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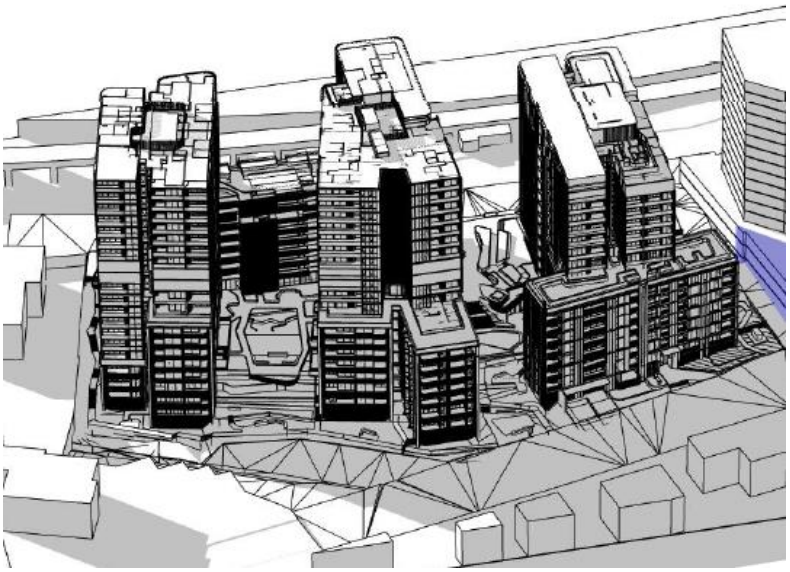

PEDESTRIAN WIND ENVIRONMENT STATEMENT

240-244 BEECROFT ROAD, EPPING

WE165-07F02(REV0)- WS REPORT

MARCH 28, 2024

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EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the proposed development located at 240-244 Beecroft Road, Epping, 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 three predominant wind directions for the region, namely the north-east, south to south-east, and westerly winds. 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 has been undertaken for the current design of 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 provided by project architect Turner (received 8 March 2024). 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 results of this assessment indicate that the development has incorporated several design features and wind mitigating strategies and is expected to be suitable for the intended use for the majority of the outdoor trafficable areas. However, there are some areas that are likely to be exposed to stronger winds. It is expected that the wind effects identified in the report can be ameliorated with the consideration of the following treatment strategies into the design of the development:

- Retention of strategically located densely foliating evergreen landscaping on the Basement 1, Lower Ground Level, Ground Level and elevated outdoor communal spaces.
- Retention of the proposed awnings / floor slab overhang on the eastern aspect of Building B at the Ground Level.
- Retention of blade walls/louvre end screening along each of the various elevated private corner balconies throughout the development.
- Inclusion of tall, impermeable end screening along the southern edge of the Building B south-eastern corner balcony for all levels where this balcony occurs.
- Retention of the 1.2m high impermeable perimeter screening around the elevated communal areas.
- Building B, Level 15 southern terrace - Inclusion of two, 2m high, impermeable dividing screens.

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for the various trafficable outdoor areas within and around the development will be suitable for their intended uses, and that the wind speeds will satisfy the applicable criteria for pedestrian comfort and safety.

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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 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 of the architectural drawings received 8 March 2024 (as listed in Table 1 below), and any recommendations in this report are made only in-principle.

Table 1: List of Architectural Drawings Referenced

Drawing No. and Title	Revision Number	Date
DA-110-006_ Basement 02	4	05/03/2024
DA-110-007_ Basement 01	4	05/03/2024
DA-110-008_ Lower Ground	4	05/03/2024
DA-110-010_ Ground Level	4	05/03/2024
DA-110-020_ Level 01-05	5	05/03/2024
DA-110-030_ Level 06	5	05/03/2024
DA-110-040_ Level 07	5	05/03/2024
DA-110-050_ Level 08 -13	5	05/03/2024
DA-110-080_ Level 14	5	05/03/2024
DA-110-090_ Level 15	5	05/03/2024
DA-110-110_ Level 16	5	05/03/2024
DA-110-120_ Level 17	5	05/03/2024
DA-110-130_ Roof Level	5	05/03/2024

2 DESCRIPTION OF DEVELOPMENT AND SURROUNDINGS

The site is located at 240-244 Beecroft Road, within the suburb of Epping. It is bounded by Beecroft Road to the east, Ray Road to the west and low rise residential and commercial buildings to the north and south. The T9 Northern Train Line runs adjacent to Beecroft Road on the eastern side of the road. Further out to the east are mid to high-rise residential buildings. The buildings surrounding the subject development to the north, south and west are predominately low-rise residential and commercial buildings.

The existing site is currently vacant, with all previous structures on the site having been demolished. The proposed development is comprised of 5 Buildings: Building A, Building B, Building C, Building D and Building E, which are 7, 17, 18, 8 and 17 storeys in height respectively. Buildings B, C and E are located (in order) at the southern end, centre and northern end of the site. Building A abuts the western end of Building B. Building D is connected to the eastern ends of Buildings C and E. The buildings are predominantly residential with several commercial units, offices and cafés proposed for use along the ground floor levels. Communal terraces are located across various levels across each of the buildings.

A survey of the land topography indicates that there is a gradual increase in elevation towards the south-eastern direction. 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 is superimposed for each wind direction.

The critical outdoor trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are listed as follows:

- Basement 1, Lower Ground and Ground Level pedestrian accessible areas.
- Private balconies and terraces.
- Elevated communal open spaces.

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

3 REGIONAL WIND

The Epping region is governed by three principal wind directions that can potentially affect the subject development. These winds prevail from the north-east, south to south-east, and west. These wind directions were determined from an analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained from the meteorological station located at Bankstown Airport by the Bureau of Meteorology (recorded from 1993 to 2016). The data has been corrected to represent winds over standard open terrain at a height of 10m above ground level. The results of this analysis are presented in Figure 2 in the form of a directional plot of the annual and 5% exceedance mean winds for the region. The frequency of occurrence of these winds is also shown in Figure 2.

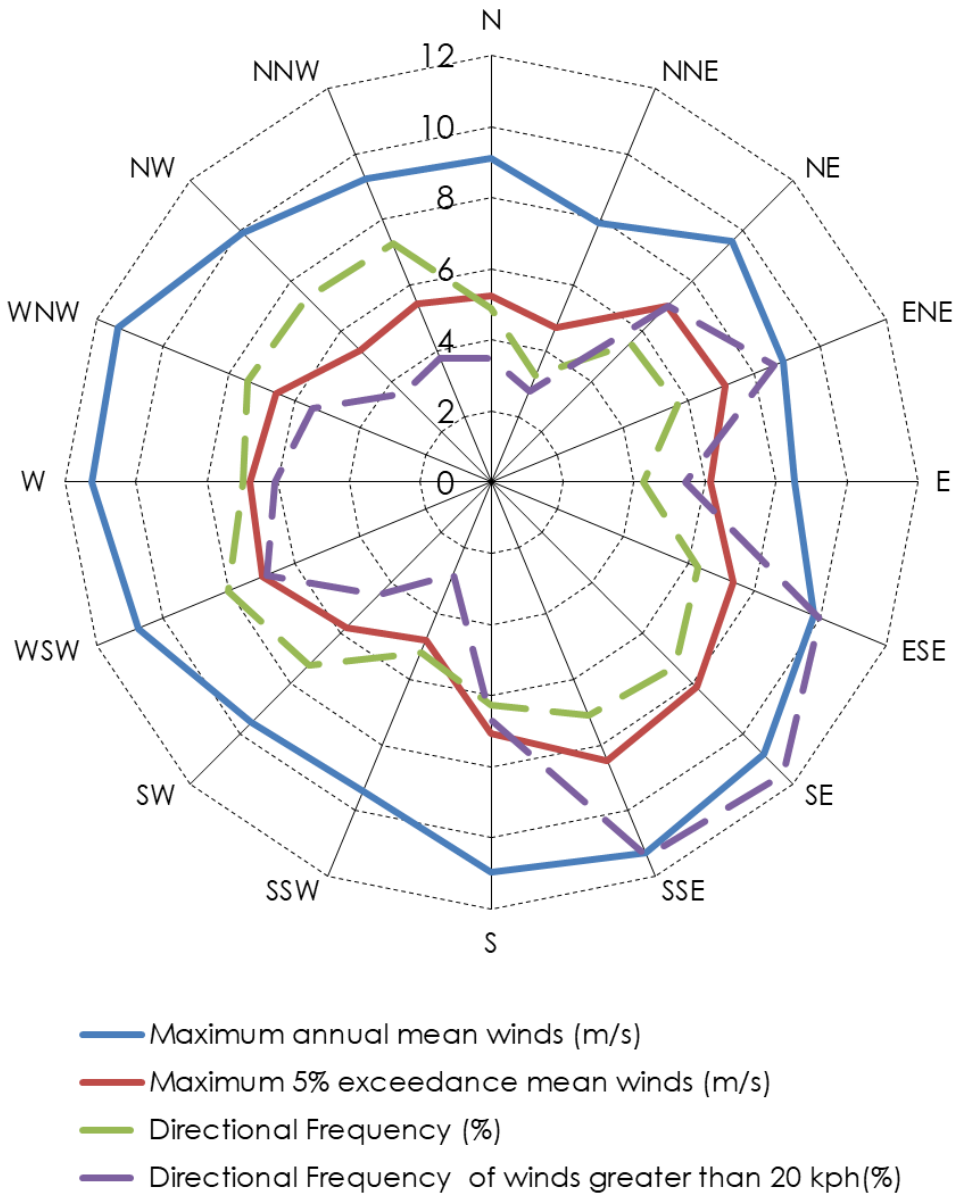

Figure 2: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Epping Region

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. Various other 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. Some Councils and Local Government Authorities have adopted elements of some of these into their planning control requirements.

For example, A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table 2 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 2: 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.

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.

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 considered 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 included in Appendix A.

For this assessment, the wind speed criteria for pedestrian comfort that are considered are listed as follows:

- Walking Criterion (8m/s with a 5% probability of exceedance)
  for general circulation and pedestrian thoroughfares, e.g. footpaths, private balconies/terraces, through-site links etc.

- Standing (Short Exposure) Criterion (6m/s with a 5% probability of exceedance)
  for stationary activities generally less than an hour, e.g. waiting areas, communal terraces, main entries, café seating etc.

- Sitting (Long Exposure) (4m/s with a 5% probability of exceedance)
  for stationary activities longer than an hour, e.g. outdoor cinemas, outdoor fine dining etc.

Note that the above wind comfort levels are derived from the Lawson (1975) criteria. Although this assessment is qualitative in nature, the abovementioned criteria for pedestrian comfort are considered when assessing the wind environment impacts. However, all areas are also assessed with consideration to a pedestrian safety criterion of 23m/s for the annual maximum gust.

5.1 Basement 1, Lower Ground and Ground Level Pedestrian Accessible Areas

The Basement 1 level is exposed to the prevailing north-easterly, westerly, and south-easterly winds. Adverse wind conditions in the form of corner accelerated flow are likely to occur at the south-westerly, south-easterly and north-westerly corners.

The Level 6 western façade offset is expected to reduce the impact of wind downwashing on the Basement 1 Level. The relatively small western and eastern building aspects are also likely to reduce wind downwashing due to the size of the exposed façade area. The tall impermeable/porous end screens should be retained on the north-western corner of the development to mitigate corner acceleration effects caused by the prevailing winds.

Significant tree planting on the western aspect of the development has been proposed, which is expected to ameliorate adverse wind conditions in this area. Therefore, this planting should be retained. The landscaping in the areas that are affected by the westerly prevailing winds should be densely foliating and of an evergreen species to ensure its effectiveness throughout the year.

The pedestrian footpath along Beecroft Road benefits from shielding from the prevailing westerly winds provided by the development's building form. However, these pedestrian footpaths are exposed to the

prevailing north-easterly and south-easterly winds, which directly impact the site, and can side stream along the eastern façade. Winds accelerating around the north-eastern and south-eastern corners are expected to impact pedestrian comfort at these footpath locations. It is also likely that the prevailing south-easterly winds will downwash off the southern façade and reattach onto pedestrian accessible areas along the eastern frontage.

Significant tree planting across all aspects of the development has been proposed, which is expected to ameliorate adverse wind conditions in this area. Therefore, this planting should be retained. The landscaping in the areas that are affected by the westerly prevailing winds should be densely foliating and of an evergreen species to ensure its effectiveness throughout the year. In addition, the retention of the awnings/overhang on the Ground Floor Level is recommended to mitigate any downwash effects that may be caused by the abovementioned prevailing winds.

The southern and northern communal areas (which are positioned between Buildings B/C and Buildings C/E respectively) are shielded from the southerly winds by the development itself. It is unlikely that wind funnelling will impact pedestrian comfort due to the large spacing between the buildings. However, both the westerly and north-easterly winds can cause adverse winds in this area, particularly at the corners of the built form where corner acceleration from the westerly and north-easterly winds and downwashing from the north-easterly winds can combine near the ground level to cause strong wind winds. Significant tree planting across all aspects of the development has been proposed, which is expected to ameliorate adverse wind conditions in this area.

The abovementioned treatments are shown in Figures 3 below.

Figure 3a: Recommended Treatments for the Basement 1 Level

Figure 3b: Recommended Treatment for the Lower Ground / Ground Level

5.2 Private Balconies and Terraces

Generally, the wind speeds at the corners of the building form are expected to be the highest due to the winds accelerating around the corner of the building. Some shielding is provided to some of these corner balconies by adjacent buildings. It is expected that the proposed blade walls/louvre screening at the corner balconies will reduce the impact of the corner accelerated flow effects and hence, should be retained. It is noted that the south-eastern corner balconies of Building B are of the greatest concern due to their position and orientation with the prevailing winds. It is recommended to include taller, impermeable screening at the Building B south-eastern corner balcony for all levels where this balcony occurs.

The Level 15, Building B southern terrace area is exposed to winds from the west and south and may experience adverse wind conditions in the form of wind side streaming and corner accelerated flow. It is recommended to include two, 2m high, impermeable dividing screens along the southern aspect of the terrace.

Centrally placed balconies are expected to be suitable for their intended uses due to the shielding/flow stagnation provided by the recessed design.

Furthermore, the use of loose glass-tops, lightweight sheets or covers (including loose BBQ lids) and other lightweight furniture is not recommended on the upper-level outdoor terraces and balconies unless it is securely attached to the balcony or terrace floor slab.

The abovementioned treatments are shown in Figures 4 below.

5.3 Communal Open Spaces

The communal open spaces on Levels 06, 07, 16 and 17 are exposed to the prevailing westerly, north-easterly and south-easterly winds. It is recommended to retain the 1.2m high impermeable screening and dense planting as this is likely to provide shielding against direct wind impact and corner accelerated flow effects.

Furthermore, the louvres which have been incorporated in the design should also be retained, as to provide some protection from the side-streaming and corner accelerating prevailing winds across the development.

The abovementioned treatments are shown in Figures 4 below.

Figure 4a: Recommended Treatment for the Level 01-05 Private Balconies and Terraces

Figure 4b: Recommended Treatment for the Level 06 Private Balconies and Terraces

Figure 4c: Recommended Treatment for the Level 07 Private Balconies and Terraces

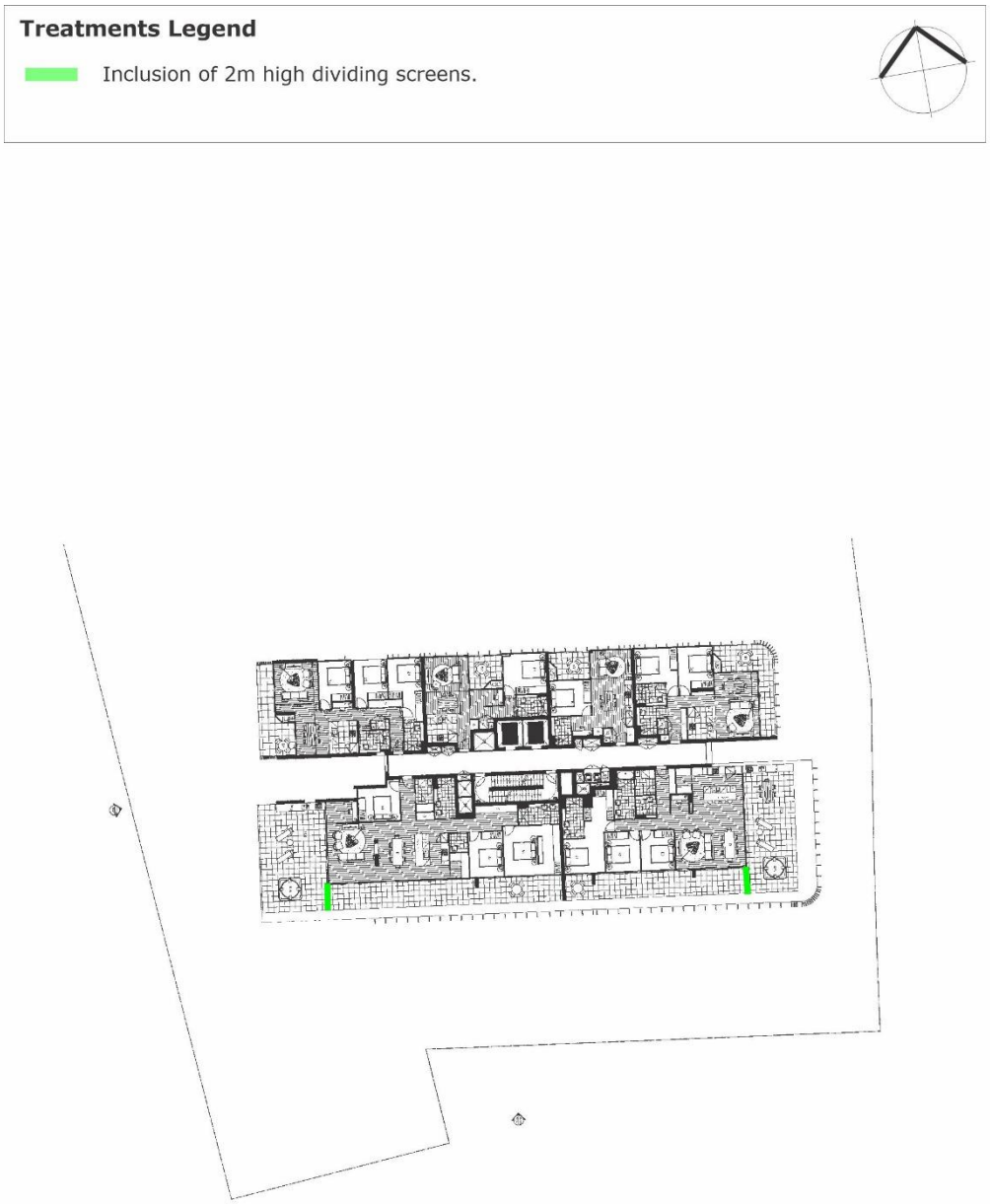

Figure 4d: Recommended Treatment for Level 15

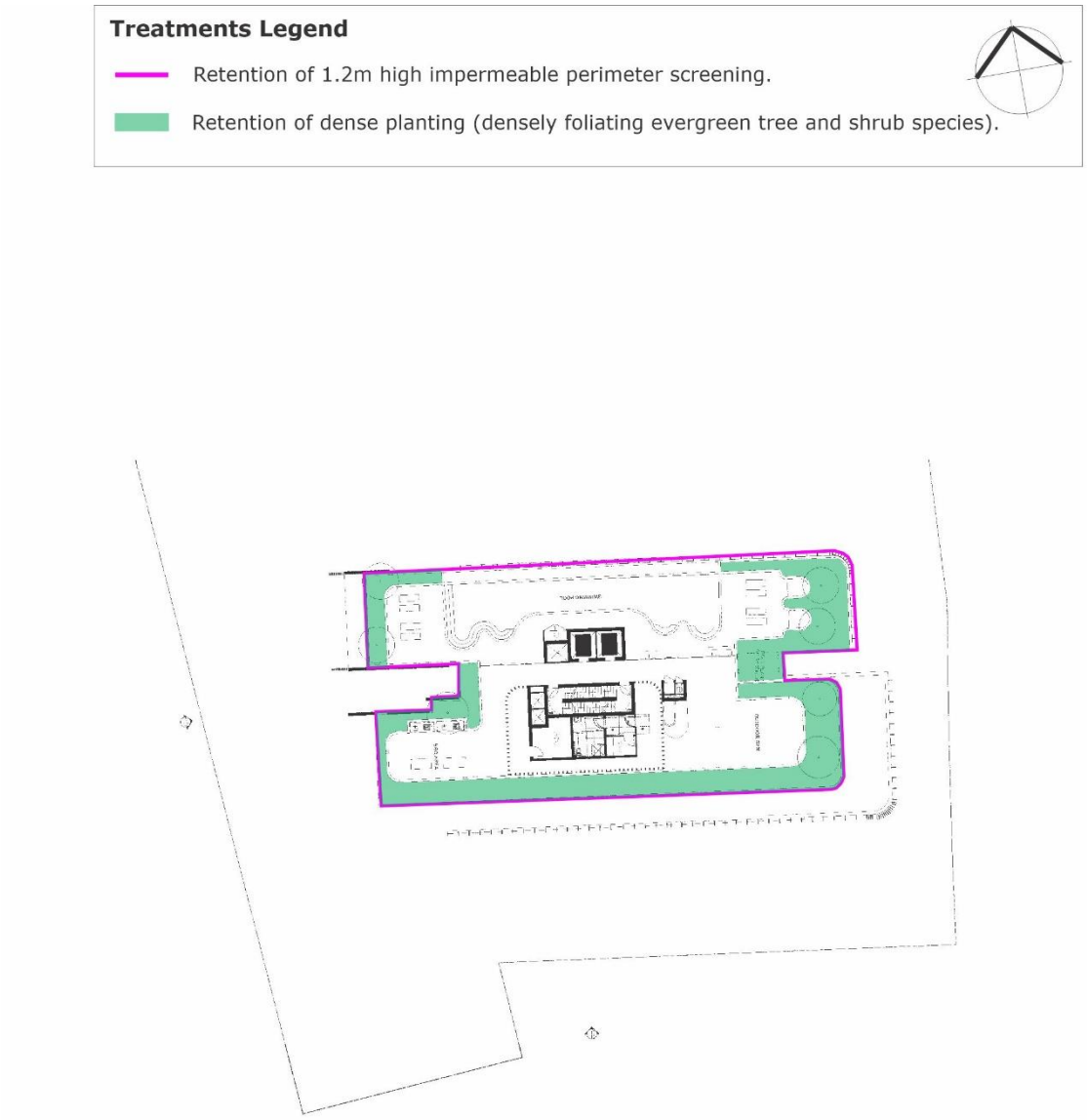

Figure 4e: Recommended Treatment for Level 16

Figure 4f: Recommended Treatment for Level 17

6 REFERENCES

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APPENDIX A WIND EFFECTS GLOSSARY

A.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 A.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.

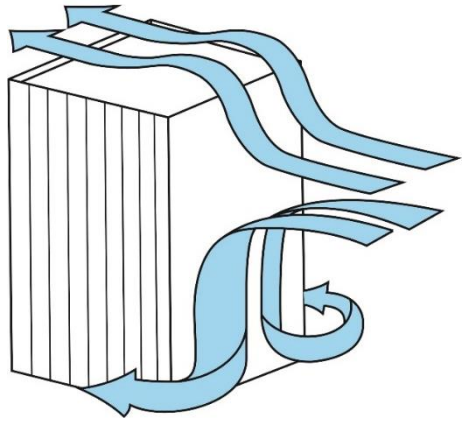

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

A.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 A.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.

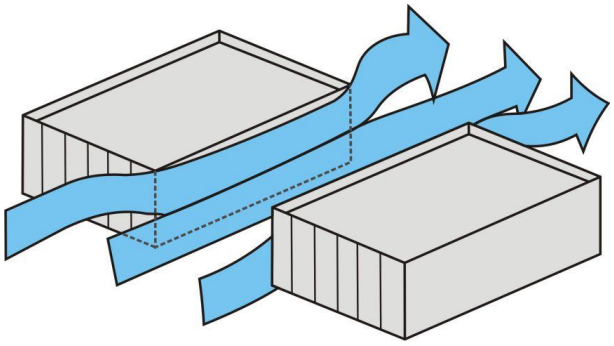

Figure A.2: Funnelling/Venturi Wind Effect

A.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 A.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.

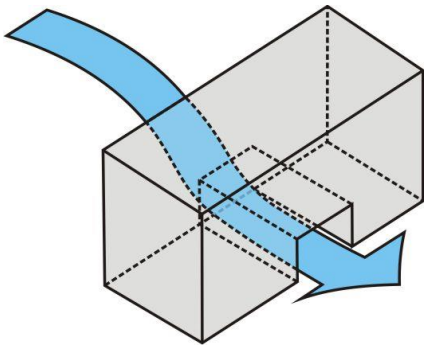

Figure A.3: Gap Wind Effect

A.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 A.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.

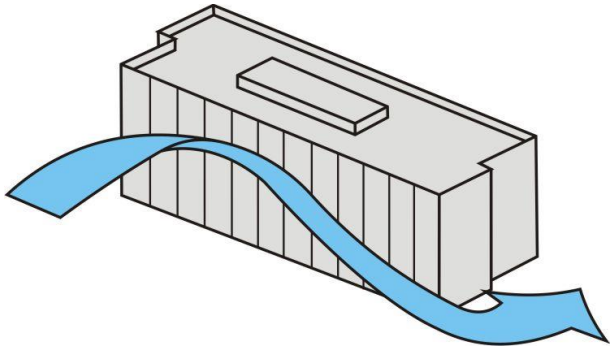

Figure A.4: Sidestream and Corner Wind Effect

A.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.