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Aplus Design Group

93-107 Cecil Ave & 9-10 Roger Ave, Castle Hill

Wind Impact Assessment

30N-24-0299-TNT-91942-0

9 December 2024

Job Title:	93-107 Cecil Ave & 9-10 Roger Ave, Castle Hill
Report Title:	Wind Impact Assessment
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Rev. #	*Comments / Details of change(s) made*	*Date*	*Revised by:*
Rev. 00	Original issue	06 Dec 2024	

Executive Summary

Aplus Design Group commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the the proposed development at **93-107 Cecil Ave & 9-10 Roger Ave, Castle Hill.** This appraisal is based on Vipac's experience as a wind-engineering consultancy.

Drawings of the proposed development were provided by **A+ Design Group** in **December 2024**.

The findings of this study can be summarized as follows:

With proposed design:

- Wind conditions in the ground level footpath areas and access ways would be expected to be within the **walking** comfort criterion **with the recommendations**;
- The main entrances would be expected to be within the **standing** comfort criterion;
- The communal open spaces would be expected to be within the recommended **walking** comfort criterion **with the recommendations**.
- The wind conditions are expected to fulfil safety 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 is highly recommended.

The assessments provided in this report have been made based on experience of similar situations. 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.

Table of Contents

1 Introduction

Vipac Engineers and Scientists has been commissioned by **Aplus Design Group** to carry out an appraisal of the pedestrian wind effects of the proposed development at **93-107 Cecil Ave & 9-10 Roger Ave, Castle Hill.**

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 is comprised of 4 buildings split into stages – Stage 1 with 2 buildings at 12.8m and 70.4m; Stage 2 with 1 building at 89.6m; and Stage 3 with 1 building at 19.2m. The site is bounded by Cecil Avenue to the north east, Roger Avenue to the south and existing developments to the remaining directions. The staging plan of the proposed development and the southern elevation of the building 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 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 **A+ Design Group** in **December 2024**. A list of drawings supplied is provided in Appendix C of this report.

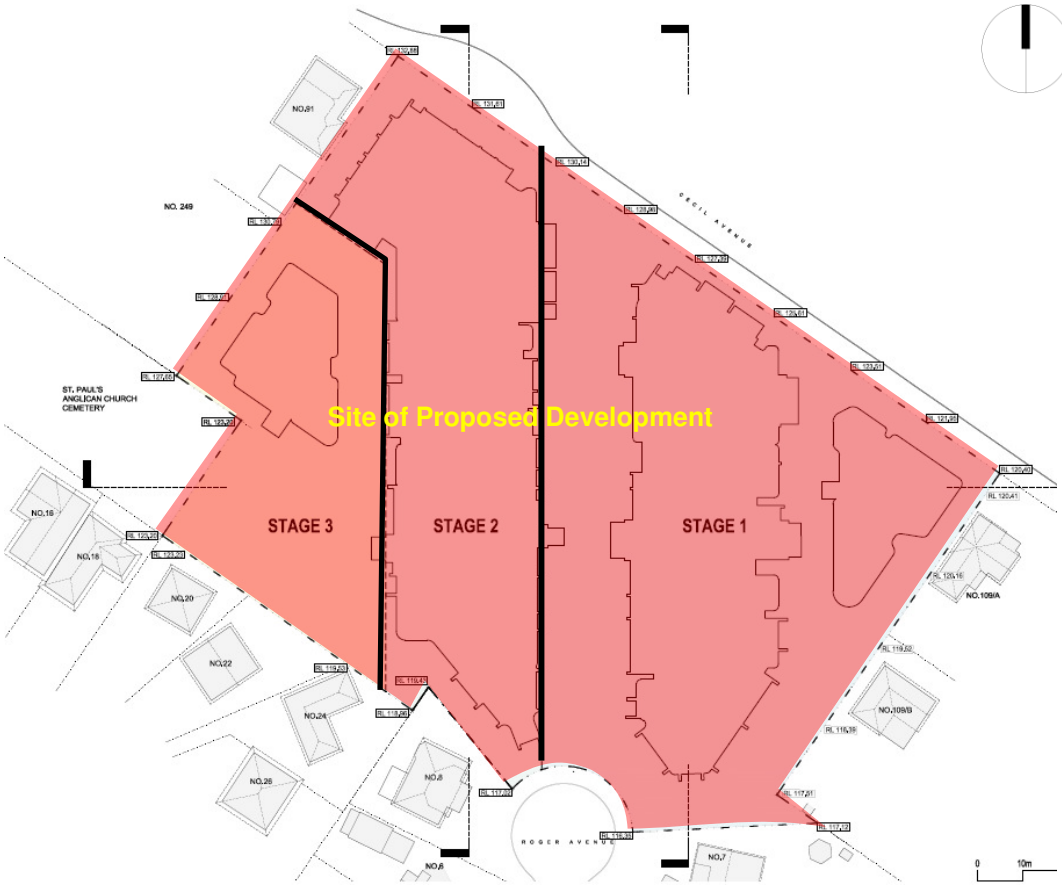


Figure 1: Staging plan of the proposed development.

Figure 2: Southern elevation of the proposed development.

2 Analysis Approach

In assessing whether a proposed development is likely to generate adverse wind conditions in ground level footpath areas, Vipac has considered the following 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; and
- 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 gust and mean wind speeds with a probability of once per year and 5% expected at that location. The location may be deemed generally acceptable for its intended use while gust and mean wind speeds are 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. 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 a relatively hilly terrain. The site is surrounded within an approximately 5.6km radius predominately by low to mid-rise developments. A satellite image showing these site surroundings is shown in Figure 3.

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).

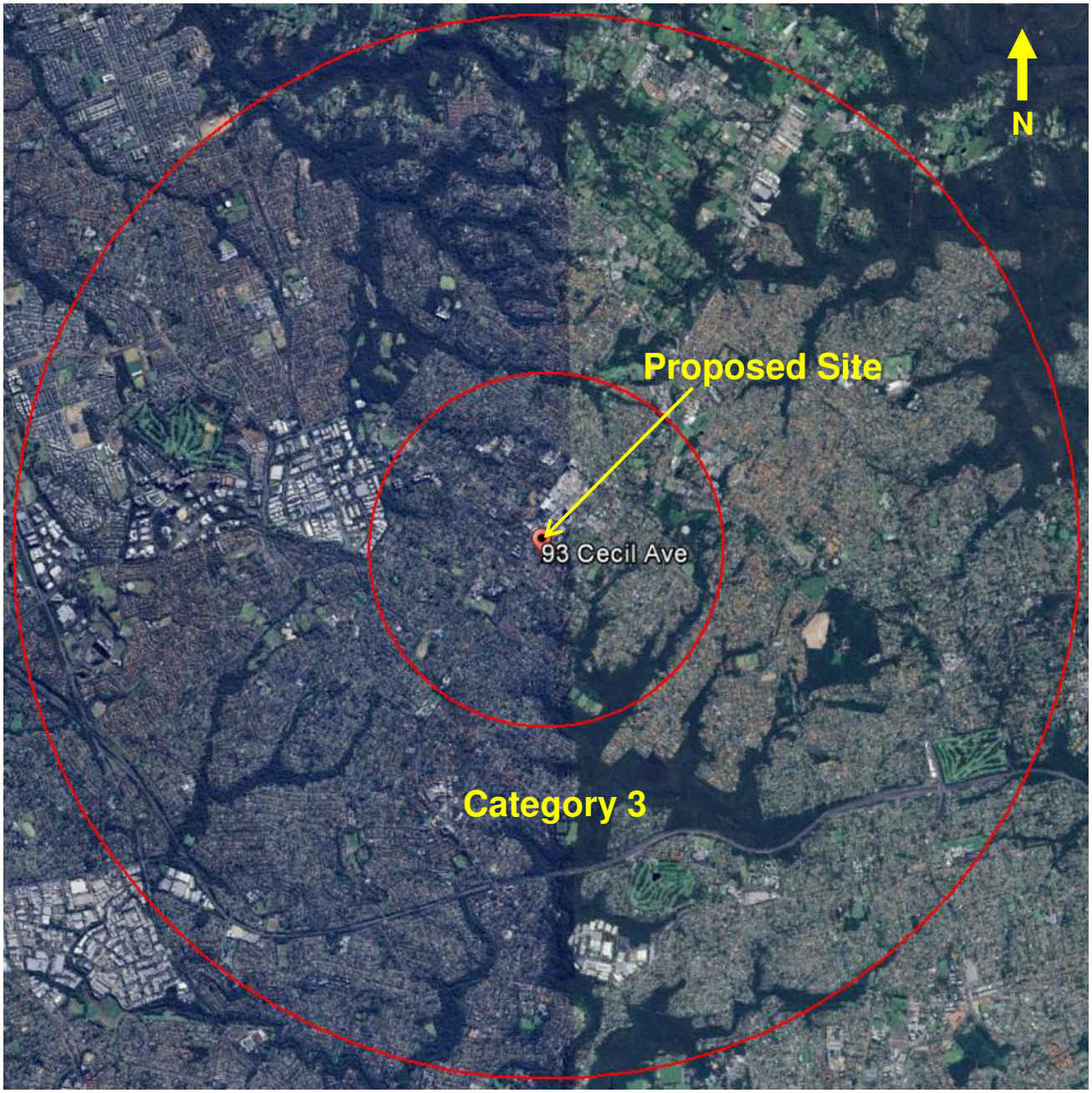


Figure 3: Assumed terrain categories for wind speed estimation.

2.2 Regional Wind Climate

The mean and gust wind speeds have been recorded in Bankstown Wind Station WS_066137 (the wind station recommended by some Councils in non-coastal areas of Sydney) for over 20 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 once per year (i.e. 1 year return period) and with a probability of occurring 5% of the time are shown in Figure 4. The wind data at this free stream height is common to all Castle Hill sites and may be used as a reference to assess pedestrian level wind conditions at the development site.

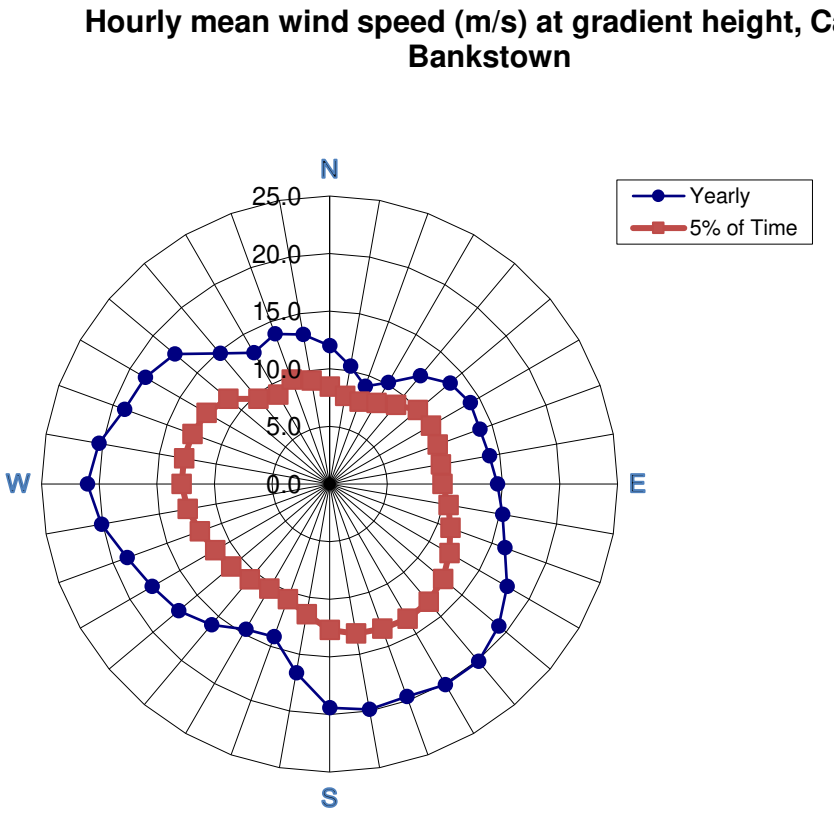


Figure 4: Directional Distribution of Mean Hourly Wind Velocities (m/s) of Annual Return Period and 5% of time at the gradient height for Castle Hill (data from Bankstown Wind Station).

2.3 Building Geometry and Orientation

The proposed development is comprised of 2 high-rise and 2 low-rise buildings. The overall dimensions are approximately 116m x 162m as shown in Figure 5. The development incorporates tower setback design for the two tallest developments.

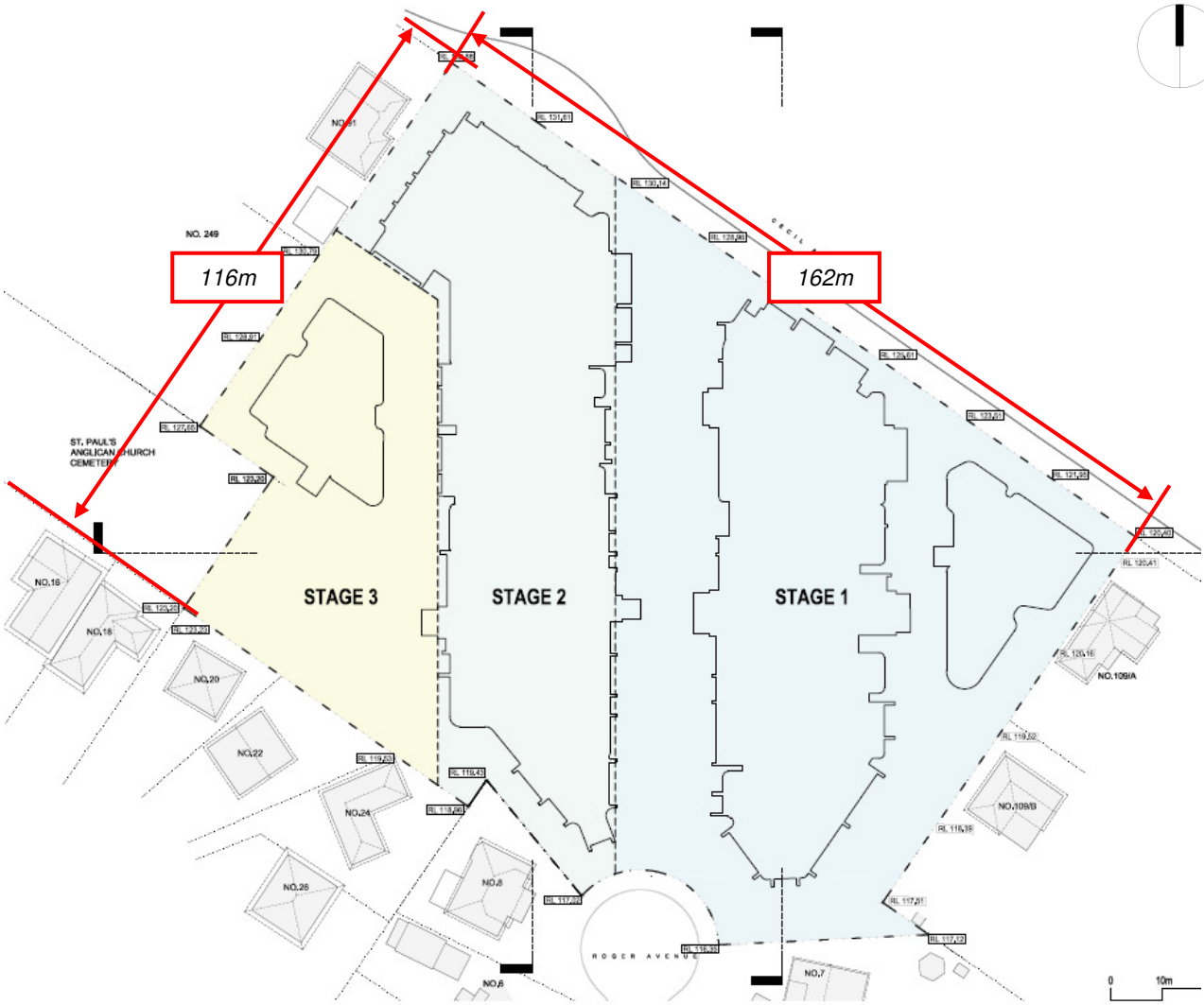


Figure 5: Staging plan with the overall dimensions overlaid.

2.4 Flow interactions with Adjacent Developments

The immediately adjacent developments are shown in Figure 6. At ground level, the site is exposed to direct winds from the northerly westerly direction channelling along Cecil Avenue. The building is oriented such that adverse impacts from corner acceleration is expected at ground level. The development is taller than the surrounding buildings and so is exposed to winds from all directions at the upper levels.

Figure 6: Immediately adjacent surroundings and their approximate number of floors (F).

2.5 Assessment Criteria

The wind requirement from the North Sydney DCP (p2 in 2.3.3 – wind speeds) states that the development should not result in wind speed exceeding 13 m/s at footpaths and accessible outdoor spaces. However, neither probability of exceedance (once per year, 0.1% of time, etc) nor the definitions (gust, mean, or GEM, etc) are specified to the 13 m/s wind speed. As such, it is difficult to assess wind conditions against this requirement.

Therefore, the wind comfort criteria from the Central Sydney Planning Strategy (for 2016-2036, updated in May 2023) has been applied to this study. We believe that these criteria are feasible and have similar gauge effect to the North Sydney DCP 2.3.3. 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 each wind direction.	Acceptable for **walking** (steady steps for most pedestrians)
Hourly ***mean*** wind speed, 5% of the time, **≤6m/sec,** for each wind direction.	Acceptable for **standing** (wind shopping, vehicle drop off)
Hourly ***mean*** wind speed, 5% of the time. **≤4m/sec,** for each wind direction.	Acceptable for **sitting** (outdoor cafes, gardens, park benches)

**Note: Hourly Mean wind speed is the maximum of mathematical mean or Gust equivalent mean (Gust divided by 1.85).*

The wind speed assessment is undertaken for winds occurring between 6am and 10pm (AEST).

2.5.1 Use of Adjacent Pedestrian Occupied Areas & Recommended Comfort Criteria

The consideration of the (intended) function of the environment heavily influences the appropriateness of the recommended wind comfort criteria. For example, people frequenting locations such as parks are will likely tolerate a windier environment when compared to people dining at an outdoor café.

This is partly due to the pedestrian's judgement in clothing and predetermined expectation of the wind environment and partly due to the sensitivity of their activities to wind. For example, patrons at outdoor dining areas are highly sensitivity to wind due to the stationary nature of the activity; whereas pedestrians on the public footpaths may maintain a level of comfort under otherwise uncomfortable conditions by partaking in general activities performed on the footpath such as walking.

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

Table 2: Recommended application of criteria

Area	**Specific location**	**Recommended Criteria**
Public Footpaths, Access ways	Along Cecil Avenue, Roger Avenue and central thoroughfare (Figure 7 to Figure 9)	Walking
Building Entrances	Main building entrances throughout site (Figure 7 to Figure 9)	Standing
Outdoor Communal Areas	Levels 4, 10, 11, 12, 15, 16 & 19 (Figure 9 to Figure 12)	Walking
Balcony/Terraces	Up the height of the building	Walking (See discussion below)

2.5.2 Terrace / Balcony Recommended Criterion Discussion

There are Private Balconies and Terraces located up the height of the development. Vipac recommends as a minimum that balcony/terrace areas meet the criterion for walking since:

- these areas are not public spaces;
- the use of these areas is optional, and only intended to be used on fair weather days with calm winds;
- residents at private open spaces can chose to retreat indoors during uncomfortable wind conditions, whiel a pedestrian or person using a public area may not have this option.
- 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.

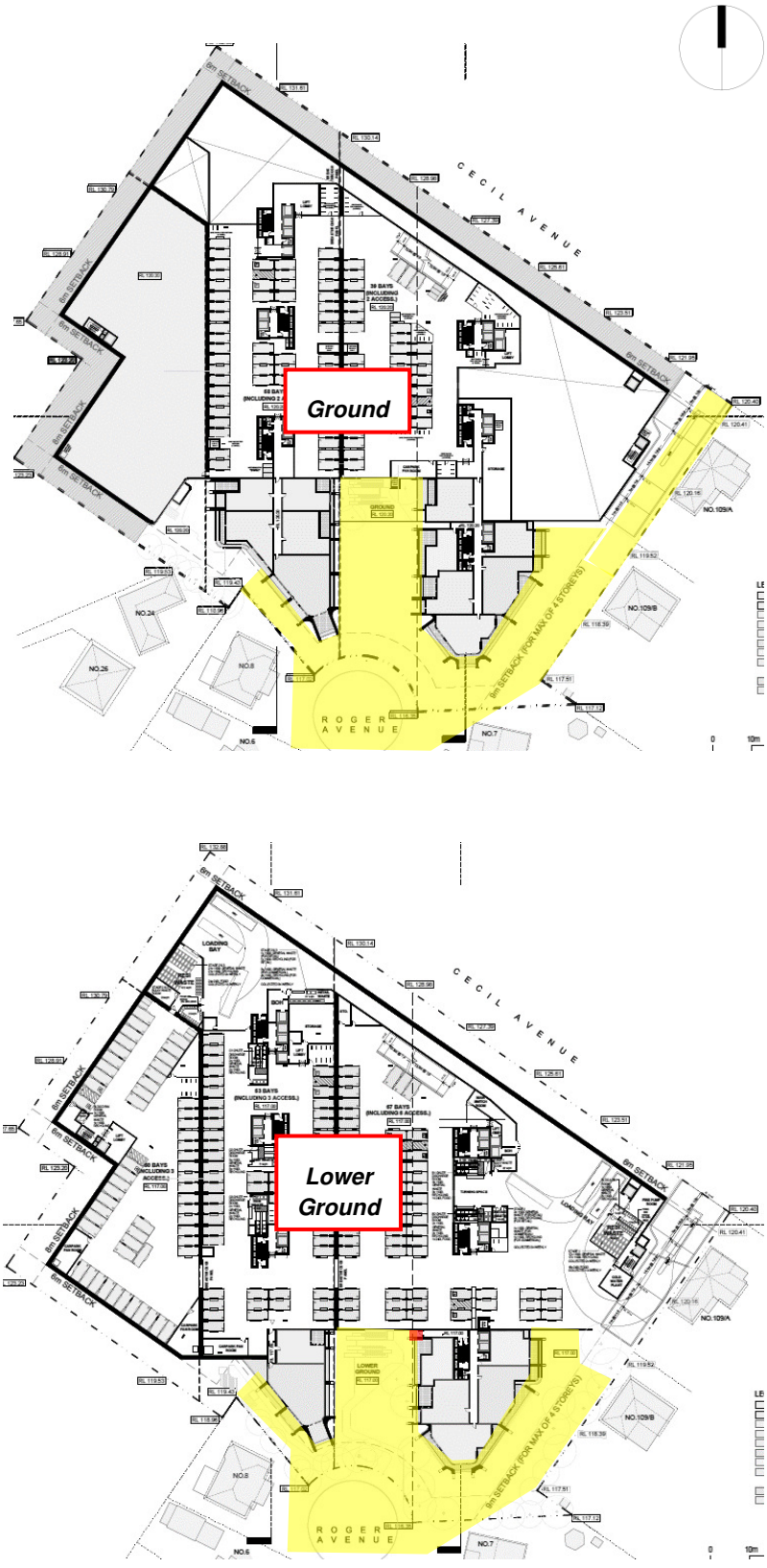


Figure 7: Lower Ground (bottom) and Ground (top) floor plans with recommended wind criteria overlaid.

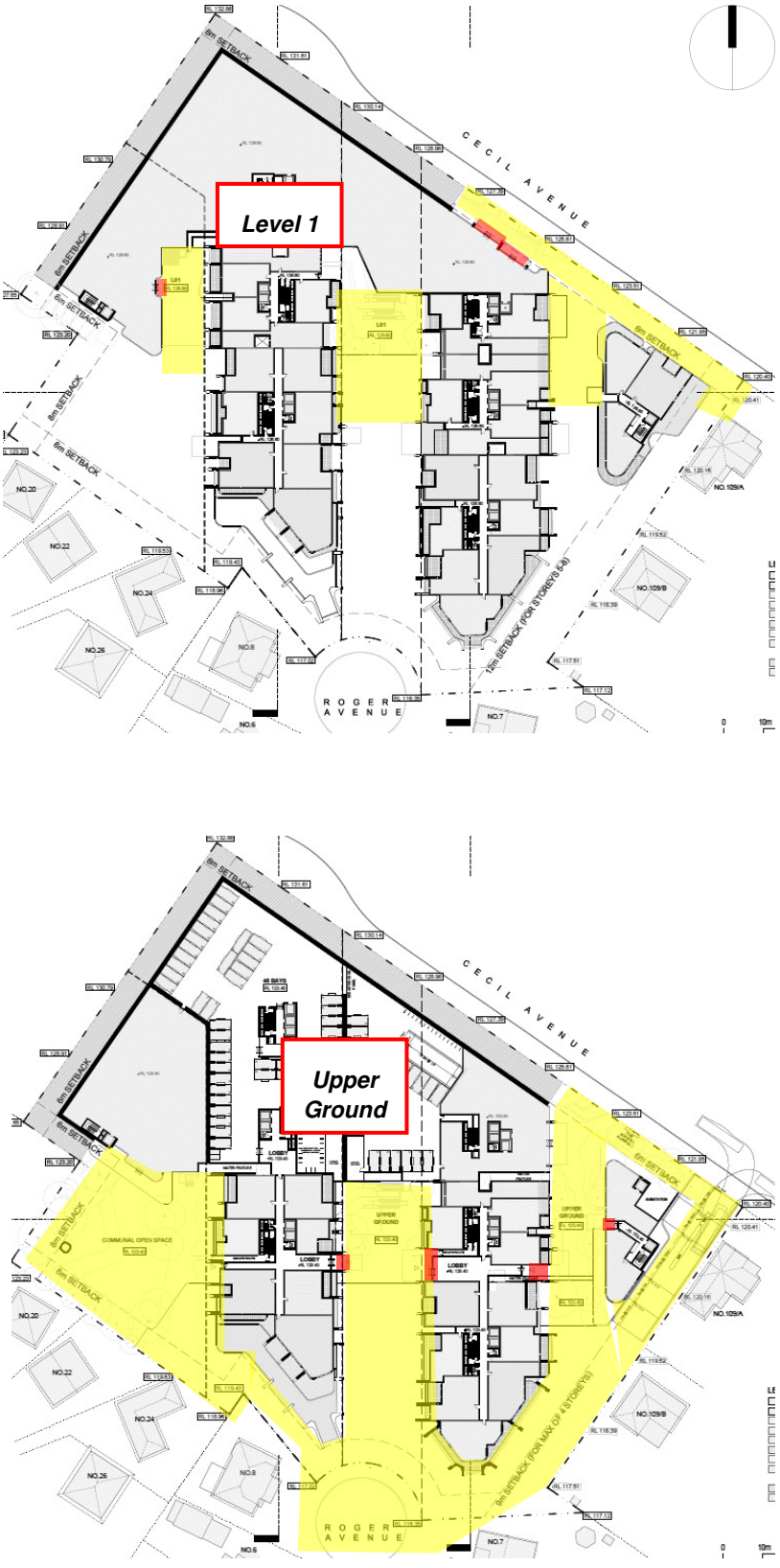


Figure 8: Upper Ground (bottom) and Level 1 (top) floor plans with recommended wind criteria overlaid.

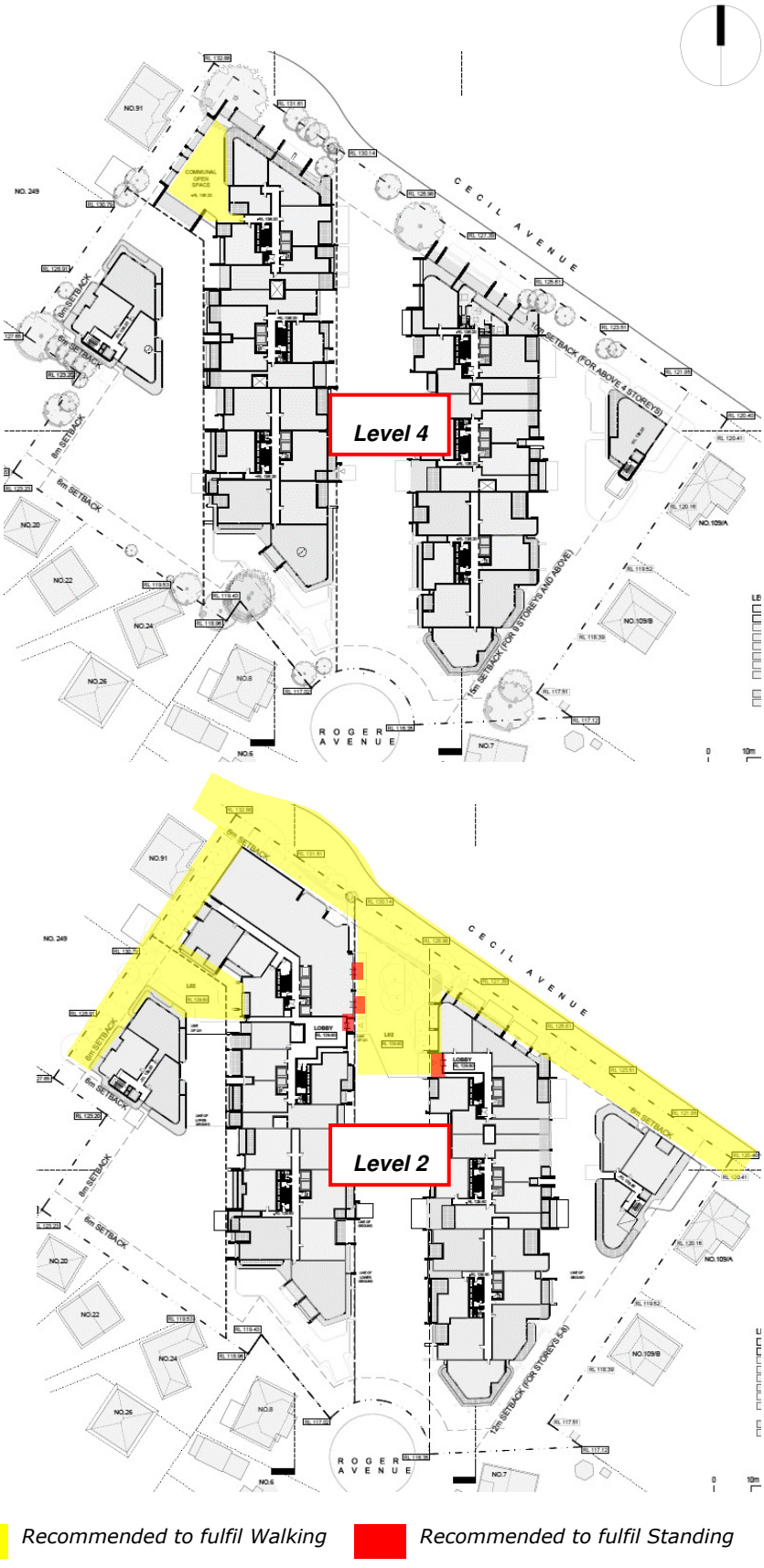


Figure 9: Level 2 (bottom) and Level 4 (top) floor plans with recommended wind criteria overlaid.

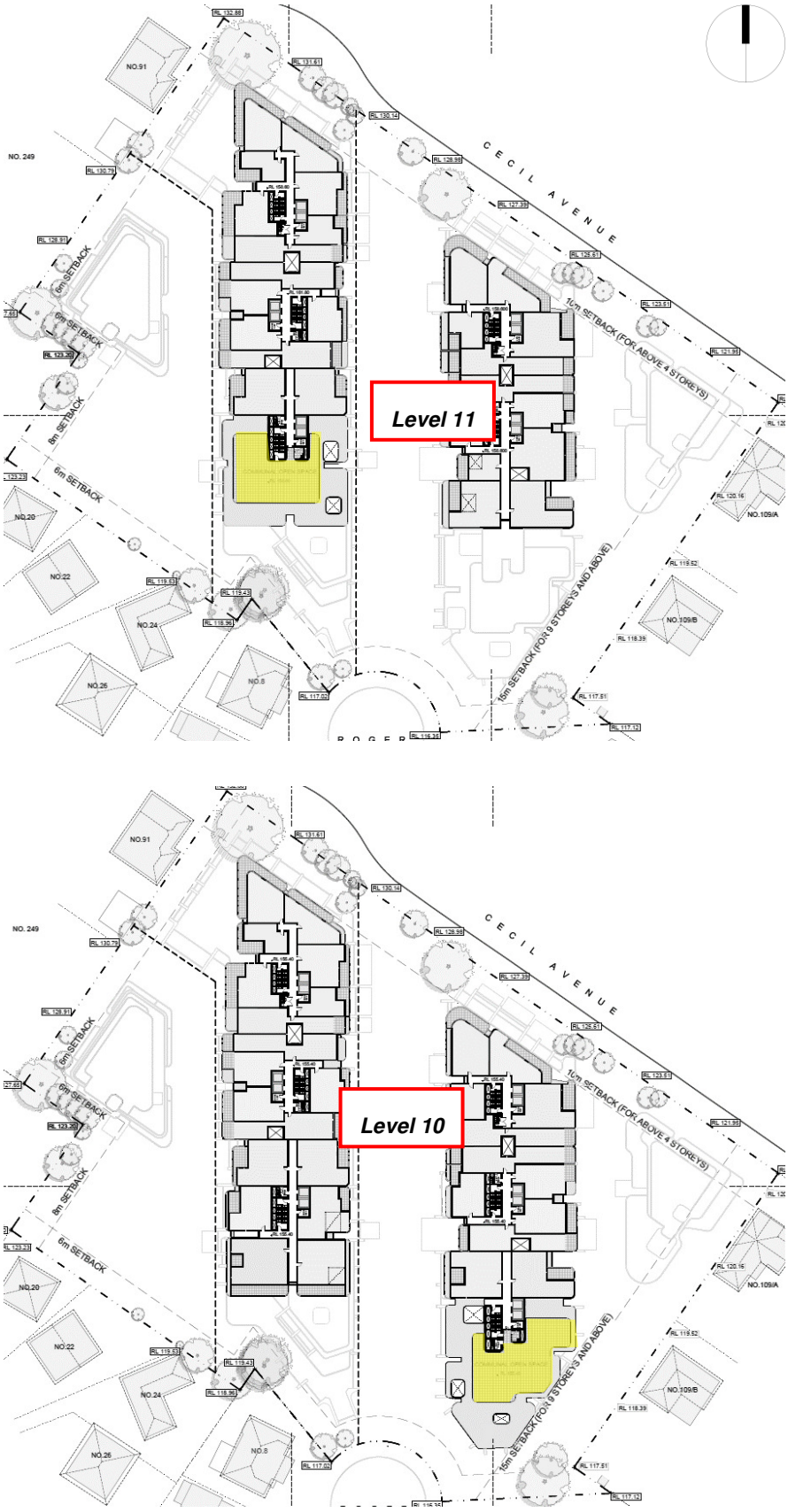
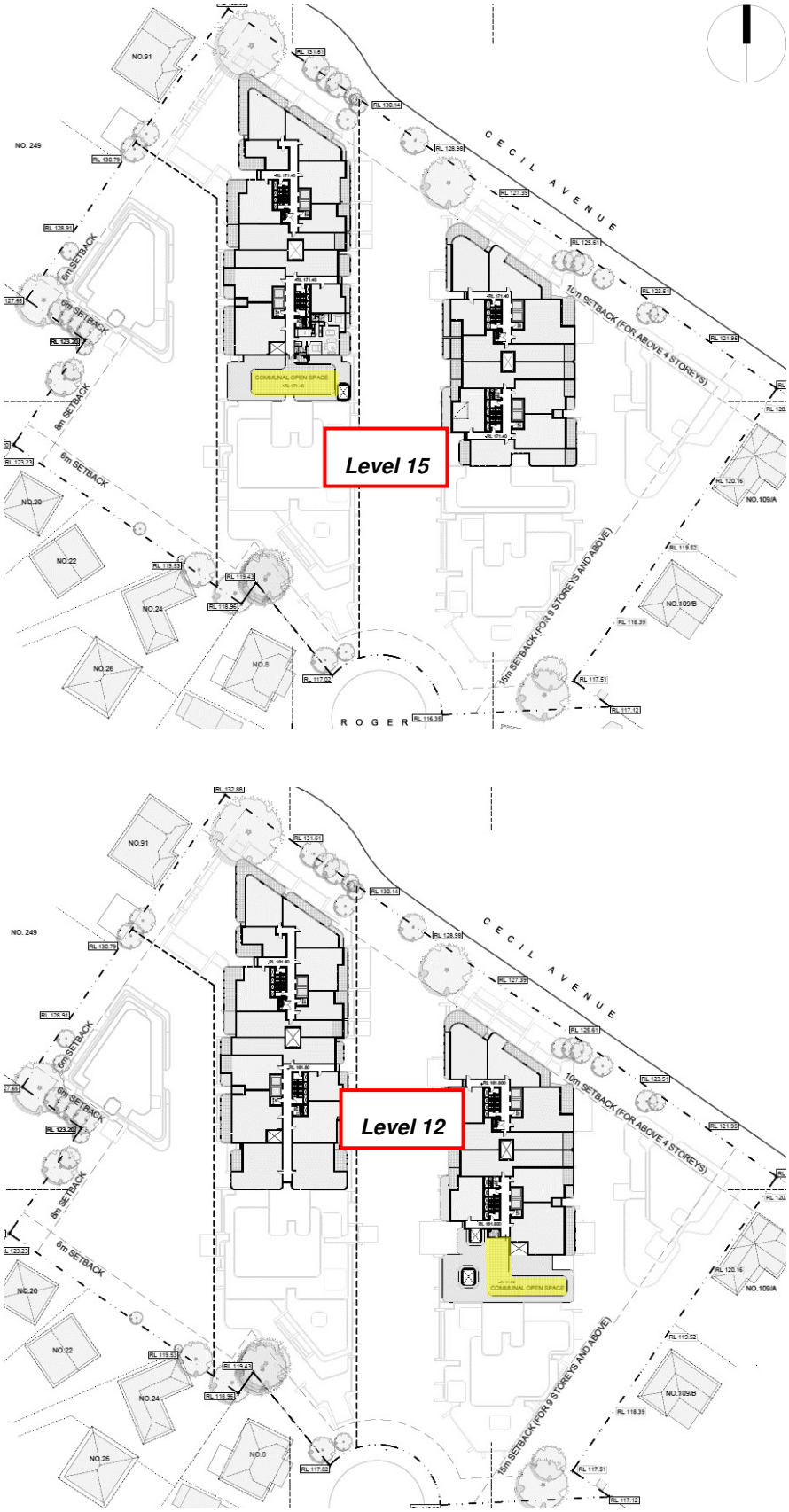


Figure 10: Level 10 (bottom) and Level 11 (top) floor plans with recommended wind criteria overlaid.



Recommended to fulfil Walking

Figure 11: Level 12 (bottom) and Level 15 (top) floor plans with recommended wind criteria overlaid.

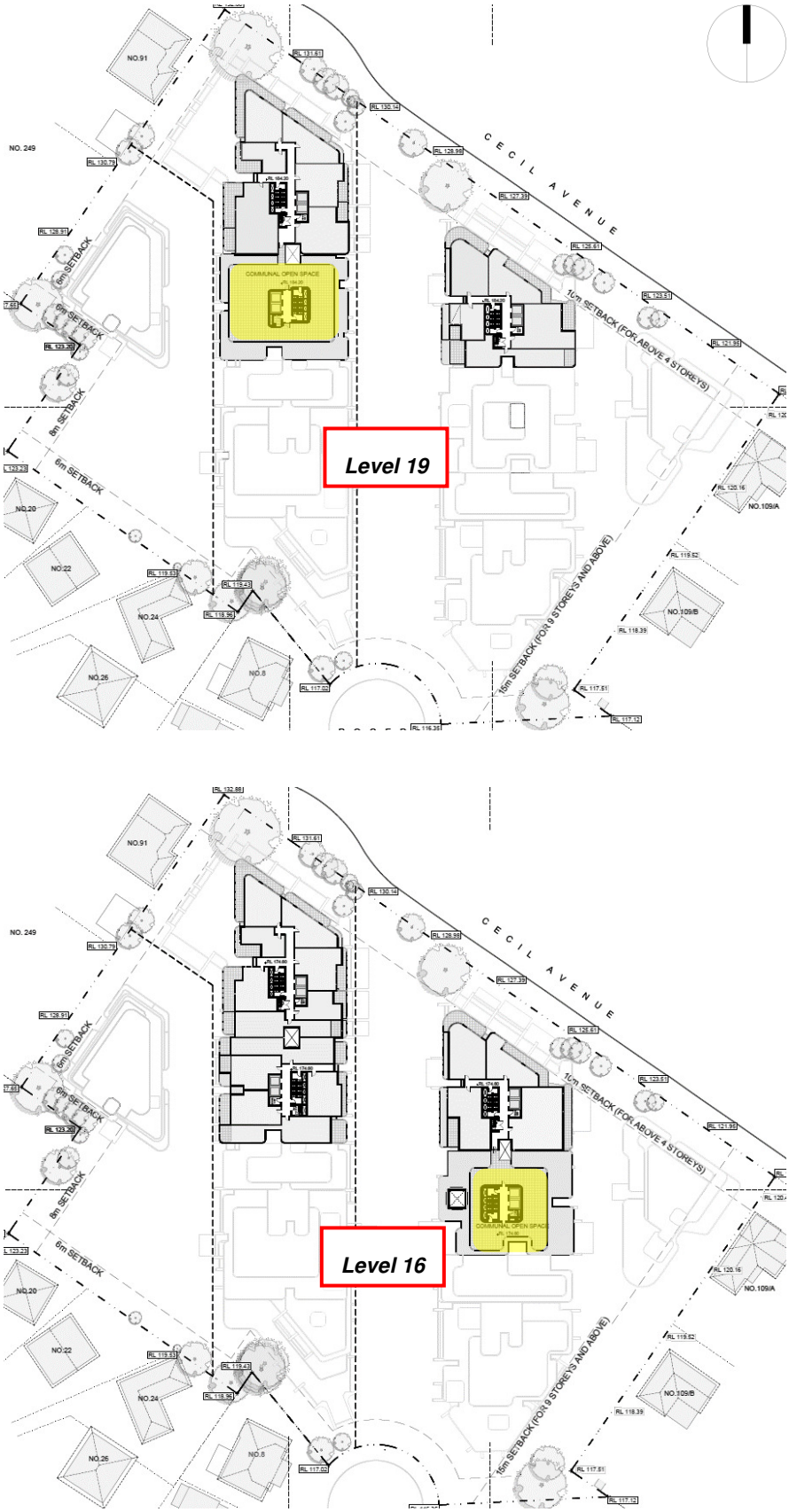


Figure 12: Level 16 (bottom) and Level 19 (top) floor plans with recommended wind criteria overlaid.

3 Pedestrian Level Wind Effects

3.1 Ground Level

The proposed design has a number of features that are expected to be beneficial to the pedestrian wind environment. This is inclusive but not limited to the following:

- Tower setback design for all four developments;
- Extensive colonnades along the two high developments in Stage 1 and Stage 2;
- Canopies along the two high developments in Stage 1 and Stage 2;
- Rounded / chamfered building corners; and
- Setback to entrances.

Due to the proposed height above the surrounding areas, the proposed development is particularly exposed to adverse winds from the dominant wind directions channelling in between the two high developments in Stage 1 and Stage 2. Such that high wind levels are expected along the central pedestrian link. As such, arbour structures (40% porosity) are proposed over this area (Figure 13).

Some elevated wind levels are predicted at the north-western corner of the Stage 2 building. However, the tower setback design from Level 4, in combination with shielding received from neighbouring developments, are expected to be beneficial. Such that wind speeds are expected to be within the recommended walking comfort criterion.

Due to the setback design of all main entrances, wind speeds at these locations are expected to be within the recommended standing comfort criterion.

Figure 13: Level 2 plan with the recommended wind control measures overlaid for the ground level.

3.2 Communal Open Spaces

All the communal open spaces benefit from having relatively small dimensions.

The communal open space on Upper Ground level received relatively high shielding value from the development itself as well as the neighbouring existing developments. As such, wind speeds are expected to be within the recommended walking comfort criterion.

The terraces up the height of the developments have incorporated solid balustrades of varying heights. In general, it is recommended that:

- the level 4 terrace has a minimum 1.2m high solid balustrades (Figure 14);
- the level 10-12 terraces have a minimum 1.5m high solid balustrades (Figure 14); and
- the level 15-18 terraces have a minimum 1.8m high solid balustrades (Figure 14).

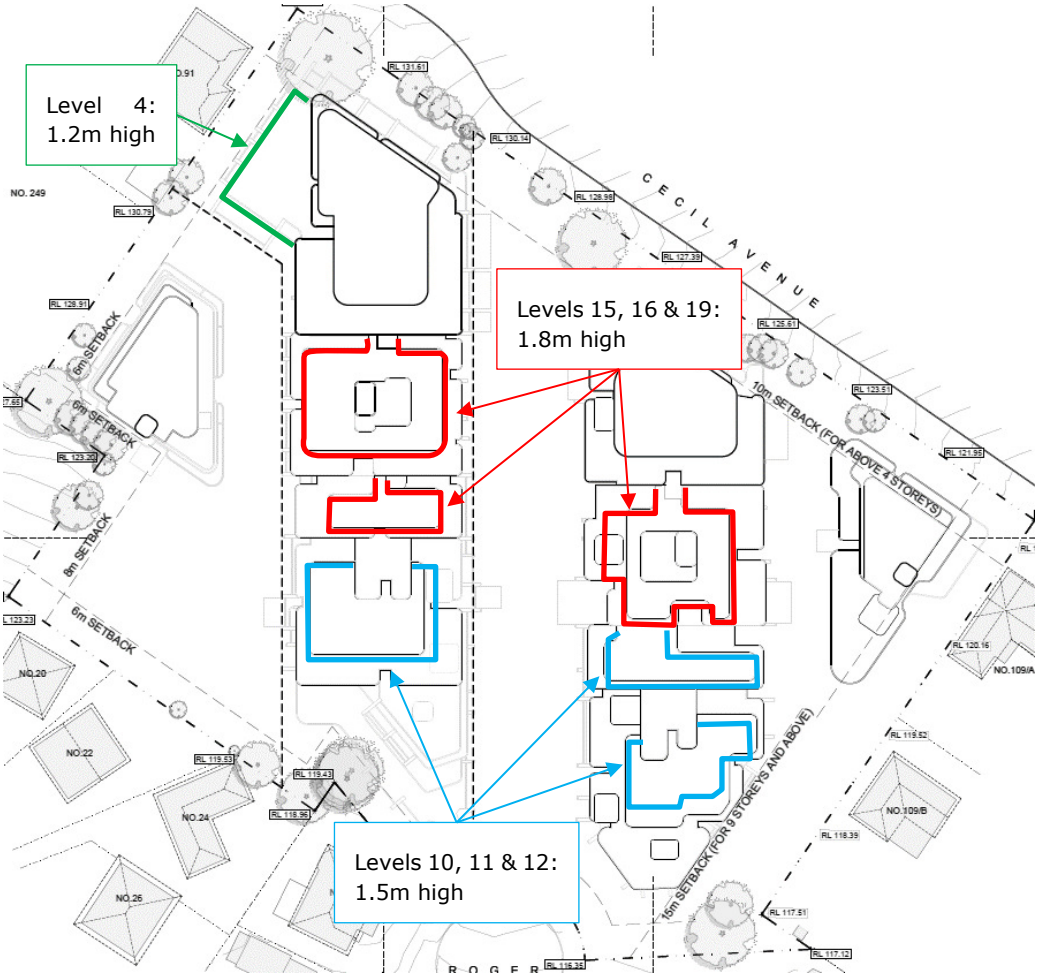


Figure 14: Minimum balustrade heights recommended for the various terraces, overlaid on the roof plan.

The proposed development would be expected to generate wind conditions within the safety criterion.

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

Vipac recommends a scaled wind tunnel study or CFD simulations be conducted at the detail design stage to quantity the wind conditions and determine the proper wind control measures wherever necessary.

4 Conclusions

An appraisal of the likely wind conditions at the pedestrian ground level and terrace areas of the proposed development at **93-107 Cecil Ave & 9-10 Roger Ave, Castle Hill** 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 and access ways would be expected to be within the **walking** comfort criterion **with the recommendations**;
- The main entrances would be expected to be within the **standing** comfort criterion;
- The communal open spaces would be expected to be within the recommended **walking** comfort criterion **with the recommendations**.
- The wind conditions are expected to fulfil safety 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.

Vipac recommends a scaled wind tunnel study or CFD simulations be conducted at the detail design stage to quantity the wind conditions and determine the proper wind control measures wherever necessary.

This Report has been Prepared

For

Aplus Design Group

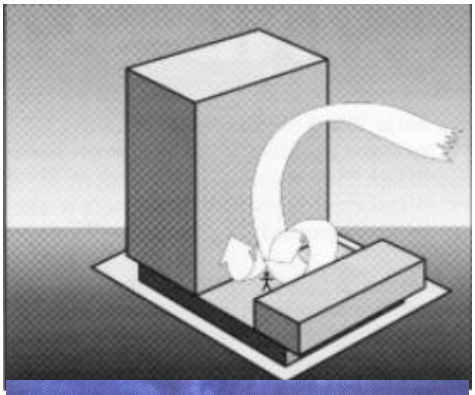
By

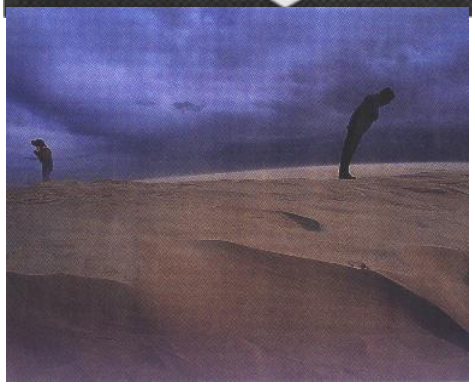
VIPAC ENGINEERS & SCIENTISTS PTY LTD.

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

[4] *The Aerodynamic Characteristics of Windbreaks, Resulting in Empirical Design Rules* J.Gandemer, Publisher: *Journal of Wind Engineering and Industrial Aerodynamics*

[6] *Wind Protection by Model Fences in a simulated Atmospheric Boundary Layer* J.K. Rain, D.C. Stevenson, Publisher: *Journal of Industrial Aerodynamics, 2*

[7] *Criteria for Environmental Wind Conditions* W.H Melbourne, Publisher: *Journal of Wind Engineering and Industrial Aerodynamics*

[8] *Wind Design Guide* J.Bennett Publisher: *BBSC 433 – Architectural Aerodynamics*

[9] *Central City Built Form Review: Wind Assessments*, Global Wind Technology Services

[10] *Wind Guidelines for Planning Applicants* H.Fricke Publisher: *Moonee Valley City Council*

Appendix C Drawings List

Drawings (Issue A) received: **December 2024**

DRAWING LIST

DRAWING NO	REV	DRAWING NAME
A001		DRAWING LIST
A002		DEVELOPMENT SUMMARY
A003		BASIX COMMITMENTS
A004		COMPLIANCE TABLE
A100		**SITE**
A101		LOCATION PLAN
A102		SITE ANALYSIS
A103		SITE PLAN
A104		STAGING PLAN
A105		DEMOLITION PLAN
A106		SETBACK DIAGRAM
A200		**FLOOR PLANS**
A201		BASEMENT 3
A202		BASEMENT 2
A203		BASEMENT 1
A204		LOWER GROUND
A205		GROUND
A206		UPPER GROUND
A207		LEVEL 1
A208		LEVEL 2
A209		LEVEL 3
A210		LEVEL 4
A211		LEVEL 5
A212		LEVEL 6
A213		LEVEL 7
A214		LEVEL 8
A215		LEVEL 9
A216		LEVEL 10
A217		LEVEL 11
A218		LEVEL 12
A219		LEVEL 13
A220		LEVEL 14
A221		LEVEL 15
A222		LEVEL 16
A223		LEVEL 17
A224		LEVEL 18
A225		LEVEL 19
A226		LEVEL 20
A227		LEVEL 21 - 25
A228		LEVEL 26
A229		ROOF
A301		NORTH ELEVATION (CECIL AVENUE)
A302		SOUTH ELEVATION
A303		EAST ELEVATION
A304		WEST ELEVATION
A305		INTERNAL EAST & WEST ELEVATION - THROUGH SITE LINK
A306		INTERNAL ELEVATION - BUILDING A, D