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Teddington Riverside

Teddington, London Borough of Richmond upon Thames

Final Report

Pedestrian Wind Microclimate Assessment Desk Study

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SUBMITTED TO

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VERSION HISTORY

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OBJECTIVE

The objective of this study was to review the architectural drawings of the Proposed Development at Teddington Riverside in the London Borough of Richmond upon Thames and to make a desk-based assessment of the expected environmental wind conditions at street level. The study is based on an assessment of the background wind climate and our extensive experience of the wind flow around buildings. Results are presented in terms of the well-known Lawson Comfort Criteria.

1. Summary

This is an assessment of the likely wind conditions around the Proposed Development at Teddington Riverside. It outlines the overall methodology and the use of the Lawson Comfort Criteria to describe the expected on-site wind conditions. The assessment is based upon analysis of meteorological data for London, adjusted to the Site, and a review of the scheme 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 quantified in terms of the Lawson Comfort Criteria. These have been used for over thirty years throughout the UK in assessments of this kind.

The assessment initially assumes no beneficial effect from landscaping in order to determine a conservative, (i.e. relatively windy) worst-case scenario. However, the beneficial effects of planting and/or other landscape features are discussed in the mitigation section of this report. It should also be noted that the 'design case' for thoroughfares and main building entrances is based upon the wind conditions in the windiest season because these need to be usable throughout the year whereas amenity spaces or seating areas are assessed for the summer season (because of the expectation that they should be 'comfortable' in the summer).

Results from the assessment show that the wind microclimate around the Proposed Development is expected to be compatible with the intended pedestrian use of the Site. At ground level, the thoroughfares and main building entrances are in regions where the wind environment is suitable for leisure walking, standing/entrance use or sitting in the windiest season. In the summer, the majority of the Site is expected to be suitable for sitting which is compatible with amenity areas. There are no recommendations for mitigation but it is noted that the proposed landscaping will provide additional beneficial shelter during the summer when trees are established and in full leaf.

2. Site Description

2.1 Site and Context

The Site is in Teddington, in the London Borough of Richmond upon Thames. It is bounded by Broom Road to the southwest, the River Thames to the north, the Anglers Public House to the west and low-rise buildings to the east. Bushy Park is approximately 1km SSW of the Site (nearest point) whereas Richmond Park is approximately 2km ENE of the Site (nearest point). To the south of Broom Road there is an open area comprising tennis courts and playing fields.

The Ordnance Survey Landranger reference for the Site is TQ167713 and it is currently occupied by low-rise commercial buildings with some surface level car-parking. Figure 1 shows an aerial view of the Site and surroundings and the approximate Site location.

2.2 The Proposed Development

The Proposed Development is a residential scheme with four main blocks, denoted A to D, in the north part of the Site and blocks E along the Broom Road elevation. There is open space between the buildings containing car-parking and amenity/garden areas. The heights of the buildings are: G+4 (Building A), G+6 (Building B), G+5 (Building C), G+4 (Building D) and the villas (Buildings E) are 3-storeys. Figure 2 shows the 6th floor plan and selected elevations of the Development. Entrances are

denoted in Figure 4 by the orange circles. There are amenity areas in the garden spaces between the buildings.

3. Meteorological Data

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.

3.1 General Meteorological Data

Joint frequency tables of wind speed, divided into ranges of the Beaufort Scale, and direction on an annual basis for 30° sectors around the compass were obtained for London and are presented in Figure 3 of this report for meteorological standard conditions of open-countryside terrain. The presentation of results in this report is for annual and seasonal data defined as spring (March, April, and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February).

Analysis of the meteorological data indicates the expected peak from the south-westerly direction which is prevalent throughout the year and the secondary north-easterly during the spring.

3.2 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 generating conditions similar to that of open countryside even within a built-up area. An assessment of the terrain roughness surrounding the Site was conducted using the BREVe3 software[1].

Table 1 in this report 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 10m. The mean factors for the site at 10m ranged from 0.77 to 1.01; these values reflect the urban terrain roughness in most wind directions and the wide, open playing fields due south of Broom Road respectively.

4. Benchmarking the Wind Environment

4.1 Lawson Comfort Criteria

The wind microclimate assessment uses a set of criteria (after Lawson) to benchmark the predicted wind conditions. The comfort criteria levels defined by Lawson are summarised in Table 2 of this report. Table 3 presents the Beaufort Land Scale to which the Comfort Criteria refer.

The criteria set out six pedestrian activities and reflect the fact that less active pursuits require calmer wind conditions. The six categories are sitting, standing, entering/leaving a building, leisure walking, business walking and roadway/car-park, in ascending order of activity level. The wind conditions in an area for sitting need to be calmer than a location that people merely walk past.

For each pedestrian activity there is a threshold wind speed and frequency of occurrence beyond which the conditions would be unacceptable for the stated activity. For example, if the wind speed exceeds Beaufort Force 4 for more than 4% of the time, the wind microclimate would be unsuitable for

[1] BREVe is a wind loading software package employed to determine the ground roughness, altitude and topography factors which are used to calculate the Site's exposure to the wind.

Leisure Walking. The criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season – i.e. thermal comfort is not considered.

Previous experience has shown that the business walking and roadway classifications are associated with occasional strong winds during the winter season which, if they occurred, would usually require mitigation.

4.2 Strong Winds

Lawson also provided guidance about the potential for strong winds to occur. If the wind speed occasionally exceeds the lower Beaufort Force 6 threshold on a pedestrian thoroughfare then it would not usually cause a nuisance to pedestrians whereas wind speeds in the B7 and B8 ranges would impede walking.

Experience has shown that the B7 and B8 wind speeds are associated with the business walking and roadway classifications of the comfort criteria. These would typically require mitigation if they occurred on a mixed-use Development.

4.3 'Target' Wind Conditions for the Proposed Development

For a mixed-use development in an urban area the target wind microclimate would typically be suitable for leisure walking on main thoroughfares and standing/entrance use at entrances, bus-stops and taxi ranks throughout the year. In other words these areas/activities need to be carried out even during the windiest season.

Where there are amenity areas, such as gardens, street benches, street cafes, these should target sitting conditions during the summer months because these areas are expected to be used more frequently by residents/pedestrians in the summer. Achieving the sitting classification in the summer means that these same areas would usually be suitable for standing in the windiest season because of the stronger winds that occur in the winter. In the UK, this situation is considered acceptable as there are usually other climatic factors, such as air temperature and precipitation which influence expectations about the 'usability' of amenity areas in the winter.

5. Existing Wind Microclimate

5.1 'Background' Windiness of the Site

Analysis of the meteorological data adjusted for the terrain roughness approaching the Site provides an indication of the 'background' windiness for the Site. This analysis concluded that the existing conditions, at 2m above ground, at the Site are likely to be tolerable for standing/entrance use during the windiest season. The implication of this result is that, after development, if the Site has a number of areas where the conditions are tolerable for (say) leisure walking, then these would be perceived to be 'windy' relative to general conditions in the area.

5.2 On Site Existing Conditions

Pedestrian Comfort

The Site is currently occupied by low-rise buildings, which form a reasonably solid blockage to the wind, with little permeability between Broom Road and the River Thames. It is unlikely that there will be significant building-induced acceleration of the wind.

The south-facing corners of the existing buildings will be more exposed to the prevailing south westerly winds and these and the northwest corner are expected to be the windiest parts of the Site. The wind environment at these corners would be potentially suitable for leisure walking. The riverside elevation is screened from the direct effect of the prevailing south westerly winds and would be a relatively sheltered area.

Strong Winds

Strong winds, in excess of Beaufort Force 6, are not expected to occur at the existing Site.

6. Wind Conditions Around the Proposed Development

Comparison of the existing wind conditions, as described in the previous section, with those around the Proposed Development can be misleading because it does not take account of any changes in pedestrian use of the Site. Consequently, the assessment presented in this report compares the expected wind conditions for the Proposed Development with the desired pedestrian activity on or around the Site.

Figure 4 summarises the expected levels of comfort at ground level around the Site, during the windiest season.

6.1 Pedestrian Comfort

The expected comfort levels, for the windiest season (i.e. winter), within and around the Site at ground level are shown in Figure 4. The windier zones, suitable for leisure walking, are shown in yellow, whereas the calmer zones, suitable for standing/entrance use and sitting are indicated in blue and green respectively.

At ground level, the windier leisure walking zones are restricted to the southwest-facing corners of the Proposed Development and the openings through, or between, the buildings that are more directly exposed to prevailing winds. The expected wind microclimate is discussed below. The proposed development is not particularly tall and so the main wind interactions with the wind are likely to be caused due to wind being channelled along the facades of the buildings, to accelerate around the corners.

Thoroughfares

The wind microclimate on thoroughfares across the Proposed Development is suitable for either leisure walking, standing or sitting during the windiest season (Figure 4). The northwest elevation of Building A is exposed to south westerly winds; these will be directed northwards, by Building A, to accelerate around the northwest corner whereas the difference in pressure between the northwest and southeast elevations will cause wind to blow through the ground level opening in this Building. In both these areas the wind environment is classified as suitable for leisure walking.

For similar reasons there are windy corner zones associated with the Villa Buildings (E) and Building D.

The leisure walking, standing and sitting classifications represent a wind environment that would be suitable for or calmer than required for people to walk comfortably around the Proposed Development.

Entrances

The entrance locations are identified in Figure 4 by the orange dots. All the entrances are in areas where the wind environment is classified as suitable for sitting or standing. The entrances to the easternmost residences in the two Villa blocks (E) are adjacent to a corner zone classified as suitable for leisure walking. However, the entrances are slightly set-back and so locally, conditions are expected to be suitable for an entrance in the windiest season.

All of the entrances to the buildings are therefore considered to be in areas where the wind microclimate is suitable for standing/entrance use (blue zones in Figure 4) which matches the target condition for an entrance.

Amenity / Gardens

The plans (e.g. Figure 2a) show the spaces between the buildings and around the Site to be landscaped to varying degrees and accessible to residents.

The Proposed Development is more open than the existing massing, with ‘avenues’ between the buildings that connect the river to the Broom Road elevation of the Site. Consequently, the riverside elevation is likely to be windier than at the current time. The wind environment shown in Figure 4 is for the windiest season; from experience the calmer winds that blow in the summer typically produce a one category calming of the wind environment which means that the majority of the Site is expected to be suitable for sitting with standing conditions in the windier zones (shown in yellow in Figure 4).

This predominance of sitting conditions implies that most of the open space around the Site would be compatible with sedentary activity such as long-term sitting in the summer.

6.2 Strong Winds

Because of the modest height of Proposed Development wind speeds are not expected to exceed the lower wind speed threshold of Beaufort Force 6. Consequently, ‘strong winds’ are not expected to occur at the Site.

7. Mitigation Measures

The assessment above assumed that no planting or landscaping was present around or within the development, in order to present a conservative (i.e. windier) scenario. The proposed landscape design shows that there are numerous trees along the bank of the river and also running southwest/northeast between and parallel with the buildings. These trees are expected to provide beneficial shelter particularly during the summer, when in full leaf, because they in-fill the open spaces between the buildings and so reduce the permeability of the Site to winds from the southwest and northeast.

These features are expected to increase shelter within the Proposed Development compared to the wind conditions described above, particularly when the trees and plants are established and in full leaf (i.e. summer season). Thus the majority of areas will be calmer than the conditions described in worst-case and summer seasons described in previous sections of this report.

We would not expect the leafless trees to provide beneficial shelter in the winter.

The wind environment is expected to be suitable, or calmer than desired, for the intended use of the Site during the windiest season and the summer season. There are no recommendations for mitigation.

8. Concluding Remarks

In conclusion:

1. The meteorological data for the Site indicate prevailing winds from the southwest throughout the year and a secondary wind from the northeast which is most prevalent in the spring.
2. The background exposure of the Site, due to the surrounding terrain roughness, broadly reflects the urban surroundings but there is an increase in exposure when the winds blow from the south. For the existing site the wind microclimate at ground level is expected to be generally suitable for standing during the windiest season but with leisure walking in the vicinity of the west-facing corners of the existing buildings.
3. For the Proposed Development the wind microclimate at ground level during the windiest season is classified as suitable for leisure walking, standing or sitting.
4. In the windiest season, all the thoroughfares are expected to have a wind microclimate that would be suitable for, at least, leisure walking which is compatible with the target condition for thoroughfares.
5. In the windiest season, all the entrances to the buildings are expected to have a wind microclimate that would be suitable for, at least, standing/entrance use, which is compatible with the target condition outside an entrance.
6. In the summer season, considered to be the season when people most expect to be able to sit comfortably in gardens, the Site is expected to have a wind microclimate that would be suitable for sitting in the garden areas and along the riverfront, which is compatible with the target condition for amenity areas.

Wind Direction>>	0	30	60	90	120	150	180	210	240	270	300	330
Mean Factor at 2m	0.58	0.43	0.44	0.43	0.42	0.61	0.73	0.62	0.58	0.42	0.42	0.42
Mean Factor at 10m	0.89	0.79	0.81	0.80	0.77	0.85	1.01	0.86	0.81	0.79	0.78	0.77

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

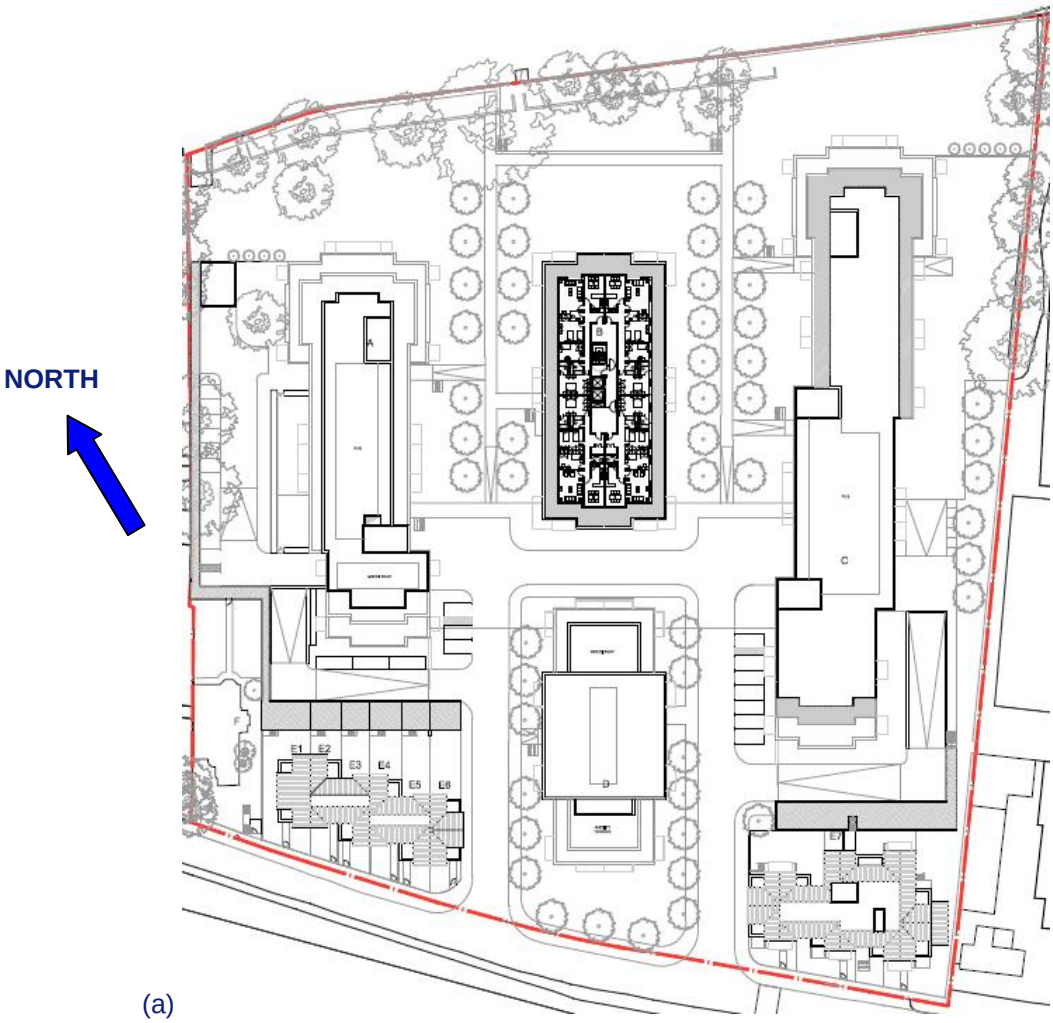
Description	Threshold	Suitable Activity
Roads and Car Parks	6% > B5	open areas where pedestrians are not expected to linger
Business Walking	2% > B5	'purposeful' walking or where, in a business district, pedestrians may be more tolerant of the wind because their presence on Site is required for work
Leisure Walking	4% > B4	Strolling
Pedestrian Standing	6% > B3	waiting at bus-stops, window shopping etc
Entrance Doors	6% > B3	pedestrians entering/leaving a building
Sitting	1% > B3	long-term sitting, for example, sitting outside a café

Table 2: Lawson Comfort Criteria

Beaufort Force	Hours Average Wind Speed (m/s)	Description of Wind	Noticeable Wind Effect
0	< 0.45	Calm	Smoke rises vertically.
1	0.45 – 1.55	Light Air	Direction shown by smoke drift but not by vanes.
2	1.55 – 3.35	Gentle Breeze	Wind felt on face; leaves rustle; wind vane moves.
3	3.35 – 5.60	Light Breeze	Leaves & twigs in motion; wind extends a flag.
4	5.60 – 8.25	Moderate Breeze	Raises dust and loose paper; small branches move.
5	8.25 – 10.95	Fresh Breeze	Small trees, in leaf, sway.
6	10.95 – 14.10	Strong Breeze	Large branches begin to move; telephone wires whistle.
7	14.10 – 17.20	Near Gale	Whole trees in motion.
8	17.20 – 20.80	Gale	Twigs break off; personal progress impeded.
9	20.80 – 24.35	Strong Gale	Slight structural damage; chimney pots removed.
10	24.35 – 28.40	Storm	Trees uprooted; considerable structural damage.
11	28.40 – 32.40	Violent Storm	Damage is widespread; unusual in the U.K.
12	> 32.40	Hurricane	Countryside is devastated; only occurs in tropical countries.

Table 3: Beaufort Land Scale

Figure 1: Aerial Views of the Existing Site (approx. Site highlighted in yellow)



(a)

(b)

(c)

(d)

Figure 2: (a) Level 6 Plan; (b) Block C & E, East & West Elevation; (c) Block B & D, East & West Elevation; (d) Block A & E, East & West Elevation

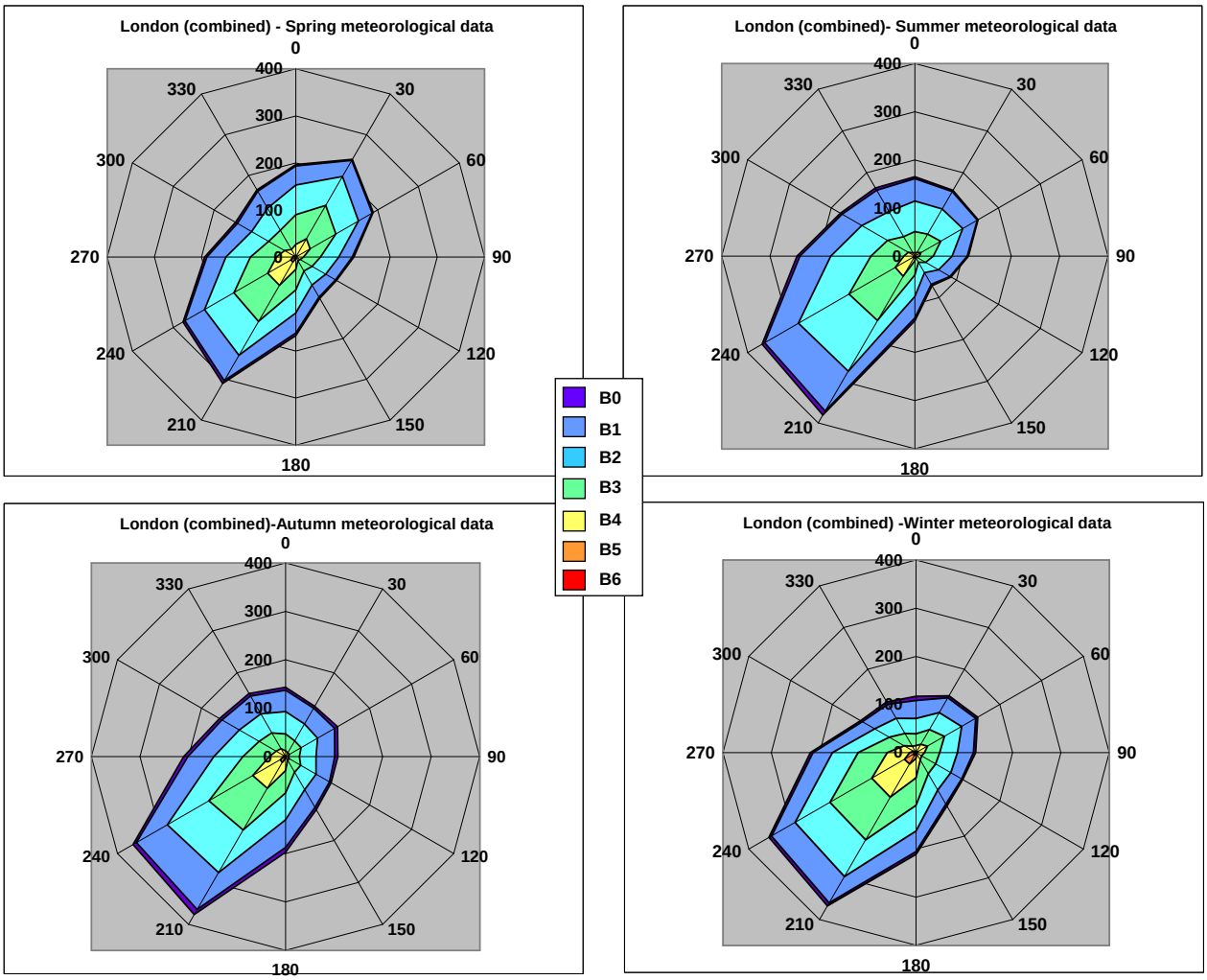


Figure 3: Seasonal wind roses for London (in Beaufort Force)
(Radial axis indicates the hours for which the stated Beaufort Range is exceeded)

Figure 4: Ground Floor Plan Showing Expected Worst-Case (Winter Season) Comfort Levels