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Vipac Engineers & Scientists

D.W Keir Pty Ltd

**264-270 Normanby Road, South Melbourne
(Site 01)**

Wind Impact Statement

30N-18-0279-TNT-6754873-5

14 November 2019



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EXECUTIVE SUMMARY

D.W Keir Pty Ltd commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the ground level areas adjacent to the proposed development at **264-270 Normanby Road, South Melbourne**. This appraisal is based on Vipac's experience as a wind-engineering consultancy, and assessed in accordance to Clause 43.02 – Schedule 30 of the Port Phillip Planning Scheme

Drawings of the proposed development were provided by **Hayball** in **April 2019**. The findings of this study can be summarized as follows:

- With the proposed design, the ground level footpaths would be expected to have wind levels within the walking comfort criterion;
- With the proposed design **with the recommended commercial lobby entrance windscreen**, the wind conditions near the building entrance areas would be expected to be within the recommended standing criterion.
- With the proposed design, the podium roof outdoor amenity area is expected to be within the recommended walking comfort criterion.

Educating occupants about wind conditions at open terrace/balcony areas during high-wind events and fixing loose, lightweight furniture on the terrace are highly recommended.

The assessments provided in this report have been made based on experience of similar situations in Melbourne and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without experimental validation may not account for all complex flow scenarios in the vicinity. We recommend wind tunnel testing be undertaken to verify these predictions and determine the optimised wind control treatments, if required.



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1 INTRODUCTION

D.W Keir Pty Ltd commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the ground level areas adjacent to the proposed development at **264-270 Normanby Road, South Melbourne**. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

The proposed development is bounded by Normanby Road to the South, Munro Street to the North and existing developments to the East and a new laneway to the West (see Figure 1). The proposed development is a 19 storey building incorporating a 4 level podium (see Figure 2). The surrounding developments, within a 3km radius, are a mixture of suburban dwellings, offices and residential complexes.

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 large 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 **Hayball** in **April 2019** as listed in Appendix C of this report.



Figure 1: Aerial view of the proposed development site at 264-270 Normanby Road, South Melbourne.

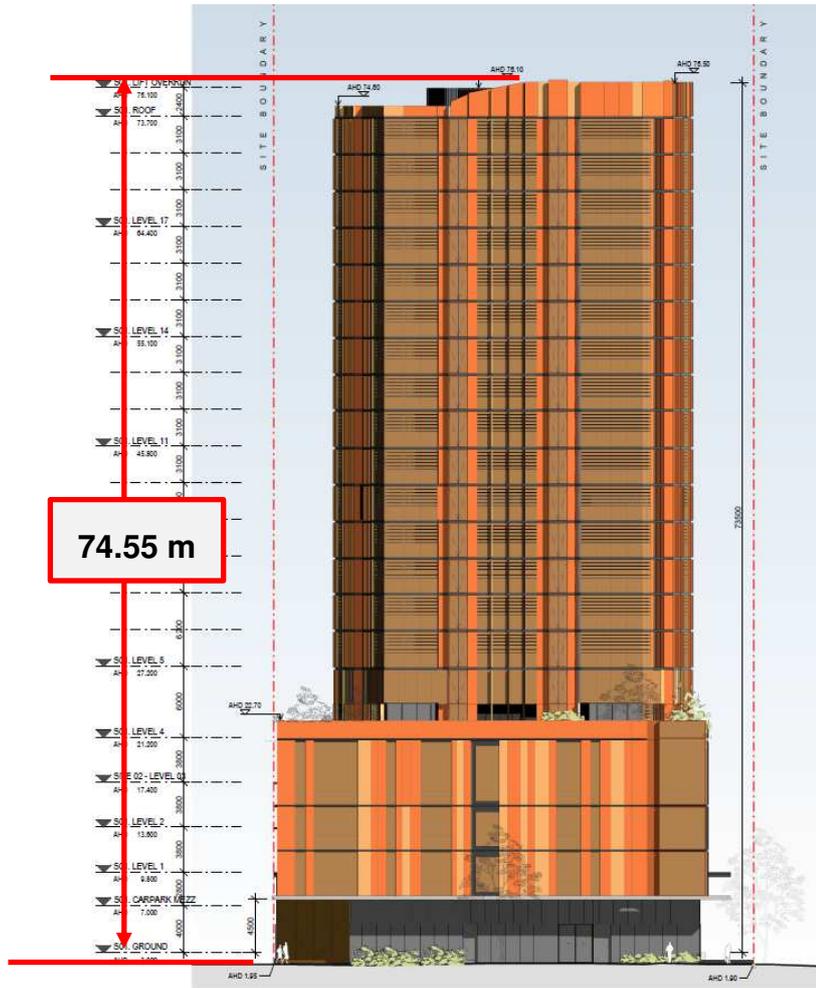


Figure 2: Northern Elevation of the proposed development with its approximate height in meters

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 predominantly surrounded within a 3 km radius by a mix of suburban dwellings, industrial areas as well as residential and office developments and the Melbourne CBD to the North East. There are a number of future buildings proposed in the area of a similar height to the proposed development. Considering the immediate surroundings and terrain, the site of the propose development is assumed to be within Terrain Category 3 for the azimuth degrees of 0-70, Terrain Category 2.5 from 160-220 azimuth degrees and Terrain Category 3 all other wind directions [1] (see Figure 3).

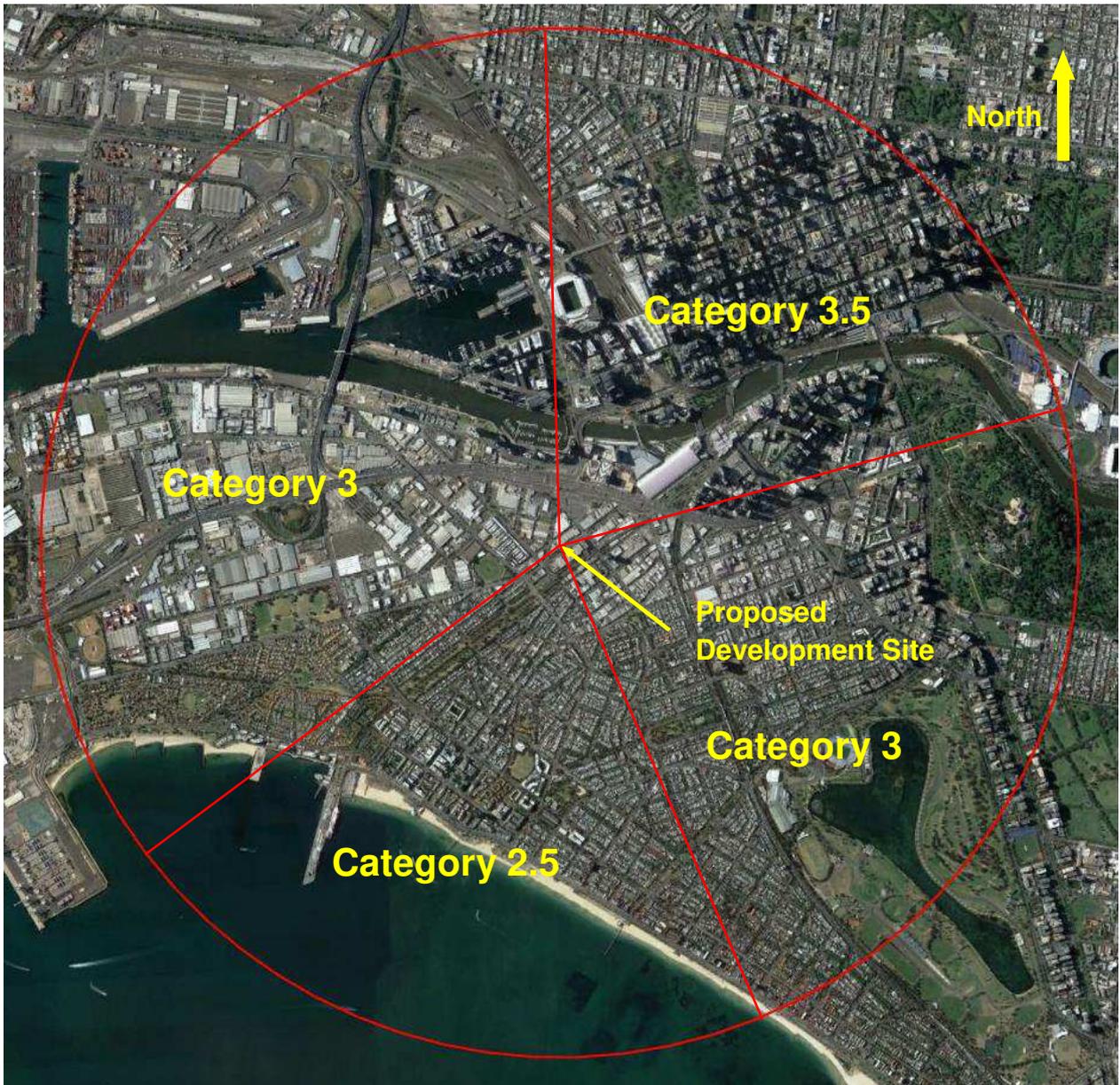


Figure 3: Assumed terrain categories for wind speed estimation.

2.2 REGIONAL WIND CLIMATE

The mean and gust wind speeds have been recorded in the Melbourne area for 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 for 36 directions at the gradient height ($\approx 500\text{m}$), with a probability of occurring once per year (i.e. 1 year return period) is shown in Figure 4. The wind data at this free stream height are common to all Melbourne city sites and may be used as a reference to assess ground level wind conditions at the site. Figure 4 indicates that the stronger winds can be expected from the northerly, southerly, and westerly directions.

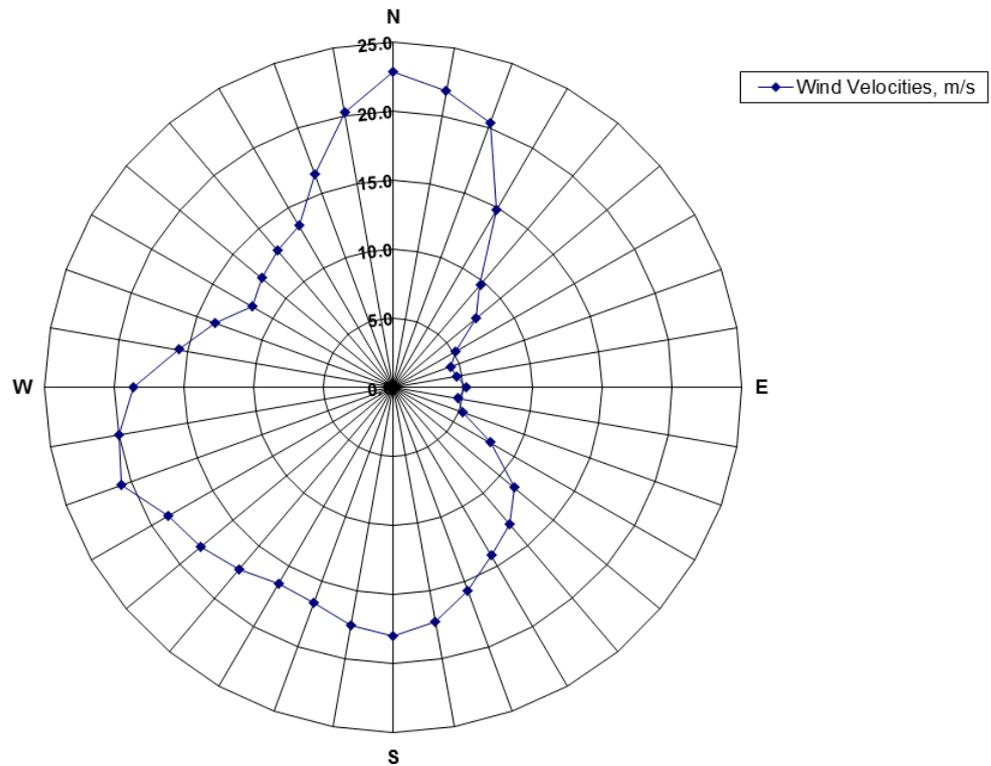


Figure 4: Directional Distribution of Annual Return Period Maximum Mean Hourly Wind Velocities (m/s) for 36 wind directions at the gradient height of 500m in Melbourne.

2.3 BUILDING GEOMETRY AND ORIENTATION

The proposed development is a 19 level development incorporating a 4 storey podium. The overall plan-form dimensions are approximately 39 m x 49m (Figure 5) with the long axis running from Munro Street to Normanby Road. It features a new laneway to the west, active street frontages to the north and south, and the podium is conjoined with the neighbouring development to the east.

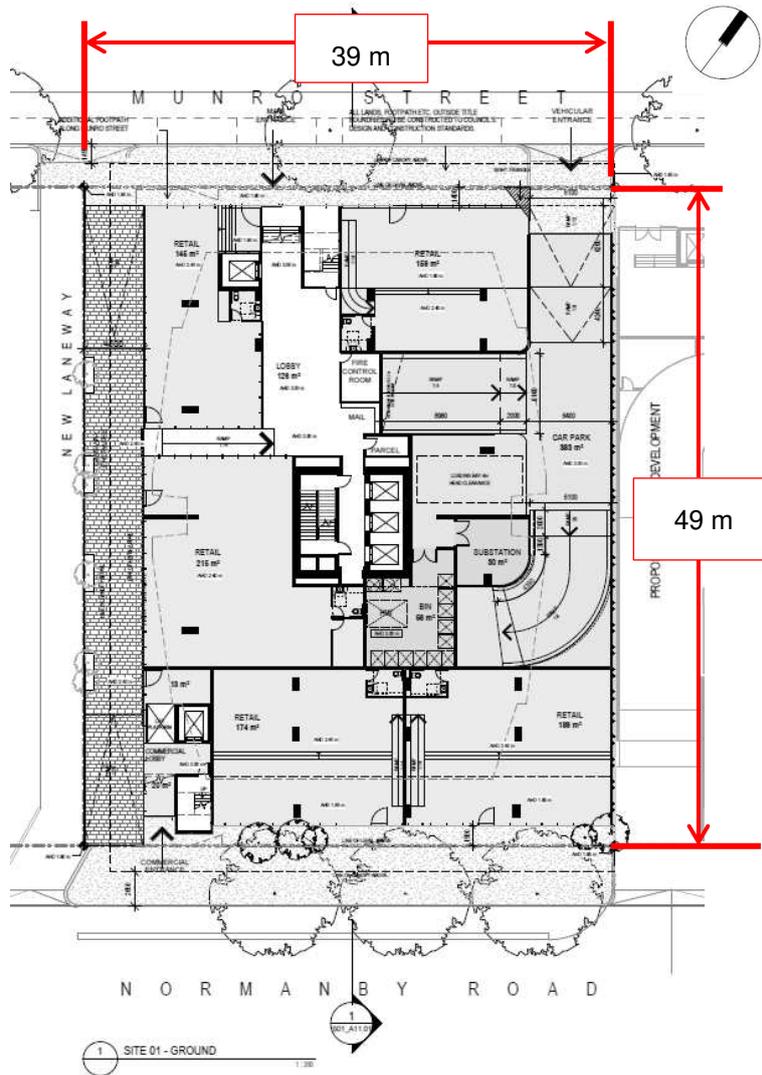


Figure 5: Site Plan of the proposed development.

2.5 ASSESSMENT CRITERIA

With some consensus of international opinion, pedestrian wind comfort is rated according to the suitability of certain activities at a site in relation to the expected annual peak 3-second gust velocity at that location for each wind direction. Each of the major areas around the site are characterized by the annual maximum gust wind speeds. Most patrons would consider a site generally unacceptable for its intended use if it were probable that during one annual wind event, a peak 3-second gust occurs which exceeds the established comfort threshold velocity (shown in Table 1). If that threshold is exceeded once per year then it is also likely that during moderate winds, noticeably unpleasant wind conditions would result, and the windiness of the location would be considered as unacceptable.

Table 1: Recommended Wind Comfort and Safety Gust Criteria

Annual Maximum Gust Speed	Result on Perceived Pedestrian Comfort
>23m/s	Unsafe (frail pedestrians knocked over)
<20m/s	Acceptable for fast walking (waterfront or particular walking areas)
<16m/s	Acceptable for walking (steady steps for most pedestrians)
<13m/s	Acceptable for standing (window shopping, vehicle drop off, queuing)
<11m/s	Acceptable for sitting (outdoor cafés, gardens, park benches)

In a similar manner, a set of hourly mean velocity criteria (see Table 2) with a 0.1% probability of occurrence are also applicable to ground level areas in and adjacent to the proposed development. An area should be within both the relevant mean and gust limits in order to satisfy the particular human comfort and safety criteria in question.

Table 2: Recommended Wind Comfort and Safety Mean Criteria

Mean Speed in 0.1% of Time	Result on Perceived Pedestrian Comfort
>15m/s	Unsafe (frail pedestrians knocked over)
<13m/s	Acceptable for fast walking (waterfront or particular walking areas)
<10m/s	Acceptable for walking (steady steps for most pedestrians)
<7m/s	Acceptable for standing (window shopping, vehicle drop off, queuing)
<5m/s	Acceptable for sitting (outdoor cafés, gardens, park benches)

The Beaufort Scale is an empirical measure that related the wind speed to observed conditions on the land and sea. Table 3 describes the categories of the Beaufort Scale. The comparison between these observed conditions and the comfort criteria described above can be found in Table 4.

Table 3: Beaufort Scale - empirical measure relating wind speed to observed conditions on land

Beaufort Number	Descriptive Term	Wind Speed at 1.75 m height (m/s)	Specification for Estimating Speed
0	Calm	0-0.1	
1	Light Air	0.1-1.0	No noticeable wind
2	Light Breeze	1.1-2.3	Wind felt on face
3	Gentle Breeze	2.4-3.8	Hair disturbed, clothing flaps, newspapers difficult to read
4	Moderate Breeze	3.9-5.5	Raises dust and loose paper; hair disarranged
5	Fresh Breeze	5.6-7.5	Force of wind felt on body, danger of stumbling when entering a windy zone
6	Strong Breeze	7.6-9.7	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, sideways wind force about equal to forwards wind force, wind noise on ears unpleasant
7	Near Gale	9.8-12.0	Inconvenience felt when walking
8	Gale	12.1-14.5	Generally impedes progress, great difficulty with balance in gusts
9	Strong Gale	14.6-17.1	People blown over

Table 4: Comparison between Mean comfort criteria and the observed conditions

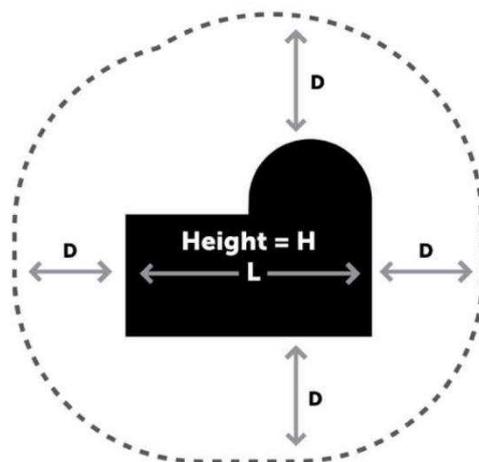
Comfort Criteria	Beaufort Scale Equivalent
Safety	9 – Strong Gale
Walking	5 – Fresh Breeze
Standing	4-5 – Moderate to Fresh Breeze
Sitting	<4 – Moderate Breeze

Port Phillip developments with a total building height over 40 meters are required, as per the Design Development Overlay (Clause 43.02 – Schedule 30) of the Port Phillip Planning Scheme, to be under specific wind criteria. The document recommends the following wind comfort criteria listed in Table 5. **This set of wind criteria were applied in this study.**

Table 5: Wind Criteria from Clause 43.02 – Schedule 30 to the Design and Development Overlay

Measurements	Result on Perceived Pedestrian Comfort
Maximum 3 second gust exceeds 20m/sec $\leq 0.1\%$ of the time from all directions combined.	Accepted international criterion for human safety, to avoid a healthy pedestrian losing balance
Mean wind velocity exceeds 5m/sec $\leq 20\%$ of the time	Acceptable for walking (steady steps for most pedestrians)
Mean wind velocity exceeds 4m/sec $\leq 20\%$ of the time	Acceptable for standing (window shopping, vehicle drop off, queuing)
Mean wind velocity exceeds 3m/sec $\leq 20\%$ of the time	Acceptable for sitting (outdoor cafés, gardens, park benches)

This criterion specifically calls for the safety criterion to be used to assess infrequent winds (e.g. peak event of $\leq 0.1\%$ of the time); and the perceived pedestrian comfort to be assessed based on frequently occurring winds (e.g. winds that occurs 80% of the time). The Schedule specifies that safe and comfortable wind conditions must be achieved in public accessible areas within a distance equal to half the longest width of the building above 40 m in height measured from all facades or half the total height of the building, whichever is greater, as shown Figure 7. These guidelines were applied to the subject set as shown in Figure 8.



Assessment distance D = greater of:
 $L/2$ (Half longest width of building)
 OR
 $H/2$ (Half overall height of building)

Figure 7: Assessment distance as detailed in Table 7 of Clause 43.02 - Schedule 30

2.6 USE OF ADJACENT PEDESTRIAN OCCUPIED AREAS & RECOMMENDED COMFORT CRITERIA

The following table lists the specific areas adjacent to the development and the corresponding recommended criteria.

Table 6: Recommended application of criteria

Area	Specific location	Recommended Criteria
Public Footpaths and Access ways	Along Normanby Road, Munro Street, and the new Laneway to the west. (Figure 8 and Figure 9)	Walking
Building entrances	Along the active edges at Munro Street and Normanby Road. (Figure 9)	Standing
Podium Rooftop	Outdoor amenity area (Figure 10)	Walking (see Discussion below)

Terrace Recommended Criterion Discussion

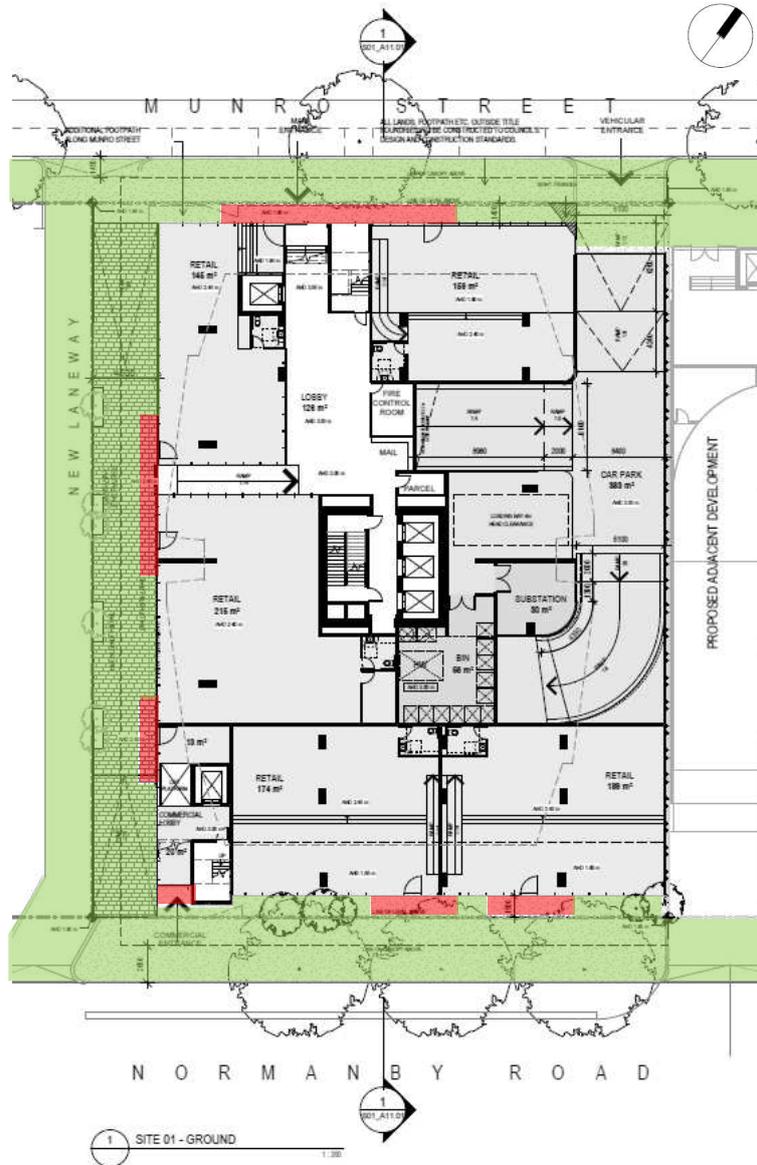
Vipac recommends as a minimum that podium rooftop terrace areas meet the criterion for walking since:

- these areas are not public spaces;
- the use of these areas is optional;
- many similar developments in Melbourne 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 find wind conditions in these areas acceptable at all times.

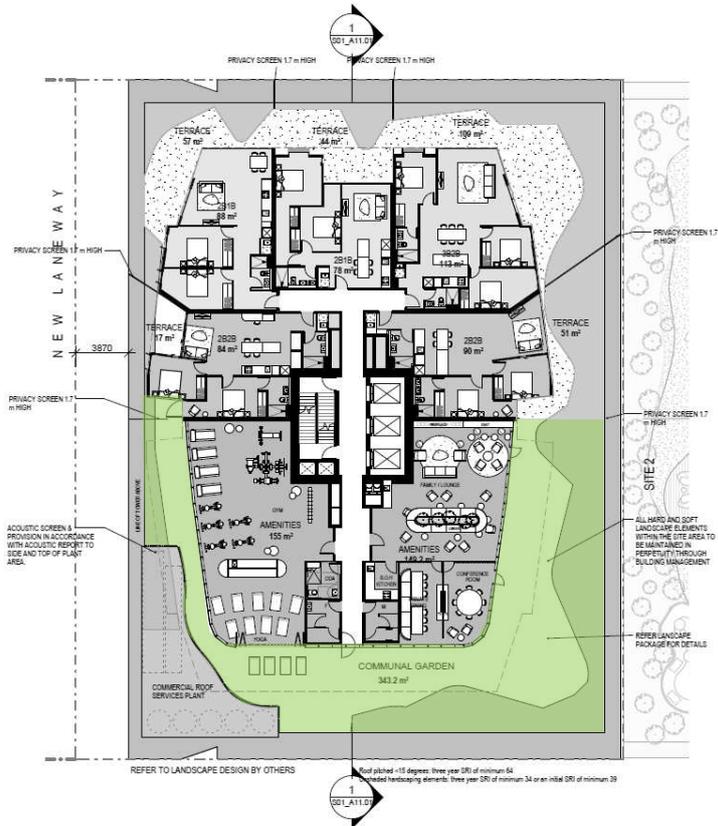


Figure 8: Satellite view of the subject site with the public accessible areas overlaid in green



Recommended to fulfil Walking Recommended to fulfil Standing

Figure 9: Site Plan of the proposed development with the recommended comfort criterion overlaid



 Recommended to fulfil Walking

Figure 10: Site Plan of the proposed development with the recommended comfort criterion overlaid

3 PEDESTRIAN LEVEL WIND EFFECTS

3.1 DISCUSSION AND RECOMMENDATIONS

Ground Floor

The proposed development stands at approximately 74.55 metres from street level and features an approximately 19 metre high podium. The tower is set back approximately 5 metres from Normanby Road and Munro Street. This setback and 2 m deep canopy is expected to reduce downwash effects. As such, the pedestrian footpaths around the proposed development and the surrounding public accessible areas are expected to be within the recommended walking comfort criterion.

Due to the 2m deep canopy along skirting the podium, the majority of the entrances are expected to be within the recommended standing comfort criterion, with the exception of the commercial lobby located on the south eastern corner. A windscreen to shield this entrance is recommended for this area (Figure 11).

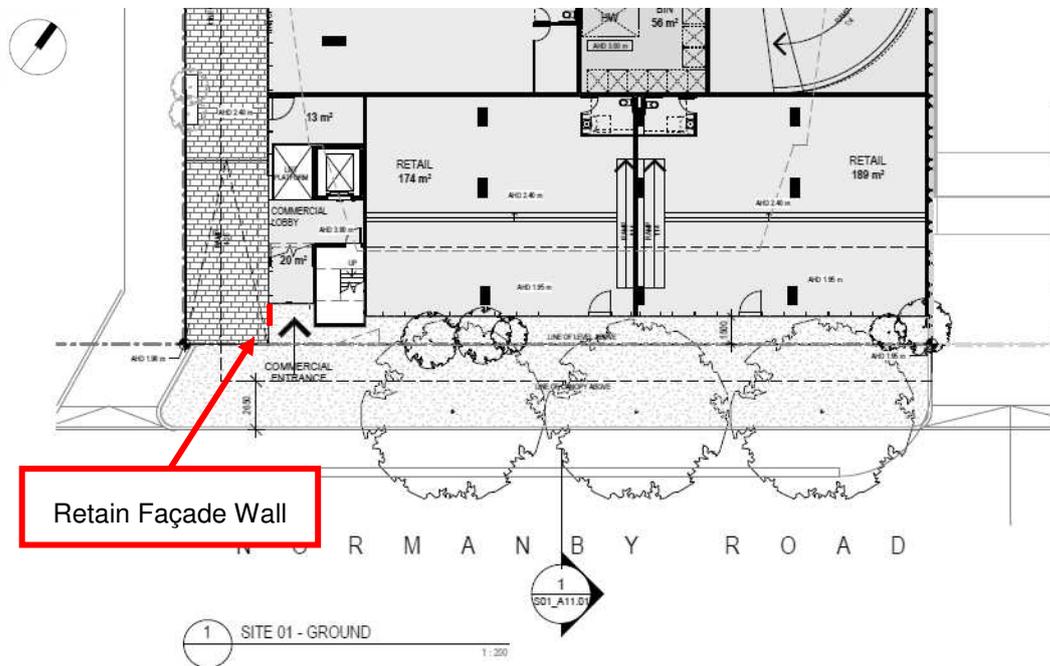


Figure 11: Plan view of the Ground level of the proposed development with wind control measures overlaid

Communal Terrace

The communal terrace areas are proposed to feature 1.7m high privacy screens as well as a mixture of soft and hard landscaping elements. The communal area is generally expected to be within the recommended walking comfort criteria.

We recommend wind tunnel testing be undertaken to verify the predictions of this desktop analysis.

4 CONCLUSIONS

An assessment of the likely wind conditions at pedestrian level of the proposed development at **264-270 Normanby Road, South Melbourne** has been made.

Vipac has carefully considered the form and exposure of the proposed development, nominated criteria for various public accessible areas in relation to their function in accordance to Clause 43.02 – Schedule 30 of the Port Phillip Planning Scheme. We have also 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 ground level footpaths would be expected to have wind levels within the walking comfort criterion;
- With the proposed design **with the recommended commercial lobby entrance windscreen**, the wind conditions near the building entrance areas would be expected to be within the recommended standing criterion.
- With the proposed design, the podium roof outdoor amenity area is expected to be within the recommended walking comfort criterion.

Educating occupants about wind conditions at open terrace/balcony areas during high-wind events and fixing loose, lightweight furniture on the terrace are highly recommended.

The assessments provided in this report have been made based on experience of similar situations in Melbourne and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without experimental validation may not account for all complex flow scenarios in the vicinity. Considering the height and exposure of the development, we recommend wind tunnel testing be undertaken to verify the results of this assessment.

This Report has been Prepared

For

D.W Keir 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: April 2019

Drawing Name	Drawing Number
Site 01 – Plans	S01_A03.01
Site 01 – Plans	S01_A03.02
Site 01 – Plans	S01_A03.03
Site 01 – Plans	S01_A03.04
Site 1 – Roof Plan	S01_A03.05
Site 01 – North Elevation	S01_A10.01
Site 01 – South Elevation	S01_A10.02
Site 01 – East Elevation	S01_A10.03
Site 01 – West Elevation	S01_A10.04
Site 01 – Section A-A	S01_A11.01