

**Loftex Chatswood Pty. Ltd.**

## 3-5 Help Street

### Environmental Wind Assessment Report

Reference: Wind Report

Rev. 04 | 1 January 2025

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 292987-00

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# Executive Summary

Arup have been commissioned to prepare an environmental wind impact assessment report for the impact of the proposed development at 3-5 Help Street, Chatswood on the pedestrian level wind conditions for comfort and safety in and around the site for SSDA approval.

It is considered that the proposed development, due to its height and relative massing, particularly compared to the low-rise buildings towards east, would have a noticeable impact on the local wind conditions, especially at street corners and private elevated areas. For prevailing winds passing through the Chatswood CBD from the other directions, the proposed development would be expected to have moderate effect.

Qualitatively, integrating the expected directional wind conditions around the site with the wind climate, it is considered that wind conditions at most locations around the site would be classified as suitable for pedestrian standing or walking in accordance with the Lawson criteria, which is consistent with the existing conditions. However, and some areas would approach thresholds associated with more strenuous activities like objective walking. These would be considered suitable for the intended use of the area around the site, which is primarily for transient activities.

All locations would be expected to pass the safety criterion, or require minor local amelioration.

Benefits of the design include the eastern façade articulation, the tower setbacks from the podium edge to the south-east and north, and the location to the east of the Chatswood CBD which gives protection to the strong prevailing winds from the south and west quadrants.

To quantify the qualitative advice provided in this report, numerical or physical modelling of the development would be required, which is best conducted during detailed design and would be recommended for such a significant building on the fringe of the Chatswood CBD.

## Disclaimer

This assessment of the site environmental wind conditions is presented based on engineering judgement. In addition, experience from more detailed simulations have been used to refine recommendations. No detailed simulation, physical or computational study has been made to develop the recommendations presented in this report.

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# 1. Introduction

Arup have been engaged to provide an experienced-based wind impact assessment report for the proposed development at 3-5 Help Street, Chatswood. This report outlines the assessment and subsequent recommendations for wind engineering services related to pedestrian wind comfort and safety on the ground level to support a State Significance Development Application (SSDA).

The Department of Planning and Environment has issued Secretary's Environmental Assessment Requirements (SEARs) for the proposed development. This report has been prepared having regard to the relevant SEARs as referenced in Table 1.

**Table 1: Applicable SEAR**

Item	SEAR	Relevant section
5.2	Environmental Amenity: <i>Assess amenity impacts on the surrounding locality, including lighting impacts, solar access, visual privacy, visual amenity, view loss and view sharing, overshadowing and wind impacts. A high level of environmental amenity for any surrounding residential or other sensitive land uses must be demonstrated.</i>	This report, in particular Section 2.3, addresses the requirements to provide a wind impact assessment, which has been prepared by a suitably qualified specialist.

Additionally, the report evaluates the concern outlined in Section 4E of Apartment Design Guide (ADG) regarding the potential limitation of balcony use above 10 storeys due to consistently high wind speeds.

**Table 2: Applicable AGD Design Guidance**

Item	4E: Private open Space and Balconies	Relevant section
Objective 4E-1	<i>Balcony use may be limited in some proposals by:</i> <ul style="list-style-type: none"><li>• <i>consistently high wind speeds at 10 storeys and above</i></li></ul>	This report, in particular Section 2.3, addresses the requirements to provide a wind impact assessment, which has been prepared by a suitably qualified specialist.

## 2. Wind assessment

### 2.1 Local wind climate

Weather data recorded at a standard height of 10 m at Sydney Airport have been used in this analysis, Figure 1. The arms of the wind rose point in the direction from where the wind is coming from. The anemometer is located about 18 km to the south of the site. The directional wind speeds measured here are considered representative of the wind conditions at the site.

It is evident from Figure 1 that strong prevailing winds are organised into three main groups which centre at about the north-east, south, and west quadrants.

Strong summer winds occur mainly from the south and north-east quadrants. Winds from the south are associated with large synoptic frontal systems and generally provide cooler conditions and contain the strongest gusts during summer. Moderate intensity winds from the north-east tend to bring cooling relief on hot summer afternoons typically lasting from noon to dusk. These are small-scale temperature driven effects; the larger the temperature differential between land and sea, the

stronger the wind. These winds are slightly tempered at Chatswood due to the greater distance from the coast

Winter and early spring strong winds typically occur from the south-west, and west quadrants. West quadrant winds provide the strongest winds affecting the area throughout the year and tend to be associated with large scale synoptic events that can be hot or cold depending on inland conditions.

The measured mean, 5%, and 0.1% exceedance wind speeds are 4.5, 9.5, and 15 m/s respectively.

A general description of flow patterns around buildings is given in Appendix A.1

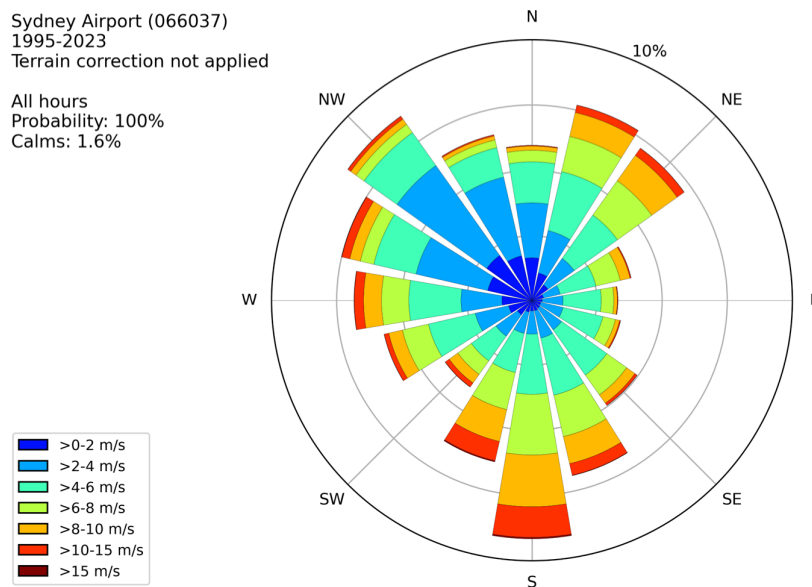


Figure 1: Wind rose showing probability of time of wind direction and speed

## 2.2 Specific wind controls

Wind comfort is generally measured in terms of wind speed and rate of change of wind speed, where higher wind speeds and gradients are considered less comfortable. Air speed has a large impact on thermal comfort and are generally welcome during hot summer conditions. This assessment is focused on wind speed in terms of mechanical comfort.

There have been many wind comfort criteria proposed, and a general discussion is presented in Appendix A.2.

The SSDA does not include any wind assessment criteria, and there are no specific wind controls in the Willoughby DCP for this site. However, the Concourse Development outlines the following wind control measures:

- “To ensure public safety and comfort the maximum wind criteria are:*
- \* 10 metres /second in retail / restaurant contiguous spaces.*
  - \* 13 metres /second in major pedestrian streets and open spaces.”*

These wind criteria do not include the duration of the wind event, nor the probability of time that they occur. These are considered to be based on the work of Melbourne (1978), which represent a peak 3 s gust event occurring in an hour for 0.1% of time from any wind direction. The applicable 13 m/s limit for this site, is a comfort criterion appropriate for pedestrian standing activities. With reference to the wind rose in Figure 1, the equivalent 0.1% exceedance gust wind speed would be about 18 m/s in Chatswood, hence there are few locations in Chatswood that would meet this

criterion without additional shielding to improve the wind conditions. This extreme gust wind speed criterion is used as an estimator of the general serviceability wind conditions at a site, which may be more relevant. To combat this limitation, as well as the once per annum gust wind speed, additional wind controls used in this wind assessment are based on the work of Lawson (1990) as described in Figure 18 and Table 3. These have both a comfort and safety component and tend to better describe the usage of the space from a comfort perspective. Converting the wind climate to the site location, the mean wind speed exceeded 5% of the time would be approximately 6 m/s at pedestrian level. With reference to Table 3, this would result in a comfort classification on the border of pedestrian standing and walking, which is considered appropriate for the known general Chatswood wind climate.

**Table 3: Pedestrian comfort criteria for various activities**

<b>Comfort</b> (max. of mean or GEM wind speed exceeded 5% of the time)	
<2 m/s	Dining
2-4 m/s	Sitting
4-6 m/s	Standing
6-8 m/s	Walking
8-10 m/s	Objective walking or cycling
>10 m/s	Uncomfortable
<b>Safety</b> (max. of mean or GEM wind speed exceeded 0.022% of the time)	
<15 m/s	General access
<20 m/s	Able-bodied people (less mobile or cyclists not expected)

### Site description

The site is located on the north-east fringe of Chatswood CBD, to the west of the block bounded by Cambridge Lane, and McIntosh, Anderson, and Help Streets, Figure 2. The site is surrounded by medium to high-rise buildings in all directions, with suburbia beyond. The proposed development rises to a maximum height of about 115 m above ground level, Figure 3. The tower is prismatic in form with an irregular plan form, Figure 4. The tower is set back from the podium edge to the north and south-east. Topography surrounding the site is essentially flat from a wind perspective.



**Figure 2. Site location (source: Google Maps 2022)**

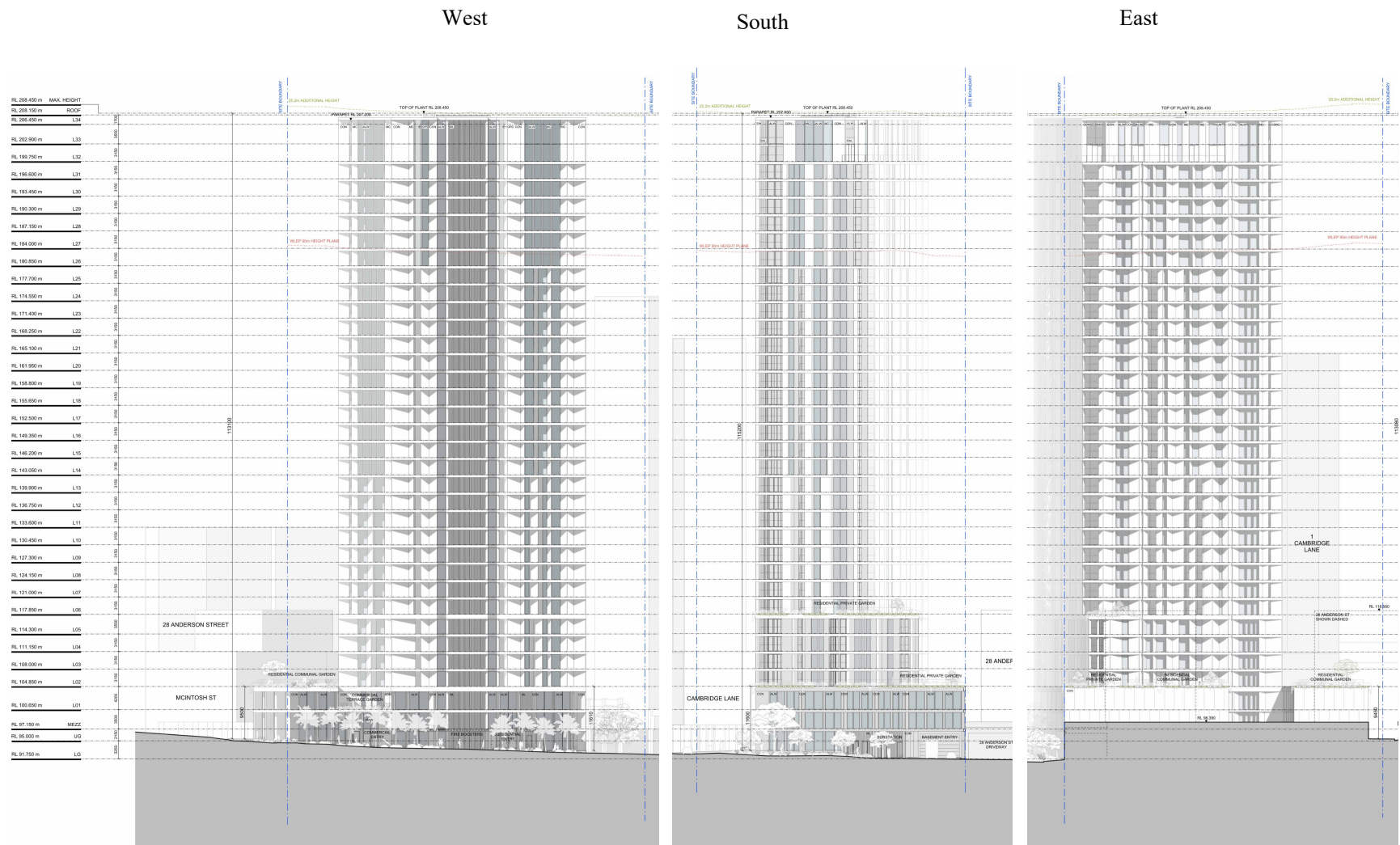
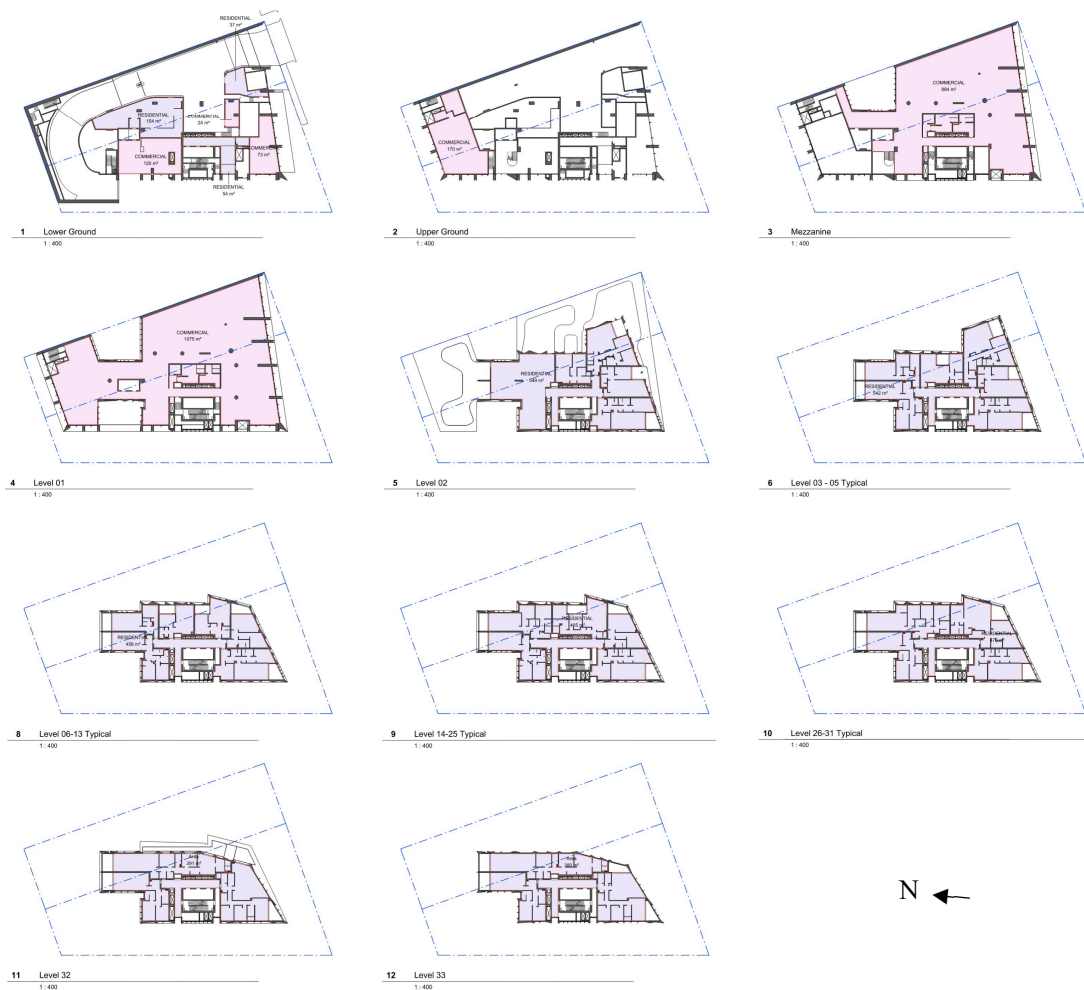


Figure 3: Various elevations (architectural drawings by EMBECE Studio)



**Figure 4: Various floor plans (architectural drawings by EMBECE Studio)**

### **2.3 Predicted wind conditions on ground plane and elevated locations**

This section of the report outlines the predicted wind conditions in and around the site based on the local wind climate, topography, and changes to the building form. The wind conditions in this part of city are known to be windy, particularly close to tall buildings on the fringe of the Chatswood CBD.

The massing of the proposed redevelopment is greater or similar compared with the massing of the surrounding buildings, hence will have an impact on the local wind conditions particularly in the exposed directions. The development will make some areas windier and others calmer depending on the incident wind direction.

#### **Winds from the north-east**

The site being to the east of Chatswood CBD is exposed to winds from the north-east. The approaching wind flows around and through the CBD as a compound massing, making buildings on the fringe having a greater impact on the wind conditions.

Winds from the north-east would impinge on the north-east corner and broad east façade of the proposed tower inducing downwash, Figure 9 and pressure-driven flow between tall neighbouring buildings, particularly along Help Street and Cambridge Lane, Figure 5. The horizontal and vertical

building articulation along the east façade, the tower setback from the podium edge in the south-east corner and north face as well as the close proximity to neighbouring buildings would reduce the amount of downwash reaching ground level.

By protecting the ground plane, the elevated accessible private outdoor areas on the tower will be windy during these conditions particularly around the building corners. A wind management plan, or fixed furniture will be required for these locations.

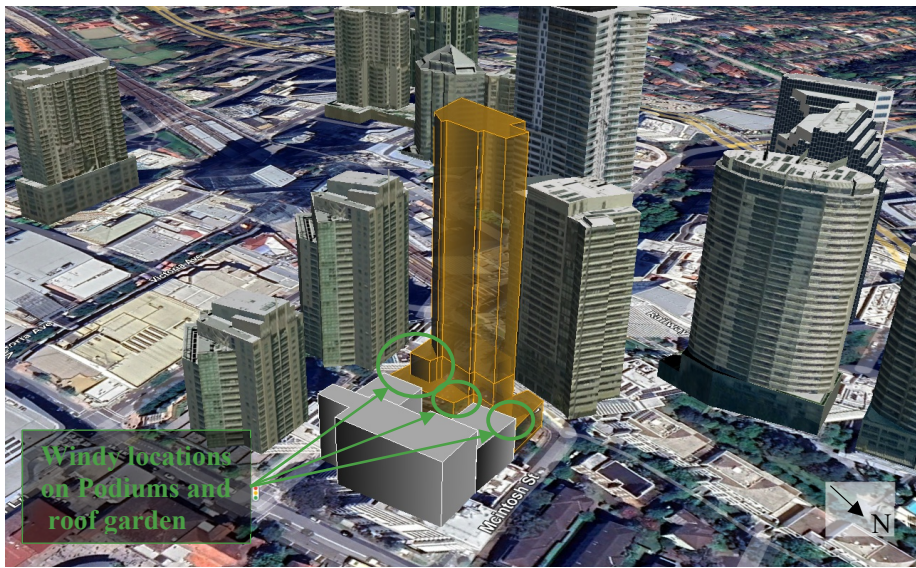
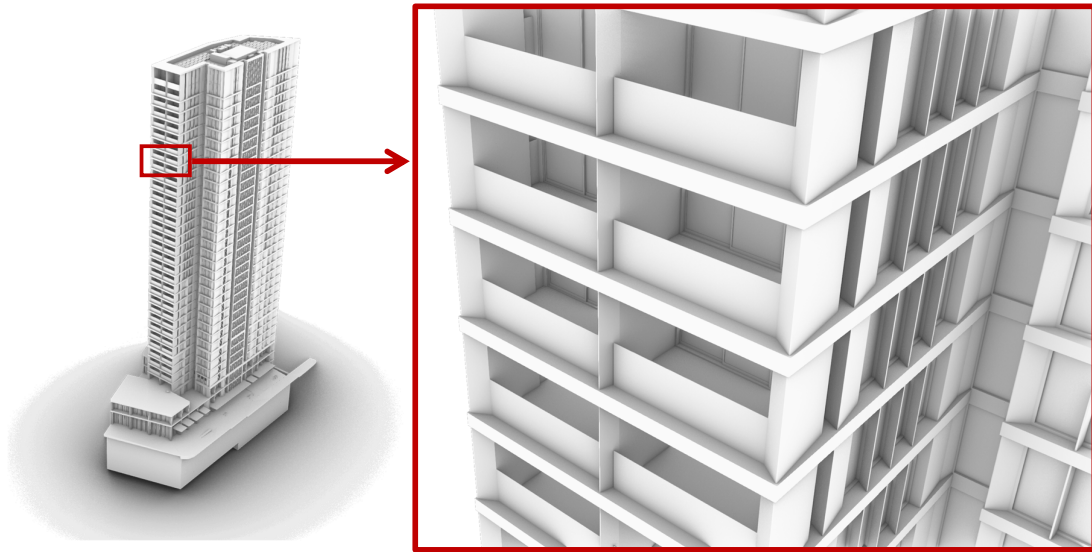


Figure 5: Flow patterns around site for winds from the north-east (Google Earth, 2024)

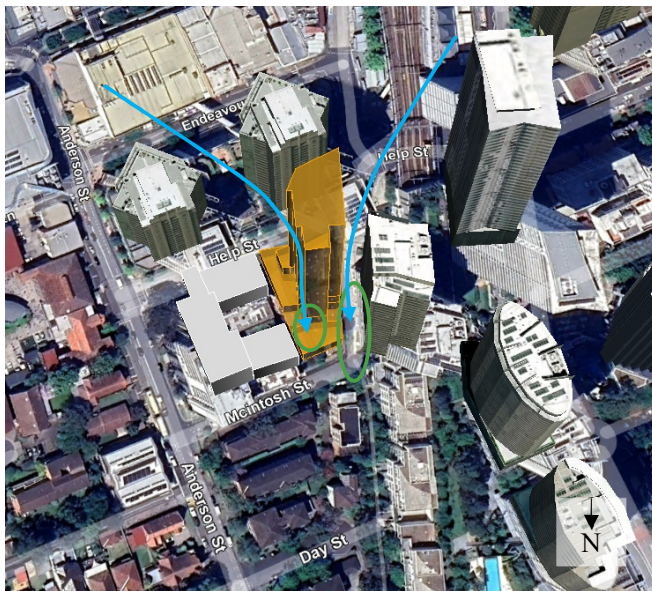
The balconies on the northern side of the building, Figure 6 , are exposed to the winds from the north-east. While the balcony design features solid balustrades and recessed placement, providing effective shielding, wind conditions within a certain range may still impact the suitability of these spaces for use by tenants. It is expected the comfort and safety level comply with the ADG criteria, but usability of the balconies would be limited during stronger winds from north quadrant.



**Figure 6: Northern balconies**

### **Winds from the south**

The site benefits from some protection against winds coming from the south quadrant due to numerous tall upstream buildings that channel the flow along open corridors, such as the rail corridor, Railway Street and to a lesser extent Orchard Road. The irregular Chatswood Street layout is beneficial to the local wind environment by encouraging flow around and over the city massing. However, with the proposed building reaching over 100m in height is expected to have a noticeable influence, particularly in the corner of Cambridge Lane and McIntosh Street, as well as in the setback from the podium edge in the north, Figure 7.



**Figure 7: Flow patterns around site for winds from the southern quadrant (Google Earth, 2024)**

## Winds from the west

Similarly to winds from the south, the site is well protected from winds from the west, and north-west, quadrants by the upstream tall buildings, which channel the wind along the open flow corridors and would be expected to have minimal impact on the local wind conditions. However, with the proposed building exceeding 100m in height, localised wind conditions would occur along Help Street, particularly when wind comes from the south-west quadrant, Figure 8.

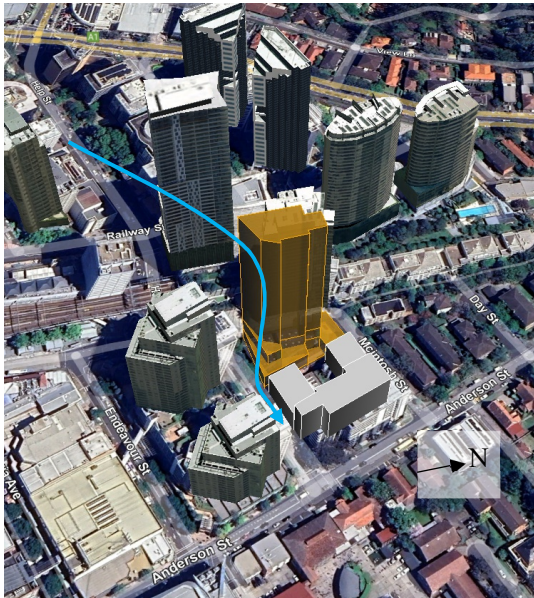


Figure 8: Flow patterns around site for winds from the south-west (Google Earth, 2024)

## Discussion

The height and massing of the proposed development is similar to other large developments to the west in this Chatswood area, but significantly greater than the general low-rise buildings to the east. While winds from the east quadrant are less frequent, the proposed development would still be expected to have a noticeable impact on local wind conditions when they occur. The impact is anticipated to be more moderate for the other, generally more critical wind directions in the Sydney region.

Comparing the wind conditions with the Melbourne criteria in the Willoughby DCP, it would be expected that all locations would exceed the 13 m/s gust criterion. Qualitatively, integrating the expected directional wind conditions around the site with the wind climate, it is considered that wind be classified as suitable for pedestrian standing or walking according to the Lawson criteria. However, at street corners, wind conditions would approach thresholds associated with objective walking.

All locations would be expected to pass the safety criterion.

## 3. Additional advice

The main entrances from Cambridge Lane are well located remote from the building corners. The introduced segmented awning along Cambridge Lane will provide rain protection to pedestrians and reduce the downwash flow close to the north corner, but limited wind protection as the flow along Cambridge Lane will primarily be horizontal.

The outdoor area to the north of the development and the corner of Cambridge Lane will be windy during summer winds on hot days from the north-east. The proposed outdoor areas in the Landscaping plan along Cambridge Lane, Figure 4, are well located in the centre of the west façade where protection will be provided by the building and the laneway planting.

The single vehicular to the basement carparking levels is to the south. For winds from the south-east, this location would be expected to experience high positive pressure.

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- San Francisco Planning Department, (2015) San Francisco Planning Code Section 148.
- Willoughby City Council, (2006), Willoughby Development Control Plan.

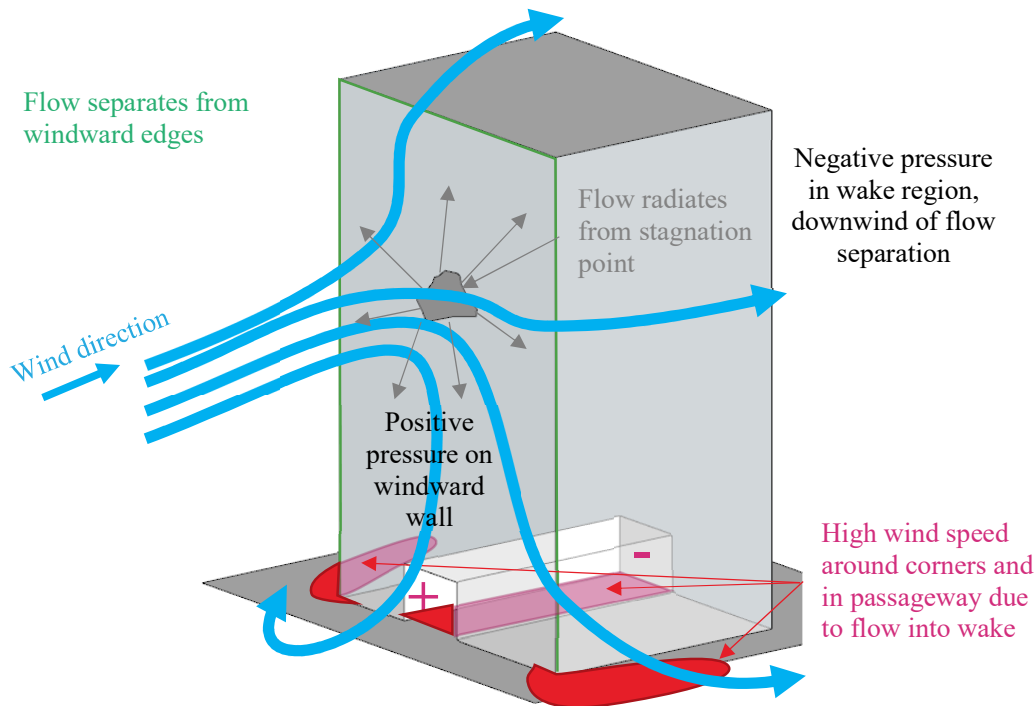
## A.1 Wind flow mechanisms

An urban environment generates a complex wind flow pattern around closely spaced structures, hence it is exceptionally difficult to generalise the flow mechanisms and impact of specific buildings as the flow is generated by the entire surrounds. However, it is best to start with an understanding of the basic flow mechanisms around an isolated structure.

### Isolated building

When the wind hits an isolated building, the wind is decelerated on the windward face generating an area of high pressure, Figure 9, with the highest pressure at the stagnation point at about two thirds of the height of the building. The higher pressure bubble extends a distance from the building face of about half the building height or width, whichever is lower. The flow is then accelerated down and around the windward corners to areas of lower pressure, Figure 9. This flow mechanism is called **downwash** and causes the windiest conditions at ground level on the windward corners and along the sides of the building.

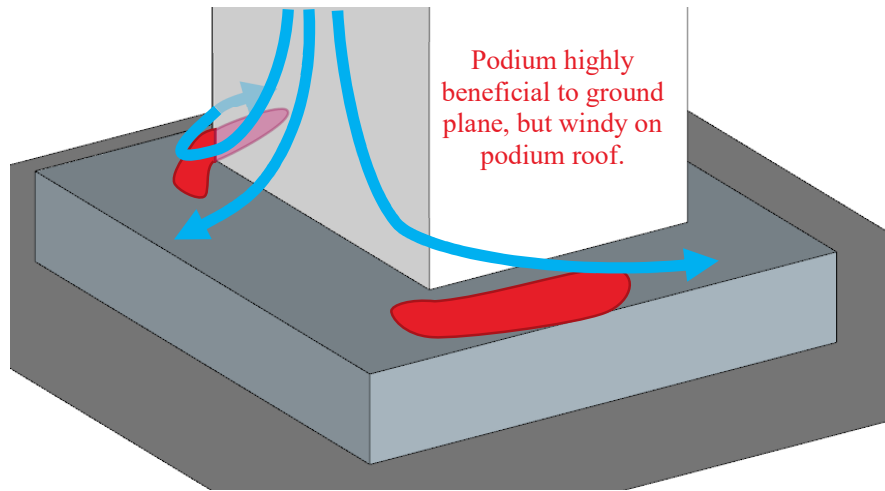
Rounding the building corners or chamfering the edges reduces downwash by encouraging the flow to go around the building at higher levels. However, concave curving of the windward face can increase the amount of downwash. Depending on the orientation and isolation of the building, uncomfortable downwash can be experienced on buildings of greater than about 6 storeys.



**Figure 9: Schematic wind flow around tall isolated building**

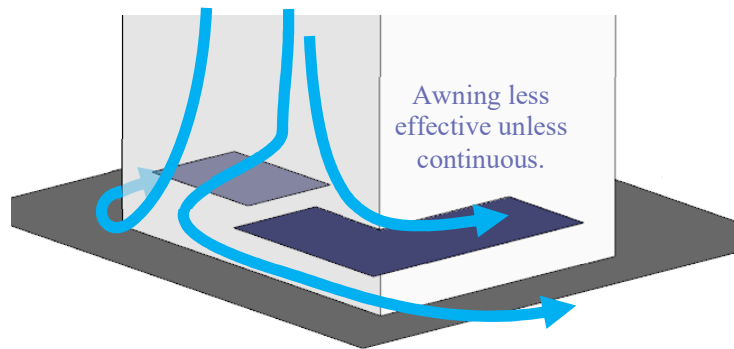
Techniques to mitigate the effects of downwash winds at ground level include the provision of horizontal elements, the most effective being a podium to divert the downward flow away from pavements and building entrances, but this will generate windy conditions on the podium roof, Figure 10. Generally, the lower the podium roof and deeper the setback from the podium edge to the tower improves the ground level wind conditions. The provision of an 8 m setback on an isolated building is generally sufficient to improve ground level conditions, but is highly dependent on the

building isolation, orientation to prevailing wind directions, shape and width of the building, and any plan form changes at higher level.



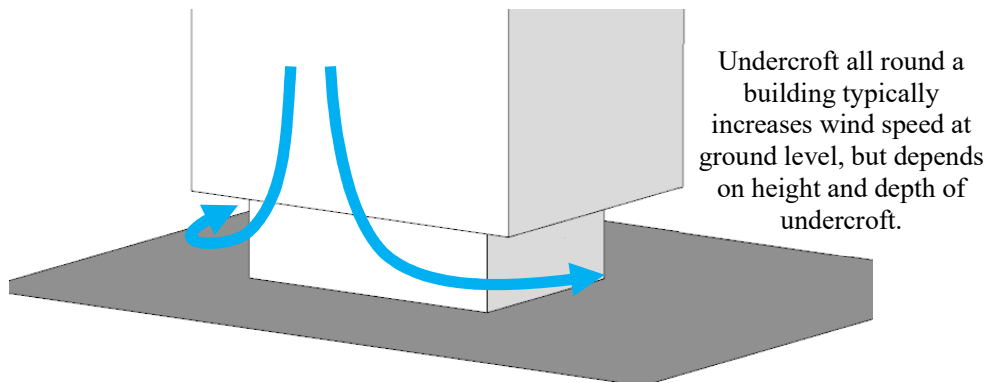
**Figure 10: Schematic flow pattern around building with podium**

Awnings along street frontages perform a similar function as a podium, and generally the larger the horizontal projection from the façade, the more effective it will be in diverting downwash flow, Figure 11. Awnings become less effective if they are not continuous along the entire façade, or on wide buildings as the positive pressure bubble extends beyond the awning resulting in horizontal flow under the awning.

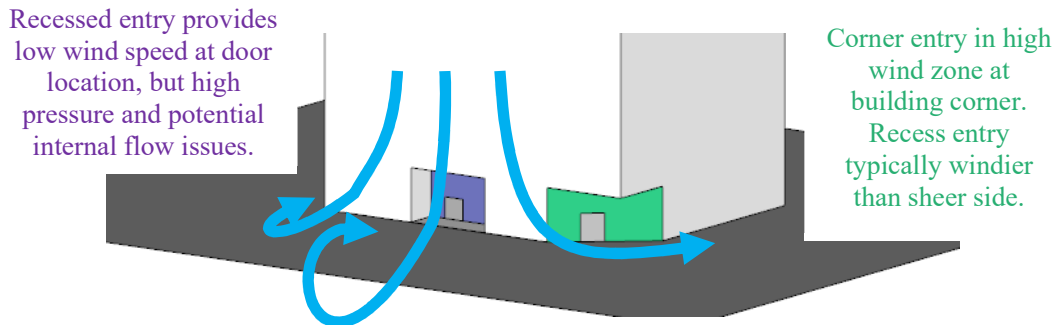


**Figure 11: Schematic flow pattern along awnings**

It should be noted that colonnades at the base of a building with no podium generally create augmented windy conditions at the corners due to an increase in the pressure differential, Figure 12. Similarly, open through-site links through a building cause wind issues as the pressure tries to equilibrate between the entrances to the link causing strong flow, Figure 9. If the link is blocked, wind conditions will be relatively calm, Figure 13. This area is in a region of high pressure and therefore there is the potential for internal flow issues. A ground level recessed corner has a similar effect as an undercroft, resulting in windier conditions, Figure 13.



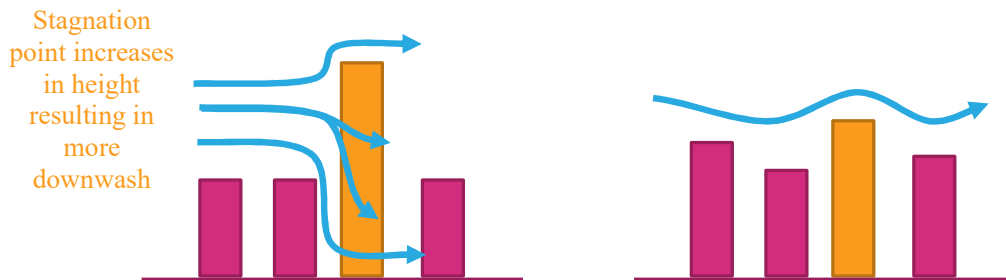
**Figure 12: Schematic of flow patterns around isolated building with undercroft**



**Figure 13: Schematic of flow patterns around isolated building with ground articulation**

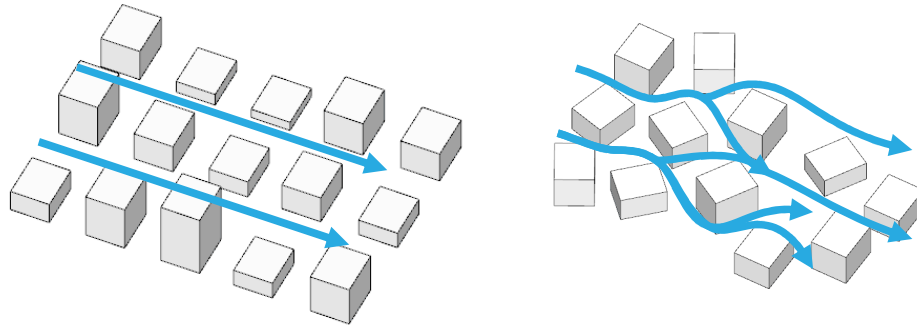
### Multiple building

When a building is located in a city environment, depending on upwind buildings, the interference effects may be positive or negative, Figure 14. If the building is taller, more of the wind impacting on the exposed section of the building is likely to be drawn to ground level by the increase in height of the stagnation point, and the additional negative pressure induced at the base. If the upwind buildings are of similar height then the pressure around the building will be more uniform hence downwash is typically reduced with the flow passing over the buildings.



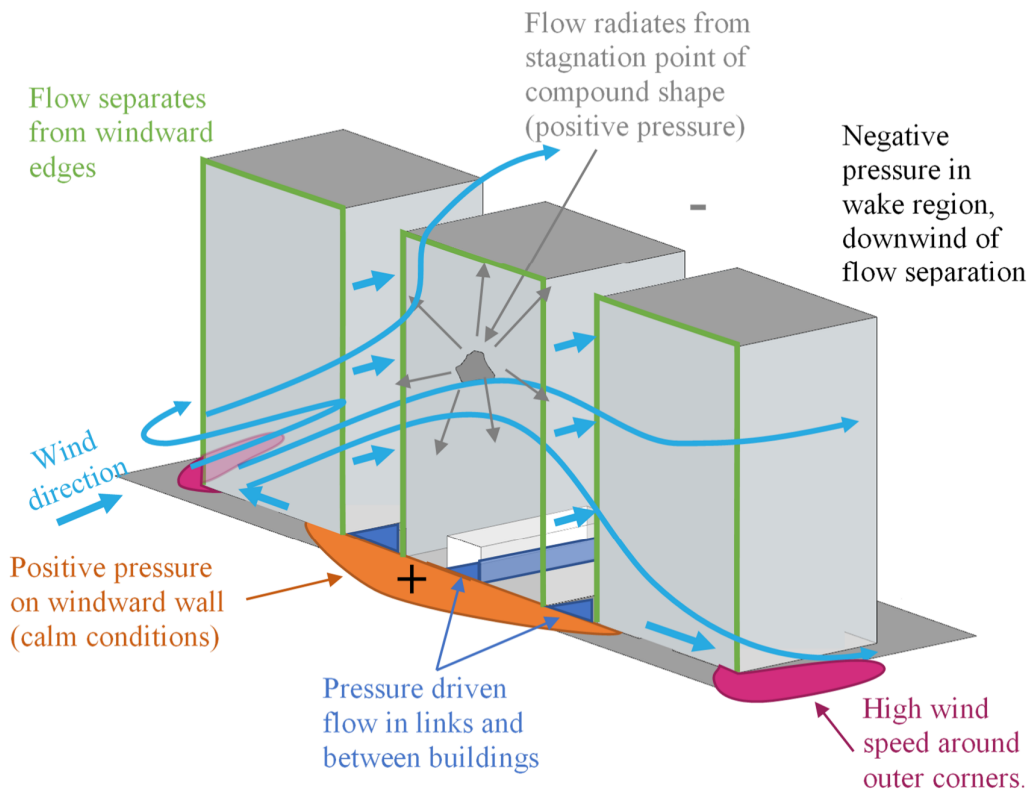
**Figure 14: Schematic of flow pattern interference from surrounding buildings**

The above discussion becomes more complex when three-dimensional effects are considered, both with orientation and staggering of buildings, and incident wind direction, Figure 15.



**Figure 15 Schematic of flow patterns through a grid and random street layout**

On the fringe of a city, the compound shape of neighbouring buildings instigates the flow pattern through the city. The overall massing causes an obstruction to the flow causing a slowing of the incident flow and increasing the windward pressure. Pressure driven flow is produced between the buildings, Figure 16. The vertical component in pressure driven flow is lower than downwash flow.



**Figure 16: General flow pattern around multiple buildings**

Channelling is instigated when pressure driven flow accelerates between two buildings, and continues along straight streets with buildings on either side, Figure 15(L). This occurs on the edge of large built-up areas where the approaching flow is diverted around the overall massing and channelled along the fringe by a relatively continuous wall of building facades. This is generally the primary mechanism producing strong wind conditions on the perimeter of a built-up area, particularly on corners, which can be exposed to multiple prevailing wind directions. The perimeter edge zone in a built-up area is typically about two blocks deep. Downwash is more important flow mechanism for the edge zone of a built-up area with buildings of similar height.

As the city expands, the central section of the city typically becomes calmer, particularly if the grid pattern of the streets is discontinued, Figure 15(R). When buildings are located on the corner of a central city block, the geometry becomes slightly more important with respect to the local wind environment.

### Single barriers and screens

The wind flow pattern over a vertical barrier is illustrated in Figure 17, showing there will be recirculation zones near the windward wall and in the immediate lee of the barrier. The typical extent of these recirculation zones relative to the height of the barrier,  $h$ , is illustrated in Figure 17. These regions are not fixed but fluctuate in time. The mean wind speed in the wake areas drops significantly compared with the incident flow. With increasing distance from the barrier the flow pattern will resort to the undisturbed state. Typically the mean velocity and turbulence intensity at barrier height would be expected to be within 10% of the free stream conditions at 10 times the height of the structure downwind from the barrier.

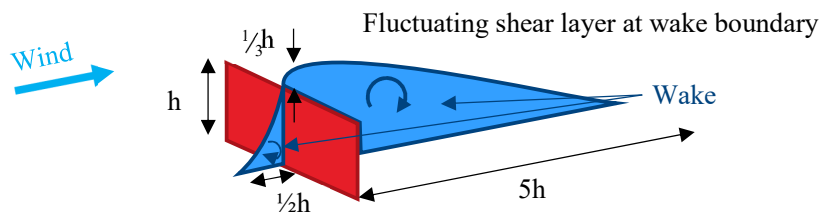


Figure 17: Sketch of the flow pattern over an isolated structure

## A.2 Wind speed criteria

### General discussion

Primary controls that are used in the assessment of how wind affects pedestrians are the wind speed, and rate of change of wind speed. A description of the effect of a specific wind speed on pedestrians is provided in Table 4. It should be noted that the turbulence, or rate of change of wind speed, will affect human response to wind and the descriptions are more associated with response to mean wind speed.

**Table 4: Summary of wind effects on pedestrians**

Description	Speed (m/s)	Effects
Calm, light air	0–2	Human perception to wind speed at about 0.2 m/s. Napkins blown away and newspapers flutter at about 1 m/s.
Light breeze	2–3	Wind felt on face. Light clothing disturbed. Cappuccino froth blown off at about 2.5 m/s.
Gentle breeze	3–5	Wind extends light flag. Hair is disturbed. Clothing flaps.
Moderate breeze	5–8	Raises dust, dry soil. Hair disarranged. Sand on beach saltates at about 5 m/s. Full paper coffee cup blown over at about 5.5 m/s.
Fresh breeze	8–11	Force felt on body. Limit of agreeable wind on land. Umbrellas used with difficulty. Wind sock fully extended at about 8 m/s.
Strong breeze	11–14	Hair blown straight. Difficult to walk steadily. Wind noise on ears unpleasant. Windborne snow above head height (blizzard).
Near gale	14–17	Inconvenience felt when walking.
Gale	17–21	Generally impedes progress. Difficulty with balance in gusts.
Strong gale	21–24	People blown over by gusts.

Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers. These have all generally been developed around a 3 s gust, or 1 hour mean wind speed. During strong events, a pedestrian would react to a significantly shorter duration gust than a 3 s, and historic weather data is normally presented as a 10 minute mean.

Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when these are compared on a probabilistic basis, there is some agreement between the various criteria. However, a number of studies have shown that over a wider range of flow conditions, such as smooth flow across water bodies, to turbulent flow in city centres, there is less general agreement among. The downside of these criteria is that they have seldom been benchmarked, or confirmed through long-term measurements in the field, particularly for comfort conditions. The wind criteria were all developed in temperate climates and are unfortunately not the only environmental factor that affects pedestrian comfort.

For assessing the effects of wind on pedestrians, neither the random peak gust wind speed (3 s or otherwise), nor the mean wind speed in isolation are adequate. The gust wind speed gives a measure of the extreme nature of the wind, but the mean wind speed indicates the longer duration impact on pedestrians. The extreme gust wind speed is considered to be suitable for safety considerations, but not necessarily for serviceability comfort issues such as outdoor dining. This is because the

instantaneous gust velocity does not always correlate well with mean wind speed, and is not necessarily representative of the parent distribution. Hence, the perceived ‘windiness’ of a location can either be dictated by strong steady flows, or gusty turbulent flow with a smaller mean wind speed.

To measure the effect of turbulent wind conditions on pedestrians, a statistical procedure is required to combine the effects of both mean and gust. This has been conducted by various researchers to develop an equivalent mean wind speed to represent the perceived effect of a gust event. This is called the ‘gust equivalent mean’ or ‘effective wind speed’ and the relationship between the mean and 3 s gust wind speed is defined within the criteria, but two typical conversions are:

$$U_{GEM} = \frac{(U_{1 \text{ hour mean}} + 3 \cdot \sigma_u)}{1.85} \quad \text{and} \quad U_{GEM} = \frac{1.3 \cdot (U_{1 \text{ hour mean}} + 2 \cdot \sigma_u)}{1.85}$$

It is evident that a standard description of the relationship between the mean and impact of the gust would vary considerably depending on the approach turbulence, and use of the space.

A comparison between the mean and 3 s gust wind speed criteria from a probabilistic basis are presented in Figure 18 and Figure 19. The grey lines are typical results from modelling and show how the various criteria would classify a single location. City of Auckland has control mechanisms for accessing usability of spaces from a wind perspective as illustrated in Figure 18 with definitions of the intended use of the space categories included in this Figure.

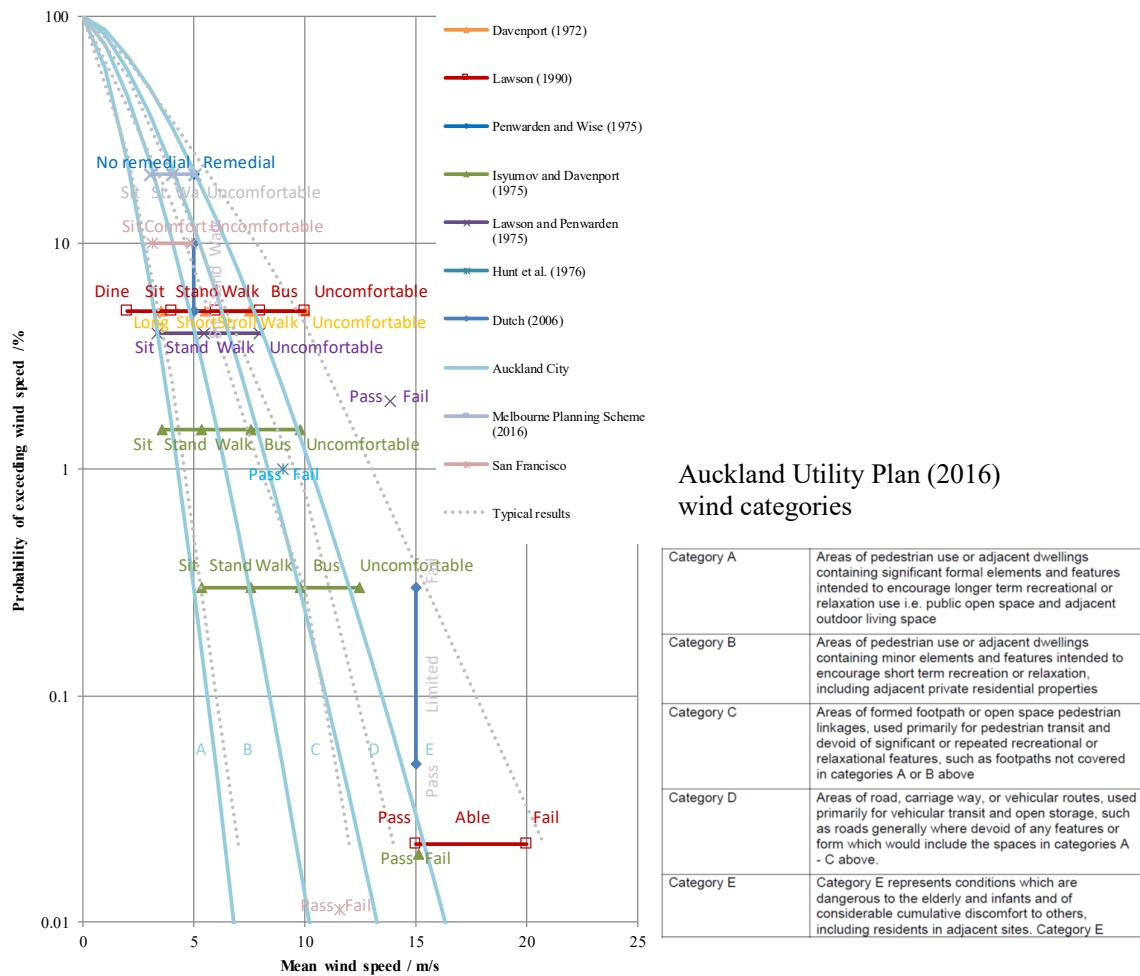


Figure 18: Probabilistic comparison between wind criteria based on mean wind speed

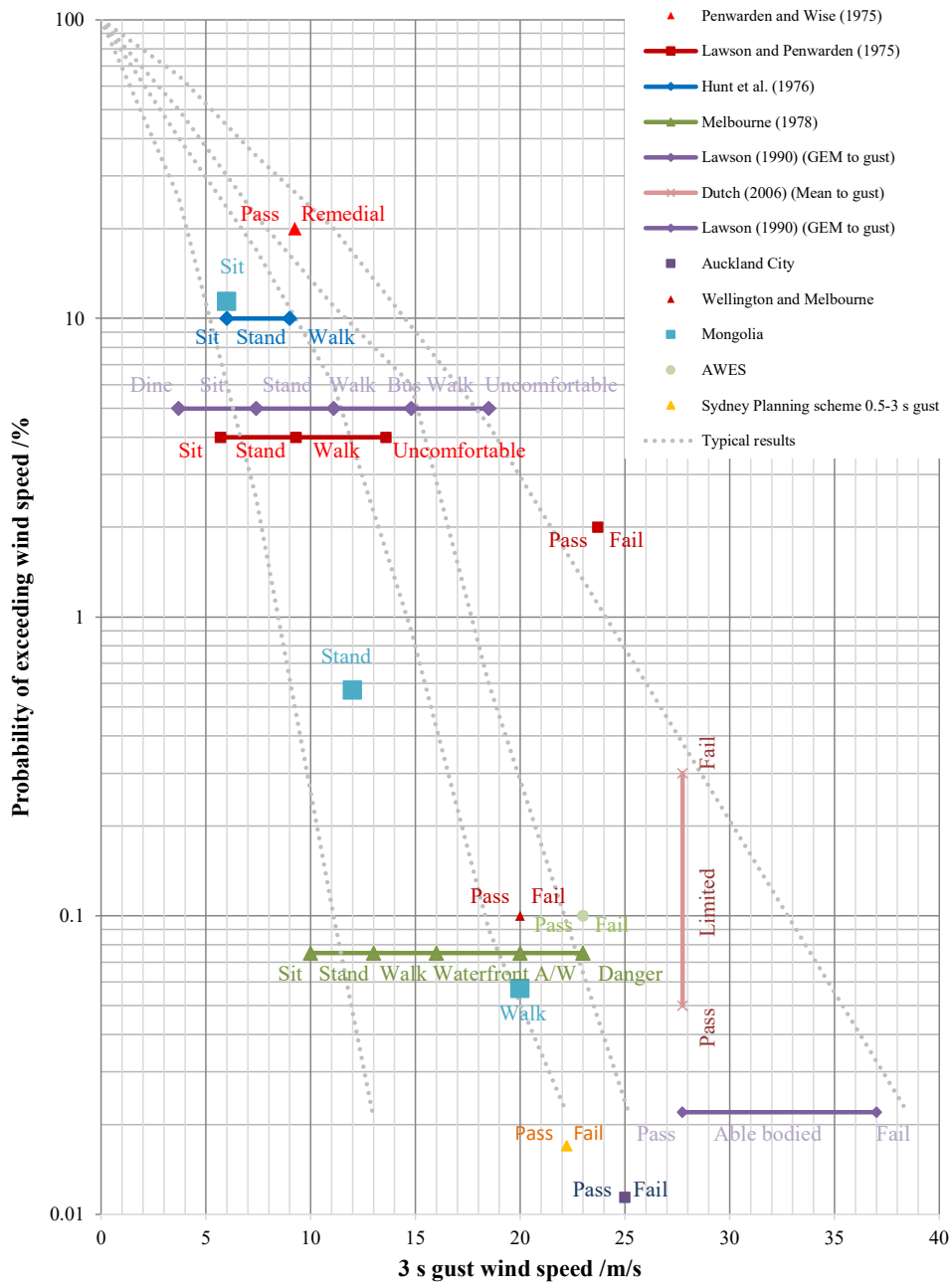









Figure 19: Probabilistic comparison between wind criteria based on 3 s gust wind speed

## A.3 Reference documents

In preparing the assessment, the following documents have been referenced to understand the building massing and features.

-  241003\_Help St SSDA GFA Gain
-  241113\_Help St SSDA Updated WIP Plans
-  241128\_HelpSt\_SSDAModel
-  ISEARs - SSD-765557 11 Help Street, Chatswood
-  ISEARs - SSD-76555711 Help Street, Chatswood
-  241203\_SSDA Design Report\_WIP
-  241204\_SSDA Architectural Set\_WIP