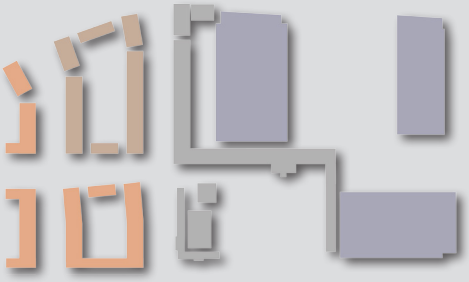
FORMER NESTLE FACTORY, HAYES

WIND ASSESSMENT

MAY 2017

BARRATT LONDON SEGRO

This is a computational fluid dynamics (CFD) informed desk-based wind microclimate assessment of the Nestle Factory development in London, UK. This report details the overall methodology, the criteria used to assess the Site and the use of CFD simulations to inform the analysis. The assessment is based upon analysis of the meteorological data for London Heathrow Airport adjusted to the Site through a terrain roughness analysis and a review of the proposal drawings in the context of the expected wind microclimate interactions.



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FINAL REPORT

FORMER NESTLÉ FACTORY, HAYES

LONDON UK

PEDESTRIAN LEVEL WIND ASSESSMENT

RWDI #1601173 - REV C

MAY 3RD, 2017

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VERSION HISTORY

RWDI Project #1601173	Nestlé Factory, Desk Based Assessment London, UK		
Engineer	**Releases**	**Dated**	**Reviewed By**
A. Proud	Rev A	February 9th, 2017	D. Hackett
A. Proud	Rev B	February 16th, 2017	
A. Proud	Rev C	May 3rd, 2017	

1 EXECUTIVE SUMMARY

This is a qualitative assessment of the likely wind microclimate in and around the proposed redevelopment of the former Nestlé Factory, Hayes, in north-west London. It outlines the overall methodology, the criteria used to assess the Site and the use of computational fluid dynamic simulations to inform the analysis. The assessment is based upon analysis of the meteorological conditions for London Heathrow Airport, approximately 4km south of the Site, adjusted to the Site through a terrain roughness analysis and a review of the proposal drawings in the context of the meteorological data.

The Site description is used mainly to identify building massing and features that are pertinent to the wind microclimate on Site. The expected main flow interactions around the Site are then described and the wind microclimate qualified in terms of the Lawson Comfort Criteria and relative to a baseline windiness determined through the terrain roughness assessment.

Prevailing winds for the Site are from the south-west throughout the year, the windiest season in northern Europe typically being the winter, with a secondary prevalence from the north-east during the spring season. During the summer season winds are generally calmer than during the other seasons. These conditions are consistent with those for the majority of the south-east of England.

The Proposed Development is a residential development consisting of seven blocks. The neighbouring commercial development, included as a cumulative, was not directly assessed. The development has ground floor and podium amenity spaces and protruding balconies on the residential blocks. The Site is generally suitable for the intended pedestrian uses, with thoroughfares expected to be suitable for walking use or calmer. Walking use is one category windier than suitable for a residential thoroughfare and mitigation measures will be required.

Entrances to Block B, Block C, Block D and Block F are expected to be too windy for entrance use. Conditions suitable for strolling at entrances could be improved with the use of shrubs in planters or hedges at least 1.5m in height either side of the entrance location, side-screens (solid or no more than 50% porous) at least 1.5m in height and width or recessing entrances by at least 1.5m from the façade line.

Amenity spaces to the north of Block E are likely be to windier than acceptable for an amenity space during the summer season. The landscaping masterplan would be expected to improve conditions for occupants at a majority of locations, however, further landscaping south-west of Viveash Square is required to shelter occupants. Block B and Block C podium amenity spaces, with the landscaping detailed in the Landscaping Masterplan, would be expected to have wind conditions acceptable for amenity use during the summer season.

Balconies occupants would benefit from increasing the height of balustrades from 1.1m to 1.5m. Balconies wrapping around corners on Block B, Block C, Block D and Block E are expected to be windy as wind accelerates around the building corner encircled by the balcony. Solid or porous screens will be required at one end of the balcony or span the balcony in the vicinity of the corner to shelter occupants.

The wind microclimate around the Proposed Development is generally expected to be suitable for the intended pedestrian use, however, a number of locations required the use of mitigation measures. Localised instances of “windy” conditions would be readily mitigated with the measures described in this report.

2 INTRODUCTION

RWDI was retained by Barratt London to conduct a desk based assessment informed by the use of computational fluid dynamics modelling of wind comfort conditions for the proposed redevelopment of the former Nestlé Factory in the London Borough of Hillingdon. This report presents the background, objectives, results and recommendations from RWDI's assessment. A summary of the overall recommendations from the study are presented in Section 6, "Conclusions & Recommendations".

3 SITE DESCRIPTION

3.1 Site and Surroundings

The existing Site is located in Hayes in the London Borough of Hillingdon. To the south, the Site is bounded by Nestles Avenue, to the north by the Grand Union Canal and the Great Western Main Line railway, the east by North Hyde Gardens and the North Hyde Electricity Substation and the west by the Squirrels trading estate.

The existing Site is occupied by the former Nestlé chocolate and coffee factory, consisting of ten industrial units, one to six storeys in height, the majority of which are interconnected as components of the central factory structure.

The immediate surrounding area consists of a mixture of low- to mid-rise suburban residential and industrial/commercial units. To the south of the Site is an area of suburban residential properties, industrial, commercial and residential sites are located to the north of the Grand Union Canal, including a British Airways Maintenance and Tarmac site, to the east of the site are areas of low rise commercial and residential areas, and to the west, low rise commercial and industrial units. Residential developments up to nine storeys are located to the north-west of the Site, immediately north of Hayes and Harlington railway station and London Heathrow airport is approximately 4km to the south-west.

There are three consented cumulative schemes located within 1km of the Site:

- The Old Vinyl Factory, Blyth Road;
- 20 Blyth Road; and
- Hayes and Harlington Crossrail Station.

Each of these sites is located to the west of the Proposed Development Site, north of the Great Western Main Line, out with the domain of the computational model and have been considered qualitatively within this assessment.

Cumulative schemes located within the radius of the computational model are as follows:

- Buccleuch Site;
- No.1 Nestles Avenue; and
- Squirrel Trading Estate.

However, as plans of the detailed design of these schemes were not forthcoming it was not possible to include them within the simulation.

Four commercial units are proposed to the west of the Site to be considered in a joint application and as such have been assessed as a cumulative scheme.

The surrounding terrain is suburban in nature with few tall buildings (buildings significantly above the height of the surrounding buildings) in the prevailing wind directions. From approximately 1km to the south and south-west, the open nature of the farm land and London Heathrow airport result in increased wind speeds on approach to the Site. The lack of obstacles allows for a steeper velocity gradient in the wind and higher wind speeds closer to ground level. An aerial view of the Site can be seen in Figure 1 and the site can be found at OS Landranger grid reference TQ101791.

Figure 1: Aerial Photograph of the Existing site (Approximate extent of the Site highlighted)

3.2 The Proposed Development

The Proposed Development will constitute part-Demolition of existing factory buildings and associated structures, and redevelopment comprising 1381 residential units and 22663m^2 of commercial floor space, amenity and play space (including allotments), landscaping, access, service yards, associated car parking and other engineering works.

The Proposed Development consists of eight residential blocks (B to I) of 3 to 11 storeys (Figure 2). Block D and E and Block C and B are stepped to increase in storey height from three storeys at Nestles Avenue to up to eleven storeys at the northern end of the blocks.

Block F, Block G and Block I will redevelop the existing 'main factory' and 'canteen' buildings, incorporating aspects of the existing Site structures. Block G and Block H at the south of the Site will be up to 6 storeys in height while Block F (including elements of the existing 'main factory') will be built up to eleven storeys at the most northerly end of the block.

Outdoor amenity space across the Site will include resident's gardens, play areas and a running track bordering the Great Western Main Line, play areas and terraces between Block F and the Grand Union Canal, a sports court between Block D and Block E, play areas, an exercise area and landscaping between Block C and Block D, and exercise area to the south of Block C, and an exercise area, play area and landscaping to the east of Block I. Play areas and general amenity space is also expected on the first floor podium in Block B and Block C.

Multiple blocks of the Proposed Development have protruding balconies at above the ground floor. Blocks B, C, F1 and H have balconies protruding from all aspects, Block D and Block F3 have balconies on the northern, western and eastern façades, Block E and Block F2 have balconies on the eastern and western façades and Block G has balconies protruding from the southern and western facades.

Figure 2: Plan view with Block labels for the Proposed Development (amenity spaces highlighted blue)

4 METHODOLOGY AND ASSESSMENT CRITERIA

Knowledge of the prevailing wind direction focuses attention on the likely impact of these winds on the Site, except where the proposed building massing / layout indicates that winds from other directions are likely to be important. As such wind angles of 45°, 180°, 225° and 270° were chosen for assessment of the Proposed Development.

4.1 General Meteorological Data

Meteorological data derived from the meteorological station at London Heathrow airport (located approximately 4km to the south-west of the Site) has been corrected to standard conditions of 10m above open flat level country terrain (Figure 3). The meteorological station data is combined with terrain roughness values obtained from the BREVe 3.2 software package to allow for data to be adjusted to Site specific conditions.

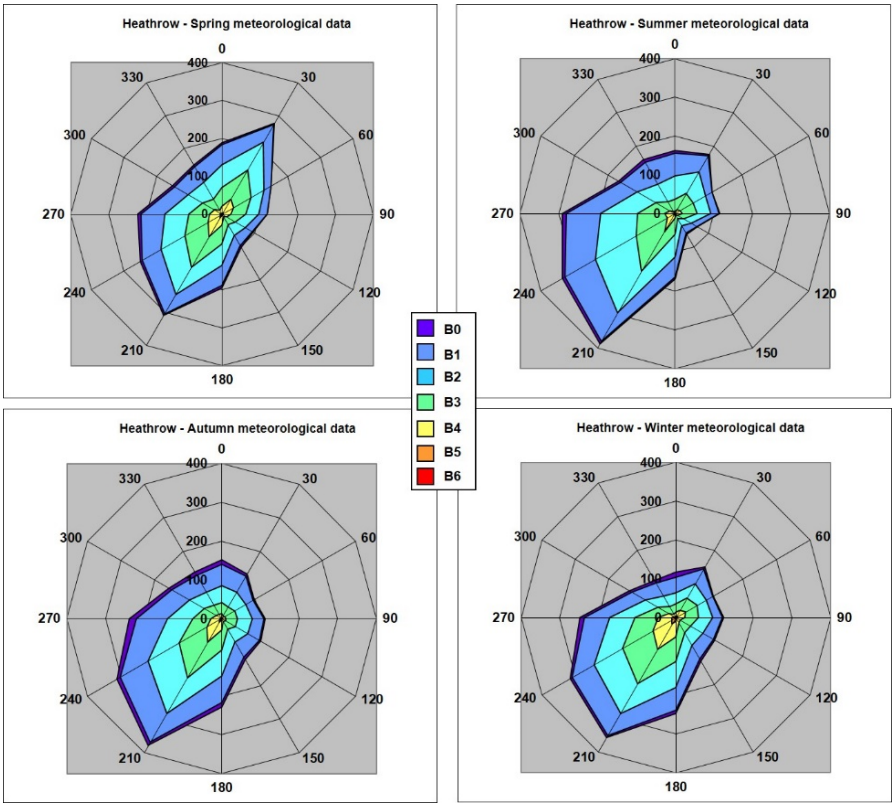


Figure 3: Seasonal wind roses for Heathrow airport

Approximately 30 years of meteorological data for Heathrow airport was used in this report and is presented in Figure 3 as wind roses for each season. Wind speed is represented by Beaufort Force ranges while the radial axes represent the cumulative number of hours per season that the wind speed exceeds the particular Beaufort Force from any given circumferential direction. The assessment presented in this report focusses on the windiest season (generally winter (December to February) in northern Europe), representing a 'worst-case' scenario, and a summer season (June to August), when amenity spaces are expected to be most frequently used.

The meteorological data presented in Figure 3 indicate that the wind is most prevalent from the south-western quadrant throughout the year. During the spring season there is a pronounced increase in the frequency and magnitude of (generally cold) winds from the north-east. This pattern of conditions is typical for many areas of southern England.

4.2 Terrain Roughness

Another consideration is the terrain roughness in each wind direction because wide, open spaces permit the wind to blow down to ground level, resulting in conditions similar to those of open countryside even within a built-up area. An assessment of the terrain roughness for the Site was conducted using the BREVe3 software.

Table 1 presents the 'mean factors' for the Site where the mean factor represents the ratio of wind speed on site, at the stated reference height, as a fraction of the wind speed in open, flat countryside at a height of 2m (approximation of pedestrian height) and 10m (height above expected natural obstructions). The table shows that the terrain is fairly consistent across all directions in relation to its effect on wind speed.

Table 1: BREVe3 mean factors at 2m and 10m above ground level

Wind Direction>>	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
Mean Factor at 2m	0.43	0.43	0.46	0.45	0.44	0.44	0.45	0.44	0.43	0.43	0.43	0.42
Mean Factor at 10m	0.59	0.58	0.63	0.61	0.60	0.60	0.61	0.60	0.59	0.58	0.59	0.58

4.3 Comfort Criteria

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 2. 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 set out five pedestrian activities with an associated range of wind speeds which reflect the fact that less active pursuits require more benign wind conditions. In ascending order of activity level, the categories are:

- Sitting;
- Standing or entering/leaving a building[1];
- Strolling;
- Walking; and

[1] Note that the standing and entrance classifications have the same benchmark wind condition and are combined in the discussion that follows.

- Uncomfortable.

Wind conditions in an area for sitting need to be calmer than a location that people merely walk past and this is reflected in the Comfort Criteria. The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season.

The distinction between strolling and walking is that in the strolling scenario pedestrians are more likely to take on a more 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 windier conditions.

The coloured key in Table 2 corresponds to the presentation of wind tunnel test results described later in this report.

Table 2: 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

Generally, the target conditions are:

- Strolling use during the windiest season on pedestrian thoroughfares (with walking conditions potentially being tolerated in areas where pedestrians would not linger);
- Standing / entrance use conditions at entrances, drop off areas or taxi ranks, and bus stops throughout the year; and
- Sitting use conditions at outdoor seating and amenity areas during the summer season when these areas are more likely to be frequently used by pedestrians. It is noted that in large mixed use amenity spaces a mixture of sitting use and standing / entrance use can be considered acceptable as users can choose to sit in 'calmer' areas, with 'windier' areas acceptable for more active pursuits.

4.4 Strong Winds

Lawson[2] also specified a lower limit strong wind threshold when winds exceed 15m/s for more than 2 hours of the year. Exceedance of this threshold may indicate a need for remedial measures or a careful assessment of the expected use of that location. Wind Speeds that exceed 20m/s for more than 2 hours of the year represent safety issue for all members of the population, which would require mitigation to provide an appropriate wind environment.

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 method of the computational model used in this assessment does not take into account time-dependent aspects. This means gusts are not modelled and therefore the likelihood of strong winds must be assessed based on the above relationship. These aspects of the assessment are discussed in greater detail below.

4.5 Computational Model

Wind flow around two configurations of the Site were simulated to provide an assessment of the expected pedestrian wind conditions. The two configurations were:

- The existing Site with existing surrounding buildings; and
- The Proposed Development with existing surrounding buildings.

Configuration 1 was performed to provide a baseline from which to assess the impact of the Proposed Development on the existing wind microclimate. Consented and non-consented cumulative schemes located within approximately 500m to the east and west of the centre of the site and 360m to the north and south of the centre of the Site include

- Hayes and Harlington Crossrail station;
- Buccleuch Site;
- No.1 Nestles Avenue; and
- Squirrel Trading Estate.

As plans of the detailed design of these schemes were not forthcoming it was not possible to include them within the computational model. The following cumulative schemes were outwith the above domain and, as such, were qualitatively assessed using engineering judgement and not included in the computational model:

- The Old Vinyl Factory, Blyth Road; and
- 20 Blyth Road.

[2] Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press

The effects of landscaping, which would generally be expected to improve conditions by providing shelter and providing obstructions to the flow, was not considered during either test in order to provide a worst case scenario.

Prevailing winds for the Site are from the south-west quadrant throughout the year, with an increase in occurrence of winds from the north-east during the spring season (Figure 3). As such, each configuration was simulated at wind angles of 45°, 180°, 225° and 270° (with 0° aligned to north). These results, included in Appendix A (Figure 6 – Figure 17), indicate the wind conditions, which can be compared against the Lawson Comfort Criteria, and form the basis of the assessment. It is useful to understand how wind from specific directions interacts with the Site, in order to guide the development of appropriate mitigation measures.

The simulation was performed using a steady-state, Reynolds Averaged Navier Stokes (RANS) based turbulence model. As a result of being a steady-state model transient aspects of the wind, such as gusts, are not considered and engineering experience and judgement, combined with meteorological data must be applied to identify the likelihood of these features occurring.

5 EXISTING SITE WITH EXISTING SURROUNDING BUILDINGS (CONFIGURATION 1)

Often a new Development will alter the pedestrian activity (i.e. intended use) on site and therefore, a comparison between the original wind conditions with those on the development site is presented. Occasionally, although wind conditions may not change after the Proposed Development is completed (e.g. stay at strolling level), mitigation would still be required if on the new Development the location of interest is intended for a critical activity (e.g. a main entrance) for which the wind condition would be unsuitable. Assessment in terms of the desired pedestrian activity on or around a site takes into consideration any change of use and this is where the comfort criteria are particularly helpful.

5.1 Pedestrian Comfort

The existing Site is occupied by former industrial units of one to five storeys, open car parking facilities and soft landscaping. Based on the terrain roughness analysis presented in Section 4.2, the conditions at 2m above ground level at an idealised "empty" site would be suitable for standing use in the windiest season and sitting in summer. The wind is expected to accelerate when interacting with building corners or when channelled between buildings of a similar height. Calmer conditions are expected downwind of buildings, where the massing of the building provides shelter from the prevailing winds.

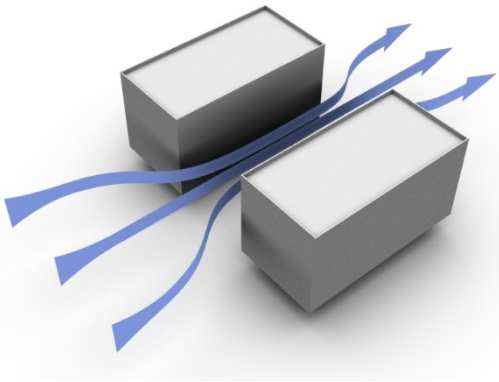


Figure 4: Flow being channelled between buildings

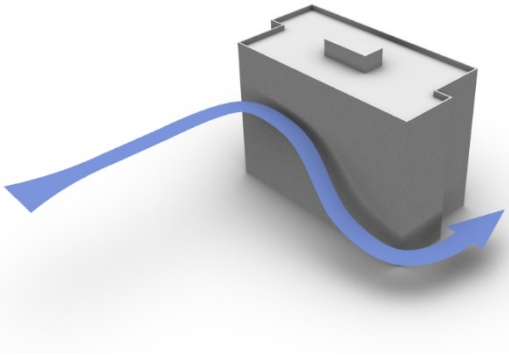


Figure 5: Flow accelerating around a building corner

Throughout the year, prevailing winds at the Site are from the south-west. As such, a spread of three wind directions were simulated across this sector during the computational analysis, 180°, 225° and 270° (Appendix A, Figures 7 – 9). During the spring season winds from the north-east increase in frequency of occurrence and magnitude necessitating a scenario simulating winds from 45° (Appendix A, Figure 6). Windiness at the Site is presented in the form of contour plots (Appendix A, Figures 6 – 9) with the baseline conditions in blue and the magnitude of the wind speed ranging from the areas with the calmest conditions highlighted green, windier conditions highlighted yellow and the windiest conditions highlighted in pink.

Windy conditions (highlighted yellow) are present where building corners are exposed to the oncoming wind direction and calmer conditions (highlighted green) are shown immediately downwind of buildings, particularly away from building corners. Flow acceleration in the channels between buildings appears in yellow (and pink in the areas with the highest local wind speeds) showing that there is a significant increase in windiness where the channels are closely aligned with the simulated wind direction.

Windier conditions are predicted in the vicinity of the car park to the south-east of the Site, which is relatively exposed with few obstructions to disrupt the wind flow. That these features appear most predominantly in the 225° and 270° scenarios correlates well with the expected existing wind flow at the Site, as detailed above.

Overall, given that the usage of the existing Site is predominately industrial, the range of wind conditions we see in the results (from being suitable for "sitting" in the more sheltered areas, to suitable for fast "walking" in the windiest areas) would not be expected to cause a nuisance. However, if the same conditions occur in a residential setting, they would potentially require mitigation, because the types of pedestrian use associated with that scenario are more sensitive to windy conditions.

5.2 Strong Winds

Strong winds in excess of 15m/s for more than 1% of the time are expected to occur in areas where conditions are significantly windier than the baseline. In particular, the passage between the main factory and the distribution building is likely to have localised instances of strong winds.

6 WIND CONDITIONS AROUND THE PROPOSED DEVELOPMENT (CONFIGURATION 2)

6.1 'Target' Wind Conditions

Wind conditions suitable for strolling or calmer (during the windiest season) are desirable on main thoroughfares, for a mixed use development in a suburban area. Standing/entrance use conditions or calmer are generally required at entrances throughout the year. Wind conditions acceptable for sitting use in the summer season are desirable for public amenity spaces.

Occurrences of strong winds in excess of 15 m/s are expected to be limited when wind conditions meet the above criteria. Experience suggests occurrences of strong winds in excess of 15m/s for greater than 1% of the time are associated with wind conditions suitable for walking or windier. As these are outwith the target conditions it is expected that these areas would require mitigation to improve conditions, which would additionally reduce the occurrence of strong winds.

The assessment made below is based on a worst-case assessment of the expected wind conditions at the site with the Proposed Development completed. This 'worst-case' assessment assumes no landscaping to be present (N.B. landscaping is discussed separately together with other potential wind mitigation measures in Section 7 of this report).

6.2 Pedestrian Comfort

The terrain roughness analysis presented in Section 4.2 provides a baseline, with conditions at 2m above ground level at an empty site acceptable for standing use during the windiest season and conditions suitable for sitting during the summer season. Wind is expected to accelerate when interacting with building corners or when channelled between buildings of a similar height. Calmer conditions are expected downwind of buildings, where the massing of the building provides shelter from the prevailing winds.

The comfort plots for the proposed scenario are presented in Appendix A for both ground level (Figures 10 – 13) and podium level (Figures 14 – 17). Areas highlighted in blue are consistent with the "empty site" baseline conditions. Calmer areas are highlighted in green (which indicate areas that are sheltered by the buildings), windier conditions are highlighted yellow and the windiest conditions highlighted in pink.

Thoroughfares

Wind conditions on thoroughfares across the Proposed Development at ground level are expected to range from acceptable for standing use through walking use during the windiest season. The main thoroughfares are closely aligned with the prevailing winds running approximately south-west to north-east.

Primary access to the Proposed Development is expected to be from Nestles Avenue at the southern boundary of the Site. Pedestrian thoroughfares run from Nestles Avenue along Wallis Walk to the entrance to Block F, between Nestles Avenue and the Grand Union Canal, between Block B and Block C and north/south between Blocks C and D and Blocks B and E.

Wind from the south-west and north-east will be channelled between Blocks C and D, and Blocks B and F respectively which will cause the wind to accelerate, creating conditions likely to be suitable for "strolling" use. With wind from the west, conditions windier than suitable for residential thoroughfares are expected on the western and northern façades of Block C which will require the presence of mitigation measures.

The north-western corner of Block E is significantly taller than the existing buildings to the west. This is expected to result in conditions around the north and west of the block suitable for strolling use during the windiest season (i.e. suitable for a residential thoroughfare). Covered passageways are located between section E1 and section E2 in Block E and section D1 and D2 in Block D (Figure 13) at ground floor level. Winds from the west and south-west will be channelled through these passageways, accelerate, and create windy conditions which would be expected to be suitable for walking use during the windiest season. These conditions are too windy for the intended use and will requiring the use of mitigation measures.

Wind flow between Block B and Block F (Canal Street) is expected to benefit from the difference in height between blocks and the shelter provided by Block B. Wind conditions are expected to be suitable for a mix of standing and strolling during the windiest season, suitable for a residential thoroughfare. The southern section of Canal Street between Block C and Block I is similarly expected to have conditions suitable for strolling during the windiest season.

Nestles Avenue, a major access route bounding the south of the Site, is expected to have a range of wind conditions suitable for sitting to strolling use. similar to the baseline (Configuration 1)

Conditions suitable for strolling (or calmer) would be considered appropriate for residential thoroughfares and would not require mitigation. Localised occurrences of walking conditions are windier than desired, and are associated with occasional strong winds in excess of 15m/s (as noted below in Section 6.3). Mitigation is required for these areas and will utilise the landscaping scheme for the Site detailed in Section 7 of this report.

Entrances

Entrances to Block B, Block C and Block E from Milk Street (western thoroughfare) and entrances facing onto Canal Street (eastern thoroughfare) from Block F and the north-east of Block B, are expected to be suitable for strolling use, one category windier than acceptable for entrance locations. Measures required to improve conditions for pedestrians have been suggested in the mitigation section of the report.

Ground Floor Amenity Space

Amenity spaces at ground floor level are highlighted in Figure 2. During the summer season, when amenity spaces are expected to be suitable for use wind conditions are generally one category calmer than the windiest season. Therefore, wind conditions suitable for standing in the windiest season would be suitable for amenity use during the summer season. A mix of conditions suitable for sitting and standing use can be acceptable for mixed use amenity spaces, however, permanent seating will be required to be in locations suitable for sitting use.

The Viveash Square and Canal Square amenity spaces will be windier than suitable for an amenity space during the summer season as a result of wind accelerating around the northern corners of Block B and Block E. Sandow Square will be windier than suitable for an amenity space due to the wind accelerating around the north western corner of Block C and being channelled between Block B and Block C. Wind conditions are expected to be suitable for standing during the summer season one category too windy for amenity use. Measures required to improve wind conditions have been suggested in the mitigation section below.

Podium Amenity Space

Block B and Block C have a single storey podium that features a central amenity space surrounded by the upper storeys of the building. Westerly winds will be captured by the eastern sections of Block B and directed to ground level, resulting in conditions suitable for standing during the summer season. Similarly, the northern and western sections of Block C direct south-westerly winds to podium level, resulting in a mix of sitting and standing use conditions on the Block C podium during the summer season.

Measures required to improve conditions on the Block B and Block C podium amenity spaces have been suggested in the mitigation section of this report.

Balconies

Blocks B, C, F1 and H have protruding balconies on all aspects, Block D and Block F3 have balconies on the northern, western and eastern façades, Block E and Block F2 have balconies on the eastern and western façades and Block G has balconies protruding from the southern and western facades. During the summer season when balconies are most frequently used, the baseline wind condition at 10m are expected to be suitable for sitting use. These conditions would be acceptable for a private balcony.

Balconies wrapping around corners are located at:

- Block B: North-west B7, south-east B3 and north-west B9;
- Block C: North-west C2, south-west C6, south-west C5 and north-west C4;
- Block D: North-east D1; and
- Block E: South-east E2.

Balconies of this type are expected to have windy conditions as wind will accelerate around the building corner. Mitigation measures are required to break up the flow and prevent the wind flowing across the balcony unimpeded. Measures to improve conditions have been suggested in the mitigation section of this report.

6.3 Strong Winds

Strong winds in excess of 15m/s for more than 1% of the time are expected to occur in areas where conditions are significantly windier than the baseline. In particular, the passageways through Block D and Block E and on the northern and southern façade of Block C. Mitigation required to improve pedestrian comfort conditions in these areas would be expected to reduce the occurrence of strong winds.

7 MITIGATION MEASURES

Although the majority of the Proposed Development is expected to have a wind microclimate suitable for its intended pedestrian use, localised occurrences of windy conditions will require mitigation in order to provide acceptable conditions.

7.1 Landscaping Masterplan

The Landscaping Overview Masterplan document (LG101 Issue D7 received 07/04/2017) is generally expected to be beneficial to the pedestrian wind environment. Details of the benefits of the Landscaping plan are detailed below. Where the landscaping plan does not provide sufficient mitigation from windy conditions, further required mitigation measures have been detailed in Section 7.2.

7.1.1 Thoroughfares

The use of semi-mature trees lining Canal Street and Milk Street and in Sandow Square is expected to result in wind conditions being suitable for residential thoroughfares.

Passageways through Block D and Block E remain windier than acceptable and will require further mitigation measures.

7.1.2 Entrances

Entrances to Block C from Milk Street and Sandow Square are up to two categories windier than suitable for entrance locations. 14 semi-mature trees along the south of Sandow Square are expected to provide shelter to entrances on the northern façade of Block C. Entrances on the western façade of Block C will require further mitigation.

Entrances to Blocks B, C and F from Canal Street and Sandow Square and Blocks B and E from Milk Street were expected to be up to one category windier than suitable for entrance locations. Semi-mature trees between parking bays on either side of the streets and semi-mature trees in Canal Square and Sandow Yard, as shown in the landscaping plan, would be expected to break up wind flow and improve conditions for pedestrians at entrances.

7.1.3 Ground Floor Amenity Space

Areas designated for amenity use to the north of the Block B and Block E (Viveash Square, Milk Street Garden, Coffee Park, Canal Street Gardens and Canal Square) are likely to be one category too windy for amenity use during the summer season. Semi-mature trees in Milk Street gardens, Coffee Park, Canal Street Gardens and Canal Square in the Landscaping plan would be expected to provide shelter to occupants of these areas and improve wind conditions.

Viveash Square has significantly less shelter from landscaping and as such, will require further mitigation measures.

7.1.4 Podium Amenity Spaces

Podium amenity space is predicted to be up to one category windier than acceptable for amenity use during the summer season. The distribution of semi-mature trees in the landscaping plan is expected to disrupt wind flow and provide shelter to occupants during the summer season. In particular, the placement of a tree at the north west corner of the podium is expected to be effective in reducing wind from the north-east flowing freely through the gap between Block B1 and Block B8.

7.2 Additional Mitigation Measures

The following measures would be required where wind mitigation provided by the landscaping plan is not expected to sufficiently improve wind conditions.

7.2.1 Thoroughfares

Passageways through Block D and Block E will likely be up to one category windier than suitable for the intended pedestrian use and as such, require further mitigation measures, primarily from westerly and south-westerly winds. Semi-mature trees of at least 3m in height or solid or porous screens no less than 1.5m in height are required to the west of the passageways to disrupt wind throughflow. Rearranging parking bays and vehicular access would allow for increased shelter through the above landscaping immediately west of the passageway.

Alternatively, controlling access to restrict pedestrian movement through the passageway, such as vehicular gates, would remove pedestrians from windy areas.

7.2.2 Entrances

Entrances on the western façade of Block C are up to two categories windier than suitable for entrance locations and are expected to require further shelter than that provided in the landscaping plan. Entrances through C1 and C2 from the west will required recessing no less than 1.5m or have side screens at least 1.5m in height and width.

Figure 18: Entrance sheltered by screens a landscaping

Figure 19: Example of a recessed entrance

7.2.3 Ground Floor Amenity Space

Viveash Square is expected to remain windier than suitable for amenity use during the summer season with the presence of the landscaping plan. This area would benefit from shelter from the south west using 5-7m trees along the south-western boundary of the amenity space.

Alternatively, the use of landscaping such as trees or solid or porous screens no less than 2m in height distributed over Viveash Square allotments would break up the wind flow over the space and be anticipated to improve wind conditions.

7.2.4 Balconies

Occupants of façade balconies would be expected to benefit from increasing balustrade height from 1.1m to 1.5m in height on balconies in windy areas (on southern and western aspects of buildings). Balconies wrapping around building corners are likely to be windy and as such would benefit from full height screens on the southern and western ends of the balcony, or screens spanning the balcony no less than 1.5m in height located in the vicinity of the building corner.

Figure 20: Example of balcony screens

Figure 21: Landscaping Masterplan (areas requiring additional mitigation highlighted orange)

8 CONCLUDING REMARKS

In conclusion:

1. A qualitative wind assessment was conducted to assess the wind microclimate around the proposed redevelopment of the former Nestlé Factory in Hayes. The assessment was informed by the use of steady-state computational fluid dynamics simulations of the Site, for the four most frequently occurring wind directions at the Site;
2. The meteorological data for the site indicates prevailing winds from the south-westerly quadrant throughout the year, with colder north-easterly winds during the spring months;
3. At the **existing site** the wind microclimate at ground level is generally suitable for normal pedestrian usage, with the exception of locally windy conditions on the thoroughfare west of the 'main factory';
4. The ground level wind microclimate for the **Proposed Development** is expected to range from being acceptable for sitting use in the most sheltered areas through to walking use where the prevailing winds are channelled between buildings and interact with building corners during the windiest season. The range of wind conditions will be similar to that experienced at the existing site; however, the change in use (from an industrial site to a relatively more sensitive residential one) would necessitate wind mitigation in key areas as described below:
    a. Pedestrian thoroughfares along the western and northern façades of Block C and through passageways in Block D and Block E will be up to two categories windier than suitable for residential thoroughfare use. Remaining thoroughfare locations are expected to have wind conditions suitable for the intended pedestrian use;
    b. Entrances to Block B, Block C and Block E from Milk Street and Sandow Square and entrances facing onto Canal Street from Block F and the north-east of Block B are expected to be up to two categories windier than suitable for entrance use. All other entrances would be suitable for the intended pedestrian use;
    c. Ground Floor amenity spaces north of Block C, E and F are expected to be one category windier than suitable for amenity use during the summer season;
    d. Wind conditions on the Block B and Block C podium levels are expected to have a mix of conditions suitable for sitting and standing use, up to one category windier than suitable for amenity use during the summer season;
    e. Corner balconies on Block B, C, D and E. will likely be windier than desired due to wind accelerating around the building corner within the balcony. Corner balconies could be improved with the placement of screens (solid or no more than 50% porous) or soft landscaping, such as shrubs in planters or hedges on the balcony in the vicinity of the corner. Other balconies would be suitable for the intended occupant use;
5. With mitigation provided by way of landscaping as set out in the landscaping masterplan (received 07/04/2017), it is anticipated that the following windy locations will be effectively mitigated:
    a. Semi-mature trees lining Canal Street and Milk Street and in Sandow Square is expected to result in wind conditions being suitable for residential thoroughfares;
    b. Semi-mature trees lining Milk Street and Canal Street and 14 semi-mature trees along the south of Sandow Square are expected to provide shelter to entrances to Blocks B, E and F and on the northern façade of Block C;

c. Semi-mature trees in Milk Street gardens, Coffee Park, Canal Street Gardens and Canal Square would be expected to provide shelter to occupants of these areas and improve wind conditions;
d. The distribution of semi-mature trees in the landscaping masterplan is would be expected to disrupt wind flow and provide shelter to occupants during the summer season;

6. Where the landscaping plan does not provide sufficient shelter further mitigation measures are required in the following areas:
    a. Passageways through Block D and Block E requires semi-mature trees of at least 3m in height or solid or porous screens no less than 1.5m in height located to the west of the passageways, or restricted pedestrian access;
    b. Entrances through C1 and C2 from the west will required recessing no less than 1.5m or have side screens at least 1.5m in height and width;
    c. Viveash Square requires 5-7m trees along the south-western boundary of the amenity space or landscaping such as trees or solid or porous screens no less than 2m in height distributed over Viveash Square;
    d. Façade balconies require increasing balustrade height from 1.1m to 1.5m in height and corner balconies require full height screens on the southern and western ends of the balcony, or screens spanning the balcony no less than 1.5m in height located in the vicinity of the building corner
7. Overall, the wind microclimate around the Proposed Development is expected to have a similar range of conditions to the existing Site. For most areas, these conditions will remain suitable; however, due to the change in usage of the Site there will be localised instances of conditions that are too windy for the intended use. It is expected these relatively windy conditions will be readily mitigated by way of the landscaping masterplan and the further required mitigation measures to produce wind conditions suitable for the intended pedestrian use.

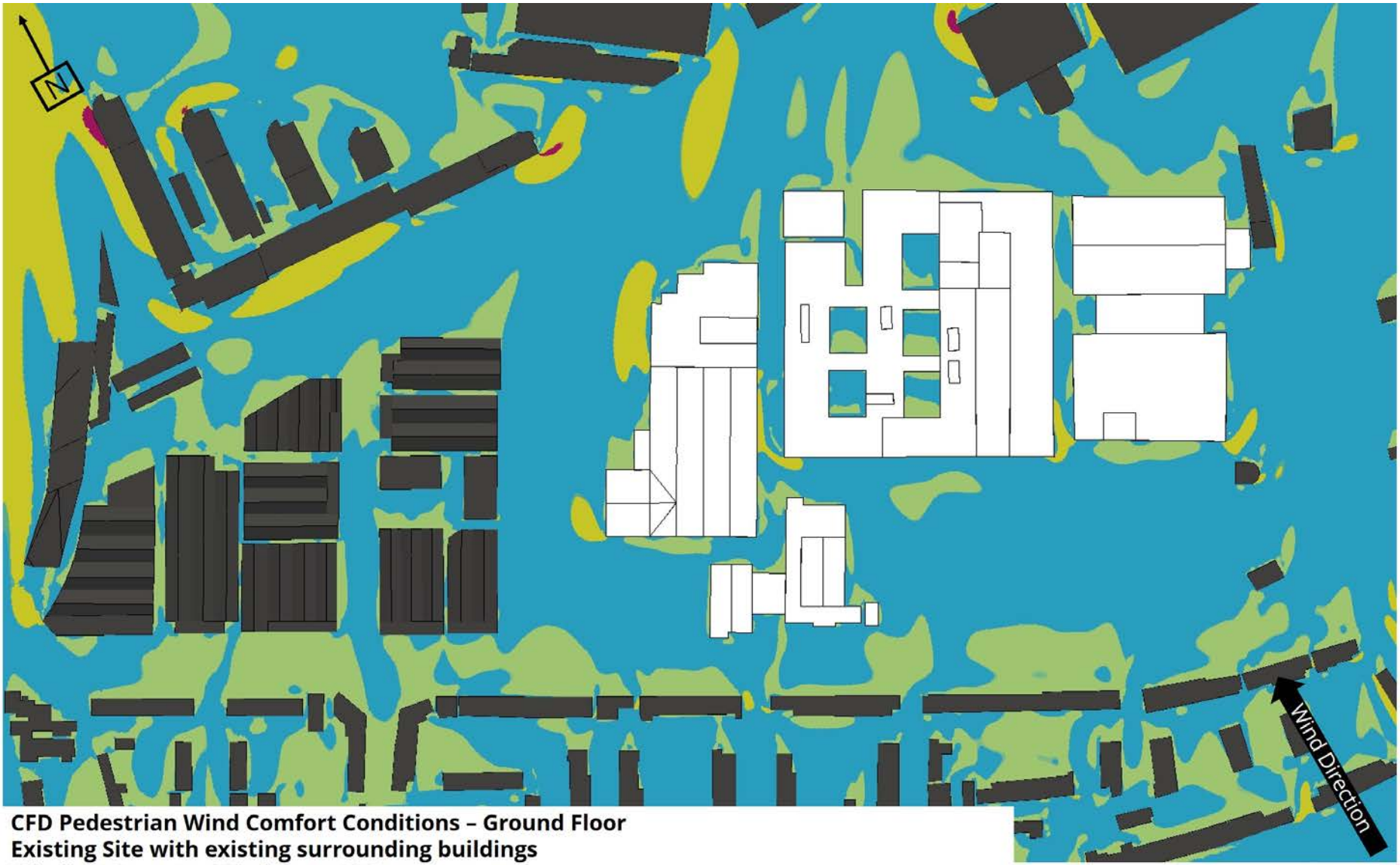
APPENDIX A - FIGURES

Results from the Computational Fluid Dynamic simulations are presented in the form of contour plots. The colour represents the wind speed, with blue shading representing the baseline, standing, suitable, conditions (Section 4) for the windiest season. Areas shaded in green represent wind conditions calmer than the baseline, yellow highlighting represents windier conditions than the baseline and pink highlighting represents the areas with the windiest conditions. Ground level plots are presented for the windiest season and podium level plots are presented for the summer season.

Areas highlighted in pink, with the highest wind speeds, would be expected to be associated with conditions that may not be suitable for low activity pedestrian usage.

CFD Pedestrian Wind Comfort Conditions – Ground Floor
Existing Site with existing surrounding buildings
Windiest Season – Wind From 45°

Figure 6



CFD Pedestrian Wind Comfort Conditions – Ground Floor
Existing Site with existing surrounding buildings
Windiest Season – Wind From 180°

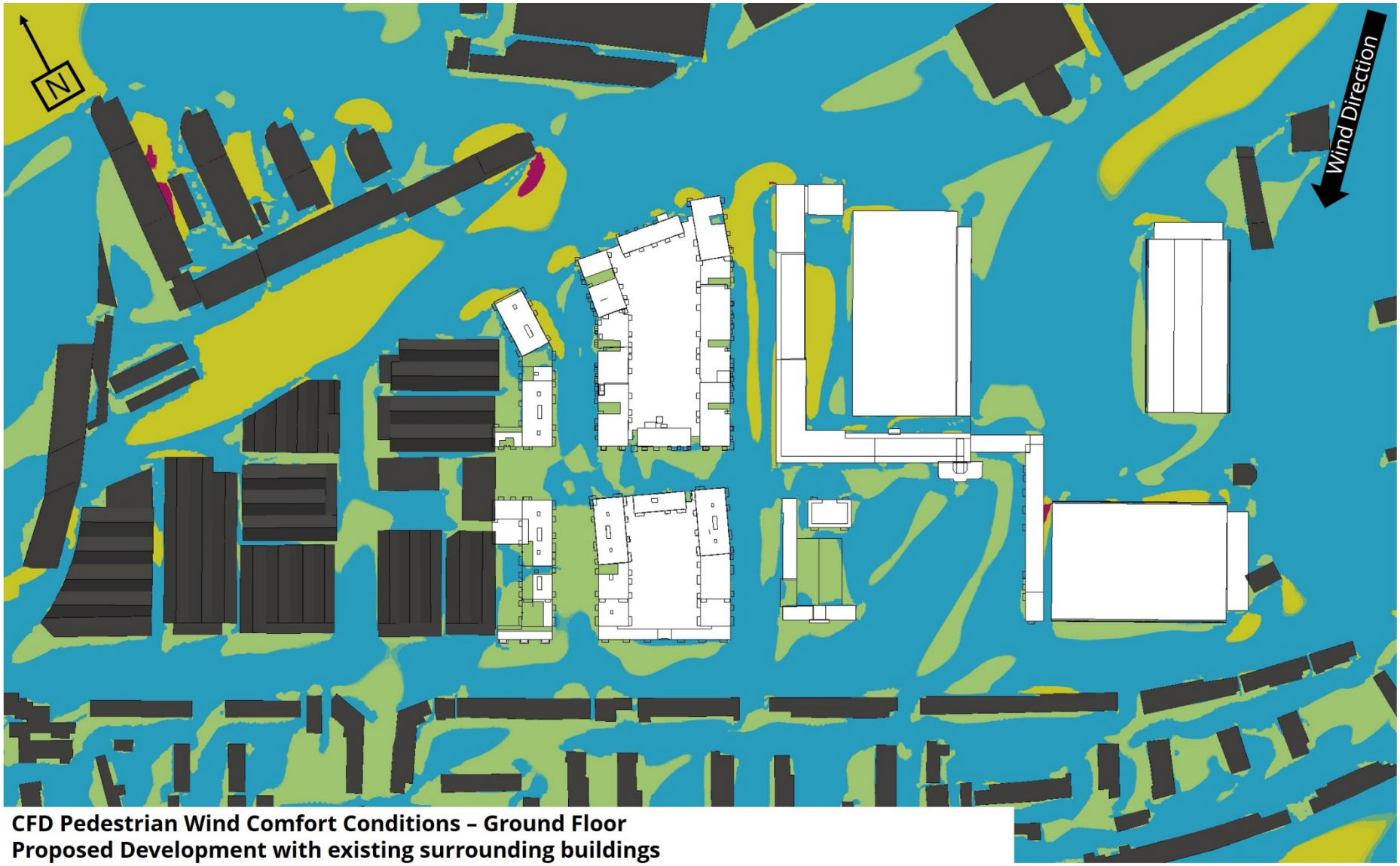
Figure 7

CFD Pedestrian Wind Comfort Conditions – Ground Floor
Existing Site with existing surrounding buildings
Windiest Season – Wind From 225°

Figure 8

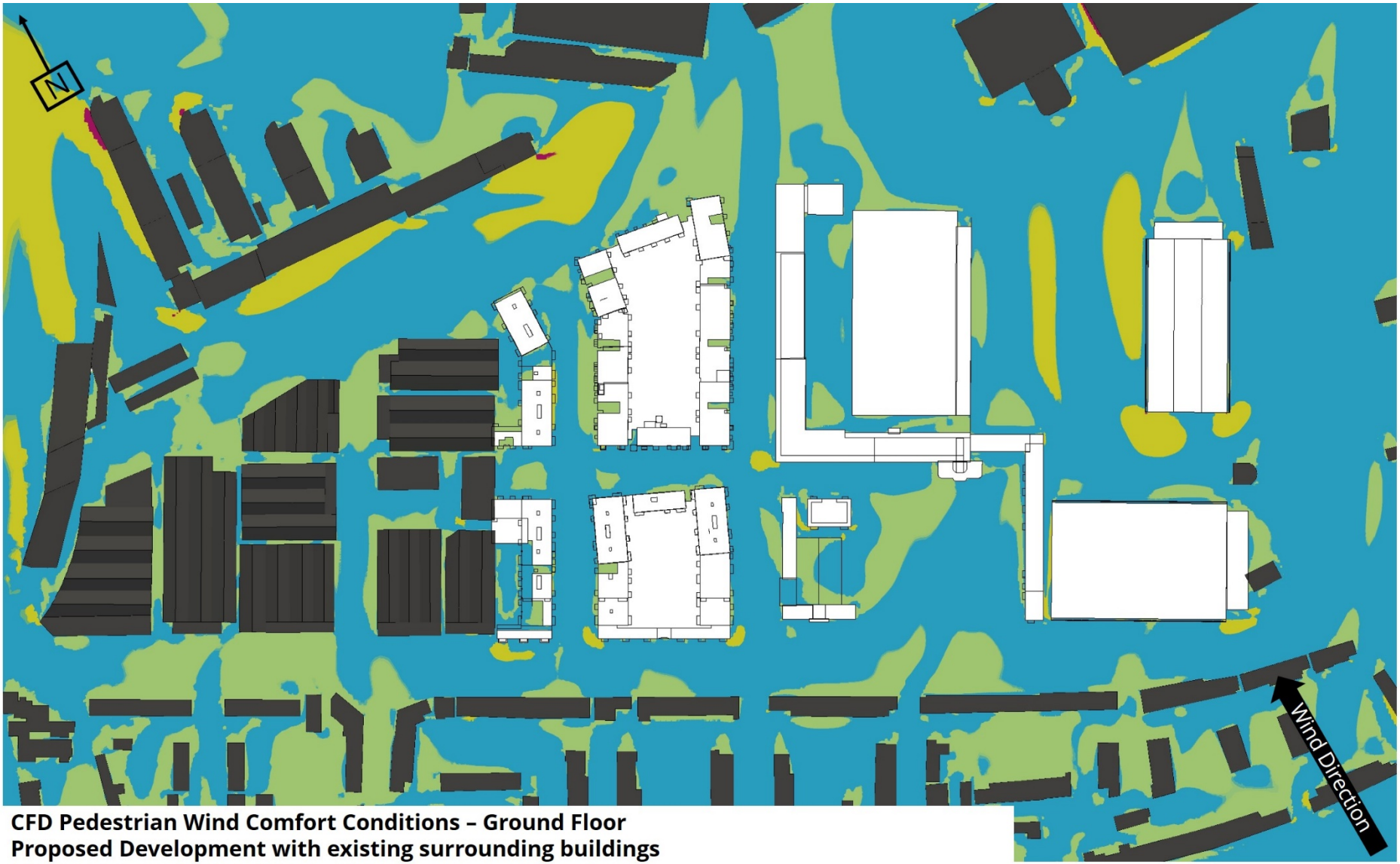
CFD Pedestrian Wind Comfort Conditions – Ground Floor
Existing Site with existing surrounding buildings
Windiest Season – Wind From 270°

Figure 9



CFD Pedestrian Wind Comfort Conditions – Ground Floor
Proposed Development with existing surrounding buildings
Windiest Season – Wind From 45°

Figure 10

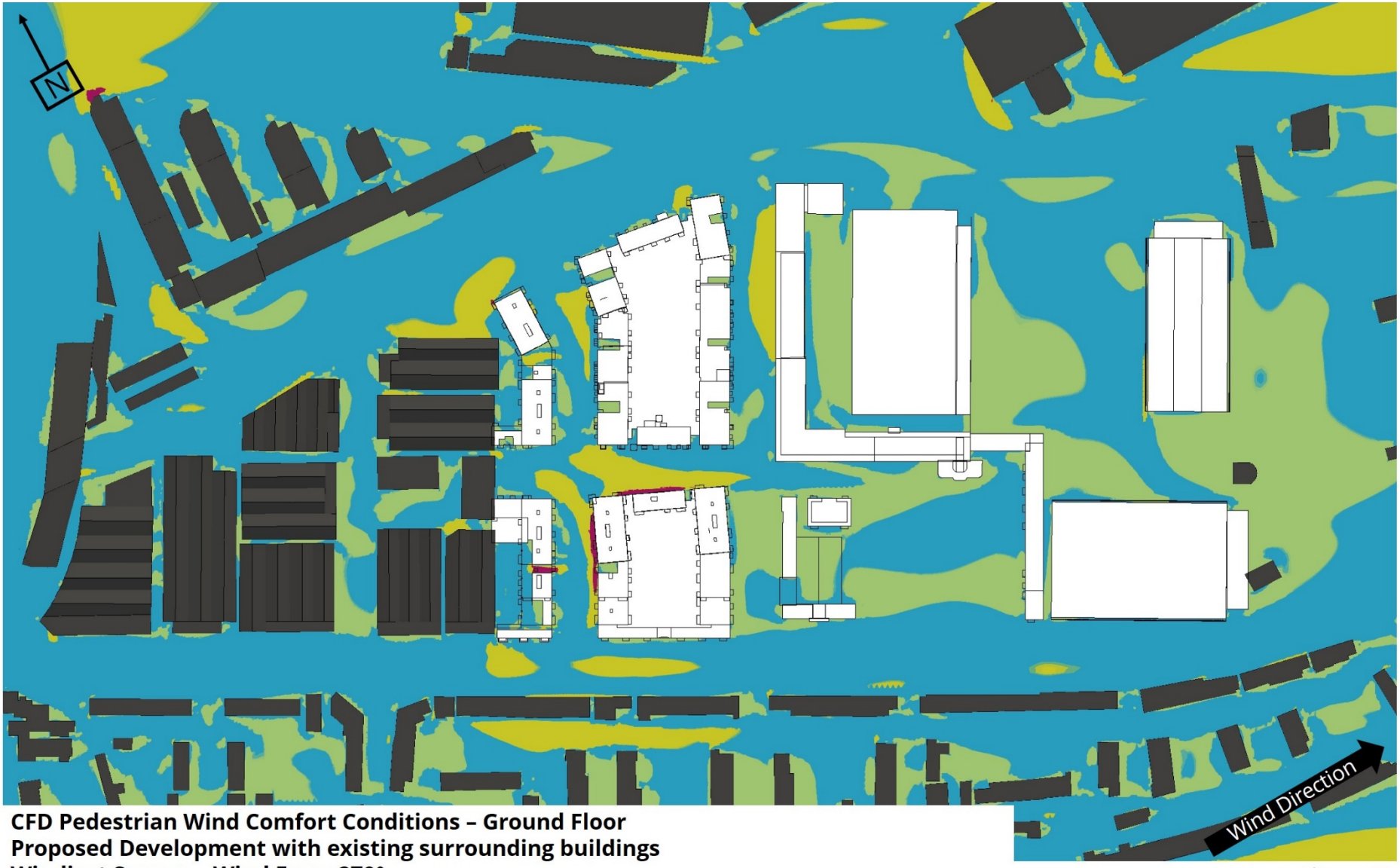


CFD Pedestrian Wind Comfort Conditions – Ground Floor
Proposed Development with existing surrounding buildings
Windiest Season – Wind From 180°

Figure 11

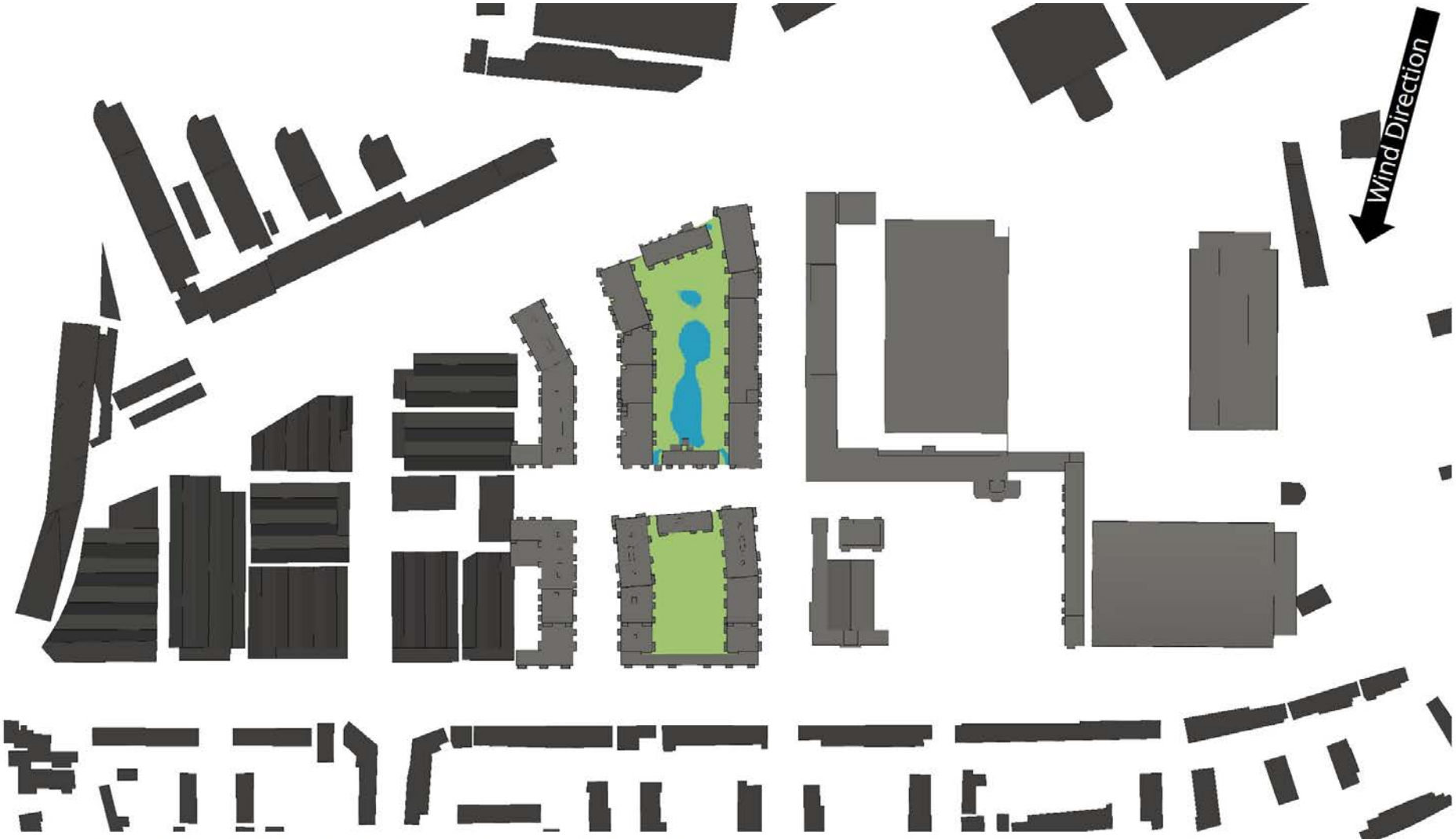
CFD Pedestrian Wind Comfort Conditions – Ground Floor
Proposed Development with existing surrounding buildings
Windiest Season – Wind From 225°

Figure 12



CFD Pedestrian Wind Comfort Conditions – Ground Floor
Proposed Development with existing surrounding buildings
Windiest Season – Wind From 270°

Figure 13



CFD Pedestrian Wind Comfort Conditions – Podium Level
Proposed Development with existing surrounding buildings
Summer Season – Wind From 45°

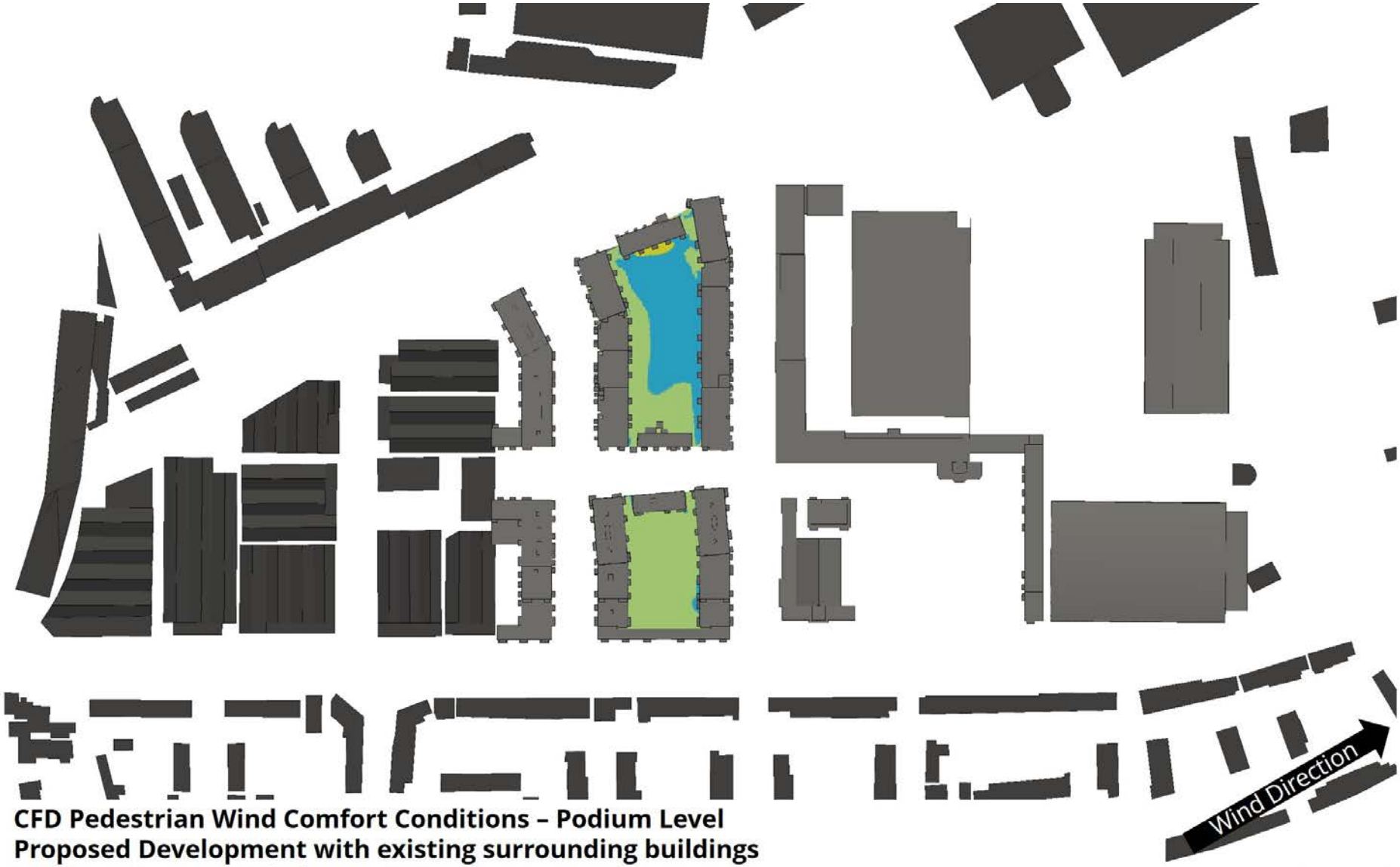
Figure 14

CFD Pedestrian Wind Comfort Conditions – Podium Level
Proposed Development with existing surrounding buildings
Summer Season – Wind From 180°

Figure 15

CFD Pedestrian Wind Comfort Conditions – Podium Level
Proposed Development with existing surrounding buildings
Summer Season – Wind From 225°

Figure 16



CFD Pedestrian Wind Comfort Conditions – Podium Level
Proposed Development with existing surrounding buildings
Summer Season – Wind From 270°

Figure 17

BARRATT LONDON SEGRO