# PEDESTRIAN WIND ENVIRONMENT STATEMENT

## TRINITI - STAGE 2, 39 DELHI ROAD, NORTH RYDE

WH621-01F02(REV2)- WS REPORT

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# DOCUMENT CONTROL

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# EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the Triniti - Stage 2 development located in North Ryde, 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-easterly, south to south-easterly, 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 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 (received 01 August 2023). 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. Ongoing design development will ameliorate identified wind effects in areas that are likely to to be exposed to stronger winds through the consideration of the following treatment:

- Ground level trafficable areas:
    - Retention of the proposed/existing tree planting.
- Communal Open Spaces:
    - Retention of all proposed landscaping elements on the Level 3 Podium and the proposed pergola (30-35% porosity) over the link bridge.
    - Retention of 1.8m high screening (raised planter & balustrade) around the perimeter of the Level 20 terraces, and retention of raised landscaping/vegetation located centrally
- Private Balconies:
    - Retention of full height impermeable screens on the north-western balconies on Building A and the north-western and south-eastern balconies on Building C
    - Retention of the proposed impermeable balustrades.

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. Nonetheless, wind tunnel testing is recommended to be undertaken at a more detailed design to quantitatively assess the wind conditions and to optimise the size and extent of the treatments required.

# CONTENTS

# 1 INTRODUCTION

This pedestrian wind environment statement is submitted to the Department of Planning and Environment (DPE) in support of a State Significant Development Application (SSDA) (SSD-55844212) for a new build-to-rent housing (BTR) development at 39 Delhi Road, North Ryde (the site).

The proposed development will specifically comprise the following:

- Site preparation and excavation.
- Construction of a new build-to-rent development comprising a shared podium with three new buildings ranging between 2 to 20 storeys specifically, the following is proposed:
  - 1,851 $m^2$ of non-residential floor area at ground level, including commercial and retail uses,
  - 39,031 $m^2$ of build-to-rent housing, including a total of 508 dwellings,
  - 1,518 $m^2$ of communal residential amenity facilities located throughout the building.
- Basement and Ground Floor carparking, comprising a total of 155 car parking spaces, 108 bicycle spaces, and 6 motorcycle spaces and 1 carwash bay.
- Vehicular access provided via Rivett Road for retail, services, loading and waste removal, and Rennie Street for residential use.
- Use of approximately 164 existing carparking spaces from adjacent Triniti basement as residential carparking.
- Activation and revitalisation of existing New Link Road to be used as a pedestrian through site link as per Letter of Offer to Council.
- Associated landscaping and public domain works; and
- Augmentation of, and connection to, existing utilities as required.

For a detailed project description refer to the Environmental Impact Statement prepared by Ethos Urban.

This wind statement presents 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, and any recommendations in this report are made only in-principle.

# 2 RELEVANT SEARS

This pedestrian wind environment statement addresses the following relevant Secretary's Environmental Assessment Requirements (SEARs) set out in Table 1 below

Table 1: Secretary's Environmental Assessment Requirements relevant to this Report

| Item | SEARS Requirement | Documentation |
|---|---|---|
| 5 | Environmental Amenity | Pedestrian Wind Environment Assessment, Section 6 |
| 7 | Public Space | Pedestrian Wind Environment Assessment, Section 6 |
| 8 | Trees and Landscaping | Pedestrian Wind Environment Assessment, Section 6 |

# 3 DESCRIPTION OF DEVELOPMENT AND SURROUNDINGS

The site is located at 39 Delhi Road, North Ryde within the Ryde Local Government Area (LGA). The site is legally described as Lot 21 in DP 1003588 and has a total area of approximately 27,410m$^2$. The site currently comprises the existing Triniti Business Campus (Stage 1) on the northern portion of the site and the Triniti Stage 2 site on the southern portion of the site, which is currently vacant.

A summary of the surrounding development is provided below:

- **North:** The site is immediately bounded by Delhi Road to the north. Beyond Delhi Road, is the Macquarie Park Cemetery and Crematorium.
- **East**: The site is immediately bounded by Julius Avenue to the north-east and Rivett Road to the south-east. Beyond these roads, a range of industrial warehouses and business park centres are located to the east, housing major tenants, including CSIRO.
- **South:** The site is bounded by the former Microsoft Campus by Goodman to the immediate south. Beyond the Microsoft Campus is Epping Road and the M2 Motorway off ramp.
- **West**: The site is bounded by Rennie Street to the immediate west. Additionally, the North Ryde Metro Station is located approximately north-west of the site. A mix of uses are grouped around the metro station, including residential development. Particularly, the Ryde Gardens and Centrale are two residential developments located to the west of the site. Further and beyond the M2 Motorway, the Lachlan's Square Village is located northwest which is accessible via a pedestrian bridge and comprises a range of amenities and facilities, including a medical centre, gym, post office, beauty services, and food and drink premises.

A site aerial is provided in Figure 1 below.


Figure 1: Aerial Image of the Site Location

A survey of the land topography indicates steep inclines around the site with terrain forming a downwards slope towards the south and west.

An aerial image of the subject site and the local surroundings is shown in Figure 2, 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:

- Ground Level areas and pedestrian footpath.
- Communal Open Spaces on the Level 3 podium, Levels 3 and 4 of Building B and Level 20 of Buildings A & C.
- Private balconies and terraces.


Figure 2: Aerial Image of the Site Location and Prevailing Wind Directions

# 4 REGIONAL WIND

The regional wind for the location 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 3 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 3.

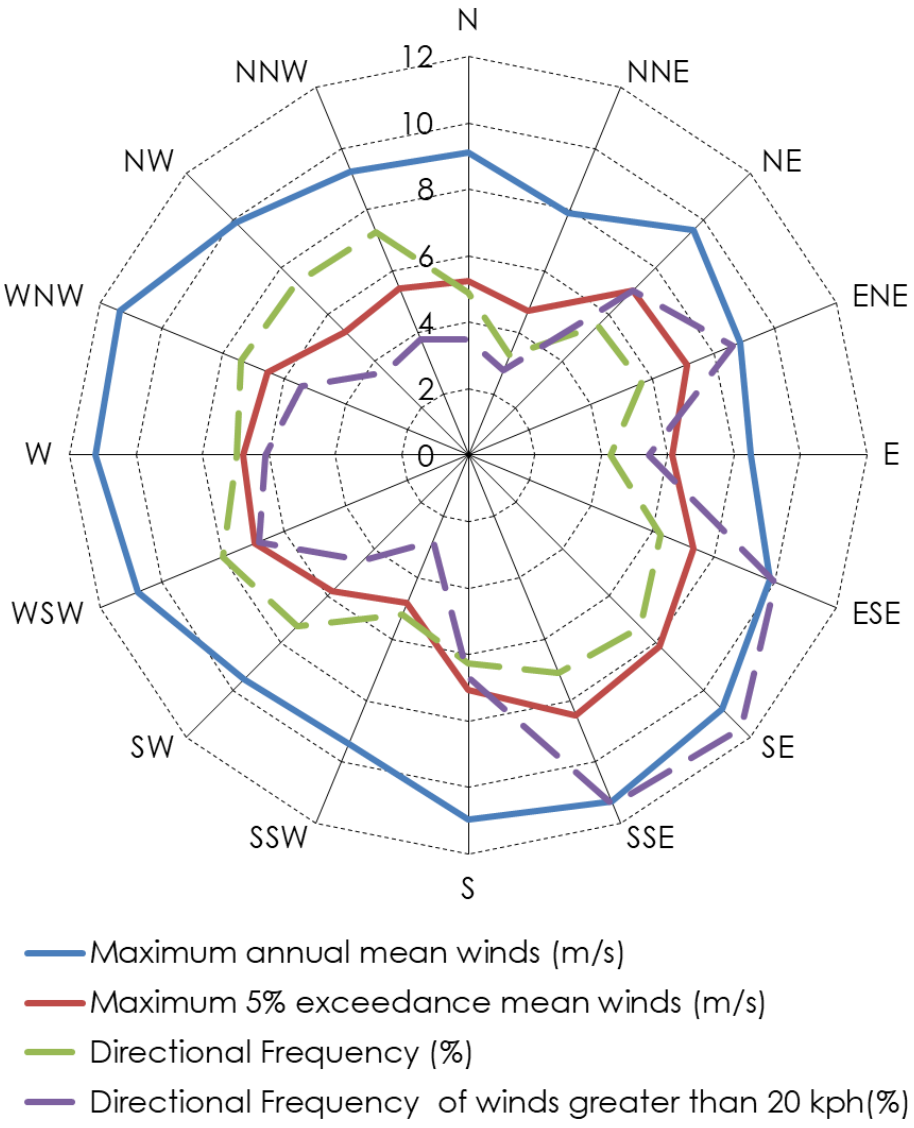


Figure 3: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Bankstown Region

# 5 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.

# 6 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 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.

## 6.1 Ground Level Areas

The pedestrian footpath on New Link Road is shielded from the prevailing westerly and south to south-easterly winds by the development itself, and from the prevailing north-easterly winds by the existing 49 Julius Avenue development. However, some of the north-easterly winds could potentially downwash of Building C's narrow aspect into New Link Road. The downwash impact on the footpath is expected to be minimal due to the tower projection over it, and the wind conditions are expected to be similar to the existing wind conditions. Note that the existing trees on New Link Road are expected to assist in breaking up potential downwashed winds hence they are recommended to be retained.

The pedestrian footpath on Revitt Road benefits from the shielding provided by the subject development itself against the prevailing westerly and north-easterly winds. However, the southerly sector winds are expected to downwash from the wider aspect of Building C. Due to the tower setback from the footpath and the dense tree planting, the downwash impact is expected to be minimal, and the wind conditions are expected to be similar to the existing wind conditions.

The pedestrian footpath on Rennie Street is shielded from the prevailing westerly winds by the existing Network Place towers, and from the majority of north-easterly and southerly sector winds by the development itself. However, some corner accelerated winds, a product of downwash effects off the narrow aspects of Building A,

are expected to impact ends of Rennie Street's footpath. Hence it is recommended to retain all proposed tree planting especially near the northern and western corners (See Figure 4).

Despite being shielded against all low-level prevailing winds, the north-east to south-west through-site link is potentially prone to funnelling effects generated from downwashed winds off the towers form. Landscaping plans shows retention of dense tree planting near the south-western entry of the through-site link and raised planters within the through-site link itself. Those elements are expected to be effective in baffling the funnelling winds therefore they are recommended to be retained in the final design (See Figure 4).


Figure 4: Recommended Treatment for the Ground Level

## 6.2 Communal Open Space

The communal open space on the Level 3 podium is shielded from the majority of the prevailing winds by the development itself and the existing neighbouring towers. However, some of the prevailing winds are still expected to downwash and funnel into this communal open space.

The landscaping plans provided show many features which are expected to be effective wind mitigation measures. The edge planting along the eastern edge, with dense tree planting concentrated in the north-eastern and south-eastern corners, is expected to assist in breaking up the north-easterly and southerly sector downwashed winds. Hence, they are recommended to be retained in the final design. Furthermore, the central landscaping within the open space especially around the playground area is recommend to be retained to enhance comfort level for short duration stationary activities (See Figure 5).

The proposed pergola section over the link bridge is expected to assist in protecting the link bridge against any winds downwashed off Building A, hence it is recommended to be retained in the final design. Note that for the pergola to be an effective wind mitigation measure its porosity should be no more than 30-35%. The abovementioned treatments are depicted in Figure 5.

The communal open spaces on Level 2 and roof of Building B benefit from the shielding provided by Buildings A & C and the existing towers to the north and south. With the retention of the perimeter standard height balustrades and the surrounding planter zone, these communal open spaces are expected to be suitable for the intended use. These treatments are shown in Figure 5 below.

The rooftop communal open spaces on Level 20 of Buildings A and C are susceptible to upwash wind effect due to the increased wind exposure at higher storeys. Furthermore, corner acceleration effects generated from winds sidestreaming along the tower form at high levels are expected to impact those communal open space. The corner acceleration effect is expected to occur mainly from the prevailing north-easterly and westerly winds on Building A and southerly and westerly winds on Building C.

To mitigate the aforementioned wind effects, it is recommended to retain the proposed 1.8m (raised planter and balustrade) screening around the perimeter of the communal space. However, due to the width of those terraces, some of the deflected upwashed winds are expected to reattach centrally. Hence it would be recommended to retain the raised landscaping centrally to protect the proposed seating areas. (See Figure 6).


Figure 5: Recommended Treatment for the Level 3 Podium Communal Open Space


Figure 6: Recommended Treatment for the Level 20 Communal Open Space

## 6.3 Private Balconies

The majority of the balconies of the development are expected to be suitable for their intended use due to the inclusion of some wind mitigation features such as their overall recessed design and impermeable balustrades. Furthermore, the balconies at lower levels of both buildings are provided increased wind protection against the prevailing winds by the existing neighbouring towers.

Screening on some more wind-prone balconies is recommended to be retained to ensure that those balconies will be suitable for their intended use. The northern corner balconies on Building A are susceptible to corner accelerated winds from the prevailing north-easterly direction. To mitigate this effect, it is recommended to retain the full height impermeable screens on the northern aspect of those balconies (See Figure 7&8). Similar corner acceleration effects mainly from the southerly and north-easterly winds are expected to occur on the eastern and western corner balconies on Building C. Therefore, the proposed full-height impermeable screens are also recommended to be retained on the southern aspect of both corner balconies (See Figure 7&8).

With the retention of the abovementioned recommendations in the final design, it is expected that wind conditions on the private balconies of the development will be suitable for their intended use.

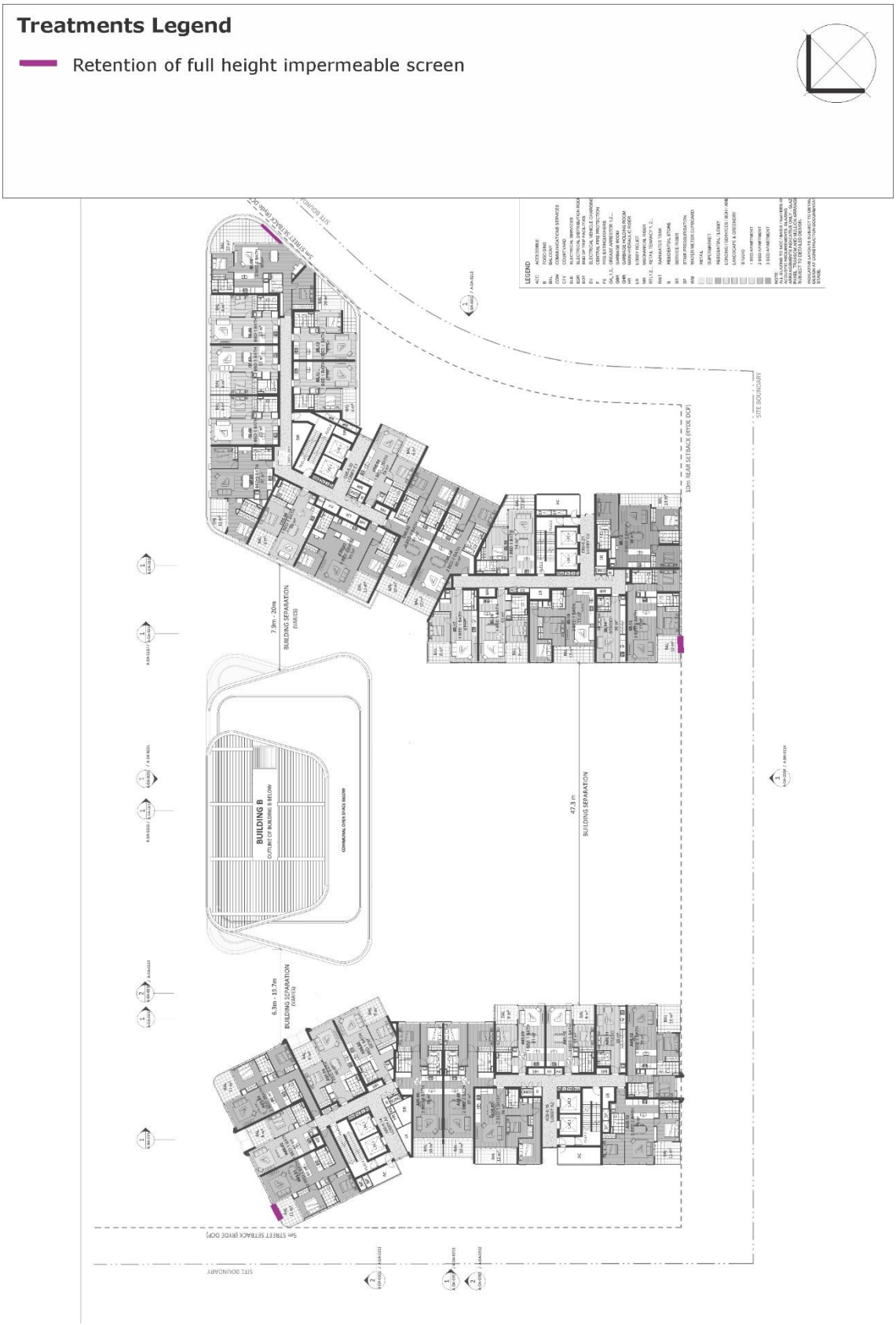


Figure 7: Recommended Treatment for the Level 3-7 Private Balconies and Terraces


Figure 8: Recommended Treatment for the Level 4-20 Private Balconies and Terraces

# 7 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.

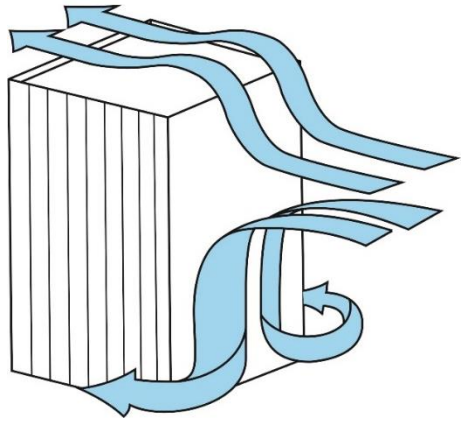

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

## 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.

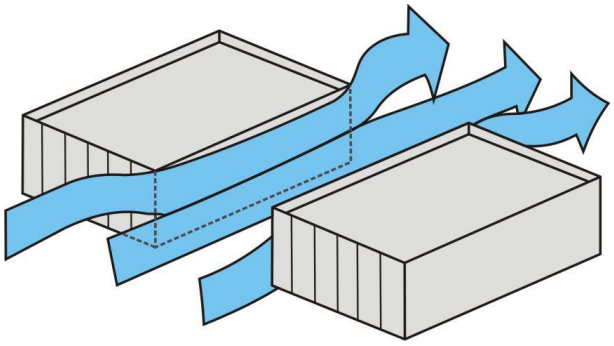

Figure A.2: Funnelling/Venturi Wind Effect

## 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.

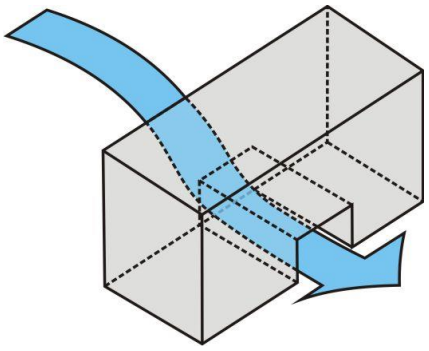

Figure A.3: Gap Wind Effect

## 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.

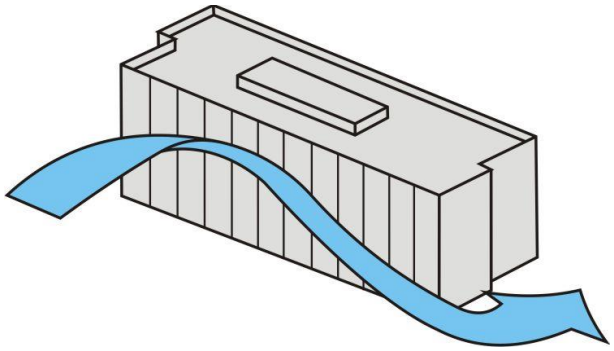

Figure A.4: Sidestream and Corner Wind Effect

## 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.