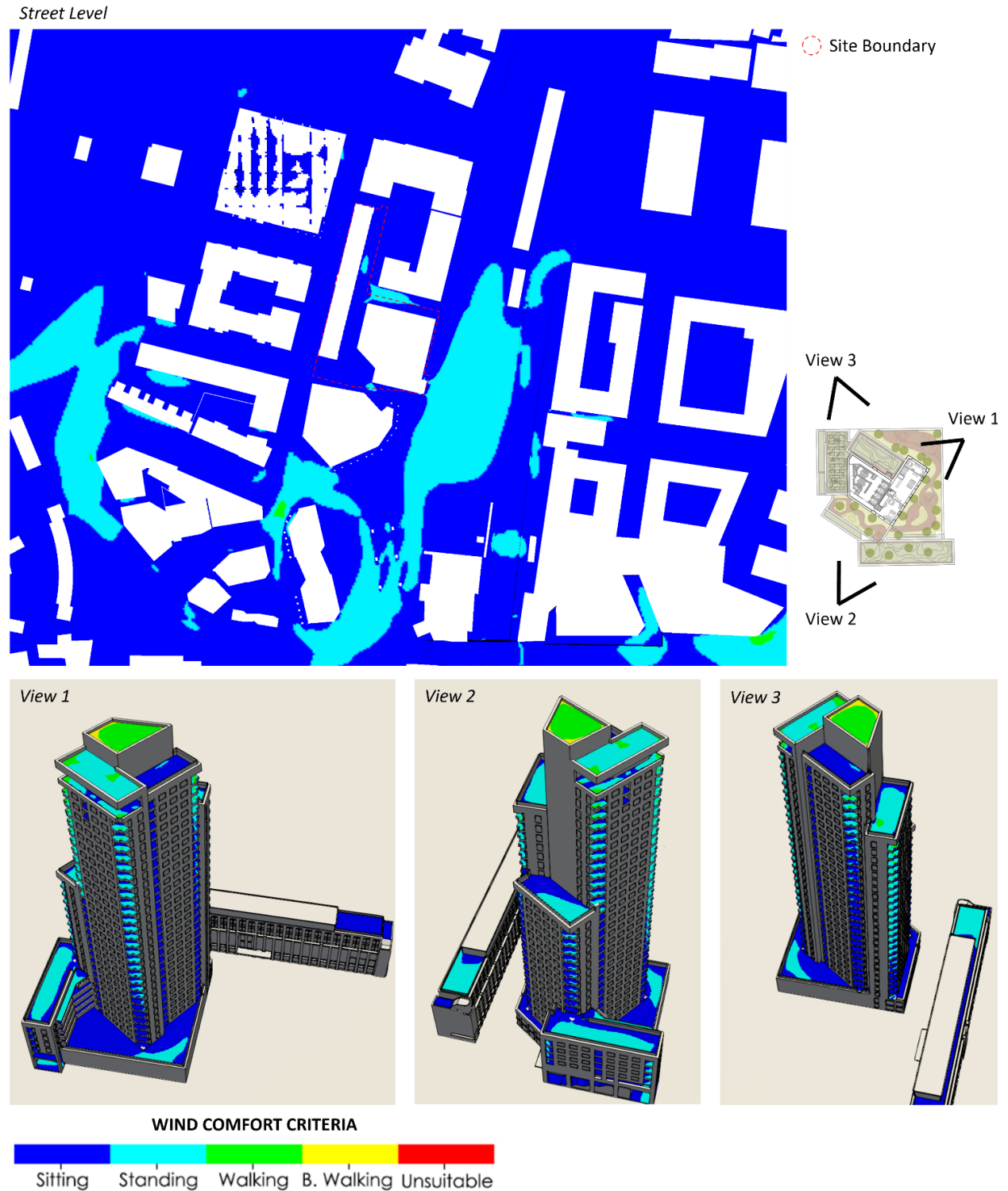
Street-level

- 4.4.13. Overall, the summer results indicate that the wind environment of the Cumulative scenario remains similar to the Proposed scenario with only 2 local minor changes.
- 4.4.14. The results show that the wind conditions near receptor 42 changes from suitable for sitting in the Proposed scenario to suitable for standing in the Cumulative scenario; however, it is expected that the proposed trees and landscape which has not been considered in this assessment, will improve wind conditions in this area. Also, near receptor 26, the wind environment changes from suitable for standing in the Proposed scenario to suitable for leisure walking in the Cumulative however, the wind environment remains suitable for the existing use and no mitigation is required.

Elevated Levels – On Site

- 4.4.15. In general, the results at the upper levels widely follow the Proposed scenario results, while there is an improvement of the wind conditions at receptor E, where this area is now entirely suitable for sitting, and at receptor C, where a larger area is now suitable for sitting compared to the Proposed scenario.

Figure 4-11 – Summer Comfort Criteria for the Cumulative scenario



5 MITIGATION

- 5.1.1. The results indicated some localised areas of wind acceleration where the recommended safety and comfort criteria were exceeded, requiring mitigation as summarised below.
- 5.1.2. To improve the wind conditions within the balconies and accessible terrace (receptor B) where the safety and comfort criteria are exceeded the introduction of mitigation measures, such as 1.1m-1.5m tall solid or porous balustrades, can be effective to improve the local wind climate within the balcony.
- 5.1.3. At the podium (receptor A) and terraces (receptors C, E and F), where seating furniture is located outside the areas rated as suitable for 'sitting', local mitigation such as perimeter screening and trees, hedges and dedicated wind baffles/screens around the seating area should be implemented to improve the local wind conditions.
- 5.1.4. The actual position and size of the proposed mitigation measures can be refined and tested during the detailed design stage to assess and optimise their performance.

6 CONCLUSIONS

- 6.1.1. This report provides an assessment of the pedestrian street-level wind environment within and around the Proposed Development site against wind comfort and wind safety criteria. The study paid particular attention to pedestrian access routes, amenity spaces, outdoor seating areas, bus stops and building entrances. Additionally, an assessment of the proposed upper levels (balconies and terraces) has been included in the study.
- 6.1.2. In general, the street-level results indicated that with the introduction of the Proposed Development on the site, the pedestrian wind environment surrounding the site was suitable for sitting, standing and leisure walking throughout the year and therefore, remained comfortable or had a negligible effect on the existing and intended pedestrian uses thus, adhering to the relevant policies of the London Plan. Additionally, the results showed that wind conditions along Ashley Road were suitable for pedestrian sitting and standing, and subsequently for cycling, and therefore, complying with the local planning policy which states that Ashley Road itself should be pedestrian and cycle friendly.

Baseline scenario

- 6.1.3. In the Baseline scenario, the results indicated that the recommended criteria for safety are met at most of the areas, with the only exception being the area near receptor 35 where the recommended safety criteria are exceeded.
- 6.1.4. The results also showed that the wind conditions within the site met the recommended criteria for comfort throughout the year.
- 6.1.5. However, the results identified a number of off-site areas where the comfort criteria were not met. More specifically, the winter comfort results indicated that the wind conditions at the Tottenham Hale Bus Station (near receptors 28, 29); at the NW building entrance of Building 1 - Argent SDP sites (receptor 27); and on the corner of Ferry Lane and Mill Mead Road (receptor 35) were not suitable for the existing uses. In summer, the results indicated that the wind environment around receptors 33 and 41 was suitable for standing and therefore, exceeded the sitting criteria; however, it is expected that the existing trees and landscape which have not been considered in the assessment, would help improve the local wind conditions in this area.

Proposed scenario

- 6.1.6. With the introduction of the Proposed Development on the site, the results indicated that the recommended criteria for safety are met at most of the areas, with the only exception being the area near receptor 35 where the recommended safety criteria are exceeded, however this exceedance remains present from the Baseline scenario and it is not caused by the Proposed Development thus, no mitigation is required.
- 6.1.7. The results at the proposed upper levels indicated that the recommended criteria for safety are met at most of the areas accessible to occupants, except for the level 30 terrace (receptor B) and some balconies of Blocks A, B and D, where the recommended criteria for safety were exceeded and therefore, mitigation will be required.
- 6.1.8. The results for the Proposed scenario showed that the wind conditions at the street level within the site met the recommended criteria for comfort throughout the year. However, within the site, the results indicated some exceedances of the recommended criteria for comfort during summer at the level 30 terrace (receptor B) and some balconies where the mitigation proposed to address the safety exceedances will likely improve the wind conditions for comfort as well. Also, the wind conditions at receptors A, C, E and F were identified as suitable for sitting and standing; however, should any outdoor seating arrangements be allocated within the areas identified as suitable for 'sitting', then no mitigation will be required at these areas.
- 6.1.9. The pedestrian comfort results also identified a number of off-site areas at the street level where the comfort criteria were not met, same as in the Baseline. Thus, the wind conditions near receptors 27, 28, 29, 35, 33 and 41 were not suitable for the existing uses; however, this showed no change from the Baseline scenario and therefore, no mitigation will be required.

Cumulative scenario

- 6.1.10. In the Cumulative scenario, with the introduction of the future schemes, the results overall followed the wind patterns identified in the Proposed scenario. Consequently, the recommended safety criteria near receptor 35 were not met; however, this exceedance remained present from the Baseline scenario and therefore, it was not caused by the Proposed Development thus, no mitigation will be required.
- 6.1.11. The pedestrian safety results of the elevated levels were similar to the Proposed scenario results thus, at the level 30 terrace (receptor B) and some balconies the recommended criteria for safety were exceeded and therefore, mitigation will be required.
- 6.1.12. Also, the pedestrian comfort results showed that the areas around the site are slightly less windy compared to the Proposed scenario. Moreover, the comfort results of the Cumulative scenario followed overall the results of the Proposed, apart from the area near receptor 42 which changed from suitable for sitting to suitable for standing however, it is expected that the proposed trees and landscape which has not been considered in this assessment will improve wind conditions in this area; and the area near receptor 26 where the conditions changed from suitable for standing to suitable for leisure walking however, the wind environment remained suitable for the existing use; therefore, no mitigation is required.

Mitigation

- 6.1.13. To improve the wind conditions within the balconies and level 30 terrace (receptor B) where the safety and comfort criteria were exceeded, the introduction of mitigation measures, such as 1.1m-1.5m tall solid or porous balustrades, can be effective to improve there the local wind climate.
- 6.1.14. At the podium (receptor A) and terraces (receptors C, E and F), where seating furniture would be allocated outside the areas rated as suitable for 'sitting' in this report, local mitigation such as perimeter screening and trees, hedges and dedicated wind baffles/screens around the seating area should be implemented to improve the local wind conditions.
- 6.1.15. The actual position and size of the proposed mitigation measures can be refined and tested during the detailed design stage to assess and optimise their performance

7 REFERENCES

1. Lawson, T., 2001. Building aerodynamics, Imperial College Press [ISBN 1-86094-187-7].
2. Department of Communities and Local Government, 2021, The National Planning Policy Framework, available online at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf.
3. Mayor of London, 2021, The London Plan “The spatial development strategy for greater London”, available at: https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf.
4. Haringey’s Local Plan Strategic Policies 2013-2026, March 2013 (2017 update), available at: https://www.haringey.gov.uk/sites/haringeygovuk/files/final_haringey_local_plan_2017_online.pdf.
5. Tottenham Area Action Plan, London Borough of Haringey, Adopted July 2017, available at: https://www.haringey.gov.uk/sites/haringeygovuk/files/final_haringey_tottenham_aap_dtp_online.pdf.
6. Development Management DPD, London Borough of Haringey, Adopted July 2017, available at: https://www.haringey.gov.uk/sites/haringeygovuk/files/final_haringey_dmp_dtp_online.pdf.
7. COST, 2007, Best Practice Guidelines for Computational Fluid Dynamics Simulation of Flows in the Urban Environment, Available online at:
<http://theairshed.com/pdf/COST%20732%20Best%20Practice%20Guideline%20May%202007.pdf>.
8. ESDU 2010 Item 01008 ‘Computer program for wind speeds and turbulent properties: flat or hilly Sites in terrain with roughness changes.
9. Shih, T.H., Liou, W.W., Shabbir, A., Yang, Z. and Zhu, J., 1995. A new k- ϵ eddy viscosity model for high Reynolds number turbulent flows. Computers & Fluids, 24(3), pp.227-238.



4th Floor
6 Devonshire Square
London
EC2M 4YE

wsp.com

PUBLIC