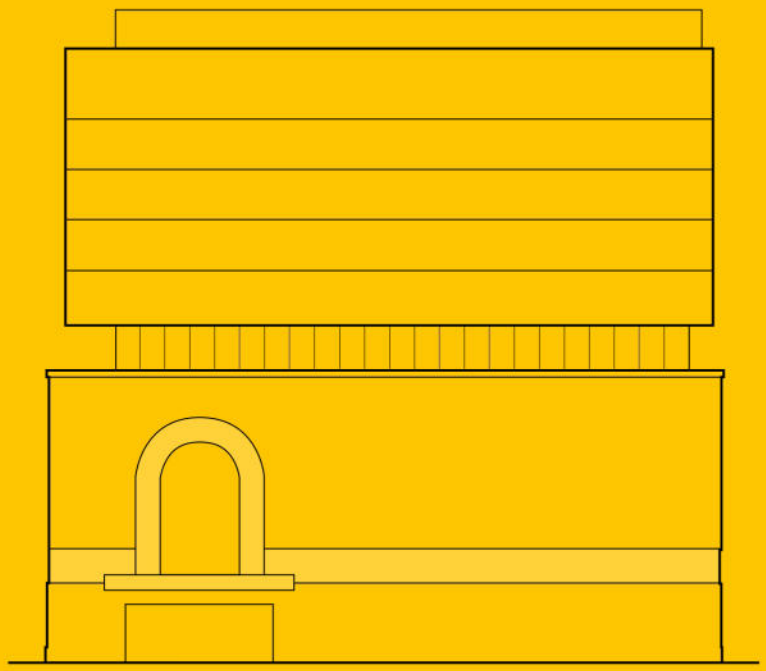

SAVILLE THEATRE

135 SHAFTESBURY AVENUE

PEDESTRIAN WIND ENVIRONMENT STATEMENT

WINDTECH

WINDTECH

PEDESTRIAN WIND ENVIRONMENT STATEMENT

135 SHAFTESBURY AVENUE, LONDON

WI278-01F02(REV1)- WS REPORT

MARCH 7, 2024

Prepared for:

SPPARC

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EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the 135 Shaftesbury Avenue development, located in London, on the local wind environment at the critical outdoor areas within and around the subject site. The effect of wind activity has been examined for the predominant wind direction for the region, namely the south-westerly winds. Year-round wind conditions, as well as wind conditions during the summer and winter seasons, are considered in this assessment. The analysis of the wind effects relating to the proposed development have been carried out in the context of the local wind climate, building morphology and land topography.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the latest architectural drawings. No wind tunnel testing or Computational Fluid Dynamics (CFD) has been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection of the architectural drawings. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects. The study has assessed the wind conditions for the following scenarios:

- Existing site conditions (baseline condition).
- Proposed development with the existing surrounding buildings.

The results of the study are summarised as follows:

- Existing Site
    - The existing five storey building on the site is not exposed to the south-westerly prevailing winds.
    - The wind conditions are therefore expected to be safe for the current pedestrian use throughout the year.
    - In terms of pedestrian comfort, wind conditions are expected to be suitable for the existing pedestrian activities, such as standing or strolling.
    - Similar wind microclimate conditions are expected in the surrounds which are also expected to be suitable for the intended pedestrian activities throughout the year.
- Proposed Development with Existing Surrounds
    - With the introduction of the proposed development, the wind conditions at ground are expected to be safe for pedestrian/occupant use throughout the year.
    - In terms of pedestrian comfort, wind conditions are expected to be suitable for the existing pedestrian activities, such as standing or strolling.
    - The wind speeds outside the main entrances are also expected to be suitable for stationary activities throughout the year. We recommend that the proposed awnings above the main building entrances be retained to provide shielding from down-washing winds during the winter worse-case wind conditions.

- Wind microclimate in the surrounding areas is not expected to alter significantly by the presence of the proposed development. The wind conditions in the surrounds are, therefore, expected to be suitable for intended pedestrian activities, including cyclist use throughout the year.

CONTENTS

1 INTRODUCTION

An opinion on the likely impact of the proposed design on the local wind environment affecting pedestrians within the critical outdoor areas within and around the subject development is presented in this report. The analysis of wind effects relating to the proposed development has been carried out in the context of the predominant wind directions for the region, building morphology of the development and nearby buildings, and local land topography. The conclusions of this report are drawn from our extensive experience in the field of wind engineering and studies of wind environment effects.

No wind tunnel testing or Computational Fluid Dynamics (CFD) has been undertaken for this assessment. Hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection, and any recommendations in this report are made only in-principle.

2 DESCRIPTION OF DEVELOPMENT AND SURROUNDINGS

The proposed development is located on Shaftesbury Avenue, in London. The site is bounded by Shaftesbury Avenue to the southeast, Stacey Street to the southwest, New Compton Street to the northwest and St Giles Passage to the southeast. Surrounding the site are predominantly medium rise commercial/residential buildings, walkways, and open areas. A survey of the land topography indicates no major elevation changes are present in the regions surrounding the site. The existing site comprises of the five storey Odeon Cinema building.

An aerial image of the subject site and the local surroundings is shown in Figure 1, with the frequency and magnitude of the prevailing winds are superimposed for each wind direction.

The proposed redevelopment comprises of the addition of 7 storeys to the existing building, increasing the overall height of the development to 12 storeys. The building extends to the boundary to the southeast and incorporates some setbacks from Level 09 to the northwest. At ground level, the area within and around the proposed development is expected to be used mostly as thoroughfares and there are no outdoor seating areas found around the proposed site.

Figure 1: Aerial Image of the Site Location and Prevailing Wind Directions

3 REGIONAL WIND

The characteristics of the regional winds were determined from an analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained from the meteorological stations located at Heathrow, Gatwick and Stansted airports. A combined total of 136 years of wind climate data has been collected from these stations, and the data from each station has been corrected so that it represents winds over standard open terrain at a height of 10m above ground. From this data, directional probabilities of exceedance and directional wind speeds for the region are determined. The results of this analysis are presented in Figures 2 for the all-year, summer and winter cases, in the form of directional plots of the annual and 5% exceedance mean winds for the region. The frequency of occurrence of these winds are also shown in Figures 2.

The principal wind direction for the London region, which can potentially affect the subject development, is from the south-west, as indicated in the following figures.

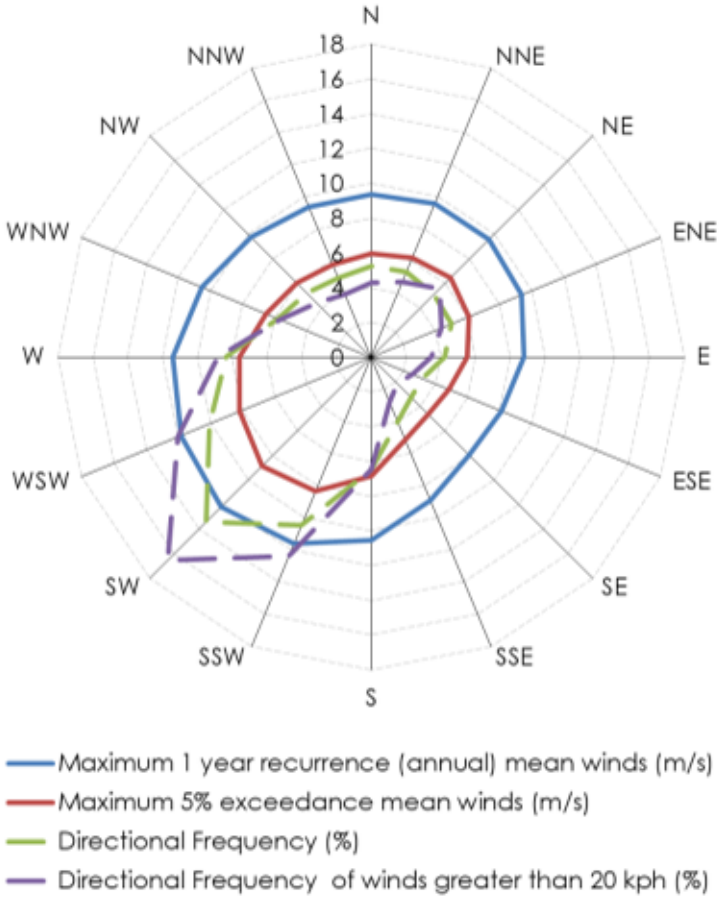

Figure 2a: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the London Region (all-year)

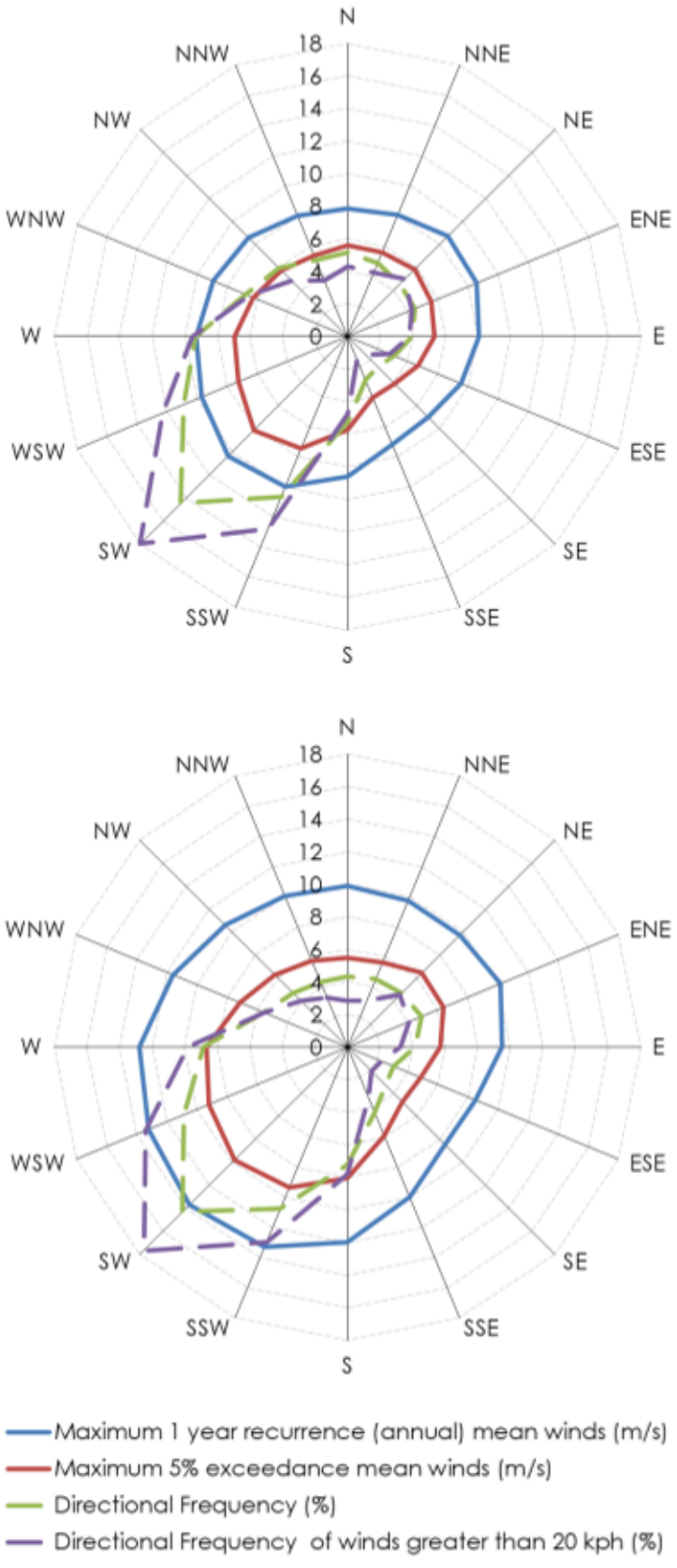

Figure 2b: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the London Region (summer top, winter bottom)

4 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking, or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Quantifying wind comfort has been the subject of much research and many researchers, such as A.G. Davenport, T.V. Lawson, W.H. Melbourne, and A.D. Penwarden, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. This section discusses and compares the various published criteria.

It should be noted that wind speeds affecting this particular development can only be accurately quantified with a wind tunnel study. This assessment addresses only the general wind effects and any localised effects that are identifiable by visual inspection and the acceptability of the conditions for outdoor areas are determined based on their intended use. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

4.1 A.D. Penwarden (1973) Criteria for Mean Wind Speeds

A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table 1 presents the modified Beaufort scale. Note that the effects listed in this table refers to wind conditions occurring frequently over the averaging time (a probability of occurrence exceeding 5%). Higher ranges of wind speeds can be tolerated for rarer events.

Table 1: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Mean Wind Speed (m/s)	Effects
Calm	0	Less than 0.3	Negligible.
Calm, light air	1	0.3 – 1.6	No noticeable wind.
Light breeze	2	1.6 – 3.4	Wind felt on face.
Gentle breeze	3	3.4 – 5.5	Hair is disturbed, clothing flaps, newspapers difficult to read.
Moderate breeze	4	5.5 – 8.0	Raises dust, dry soil and loose paper, hair disarranged.
Fresh breeze	5	8.0 – 10.8	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.8 – 13.9	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant.
Near gale	7	13.9 – 17.2	Inconvenience felt when walking.
Gale	8	17.2 – 20.8	Generally impedes progress, difficulty balancing in gusts.
Strong gale	9	Greater than 20.8	People blown over.

4.2 A.G. Davenport (1972) Criteria for Mean Wind Speeds

A.G. Davenport (1972) also determined a set of criteria in terms of the Beaufort scale and for various return periods. Table 2 presents a summary of the criteria based on a probability of exceedance of 5%.

Table 2: Criteria by A.G. Davenport (1972)

Classification	Activities	5% exceedance Mean Wind Speed (m/s)
Walking Fast	Acceptable for walking, main public accessways.	7.5 - 10.0
Strolling, Skating	Slow walking, etc.	5.5 - 7.5
Short Exposure Activities	Generally acceptable for walking & short duration stationary activities such as window-shopping, standing or sitting in plazas.	3.5 - 5.5
Long Exposure Activities	Generally acceptable for long duration stationary activities such as in outdoor restaurants & theatres and in parks.	0 - 3.5

4.3 T.V. Lawson (1975) Criteria for Mean Wind Speeds

In 1973, T.V. Lawson, while referring to the Beaufort wind speeds of A.D. Penwarden (1973) (as listed in Table 1), quoted that a Beaufort 4 wind speed would be acceptable if it is not exceeded for more than 4% of the time, and that a Beaufort 6 wind speed would be unacceptable if it is exceeded more than 2% of the time. Later, in 1975, T.V. Lawson presented a set of criteria very similar to those presented in A.G. Davenport (1972) (as listed in Table 2). These criteria are presented in Tables 3 and 4 for safety and comfort respectively.

Table 3: Safety Criteria by T.V. Lawson (1975)

Classification	Activities	Annual Mean Wind Speed (m/s)
Safety (all weather areas)	Accessible by the general public.	0 – 15
Safety (fair weather areas)	Private areas, balconies/terraces, etc.	0 – 20

Table 4: Comfort Criteria by T.V. Lawson (1975)

Classification	Activities	5% exceedance Mean Wind Speed (m/s)
Business Walking	Objective Walking from A to B.	8 - 10
Pedestrian Walking	Slow walking, etc.	6 - 8
Short Exposure Activities	Pedestrian standing or sitting for short times.	4 – 6
Long Exposure Activities	Pedestrian sitting for a long duration.	0 - 4

4.4 W.H. Melbourne (1978) Criteria for Gust Wind Speeds

W.H. Melbourne (1978) introduced a set of criteria for the assessment of environmental wind conditions that were developed for a temperature range of 10°C to 30°C and for people suitably dressed for outdoor conditions. These criteria are presented in Table 5, and are based on maximum gust wind speeds with a probability of exceedance of once per year.

Table 5: Criteria by W.H. Melbourne (1978)

Classification	Activities	Annual Gust Wind Speed (m/s)
Limit for Safety	Completely unacceptable: people likely to get blown over.	23
Marginal	Unacceptable as main public accessways.	16 - 23
Comfortable Walking	Acceptable for walking, main public accessways	13 - 16
Short Exposure Activities	Generally acceptable for walking & short duration stationary activities such as window-shopping, standing or sitting in plazas.	10 - 13
Long Exposure Activities	Generally acceptable for long duration stationary activities such as in outdoor restaurants & theatres and in parks.	0 - 10

4.5 LDDC Criteria (2001) for Mean Wind Speeds

In 2001 the T.V. Lawson criteria described in Section 4.3 was revised by T.V. Lawson. This is often referred to as the London Docklands Development Corporation criteria (LDDC Criteria). Details of the LDDC comfort criteria are presented in Table 6 and are based on the exceedance of the threshold wind speeds, occurring less than 5% of the time. This criterion defines a reasonable allowance for extreme and relatively infrequent winds that are tolerable within each category.

Table 6: LDDC Pedestrian Comfort Criteria (T.V. Lawson, 2001)

Classification	Activities	5% exceedance Mean Wind Speed (m/s)
Uncomfortable	Winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.	>10
Walking	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.	8-10
Strolling	Moderate breezes that would be appropriate for strolling along a city/town street, plaza or park.	6-8
Standing	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops	4-6
Sitting	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or comfortably sit for long periods	0-4

Details of the safety criteria are presented in Table 7 ,and are based on exceedance of 0.023% of the threshold wind speeds, occurring annually.

Table 7: LDDC Pedestrian Safety Criteria (T.V. Lawson, 2001)

Classification	Activities	Threshold Mean Wind Speed (m/s)
Unsafe for general Public & cyclists	Less able members of the public and cyclists find condition challenging	>15

5 RESULTS AND DISCUSSION

The expected wind conditions affecting the development are discussed in the following sub-sections of this report for the various outdoor areas within and around the subject development. The interaction between the wind and the building morphology in the area is considered and important features taken into account including the distances between the surrounding buildings and the proposed building form, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report. A glossary of the different wind effects described in this report is included in Appendix B.

The assessment has been carried out using the architectural drawings listed in Table 8, supplied by the design architects.

Table 8: Drawings Used in this Wind Assessment

File Name	Date received
2111-SPP-ST-0G-DR-A-20-1004 – Level 0G Floor Plan	09/01/2024
2111-SPP-ST-01-DR-A-20-1005 - Level 01 Floor Plan	09/01/2024
2111-SPP-ST-02-DR-A-20-1006 - Level 02 Floor Plan	09/01/2024
2111-SPP-ST-03-DR-A-20-1007 - Level 03 Floor Plan	09/01/2024
2111-SPP-ST-04-DR-A-20-1008 - Level 04 Floor Plan	09/01/2024
2111-SPP-ST-05-DR-A-20-1009 - Level 05 Floor Plan	09/01/2024
2111-SPP-ST-06-DR-A-20-1010 - Level 06-08 Floor Plan	09/01/2024
2111-SPP-ST-09-DR-A-20-1013 - Level 09 Floor Plan	09/01/2024
2111-SPP-ST-10-DR-A-20-1014 - Level 10 Floor Plan	09/01/2024
2111-SPP-ST-11-DR-A-20-1015 - Level 11 Floor Plan	09/01/2024
2111-SPP-ST-12-DR-A-20-1016 - Level 0R Roof Plan	09/01/2024
2111-SPP-ST-B1-DR-A-20-1003 - Level B1 Floor Plan	09/01/2024
2111-SPP-ST-B2-DR-A-20-1002 - Level B2 Floor Plan	09/01/2024
2111-SPP-ST-B3-DR-A-20-1001 - Level B3 Floor Plan	09/01/2024
2111-SPP-ST-B4-DR-A-20-1000 - Level B4 Floor Plan	09/01/2024
2111-SPP-ST-ZZ-DR-A-00-0001 – Proposed Location & Site Plan	09/01/2024
2111-SPP-ST-ZZ-DR-A-26-2001 – Section 1	09/01/2024
2111-SPP-ST-ZZ-DR-A-26-2002 – Section 2	09/01/2024

The areas within and around the development site are to be mainly used as pedestrian walkways, where conditions are required to be suitable for strolling throughout the year.

For the entrances of the proposed development, the wind conditions are recommended to be suitable for standing activities throughout the year. Sitting criteria is the suitable comfort criterion for any outdoor communal seating areas and play areas, particularly during the summer season.

Although this assessment is of a qualitative nature, the abovementioned criteria are considered when assessing the wind environment impacts.

The wind assessment is carried out for the following scenarios:

- Existing site conditions (baseline condition).
- Proposed development with the existing surrounding buildings.

5.1 Existing Site Conditions

The existing building on the site is five storeys high and is shielded from the south-westerly prevailing winds by the adjacent development across Stacey Street. The south-westerly winds are expected to channel along Shaftesbury Avenue and side stream along the building frontage, however, considering the trees along the street, these effects are expected to be substantially mitigated. The expected worst-case (winter season) wind conditions for the existing site are presented in Figure 3.

The wind speed at the existing site is expected to be rated as safe for pedestrian use throughout the year.

The wind microclimate at the existing site is expected to be suitable for strolling throughout the year. The main entrance is expected to be suitable for standing comfort. In the surrounds, wind conditions are also expected to be suitable for strolling throughout the year. The Phoenix Garden to the northwest of the site across New Compton Street is expected to be suitable for sitting comfort during the summer considering the extensive landscaping and fencing at the perimeter of the gardens. Hence, all the pedestrian areas around the existing site are expected to be suitable for the intended pedestrian activities, involving sitting, standing and/or strolling throughout the year.

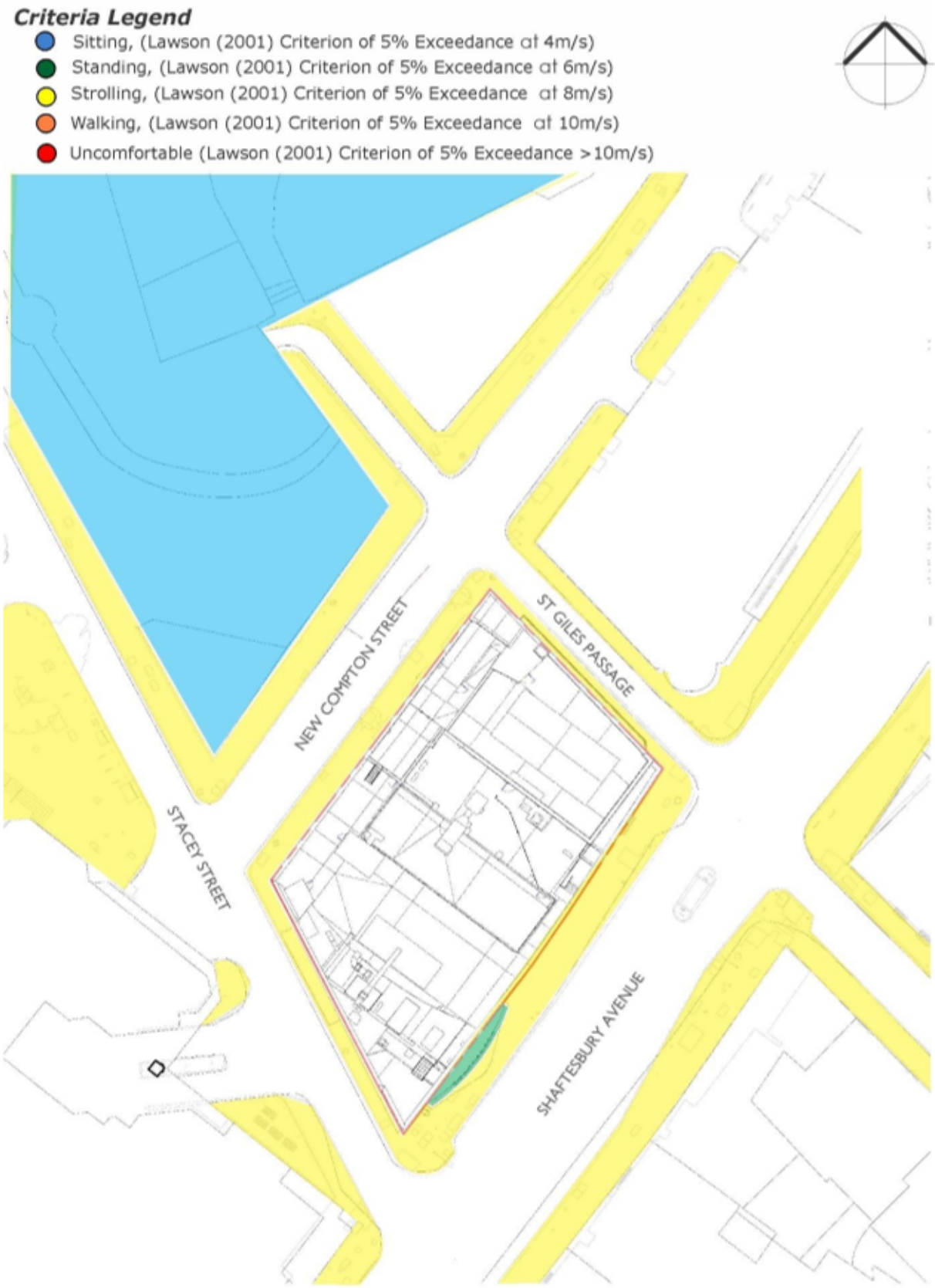

Figure 3: Wind Conditions for the Existing Site (Winter/Worst Season) – Ground Level Plan

5.2 Proposed Development

The proposed development increases the height of the building on the site to 12 storeys, however, the development will still be shielded by the adjacent development across Stacey Street. The increase in building height may result in a slight increase in the south-westerly winds channelling along Shaftesbury Avenue, however, it is expected that these effects will be mitigated by the trees along the street. Additionally, the proposed façade articulation on the upper levels of the building would be expected to assist in reducing side-streaming effects. There is also expected to be an increase in the down-washing winds on the southeast building façade, as there is no setback from this direction. However, the wind climate shows that winds from this direction are expected to be low in frequency and magnitude. The resulting expected wind conditions for the critical south-westerly prevailing wind are presented in Figure 4.

Wind conditions within the proposed site are expected to be suitable, in terms of pedestrian safety, for all users throughout the year.

The wind conditions in the surrounding pedestrian areas are not expected to alter significantly by the presence of the proposed development.

The wind microclimate at the proposed site is expected to be suitable for strolling throughout the year. The main entrances are expected to be suitable for standing comfort with the proposed awnings providing additional shelter from any downwash effects. In the surrounds, wind conditions are also expected to be suitable for strolling throughout the year. The Phoenix Garden to the northwest of the site across New Compton Street is expected to be suitable for sitting comfort during the summer considering the extensive landscaping and fencing at the perimeter of the gardens. Hence, all the pedestrian areas around the proposed site are expected to be suitable for the intended pedestrian activities throughout the year.

All the thoroughfares in the surrounds are expected to be suitable for intended pedestrian activities, involving standing and/or strolling throughout the year. The wind conditions on the roads are therefore expected to be suitable for cyclist use throughout the year.

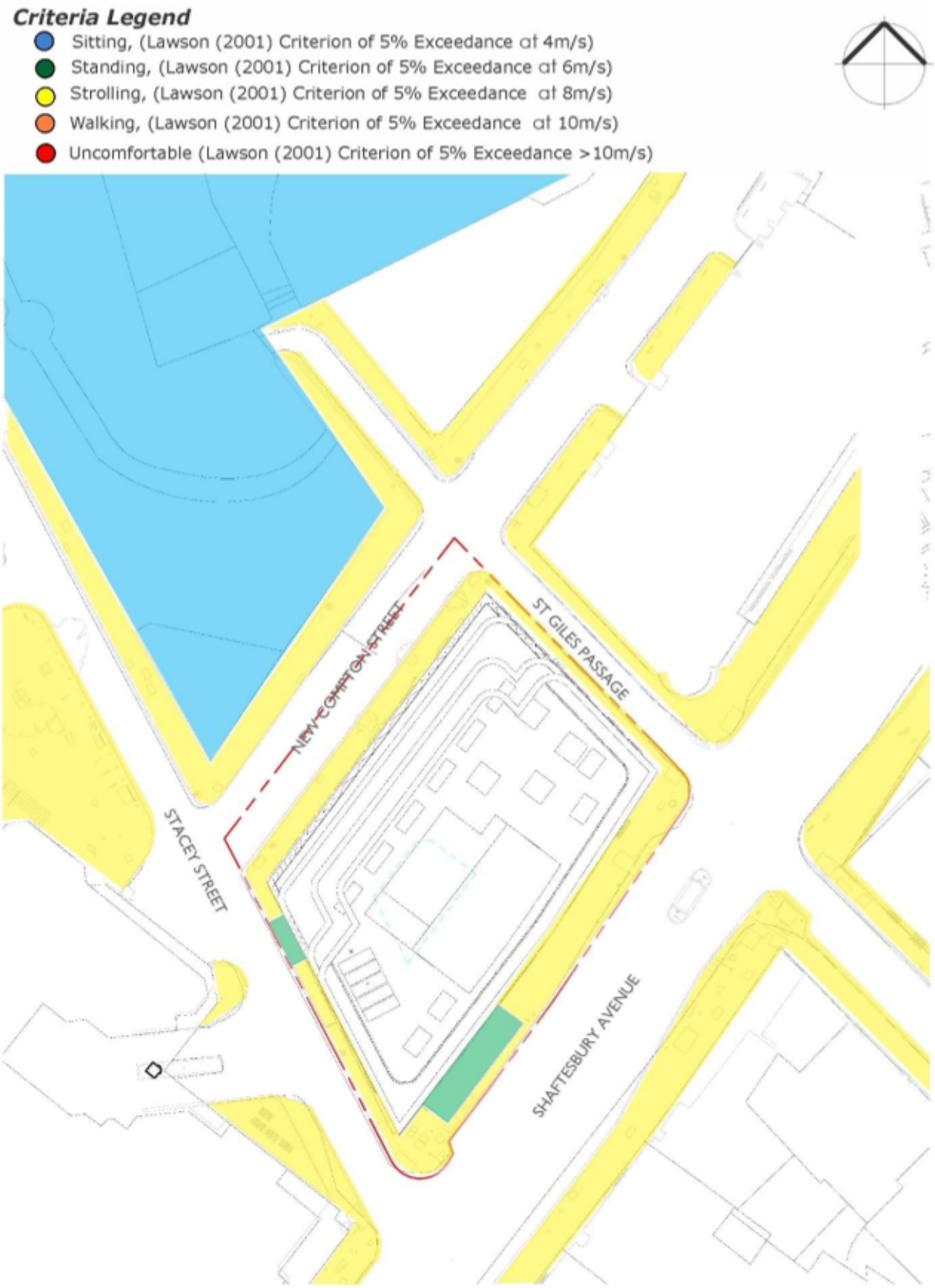

Figure 4: Wind Conditions for the Proposed Development (Winter/Worst Season) – Ground Level Plan

5.3 Mitigation Measures

The results of the study indicate that the wind conditions are expected to be suitable for intended pedestrian activities at the thoroughfares throughout the year. However, in Figure 5, additional mitigation measures are recommended in principle at ground level. These treatments are intended to provide localised wind protection for the main entrances during the winter worse-case wind conditions.

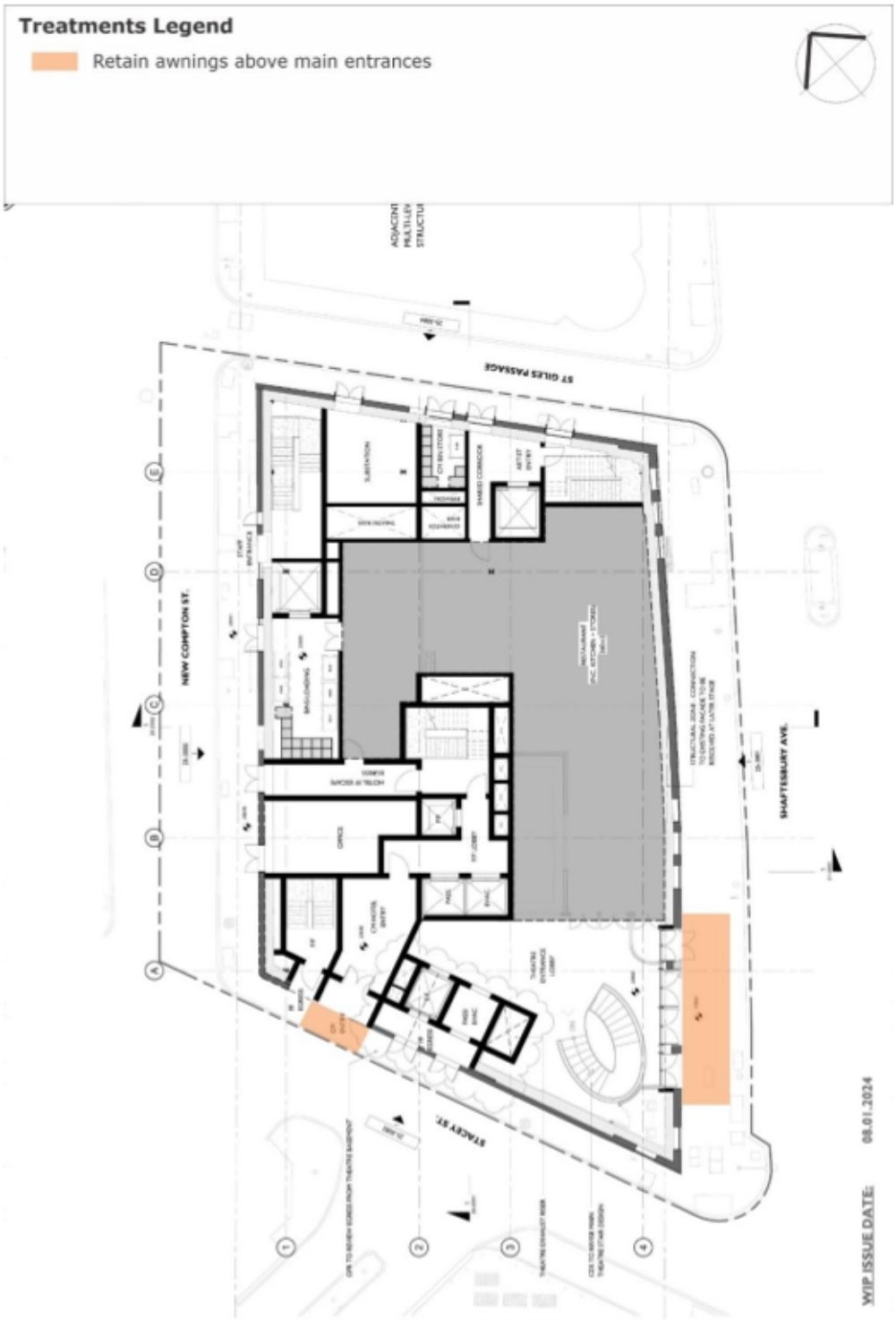

Figure 5: Suggested Treatments for the Ground Level

APPENDIX A REFERENCES

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APPENDIX B WIND EFFECTS GLOSSARY

B.1 Downwash and Upwash Effects

The downwash wind effect occurs when wind is deflected down the windward face of a building, causing accelerated winds at pedestrian level. This can lead to other adverse effects as corner acceleration as the wind attempts to flow around the building, as seen in Figure B.1.

This can also lead to recirculating flow in the presence of a shorter upstream building, causing local ground level winds to move back into the prevailing wind.

The upwash effect occurs near upper level edge of a building form as the wind flows over the top of the building. This has the potential to cause acceleration of winds near the leading edge, as well as potentially reattaching onto the roof area. This effect causes wind issues particularly near the leading edges of tall building and on the rooftop areas if there is sufficient depth along the wind direction. Upwash is more apparent in taller towers and podia.

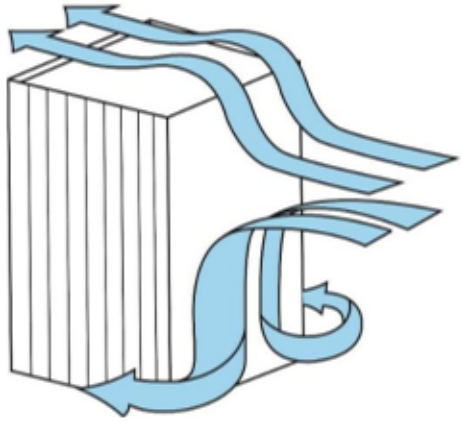

Figure B.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

B.2 Funnelling/Venturi Effect

Funnelling occurs when the wind interacts with two or more buildings which are located adjacent to each other, which results in a bottleneck, as shown in Figure B.2. This causes the wind to be accelerated through the gap between the buildings, resulting in adverse wind conditions and pedestrian discomfort within the constricted space. Funnelling effects are common along pedestrian links and thoroughfares generally located between neighbouring buildings that have moderate gaps between them.

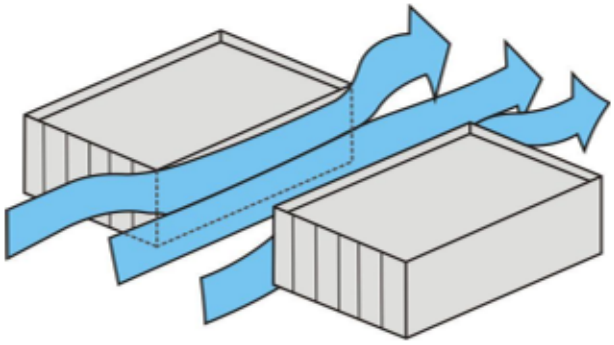

Figure B.2: Funnelling/Venturi Wind Effect

B.3 Gap Effect

The gap effect occurs in small openings in the façade that are open to wind on opposite faces, as seen in Figure B.3. This can involve a combination of funnelling and downwash effects. Presenting a small gap in the façade on the windward aspect as the easiest means through which the wind can flow through can result in wind acceleration through this gap. The pressure difference between the windward façade and the leeward façade also tends to exacerbate the wind flow through this gap.

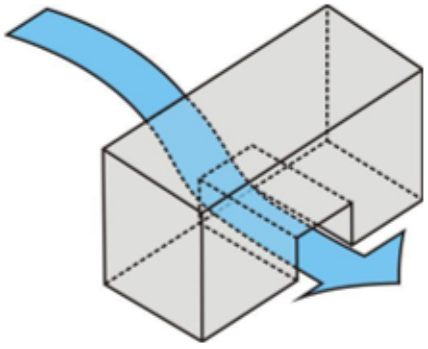

Figure B.3: Gap Wind Effect

B.4 Sidestream and Corner Effects

The sidestream effect is due to a gradual accumulation of wind shearing along the building façade that eventuates in an acceleration corner effect. The flow is parallel to the façade and can be exacerbated by downwash effects as well, or due to corner effect winds reattaching on the façade.

This is shown in Figure B.4. The corner refers to the acceleration of wind at the exterior vertical edge of a building, caused by the interaction of a large building massing with the incident wind, with the flow at the corner being accelerated due to high pressure differentials sets up between the windward façade and the orthogonal aspects. It can be further exacerbated by downwash effects that build up as the flow shears down the façade.

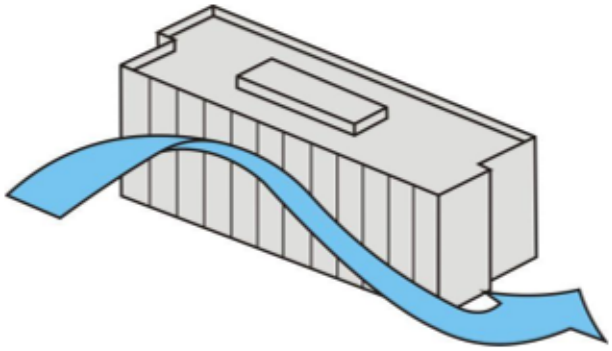

Figure B.4: Sidestream and Corner Wind Effect

B.5 Stagnation

Stagnation in a region refers to an area where the wind velocity is significantly reduced due to the effect of the flow being impeded by the bluff body. For a particular prevailing wind direction, this is typically located near the middle of the windward face of the building form or over a short distance in front of the windward face of a screen or fence. Concave building shapes tend to create an area of stagnation within the cavity, and wind speeds are generally low in these areas.