Vipac Engineers and Scientists Limited
279 Normanby Rd, Port Melbourne, VIC 3207, Australia
Private Bag 16, Port Melbourne, VIC 3207, Australia
t. +61 3 9647 9700 | **e.** melbourne@vipac.com.au
w. www.vipac.com.au | A.B.N. 33 005 453 627 | A.C.N. 005 453 627

DPG Project 18 Pty Ltd

54-56 Anderson Street, Chatswood

Wind Impact Statement

30N-20-0269-TNT-6824075-1

2 February 2021

Job Title:	54-56 Anderson Street, Chatswood
Report Title:	Wind Impact Statement
Document Reference:	30N-20-0269-TNT-6824075-1

Prepared For:	**Prepared By:**
DPG Project 18 Pty Ltd Level 14 97-99 Bathurst Street Sydney, New South Wales, 2000, Australia **Contact:** Basil Lim **Tel:** (02) 8294 2736	Vipac Engineers and Scientists Limited 279 Normanby Rd, Port Melbourne, VIC 3207, Australia **Tel:** +61 3 9647 9700

Author:	Eric Yuen 2 February 2021	Project Engineer
Reviewer:	Sophie Lamande 2 February 2021	Wind Group Leader
Issued By:	Eric Yuen 2 February 2021	Project Engineer

Revision History:

Rev. #	*Comments / Details of change(s) made*	*Date*	*Revised by:*
Rev. 00	Updated from 30N-17-0139-TNT-632241-5	18 Dec 2020	E. Yuen
Rev. 01	Plans updated	2 Feb 21	E. Yuen

Executive Summary

DPG Project 18 Pty Ltd commissioned Vipac Engineers and Scientists Pty Ltd to investigate the pedestrian wind environment in and adjacent to the proposed development at **54-56 Anderson Street, Chatswood, NSW** for planning approval purposes. This appraisal is based on Vipac's experience as a wind engineering consultancy.

Drawings of the proposed development were supplied by **Develotek Property Group** in **January 2021**, as described in Appendix C of this report. The findings of this study can be summarised as follows:

- With the proposed design, the wind conditions along the pedestrian ground level footpath areas are expected to be within the criterion for walking.
- With the proposed design and **the recommended wind control measures**, the development is expected to generate wind conditions at the ground level building entrance areas within the recommended standing criterion.
- With the proposed design and **the recommended wind control measures**, the development is expected to generate wind conditions at the ground level building sitting areas within the recommended sitting criterion.
- With the proposed design, and **the recommended wind control measures**, the wind conditions at podium roof garden and roof terraces areas are expected to be within the recommended criterion for walking. Some wind control measures (windscreens and pergola) have been recommended should more stringent comfort criteria be required. These could be determined in a scaled wind tunnel test.
- With the proposed design the wind conditions on apartment balconies are expected to be within the recommended criterion for walking.

As a general statement, educating occupants about wind conditions at open terrace/apartment balcony areas during high-wind events and tying down the lightweight furniture in these areas are highly recommended.

The recommendations and assessments provided in this report have been made based on empirical data and experience of similar situations in Sydney and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without wind tunnel model testing may not account for all complex flow scenarios in the vicinity. We recommend wind tunnel testing be undertaken in the detail design phase.

Table of Contents

1 Introduction

Vipac Engineers and Scientists has been commissioned by **DPG Project 18 Pty Ltd** to prepare a statement of wind effects for the adjacent ground level areas and roof terraces of the proposed development at **54-56 Anderson Street, Chatswood**. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

The proposed development site is bounded by Anderson St to the east, O'Brien St to the south, Wilson St to the north, and railway tracks to the west (Figure 1). The building consists of 26 storeys with a roof height of approximately 79 m above street level (Figure 2).

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level public areas and access-ways adjacent to the development as proposed. No wind tunnel testing has been carried out for this development at this stage. Vipac has carried out wind tunnel studies on a number of developments of similar shape and having similar exposure to that of the proposed development. These serve as a valid reference for the prediction of wind effects for this development. Empirical data for typical buildings in boundary layer flows has also been used to estimate likely ground level wind conditions adjacent to the proposed development [2] & [3].

Drawings of the proposed development were provided by **Develotek Property Group** in **January 2021** as listed in Appendix C of this report.

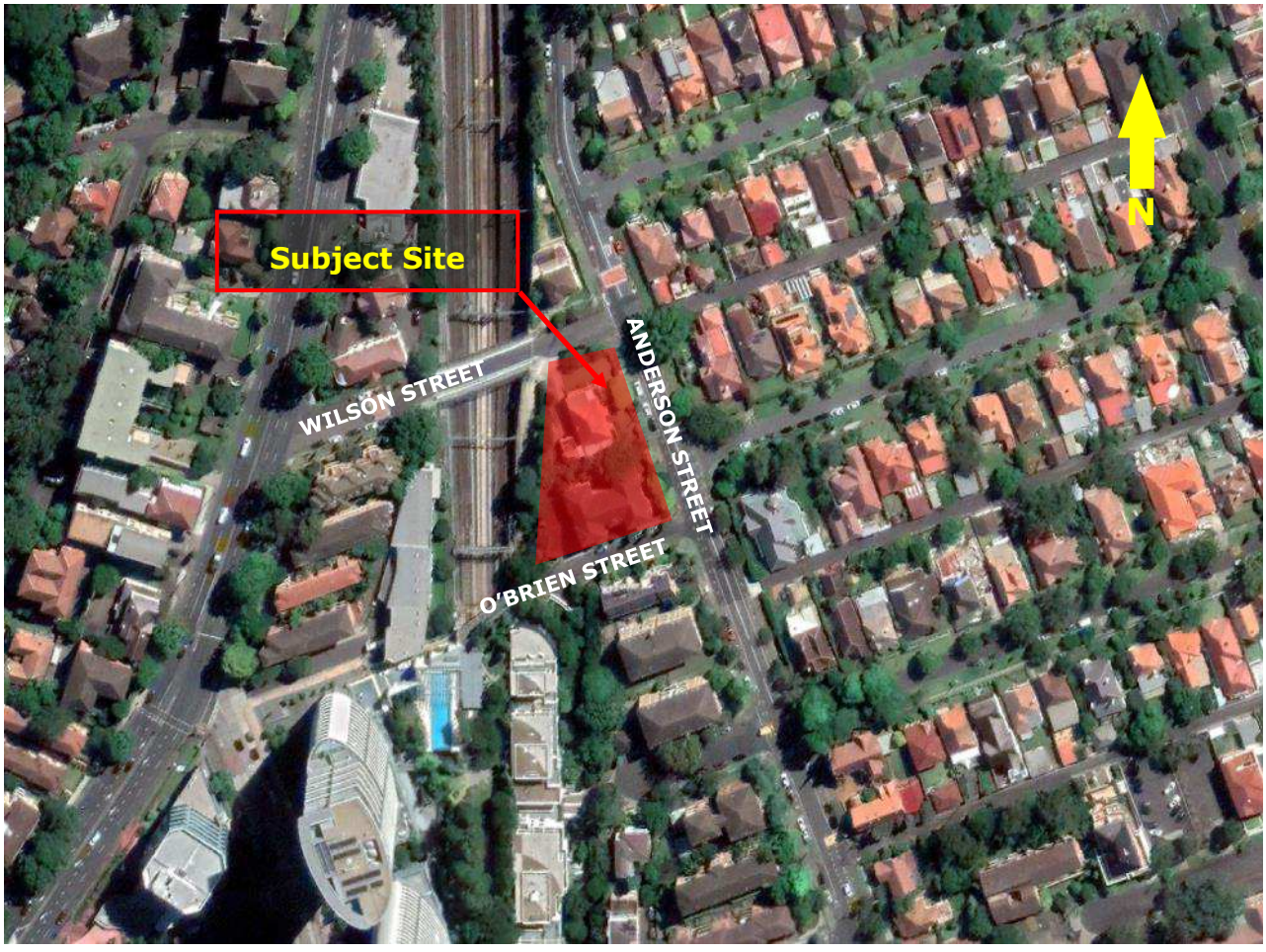


Figure 1: Satellite imagery of the proposed development site

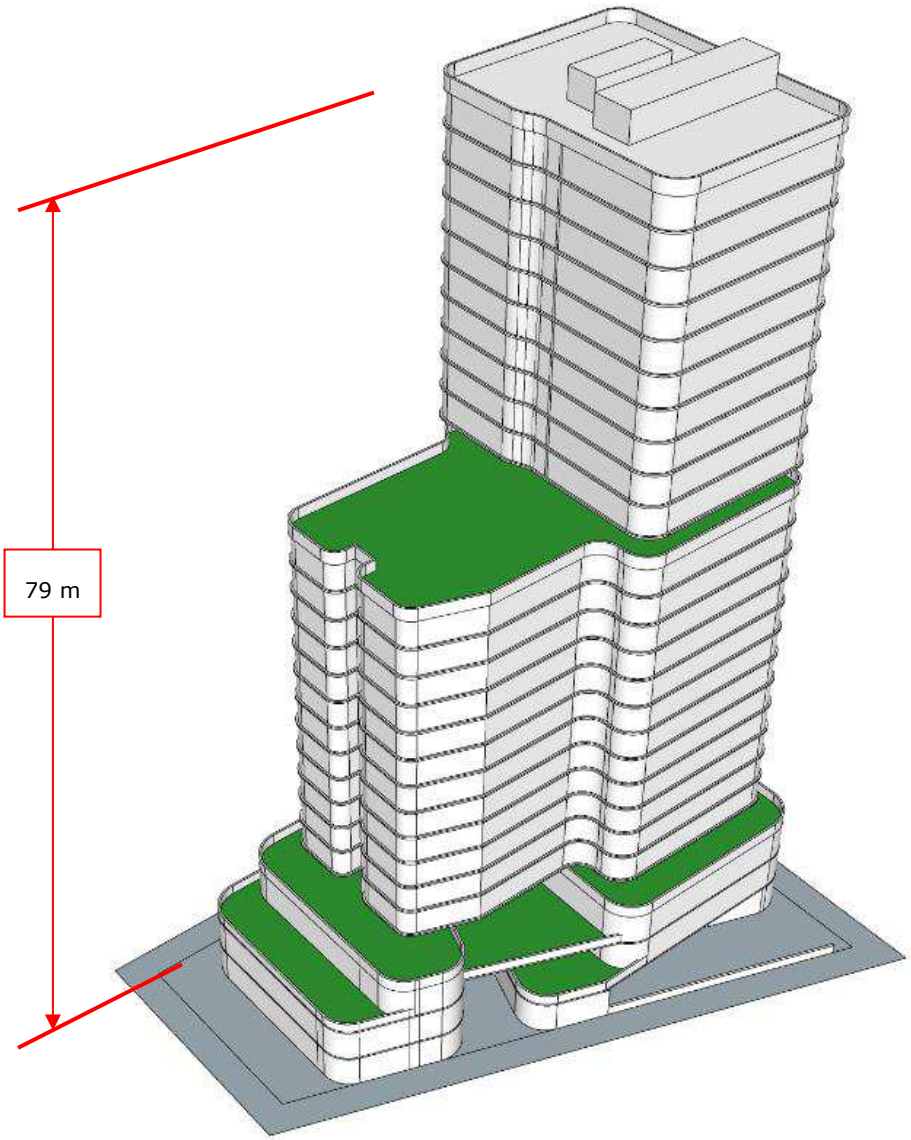


Figure 2: A perspective view from North West of the proposed development showing the approximate overall height

2 Analysis Approach

When considering whether a proposed development is likely to generate adverse wind conditions in adjacent ground level areas, Vipac considers five main points:

- The exposure of the proposed development to wind;
- The regional wind climate;
- The geometry and orientation of the proposed development;
- The interaction of flows with adjacent developments;
- The assessment criteria determined by the intended use of the public areas affected by wind flows generated or augmented by the proposed development.

The pedestrian wind comfort at specific locations around a site may be assessed by predicting the worst annual 3-second wind gust expected at that location. The location may be deemed generally acceptable for its intended use if the annual 3-second gust is within the threshold values noted in Section 2.5. For cases where Vipac predicts that a location would not meet its appropriate comfort criterion we may recommend the use of wind control devices and/or local building geometry modifications to achieve the desired comfort rating. For complex flow scenarios or where predicted flow conditions are well in excess of the recommended criteria, Vipac recommends scale model wind tunnel testing to determine the type and scope of the wind control measures required to achieve acceptable wind conditions.

2.1 Site Exposure

The proposed development is located on relatively flat terrain, surrounded within a 3 km radius by suburban housing, low rise retail and office buildings in most directions, with the built-up areas to the south sector. There are a number of future high-rise developments in planning in the nearby area (in south and west directions). Considering the immediate surroundings and terrain, for the purposes of this study, the site of the proposed development is assumed to be within Terrain Category 3 for all wind directions (Figure 3).

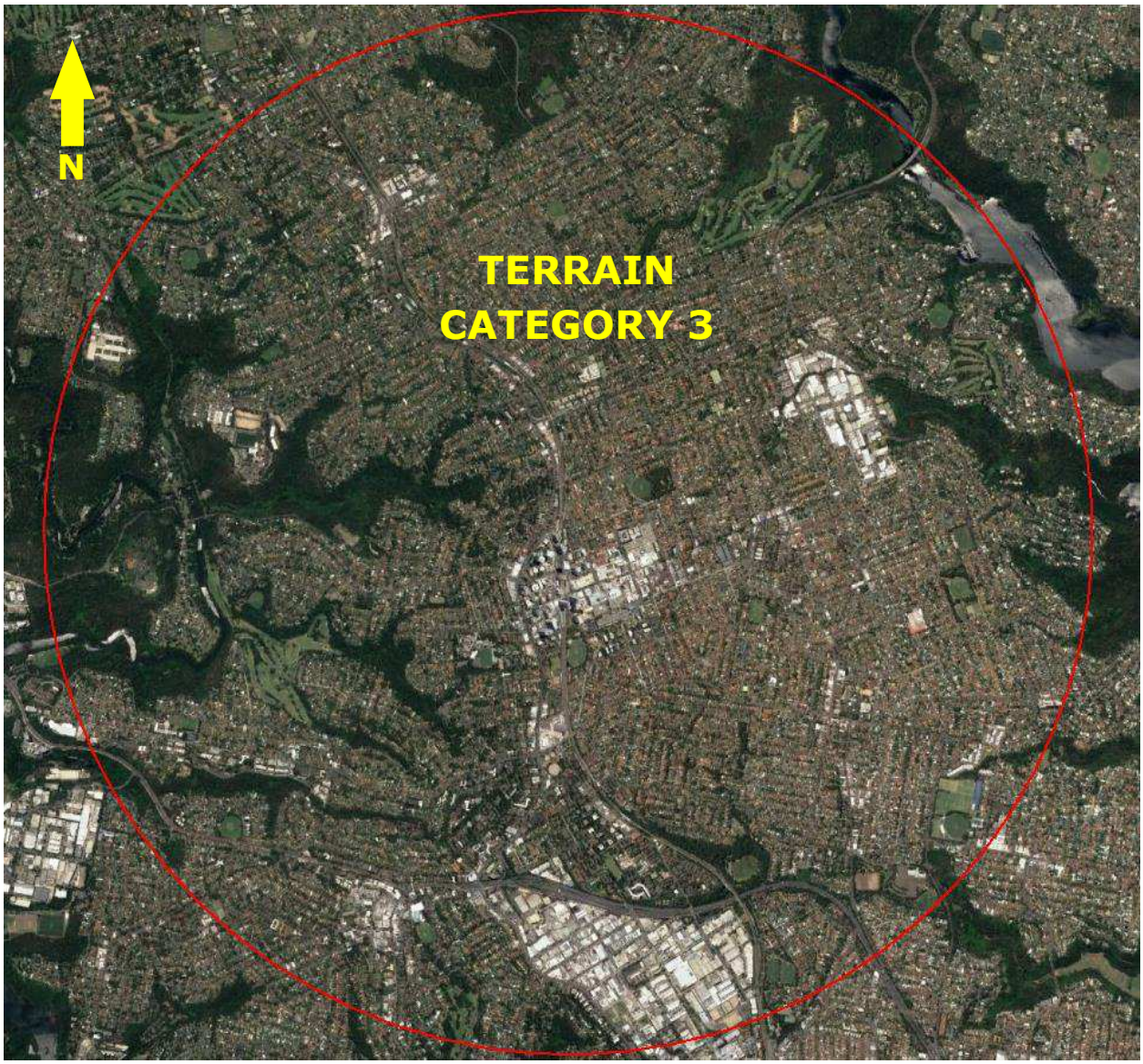


Figure 3: Assumed terrain roughness for wind speed estimation

2.2 Regional Wind Climate

The mean and gust wind speeds have been recorded in the Sydney area for over 30 years. These data have been analysed and the directional probability distribution of wind speeds have been determined. The directional distribution of hourly mean wind speed in daylight times at the gradient height with a probability of occurring 0.1% and 5% of the time are shown in Figure 3. The wind data at this free stream height is common to all Sydney sites and may be used as a reference to assess ground level wind conditions at the development site.

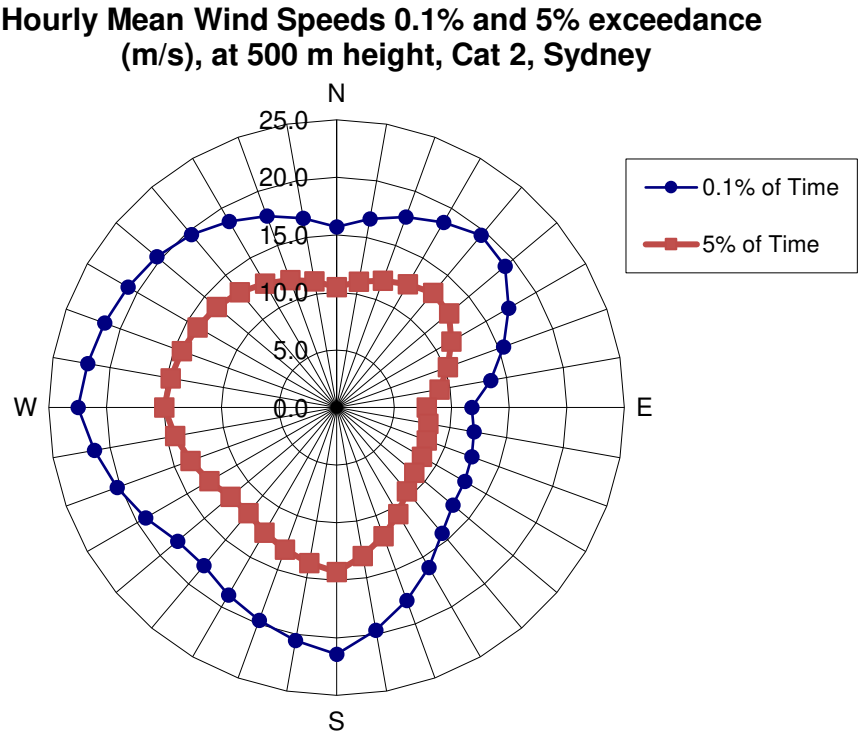


Figure 3: Directional Distribution of Mean Hourly Wind Velocities (m/s) of 0.1% and 5% of time at the gradient height for Sydney.

2.3 Building Geometry and Orientation

The proposed development site has a trapezium plan, with the dimensions of approximately 60 m x 25 – 46.5 m as shown in Figure 5. The long side runs along Anderson St. The proposed building consists of 26 storeys with a roof height of approximately 79 m above street level. The main retail frontages are on Anderson St, O'Brien St, Wilson Street through the east-west running pedestrian arcade.

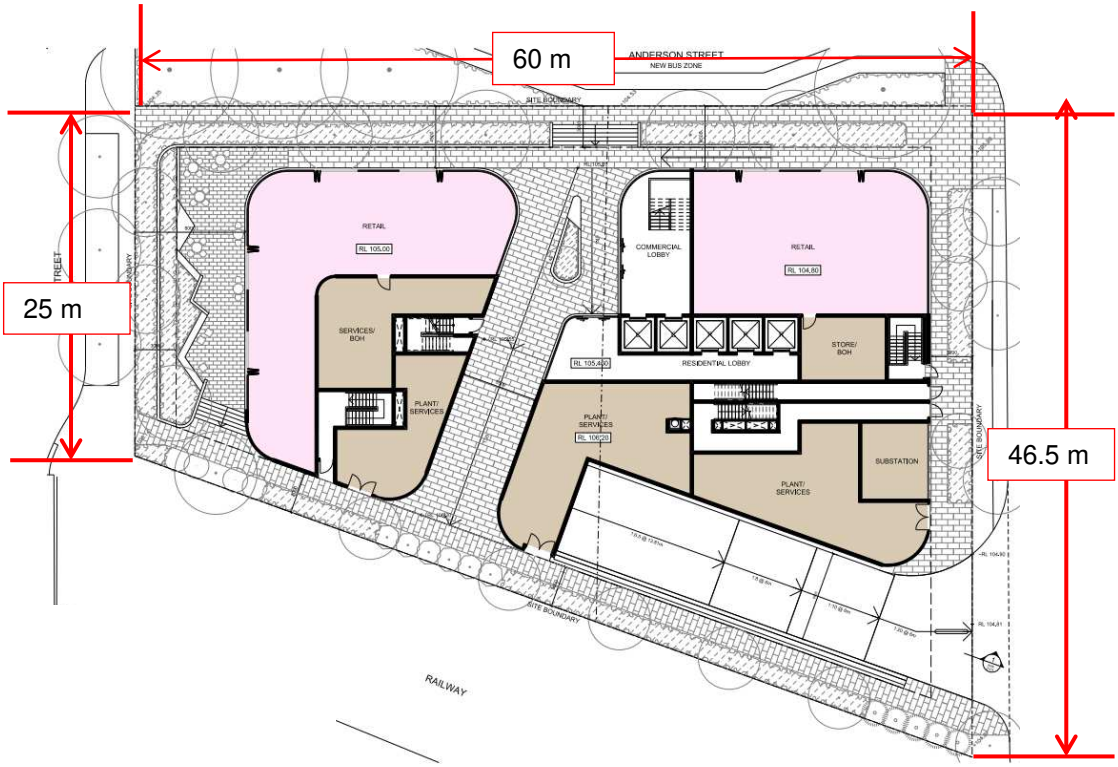


Figure 5: Ground floor plan of the proposed development with approximate dimensions

2.4 Flow interactions with adjacent developments

The immediately adjacent developments and their approximate heights are shown in Figure 6. There are existing buildings varying from 1-4 storeys surrounding the development and an approximately 27 storeys building in the southwest directions.

A 3D-view of the future surroundings of the previous design of the development is shown in Figure 7. In the future, the south to west sectors are all high-rise buildings proposed, whereas the north and east sectors remain as low rise dwellings.

Figure 6: Immediately adjacent surroundings and their approximate storeys overlaid

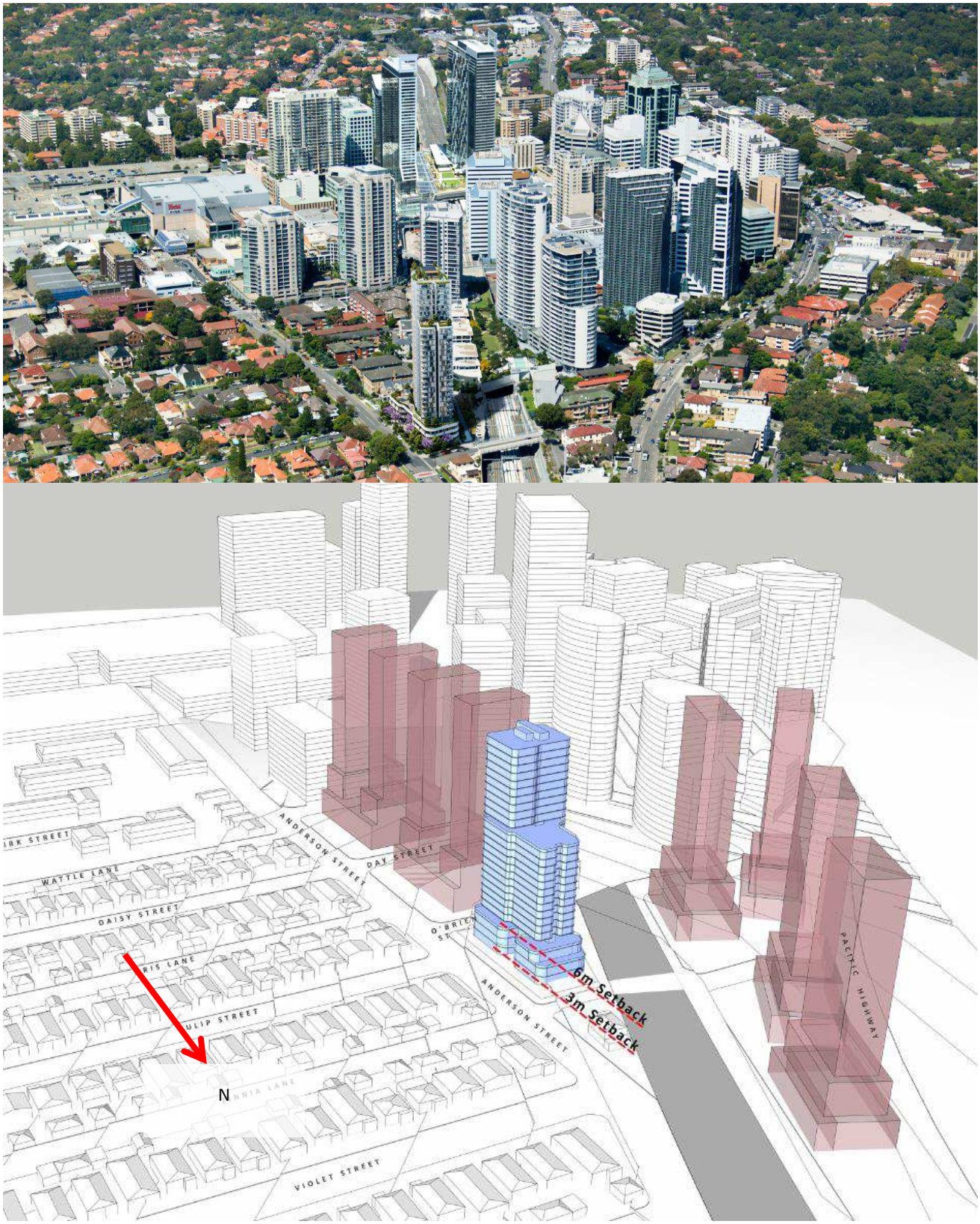


Figure 7: 3D perspective views of the current (top) and future (bottom) surroundings of the proposed development

2.5 Assessment Criteria

The wind comfort criteria from the Central Sydney Planning Strategy (Attachment B7: 4 Implementation) has been applied to this study. The document recommends the following wind safety and comfort criteria (Table 1):

Table 1: Wind Criteria summarized from Central Sydney Planning Strategy

Measurements	**Result on Perceived Pedestrian Comfort**
Peak wind speed (0.5 second gust) once per year, **≤24m/sec** for any direction.	Accepted international criterion for human safety to avoid a healthy pedestrian losing balance
Hourly ***mean*** wind speed, 5% of the time, **≤8m/sec**, for any directions.	Acceptable for **walking** (steady steps for most pedestrians)
Hourly ***mean*** wind speed, 5% of the time, **≤6m/sec,** for any directions.	Acceptable for **standing** (wind shopping, vehicle drop off)
Hourly ***mean*** wind speed, 5% of the time. **≤4m/sec,** for any directions.	Acceptable for **sitting** (outdoor cafes, gardens, park benches)

2.5.1 Use of Adjacent Pedestrian Occupied Areas & Recommended Comfort Criteria

The following table lists the specific areas adjacent to the proposed development and the corresponding recommended criteria (see Figure 8 for ground floor, Figure 9 for podium roof and Figure 10 for roof terraces).

Table 6: Recommended application of criteria

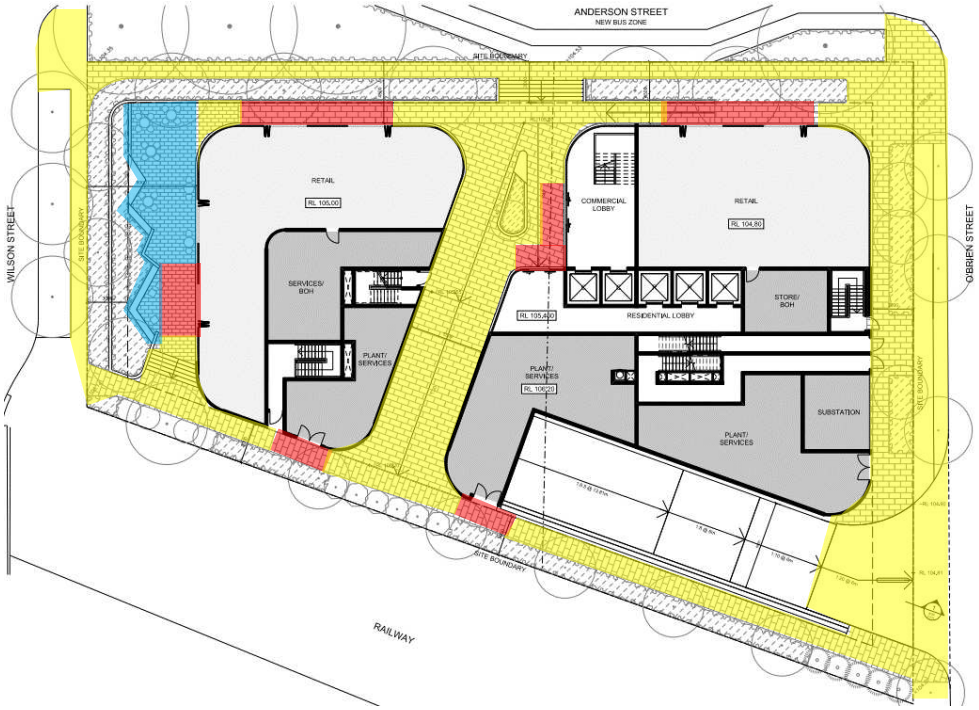
Area	**Specific location**	**Recommended Criteria**
Public Footpaths	Along the building frontage on Anderson St, Wilson St and O'Brien St.	Walking
Building entrances	Access way to Residential Lobby; retail entrances on Anderson St.	Standing
Apartment balconies and terraces	Various levels, podium roof garden and roof terraces	Walking (see discussion below)

Apartment Balcony/terrace Recommended Criterion Discussion

Vipac generally recommends as a minimum that communal terrace areas/balconies meet the criterion for walking since:

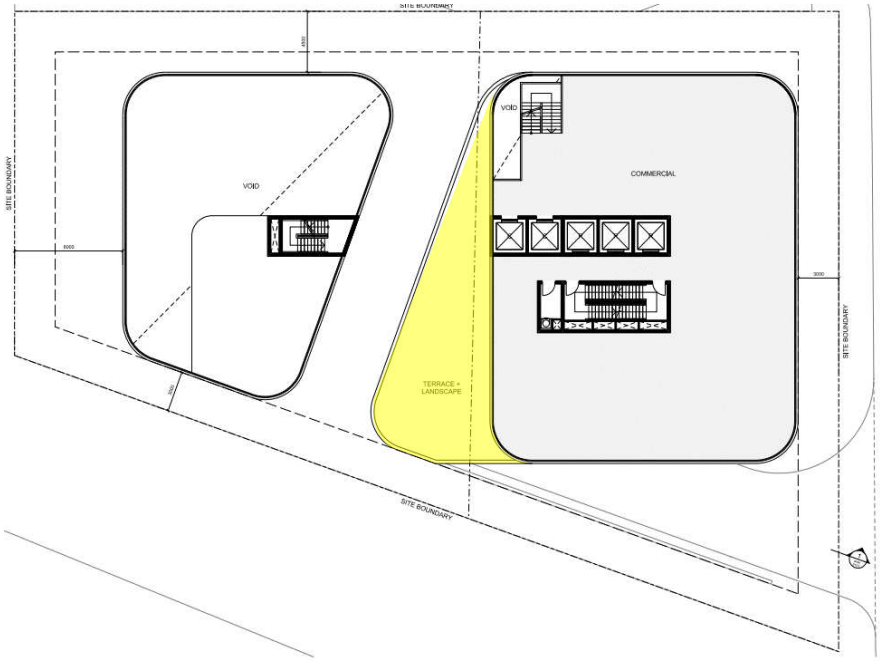
- these areas are not public spaces;
- the use of these areas is optional;
- many similar developments in Sydney and other Australian capital cities experience wind conditions on balconies and elevated deck areas in the vicinity of the criterion for walking.

Vipac wishes to state that meeting the walking criterion on elevated recreation areas will be no guarantee that occupants will always find wind conditions in these areas acceptable.



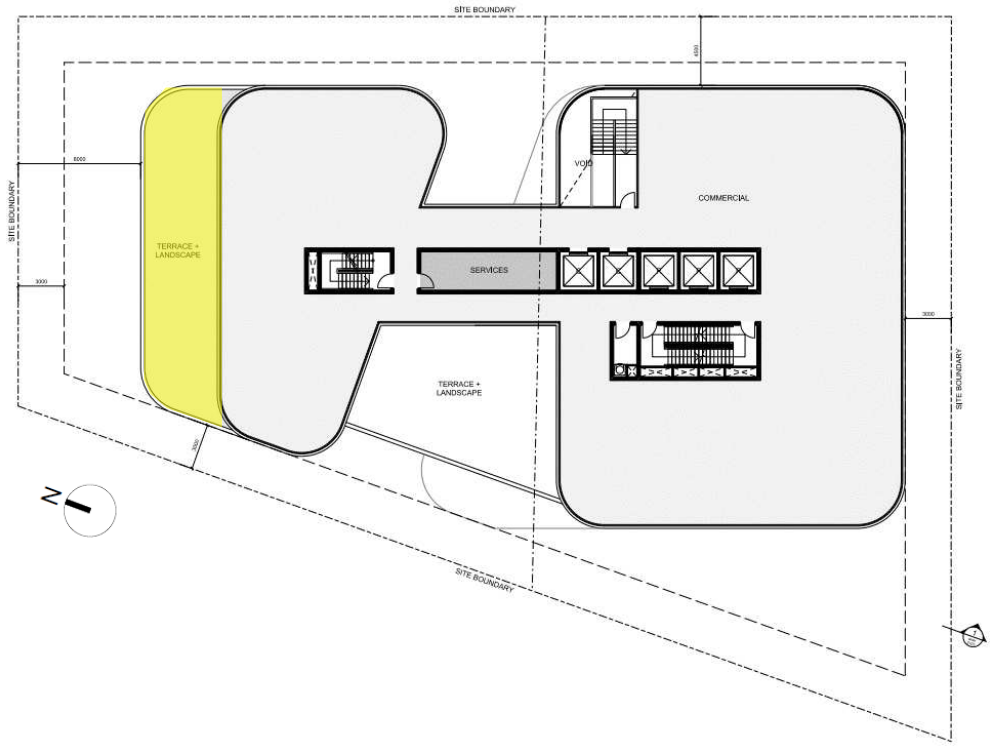
Recommended to fulfil the Walking *Recommended to fulfil the Standing* *Recommended to fulfil the Sitting*

Figure 4: Schematic plan view of the ground level of the proposed development with the recommended wind criteria overlaid



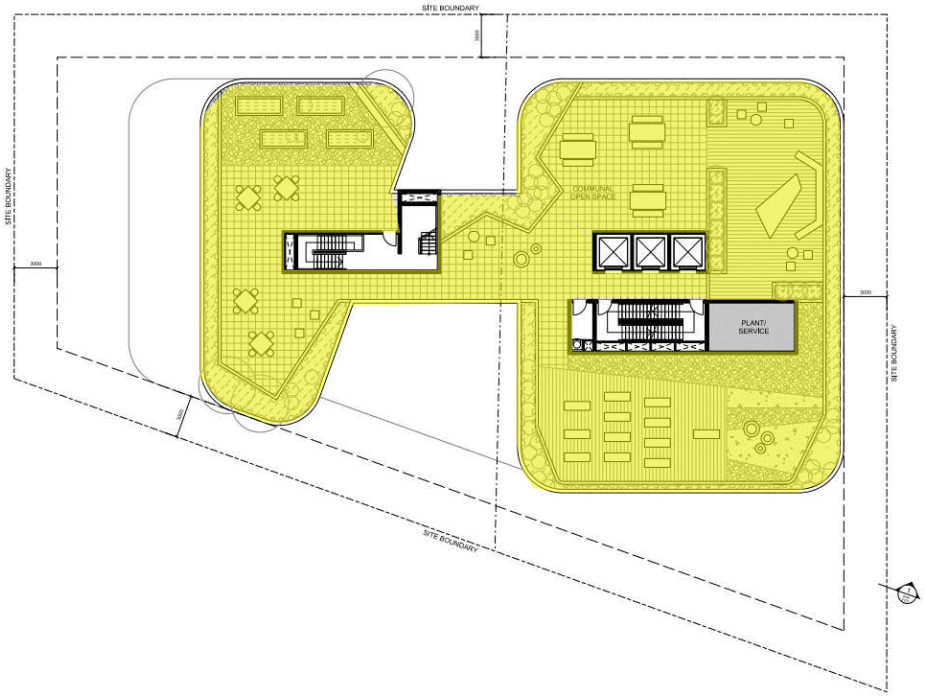
Recommended to fulfil the walking comfort Criterion

Figure 5: Schematic plan view of the Level 2 of the proposed development with the recommended wind criteria overlaid



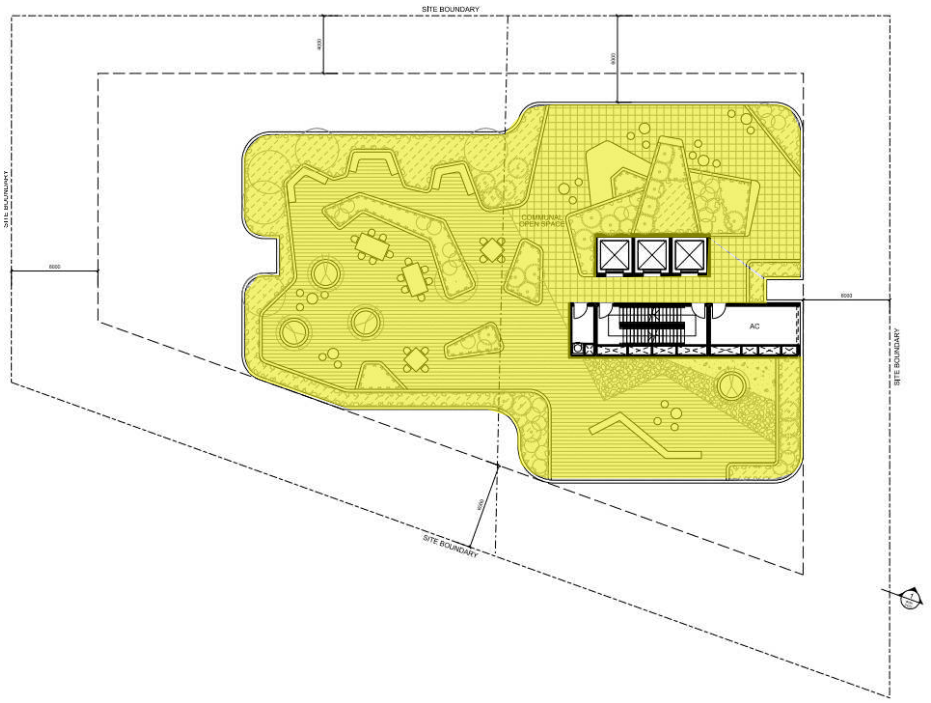
Recommended to fulfil the Walking Comfort Criterion

Figure 6: Schematic plan view of the Level 3 of the proposed development with the recommended wind criteria overlaid



Recommended to fulfil the Walking Comfort Criterion

Figure 7: Schematic plan view of the Level 4 of the proposed development with the recommended wind criteria overlaid



Recommended to fulfil the Walking Comfort Criterion

Figure 8: Schematic plan view of the Level 17 of the proposed development with the recommended wind criteria overlaid

3 Pedestrian Level Wind Effects

3.1 Discussion & Recommendations

3.1.1 Street Level

The climate in Sydney has high mean winds from the westerly, southerly and north-easterly cardinal directions. As such, it is expected that there will be some adverse wind effects at the corners of Anderson St with O'Brien St and Wilson St, as well as the east-west running arcade. However, considering the features of the design that will counteract these negative effects (i.e. appropriate set back tower from the podium), wind conditions are expected to be within or on the recommended walking criterion in all adjacent footpath areas.

The main building lobbies are located near the arcade of the development, away from building corners, and is well set back within the envelope of the building. As such, the entry is expected to be within the recommended standing comfort criterion.

Most of the retail frontages are set back from the boundary and protected by the building above, these areas would be expected to have wind conditions within the standing comfort criterion. However, the retail frontages on the northern end of the proposed design have little protection from downwash winds, as such a >1.8m deep canopy is recommended as indicated in (Figure 9)

The alfresco dining areas along Wilson Street are expected to have wind conditions exceeding the recommended sitting comfort criterion due to corner accelerating winds. As such, the 1.5m high windscreens and/or landscaping is recommended to shield the patrons from these adverse winds (Figure 9).

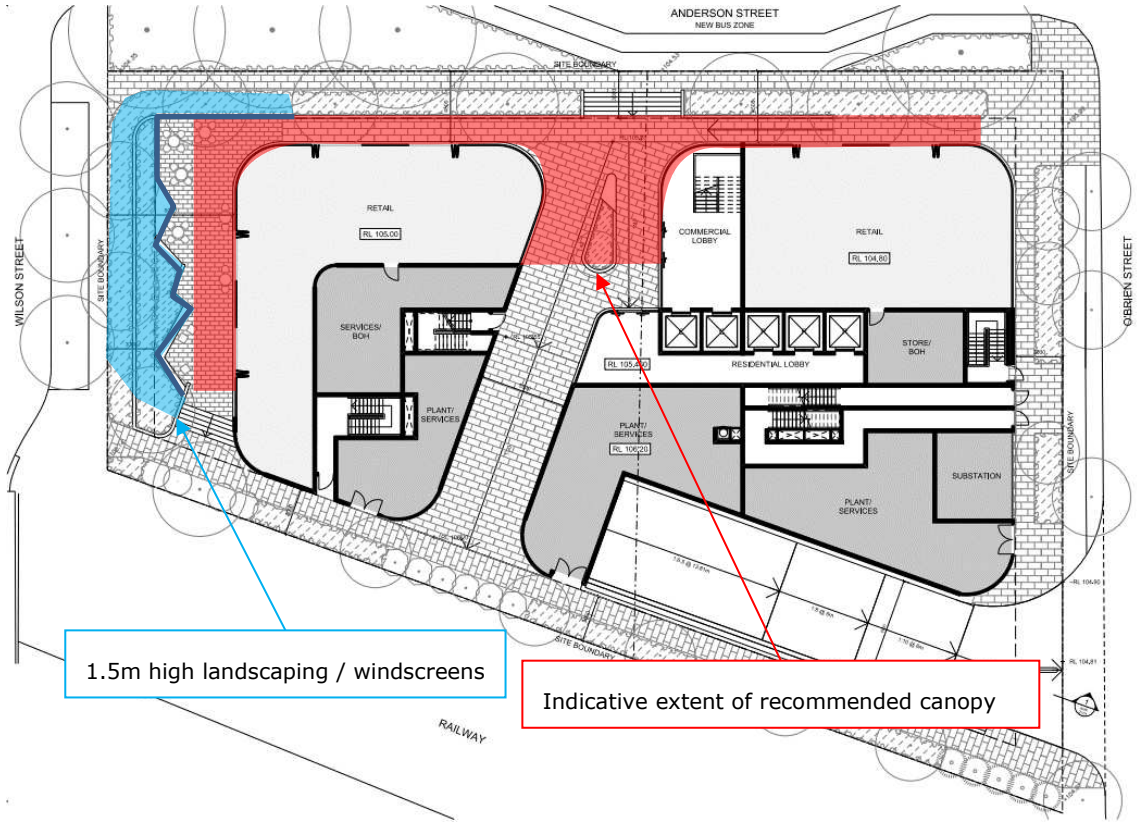


Figure 9: Level 1 Floor plan with the recommended wind amelioration strategy overlaid

3.1.2 Podium roof garden and Roof terraces

It is expected that there will be some down wash effects at the podium roof garden and the roof terraces. Wind conditions might be on or over recommended walking criterion. Vipac recommends, in general, 1.4 m high balustrade for the perimeter of podium roof garden on level 2 and 3 (Figure 10 and Figure 11). Should more stringent criteria be required (standing or sitting), some porous wind screens and/or pergolas might be necessary. These could be determined in a scaled wind tunnel test.

The community terrace on level 4 is expected to have high winds as downwash winds will be redirected through this breezeway. This level is expected to experience winds above the recommended walking comfort criterion. In order to ameliorate these winds, 1.8m high balustrades and a canopy are recommended as per Figure 12 and Figure 13. A review of the proposed design and a wind tunnel test is highly recommended to refine the design of this amenity.

Similarly, the Level 17 community terrace, due to its height above the surrounding area, is expected to experience winds above the recommended walking comfort criterion. As such, 1.8m high balustrades are recommended around the perimeter as well as arbour structures around proposed stationary outdoor amenity areas (Figure 14).

Whilst wind conditions on the proposed apartment balconies will frequently be acceptable for outdoor recreation, during moderate to strong winds, conditions in these areas may exceed human comfort criteria. Balcony areas on similar developments in many major Australian capital cities typically experience similar elevated wind conditions. High exposure, corner acceleration flows and standing vortices would sometimes preclude these areas from use for outdoor recreation.

It should be noted that this study is based on experience only and has not utilised any experimental data for the analysis.

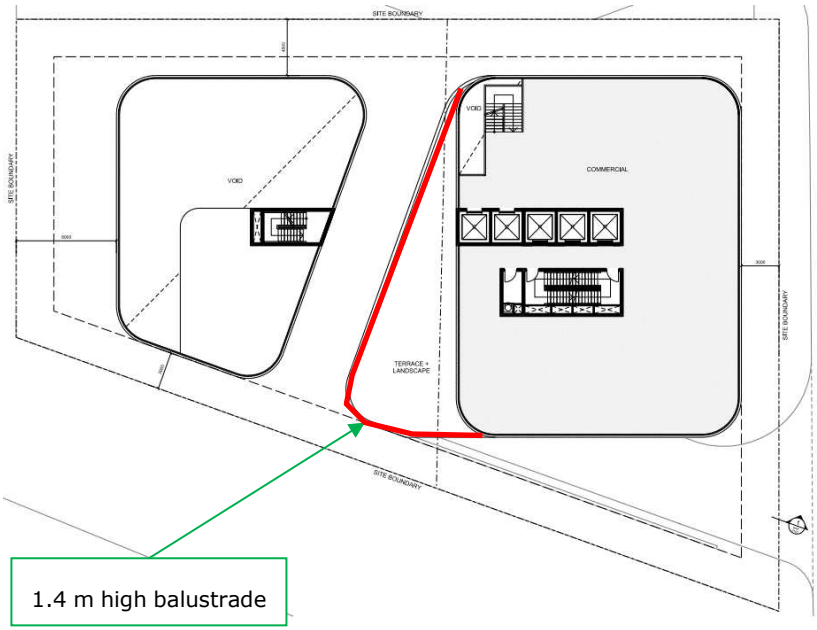


Figure 10: Level 2 Floor plan with the recommended wind amelioration strategy overlaid

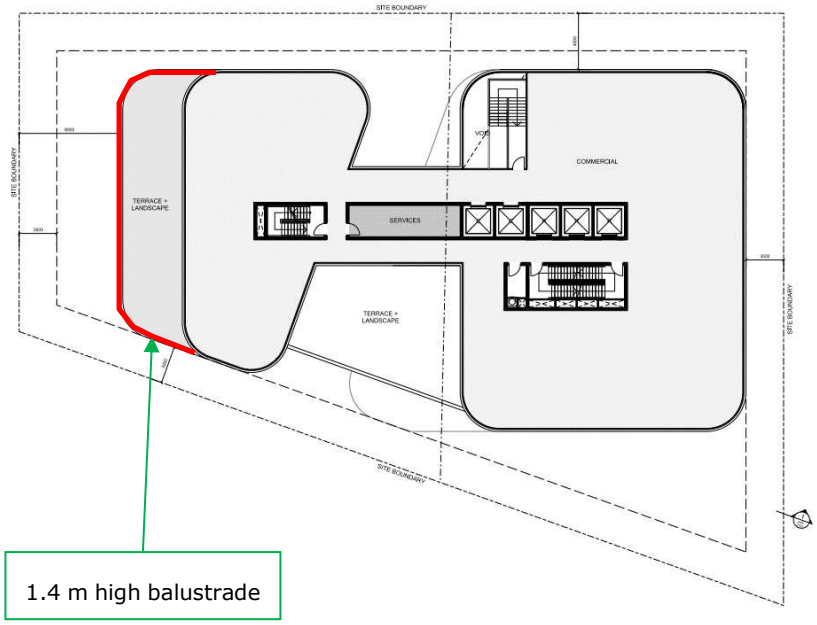


Figure 11: Level 3 Floor plan with the recommended wind amelioration strategy overlaid

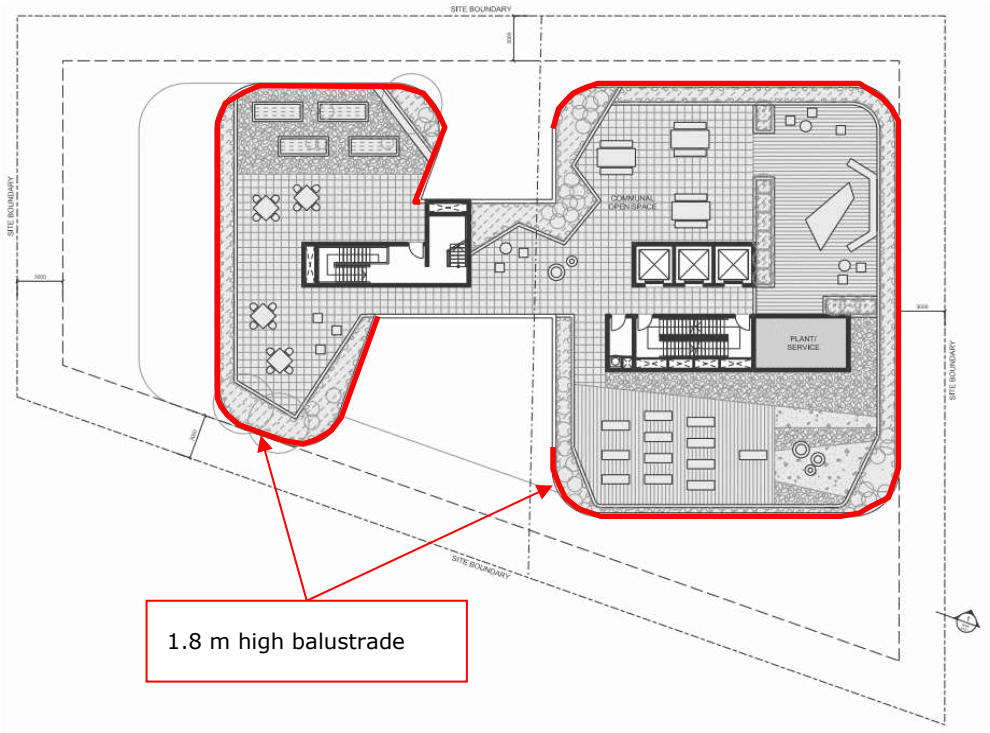


Figure 12: Level 4 Floor plan with the recommended wind amelioration strategy overlaid

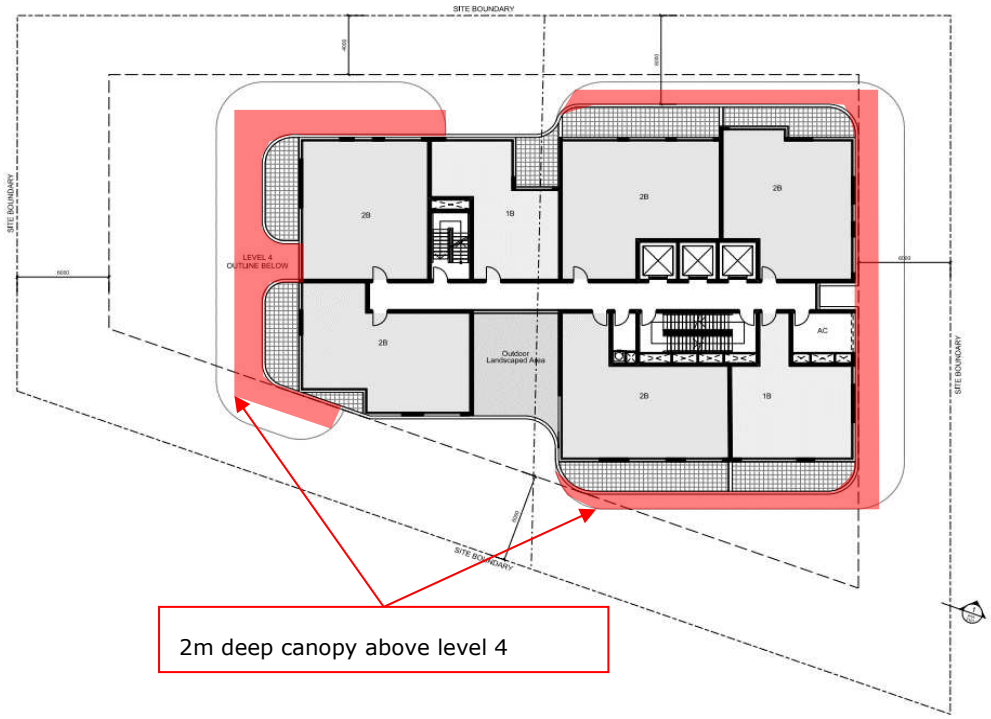


Figure 13: Level 5 Floor plan with the recommended wind amelioration strategy overlaid

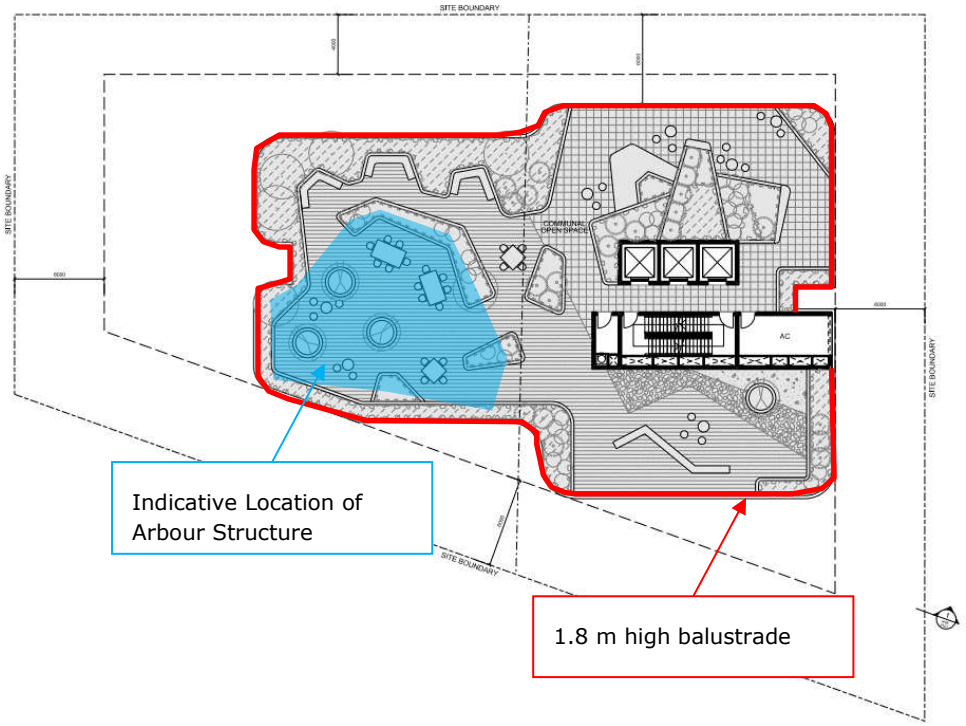


Figure 14: Level 17 Floor plan with the recommended wind amelioration strategy overlaid

4 Conclusions

An appraisal of the likely wind conditions in the adjacent ground level areas of the proposed development at **Anderson Street Project, Chatswood** has been made.

Vipac has carefully considered the form and exposure of the proposed development, nominated criteria for various public areas according to their function and referred to past experience to produce our opinion of likely wind conditions. Based on this assessment, the following conclusions are drawn:

- With the proposed design, the wind conditions along the pedestrian ground level foot path areas are expected to be within the criterion for walking.
- With the proposed design and **the recommended wind control measures**, the development is expected to generate wind conditions at the ground level building entrance areas within the recommended standing criterion.
- With the proposed design and **the recommended wind control measures**, the development is expected to generate wind conditions at the ground level building sitting areas within the recommended sitting criterion.
- With the proposed design, and **the recommended wind control measures**, the wind conditions at podium roof garden and roof terraces areas are expected to be within the recommended criterion for walking. Some wind control measures (windscreens and pergola) have been recommended should more stringent comfort criteria be required. These could be determined in a scaled wind tunnel test.
- With the proposed design the wind conditions on apartment balconies are expected to be within the recommended criterion for walking.

As a general statement, educating occupants about wind conditions at open terrace/apartment balcony areas during high-wind events and tying down the lightweight furniture in these areas are highly recommended.

The recommendations and assessments provided in this report have been made based on empirical data and experience of similar situations in Sydney and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without wind tunnel model testing may not account for all complex flow scenarios in the vicinity. We recommend wind tunnel testing be undertaken in the detail design phase.

This Report has been Prepared

For

DPG Project 35 Pty Ltd

By

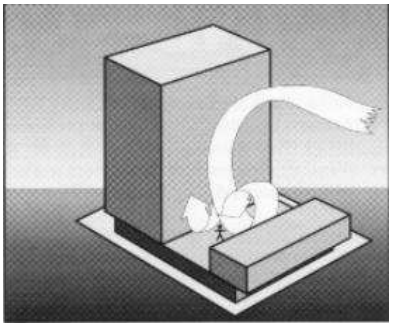
VIPAC ENGINEERS & SCIENTISTS LTD.

Appendix A Environmental Wind Effects

Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a wind velocity profile. When this wind profile encounters a tall building, some of the fast-moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.



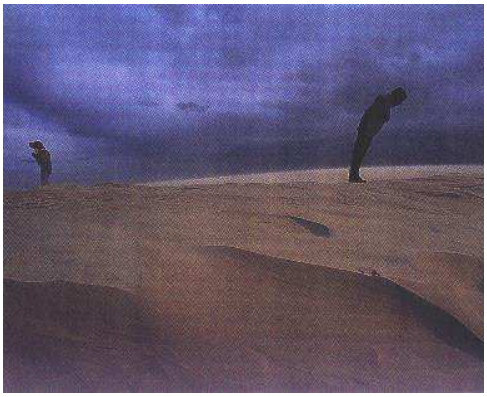
Downwash – refers to a flow of air down the exposed face of a tower. A tall tower can deflect a fast-moving wind at higher elevations downwards.

Corner Accelerations – when wind flows around the corner of a building it tends to accelerate in a similar manner to airflow over the top of an aeroplane wing.

Flow separation – when wind flowing along a surface suddenly detaches from that surface and the resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

Flow channelling – the well-known "street canyon" effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Piers and open water frontage may have such exposure.



Appendix B References

[1] *Structural Design Actions, Part 2: Wind Actions*, Australian/New Zealand Standard 1170.2:2011

[2] *Wind Effects on Structures* E. Simiu, R Scanlan, Publisher: Wiley-Interscience

[3] *Architectural Aerodynamics* R. Aynsley, W. Melbourne, B. Vickery, Publisher: Applied Science Publishers

Appendix C Drawing List

Drawings Received January 2021

Level 1 Plan	arsk0102
Level 2 Plan	arsk0103
Level 3 Plan	arsk0104
Level 4 Plan	arsk0105
Lower Typical Floor Plan (L5-L16)	arsk0106
Level 17 Plan	arsk0107
Upper Floor Plan (L18-L27)	arsk0108