Vipac Engineers and Scientists Limited

[redacted]



# Vipac Engineers & Scientists

## BEG Developments Pty Ltd

# 139-149 Boundary Road, North Melbourne

# Wind Impact Assessment



30N-20-0068-TRP-6775733-3

28 June 2021

| | |
|---|---|
| **Job Title:** | 139-149 Boundary Road, North Melbourne |
| **Report Title:** | Wind Impact Assessment |
| **Document Reference:** | 30N-20-0068-TRP-6775733-3 |

**PREPARED FOR:**
**BEG Developments Pty Ltd** C/o Fusion Project
[redacted]

**PREPARED BY:**
Vipac Engineers and Scientists Limited
[redacted]

**AUTHORED BY:**

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Date: 28 June 2021



**REVIEWED BY:**



[redacted]

Date: 28 June 2021

**REVISION HISTORY:**

| *Rev. #* | *Comments / Details of change(s) made* | *Date* | *Revised by:* |
|---|---|---|---|
| Rev. 00 | Original issue | 03/04/2020 | [redacted] |
| Rev. 01 | Plans Updated | 13/07/2020 | |
| Rev. 02 | Landscaping Plans included | 14/07/2020 | |
| Rev. 03 | Updated Plans | 10/06/2021 | |

## EXECUTIVE SUMMARY

**BEG Developments Pty Ltd** commissioned Vipac Engineers and Scientists Pty Ltd to prepare a statement of wind effects for the proposed development at **139-149 Boundary Road, North Melbourne.** This appraisal is based on Vipac's experience as a wind-engineering consultancy.

Drawings of the proposed development were supplied by **CHT Architecture** in June 2021, as described in Appendix C of this report.

The findings of this study can be summarised as follows:

With proposed design:

- wind conditions in the ground level footpath areas would be expected to be within the **walking** comfort criterion.
- wind conditions in the building entrance areas would be expected to be within the **standing** comfort criterion.
- wind conditions at the open terrace on Level 11 would be expected to be within the recommended **walking** comfort criterion.

**As such, the proposed development is expected to have an acceptable wind environment and Vipac makes no recommendation for the alteration of the design as proposed.**

As a general statement, 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. Vipac recommends wind tunnel testing be undertaken to verify these predictions and optimise any wind mitigations measures, should they be required.

TABLE OF CONTENTS

# 1 INTRODUCTION

Vipac Engineers and Scientists has been commissioned by **BEG Developments Pty Ltd** to carry out an assessment of the pedestrian wind effects at the ground level and open spaces of the proposed development at **139-149 Boundary Road, North Melbourne.**

Strong winds in pedestrian areas are frequently encountered in central business districts of cities around the world; including Sydney, Melbourne and Brisbane. Wind characteristics such as the mean speed, turbulence and ambient temperature determine the extent of disturbance to users of pedestrian areas. These disturbances can cause both comfort and safety problems and require careful consideration to mitigate successfully.

The proposed development consists of an 11-storey buildings with approximate height of 40 m from ground level. The site is bounded by Boundary Road to the east and existing buildings in the other directions. A satellite image of the proposed development site and the north elevation are shown in Figure 1 and Figure 2 respectively.

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level footpath areas 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. Empirical data for typical buildings in boundary layer flows has also been used to estimate the likely wind conditions on the ground level areas of the proposed development [2] & [3].

Drawings of the proposed development were supplied to Vipac by **CHT Architects** in June 2021. A list of drawings supplied is provided in Appendix C of this report.


*Figure 1: Aerial view of the proposed development site.*

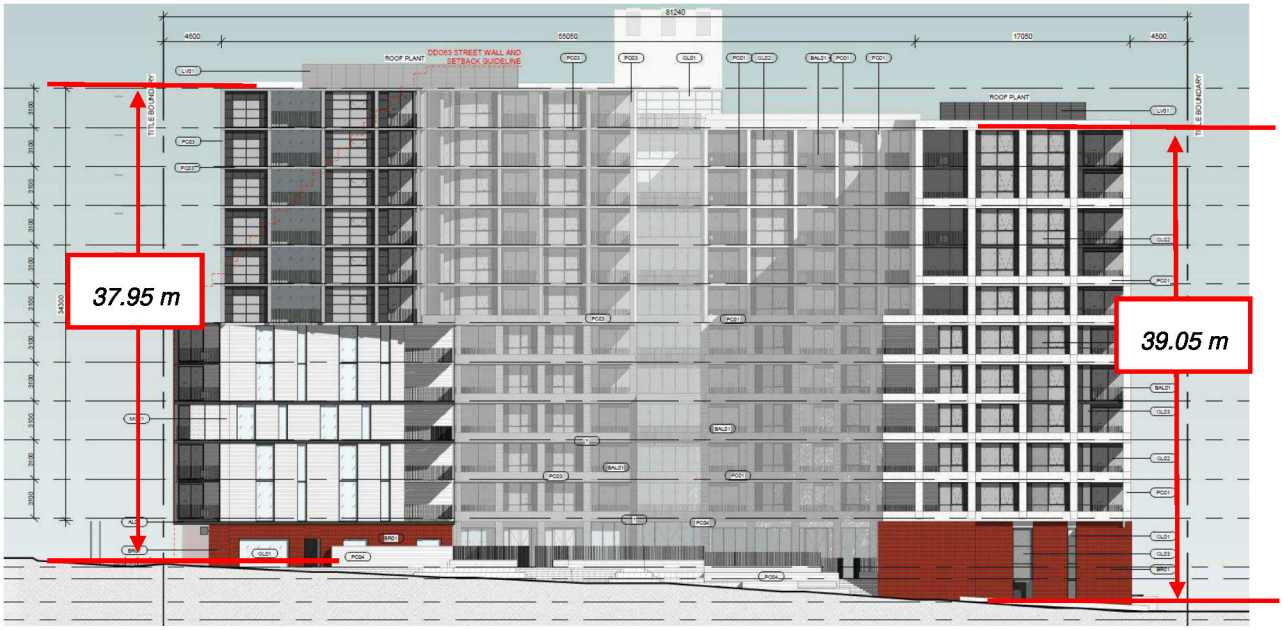



*Figure 2: North Elevation of the proposed development showing the approximate height*

## 2 ANALYSIS APPROACH

In assessing whether a proposed development is likely to generate adverse wind conditions in ground level footpath areas, Vipac has considered 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 areas affected by wind flows generated or augmented by the proposed development.

The pedestrian wind comfort at specific locations of ground level footpath areas 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. Where Vipac predicts that a location would not meet its appropriate comfort criterion, the use of wind control devices and/or local building geometry modifications to achieve the desired comfort rating may be recommended.

## 2.1 SITE EXPOSURE

The proposed development is predominantly surrounded within a 2 km radius by residential dwellings, with parklands and golf course to the east and the Melbourne CBD further away to the southeast. A satellite image of these site surroundings is shown in Figure 3.

Considering the immediate surroundings and terrain, the site of the proposed development is assumed to be within Terrain Category 2.5 for 50-120 azimuth degrees and Terrain Category 3 for all other directions (Figure 3).

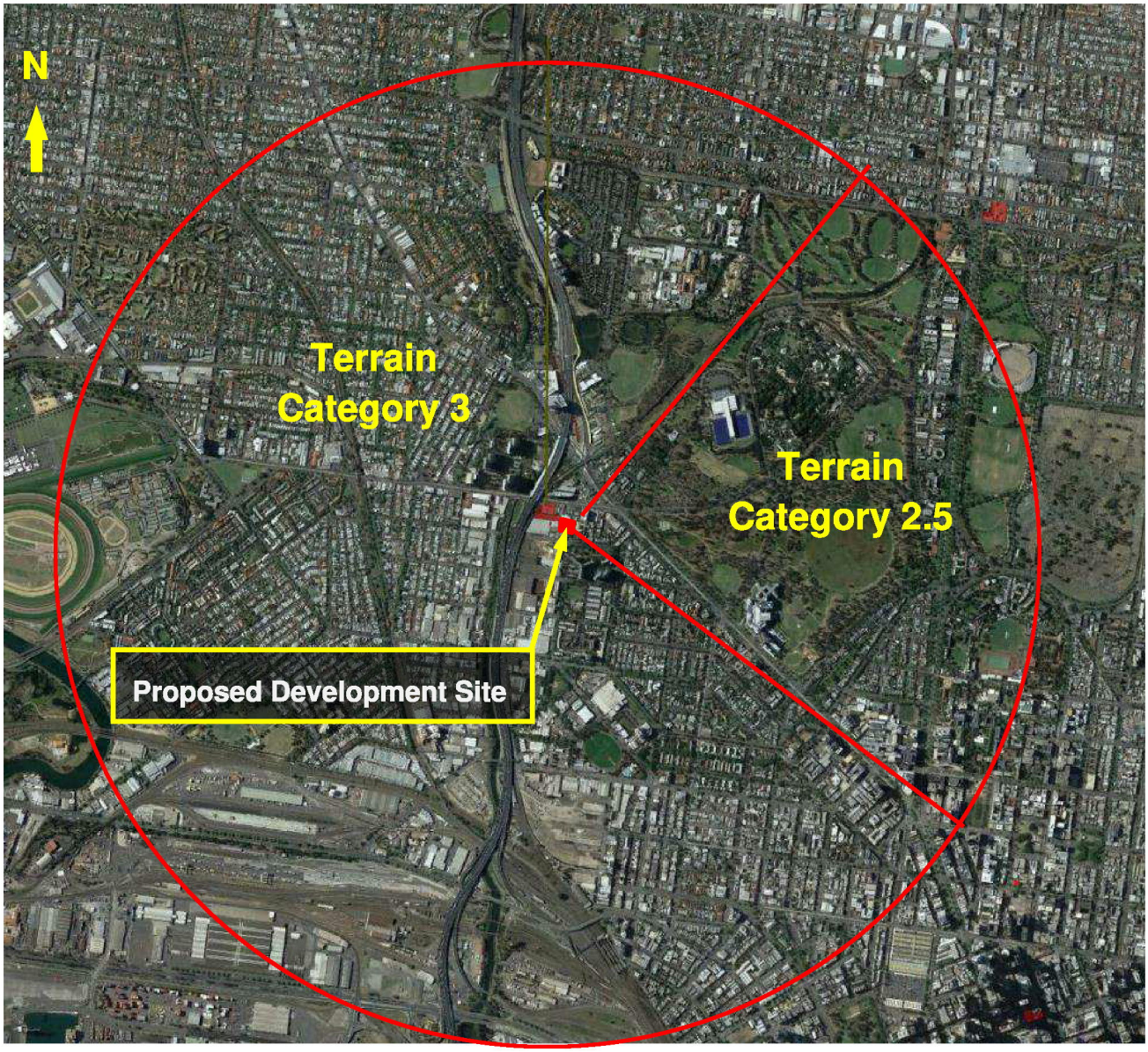



*Figure 3: Assumed terrain roughness for wind speed estimation.*

## 2.2 REGIONAL WIND CLIMATE

The mean and gust wind speeds have been recorded in the Melbourne 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 at the gradient height, with a probability of 0.1% of time and 20% of time exceeded are shown in 6. The wind data at this free stream height is common to all Melbourne city sites and may be used as a reference to assess ground level wind conditions at the site.

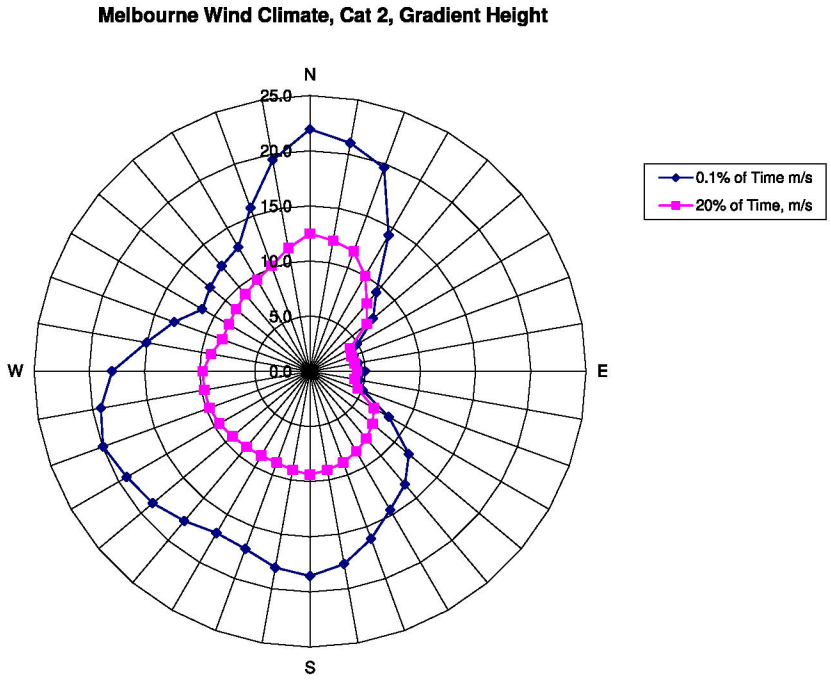



*Figure 6: Directional distribution of mean hourly wind velocities (m/s) for 0.1% and 20% of times at Gradient Height for Melbourne.*

## 2.3 BUILDING GEOMETRY AND ORIENTATION

The proposed development site has a rectangular shaped plan, with the dimensions of approximately 55 m x 81 m shown in Figure 5. The building has a maximum height of approximately 40 m from street level (Figure 2).

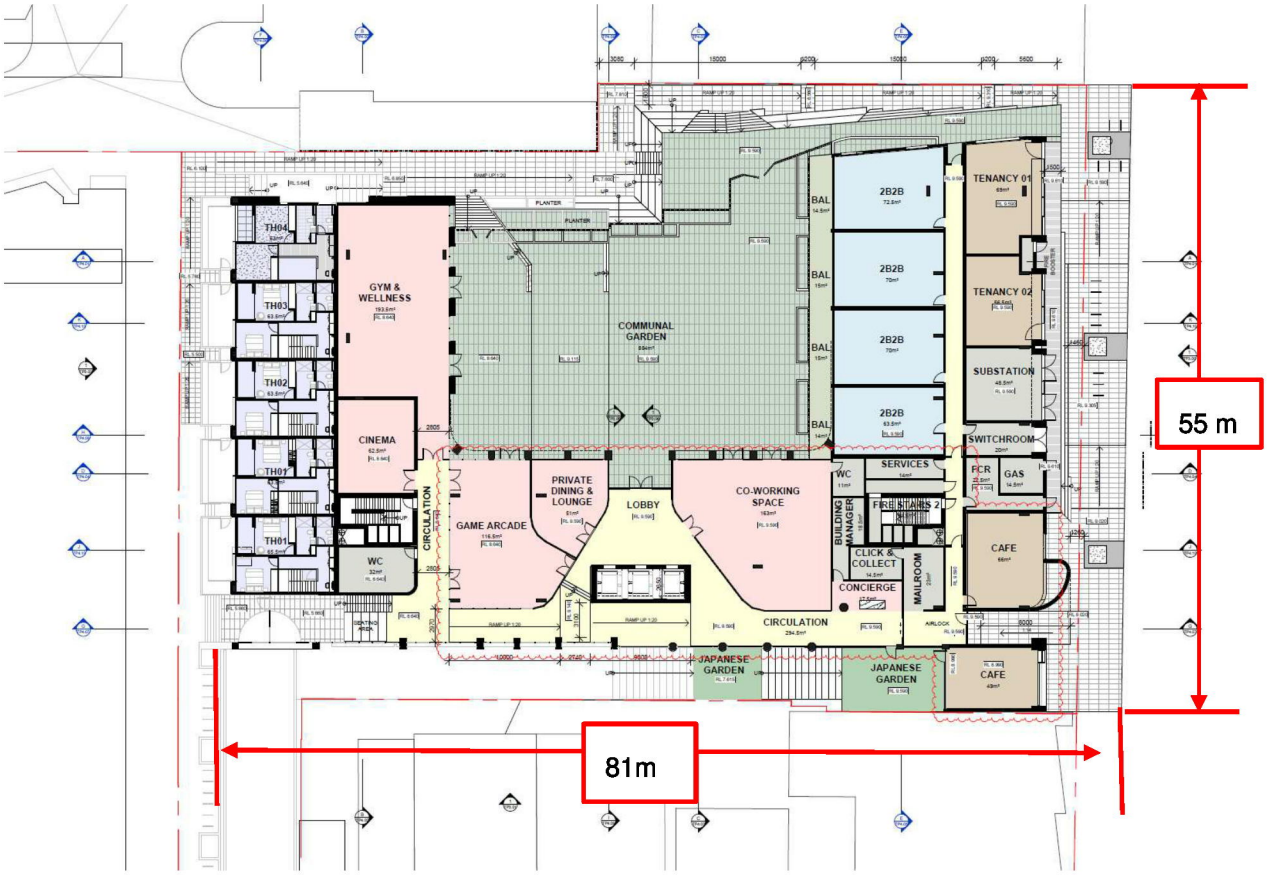



*Figure 4: Upper Ground level plan of the proposed development.*

## 2.4 FLOW INTERACTIONS WITH ADJACENT DEVELOPMENTS

The immediately adjacent developments are shown in Figure 5. There are buildings varying from 1-2 storeys surrounding the development, with future developments in the western sector ranging in height from 10-50 m.

With the current surroundings, the development is exposed to winds from all directions and is expected to experience downwash and corner acceleration effects for northerly and westerly winds. However, the future developments will provide significant shielding to the proposed developments for westerly winds. The communal terrace on Level 11 is also very exposed to northerly winds.

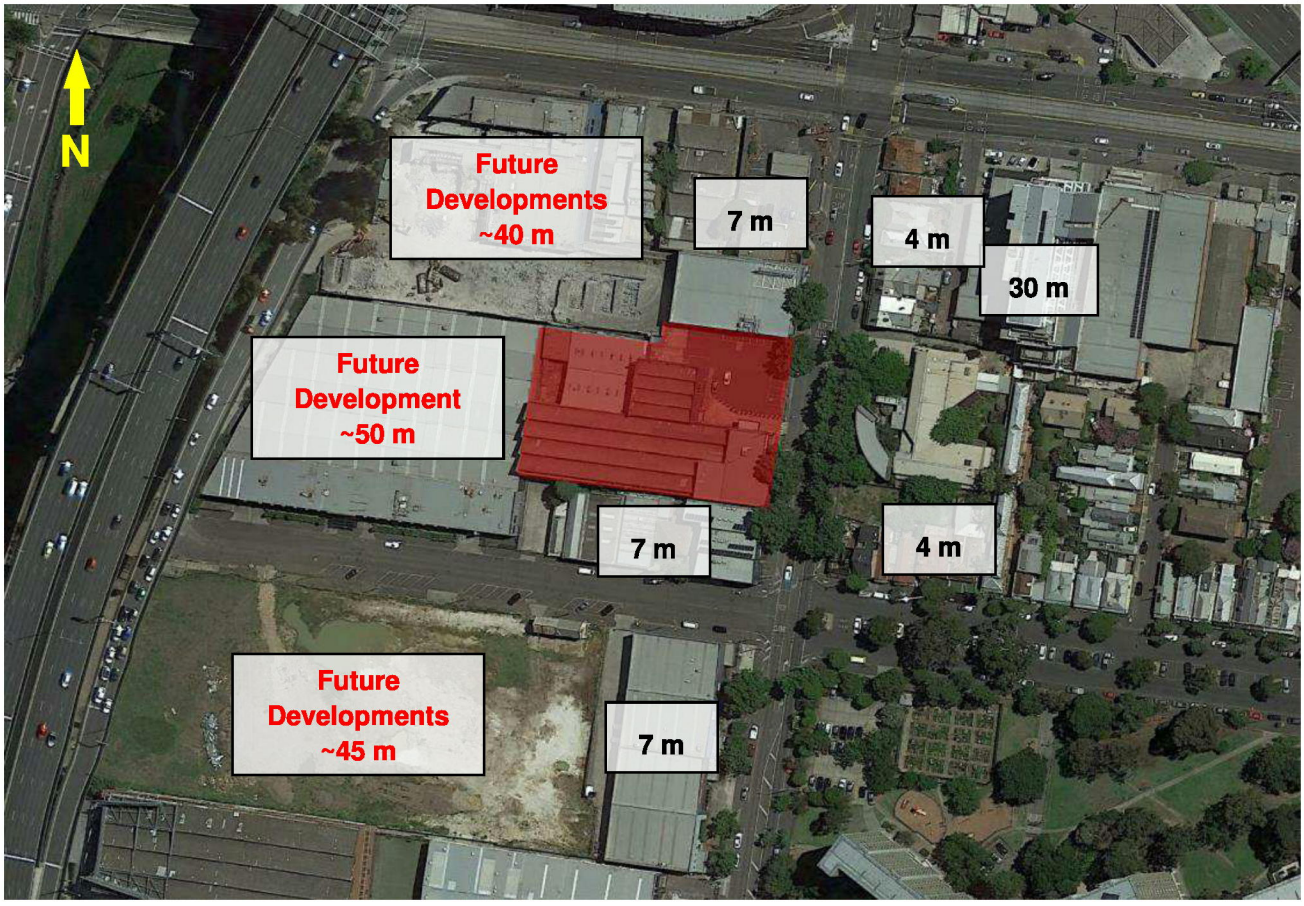



*Figure 5: Immediately adjacent surroundings and their heights in meters.*

## 2.5 ASSESSMENT CRITERIA

The Better Apartment Design Standards provides the following guidelines for the Environment Wind Criteria (Table 1).

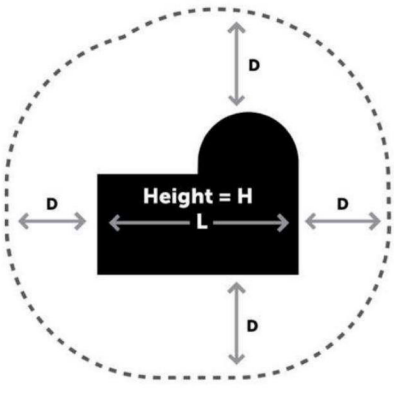
*Table 1: Wind Criteria from BADS*

| Measurements | Result on Perceived Pedestrian Comfort |
|---|---|
| Maximum 3 second gust exceeds ≤0.1% of the time, ≤ **20m/sec,** for at least 16 directions. | Accepted international criterion for human safety, to avoid a healthy pedestrian losing balance |
| Mean wind velocity exceeds ≤20% of the time, ≤ **5m/sec** for all directions combined. | Acceptable for **walking** (steady steps for most pedestrians) |
| Mean wind velocity exceeds ≤20% of the time, ≤ **4m/sec** for all directions combined. | Acceptable for **standing** (window shopping, vehicle drop off, queuing) |
| Mean wind velocity exceeds ≤20% of the time, ≤ **3m/sec** for all directions combined. | 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 ≤ 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 mean wind speed is hourly mean speed or gust equivalent mean (3 sec gust divided by 1.85), whichever is greater.

The Schedule specifies that safe and comfortable wind conditions must be achieved in publicly accessible areas within a distance equal to half the longest width of the building measured from all facades or half the overall height of the building, whichever is greater, as shown in Figure 7.




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

*Figure 7: Assessment of publicly accessible areas.*

### 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.

*Table 1: Recommended application of criteria*

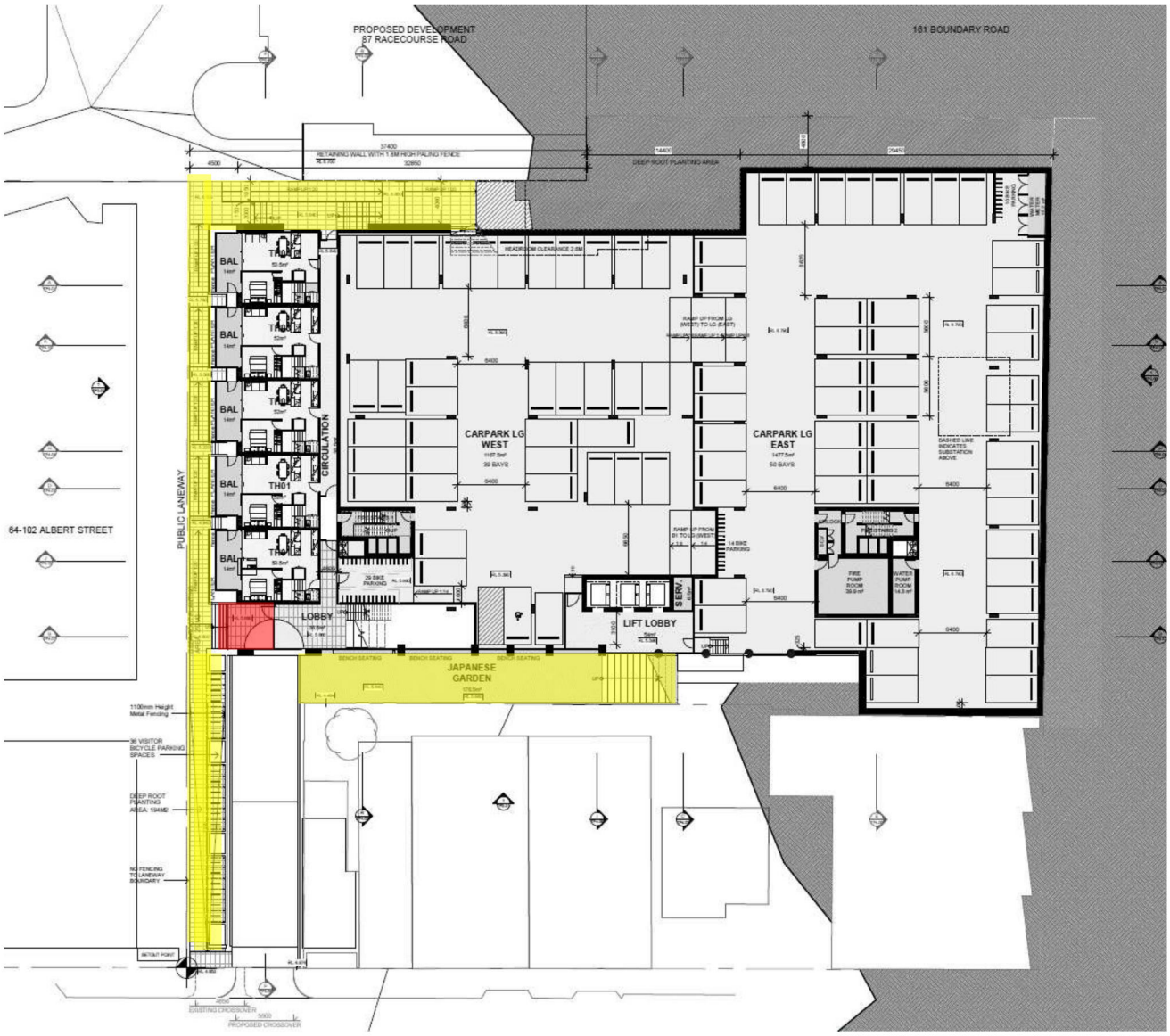
| Area | Specific location | Recommended Criteria |
|---|---|---|
| Public Footpaths and Access ways | Around the proposed development along Boundary Road (Figure 7) | Walking |
| Building entrances | Several locations, main entrance off Boundary Road (Figure 7) | Standing |
| Communal outdoor amenity areas | Courtyards at ground level and Roof Garden on Level 11 | Walking (Refer to discussion below) |

### 2.5.2 TERRACE / BALCONY AND ROOFTOP AREAS RECOMMENDED CRITERION DISCUSSION

Vipac recommends as a minimum that balcony/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.

However, it should be noted 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.




*Recommended to fulfil Walking*

*Recommended to fulfil Standing*

*Figure 6: Schematic plan view of the lower ground floor with recommended wind criteria overlaid*

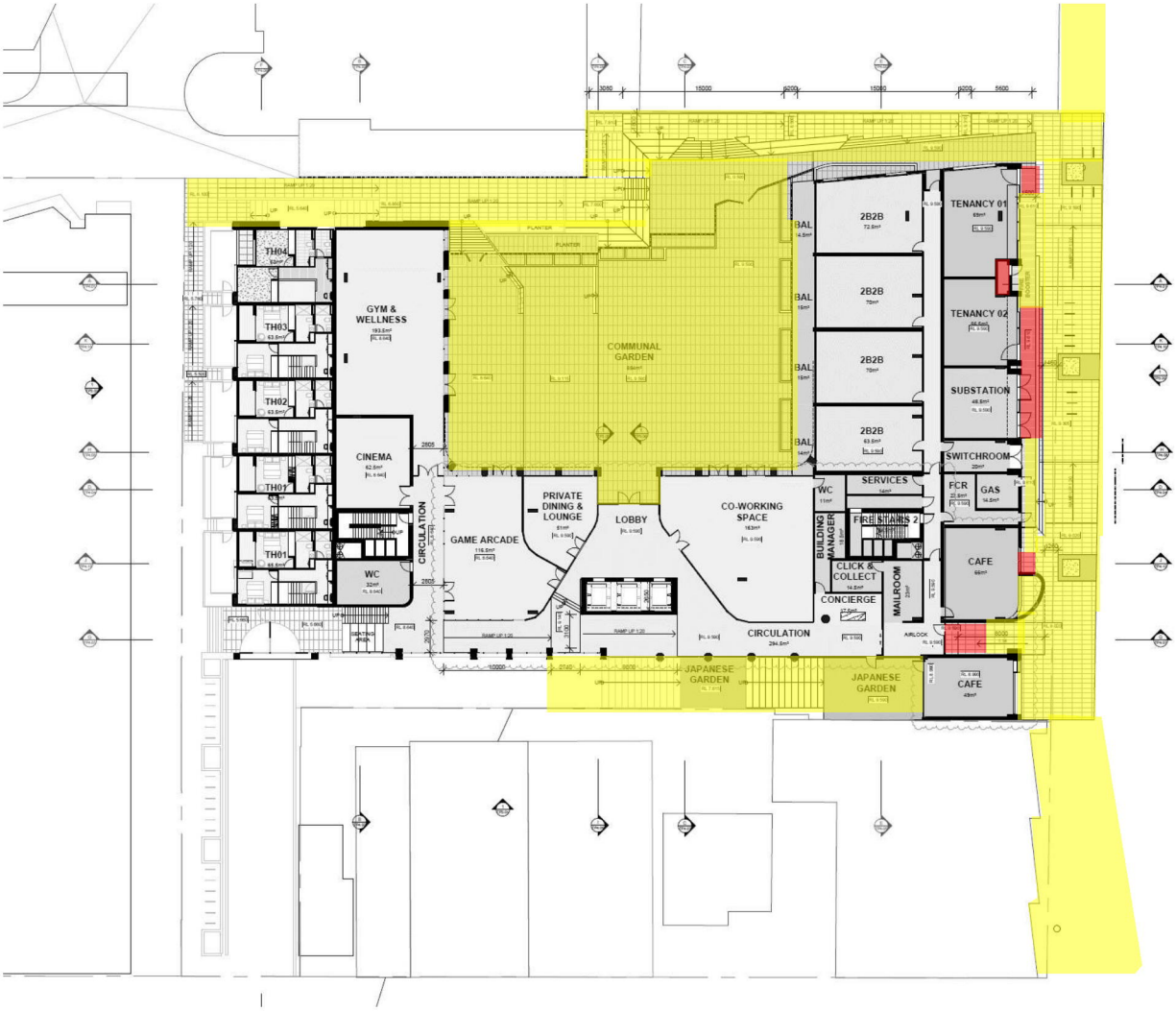



*Figure 7: Schematic plan view of the upper ground floor with recommended wind criteria overlaid*

# 3 PEDESTRIAN LEVEL WIND EFFECTS

## 3.1 DISCUSSION

### Ground Level

The pathways adjacent to the development on Boundary Road are exposed to direct northerly winds and downwash corner acceleration from northerly winds. However, we expect the wind levels will be within the walking comfort criterion. Future buildings constructed to the west of the site will also provide some additional protection from westerly winds in the future.

The main entrance area and retail frontages are located away from building corners with a setback design and are expected to meet the recommended standing comfort criterion.

The U-shape of the building will create a sheltered zone in the communal gardens and would be expected to be within the walking comfort criterion. Additionally, the landscaping in these courtyards will help to reduce wind levels further and would be expected to meet the more stringent standing comfort criteria in some areas.

As such, all ground level areas are expected to meet the recommended wind environment for pedestrian comfort.

### Roof Garden on Level 11

The roof garden located on Level 11 of the proposed development is relatively exposed to prevailing winds from the north and west due to the height above the surrounding areas. However, considering the landscaping on the perimeter and the pergola structure proposed over the seating areas (see Figure 8), we expect that this space will have an acceptable wind environment.

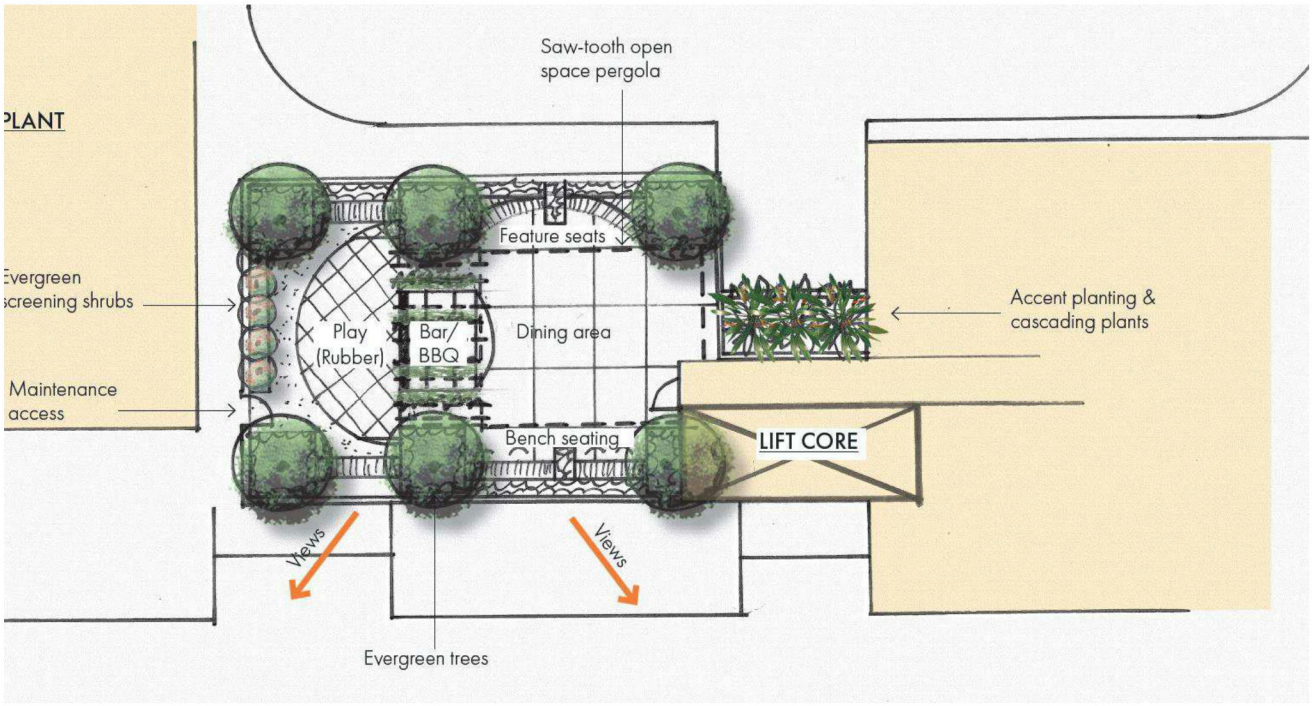



*Figure 8: Level 11 landscaping plan*

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

**Balconies General**

Whilst wind conditions on the 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. Vipac considers the proposed design to have acceptable wind environment in all balconies.

As a general statement, educating occupants about wind conditions at terrace areas during high-wind events and fixing loose, lightweight furniture is highly recommended.

We recommend wind tunnel testing be undertaken to verify these predictions.

## 4. CONCLUSIONS

An appraisal of the likely wind conditions at the pedestrian ground level and terraces of the proposed development at **139-149 Boundary Road, North Melbourne** 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.

The findings of this study can be summarised as follows:

With proposed design:

- wind conditions in the ground level footpath areas would be expected to be within the **walking** comfort criterion.
- wind conditions in the building entrance areas would be expected to be within the **standing** comfort criterion.
- wind conditions at the communal open terrace on Level 11 would be expected to be within the recommended **walking** comfort criterion.

As a general statement, 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 analyses and determine the optimal wind control strategies for the development.

*This Report has been Prepared*

*For*

*BEG Developments Pty Ltd*

*By*

*VIPAC ENGINEERS & SCIENTISTS LTD.*



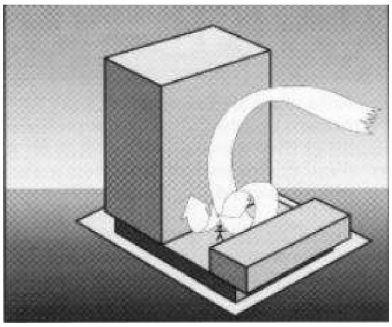
28 June 2021

# 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.



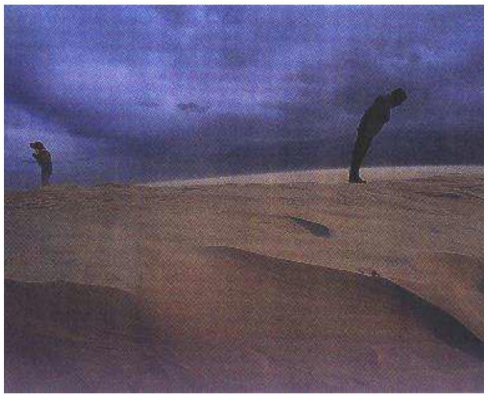
**Downwash** – refers to a flow of air down the exposed face of a tower. A tall tower can deflect a fast moving wind at higher elevations downwards.

**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

| Drawing Name | Drawing Number | Date |
|---|---|---|
| Development Summary 01 | TP0.01 | 04/06/2021 |
| New Basement 02 | TP2.02A | 04/06/2021 |
| New Basement 01 | TP2.02B | 04/06/2021 |
| New Lower Ground Floor Plan | TP2.03A | 04/06/2021 |
| New Upper Ground Floor Plan | TP2.04A | 04/06/2021 |
| Level 01 | TP2.05 | 04/06/2021 |
| Level 02 | TP2.06 | 04/06/2021 |
| Level 03 | TP2.07 | 04/06/2021 |
| Level 04 | TP2.08 | 04/06/2021 |
| Level 05 | TP2.09 | 04/06/2021 |
| Level 06 | TP2.10 | 04/06/2021 |
| Level 07 | TP2.11 | 04/06/2021 |
| Level 08 | TP2.12 | 04/06/2021 |
| Level 09 | TP2.13 | 04/06/2021 |
| Level 10 | TP2.14 | 04/06/2021 |
| Level 11 | TP2.15 | 04/06/2021 |
| Roof | TP2.16 | 04/06/2021 |
| Elevations | TP3.00 | 04/06/2021 |
| Elevations | TP3.01 | 04/06/2021 |
| Elevations | TP3.02 | 04/06/2021 |
| Elevations | TP3.03 | 04/06/2021 |
| Elevations | TP3.04 | 04/06/2021 |
| Elevations | TP3.05 | 04/06/2021 |
| Elevations | TP3.06 | 04/06/2021 |
| Section A-A | TP4.01 | 04/06/2021 |
| Section B-B | TP4.02 | 04/06/2021 |
| Section C-C | TP4.03 | 04/06/2021 |
| Section D-D | TP4.04 | 04/06/2021 |
| Section E-E | TP4.05 | 04/06/2021 |
| Section F-F | TP4.06 | 04/06/2021 |

| | | |
|---|---|---|
| Section G-G | TP4.07 | 04/06/2021 |
| Section H-H | TP4.08 | 04/06/2021 |
| Section I-I | TP4.09 | 04/06/2021 |
| Section J-J & K-K | TP4.10 | 04/06/2021 |