WINDTECH

PEDESTRIAN WIND ENVIRONMENT STATEMENT

EPPING TOWN CENTRE, EPPING

WG203-04F03(REV3)- WS REPORT

APRIL 29, 2024

Prepared for:

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DOCUMENT CONTROL

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June 21, 2023	Update of previous report (WG203-01F02(rev0), dated October 13, 2021) to include updated drawings and treatments	0	RL	SWR	EV
June 27, 2023	Treatments and minor text updates.	1	RL	SWR	EV
July 26, 2023	Minor text updates.	2	EV	SWR	EV/GC
April 29, 2024	Tower Scheme update.	3	SG	SWR	SL
April 29, 2024	Cover Image update.	4	SG	SWR	SL

EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the Epping Town Centre, located in Epping, on the local wind environment at the critical outdoor areas within and around the subject site. The effect of wind activity has been examined for the three predominant wind directions for the region, namely the north-east, south to south-east, and westerly winds. The analysis of the wind effects relating to the proposed development have been carried out in the context of the local wind climate, building morphology and land topography. This report has been prepared to support a planning proposal and addresses the impact of the proposed increase in building height control on the subject site and the surrounding environment.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the latest architectural drawings. No wind tunnel testing has been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection of the architectural drawings (received April 18, 2024) provided. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

The results of this assessment indicate that the development has incorporated several design features and wind mitigating strategies however, there are some areas that are likely to be exposed to stronger winds. It is expected that the wind effects identified in the report can be ameliorated with the consideration of the following treatment strategies into the design of the development:

- Ground level trafficable areas:
    - Retain proposed north-western landscape area with densely foliating tree and hedge planting within.
    - Inclusion of continuous impermeable awning along Rawson Street frontage on Ground level.
    - Inclusion of an impermeable awning at the base of Tower B along the southern aspect on Ground level.
    - Inclusion of an impermeable awning at the base of Tower A along the western aspect on Ground level.
    - Retain proposed landscape areas with densely foliating tree and hedge planting within the central communal open space on Level 1 and at the entrances into the area.
    - Inclusion of a combination of densely foliating evergreen planting, baffle screening along the arcade entrances to the central open communal open space on the Ground Level.
- Elevated Communal Open Spaces:
    - Retain proposed landscape areas with densely foliating tree and hedge planting within.
    - Inclusion of a perimeter screening to a height of 2-2.5m high in between Towers A and B on Level 4.

- Private balconies and terraces:
    - Full height impermeable screens or full height louvres along one of the exposed aspects of the corner balconies i.e., single aspect design.

The development of the potential future buildings to the north-east and south-south-east of the site is expected to provide significant shielding of the trafficable areas within the development from the prevailing north-east and south-south-east winds.

With the consideration of the above treatment strategies for the final design, it is expected that the proposed development will be able to achieve suitable wind conditions for the various trafficable outdoor areas within and around the development for intended uses, and that the wind speeds will satisfy the applicable criteria for pedestrian comfort and safety. Quantitative wind tunnel testing is planned to be undertaken at a later detailed design stage to quantitatively assess the wind conditions and to verify the necessity of the treatments and optimise the size and extent of the recommendations as required.

CONTENTS

1 INTRODUCTION

An opinion on the likely impact of the proposed design on the local wind environment affecting pedestrians within the critical outdoor areas within and around the subject development is presented in this report. The analysis of wind effects relating to the proposed development has been carried out in the context of the predominant wind directions for the region, building morphology of the development and nearby buildings, and local land topography. The conclusions of this report are drawn from our extensive experience in the field of wind engineering and studies of wind environment effects. This report has been prepared to support a planning proposal and addresses the impact of the proposed increase in building height control on the subject site and the surrounding environment.

No wind tunnel testing has been undertaken for this assessment. Hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection, of the architectural drawings provided (received 18 April 2024 as shown in Table 1), and any recommendations in this report are made only in-principle.

Table 1: List of Architectural Drawings Referenced

Drawing Name	Drawing Number	Date
LOWER GROUND LEVEL PLAN	DA.104	18/04/2024
GROUND LEVEL PLAN	DA.105	18/04/2024
LEVEL 1 PLAN	DA.106	18/04/2024
LEVELS 2 – 3 PLANS	DA.107	18/04/2024
LEVEL 4 - TYPICAL	DA.108	18/04/2024
SECTION	DA.200A	18/04/2024

2 DESCRIPTION OF DEVELOPMENT AND SURROUNDINGS

The site is located at the corner of Carlingford Road and Rawson Street, Epping, and is bounded by Carlingford Road to the north, Rawson Street to the east, an open carpark to the south and low-rise residential buildings to the west. The site lies within the western end of the Epping CBD with a mid-rise residential building across Rawson Street to the east and mid to high rise residential buildings further to the east. Elsewhere surrounding the subject development are predominately low-rise residential and commercial buildings, with Boronia Park to the west and Epping train station to the east-south-east.

A survey of the land topography indicates slopes upwards to the east and west along Carlingford Road and south along Rawson Street of the site.

An aerial image of the subject site and the local surroundings is shown in Figure 1, with the frequency and magnitude of the prevailing winds is superimposed for each wind direction.

The existing site consists of an existing 5 storey high commercial building at 3 Carlingford Road and a 2 storey high Coles supermarket at 53 Rawson Street. The proposed development comprises of two towers, Towers A and B.

The critical outdoor trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are listed as follows:

- Ground Level areas and pedestrian footpath.
- Ground and Level 1, 2 and 4 Communal Open Spaces.
- Private balconies and terraces.

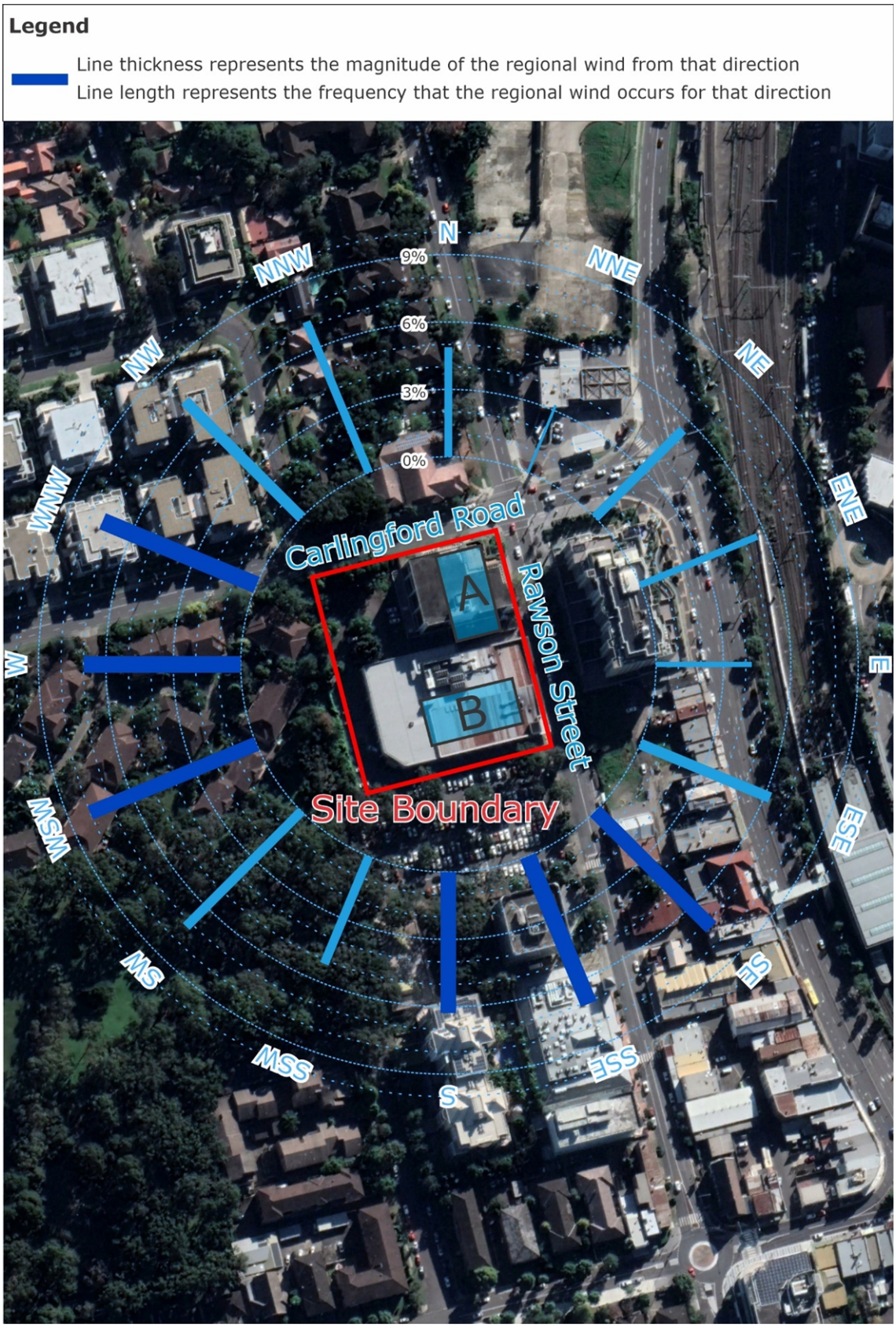

Figure 1: Aerial Image of the Site Location and Prevailing Wind Directions

3 REGIONAL WIND

The Epping region is governed by three principal wind directions that can potentially affect the subject development. These winds prevail from the north-east, south to south-east, and west. These wind directions were determined from an analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained from the meteorological station located at Bankstown Airport by the Bureau of Meteorology (recorded from 1993 to 2016). The data has been corrected to represent winds over standard open terrain at a height of 10m above ground level. The results of this analysis are presented in Figure 2 in the form of a directional plot of the annual and 5% exceedance mean winds for the region. The frequency of occurrence of these winds is also shown in Figure 2.

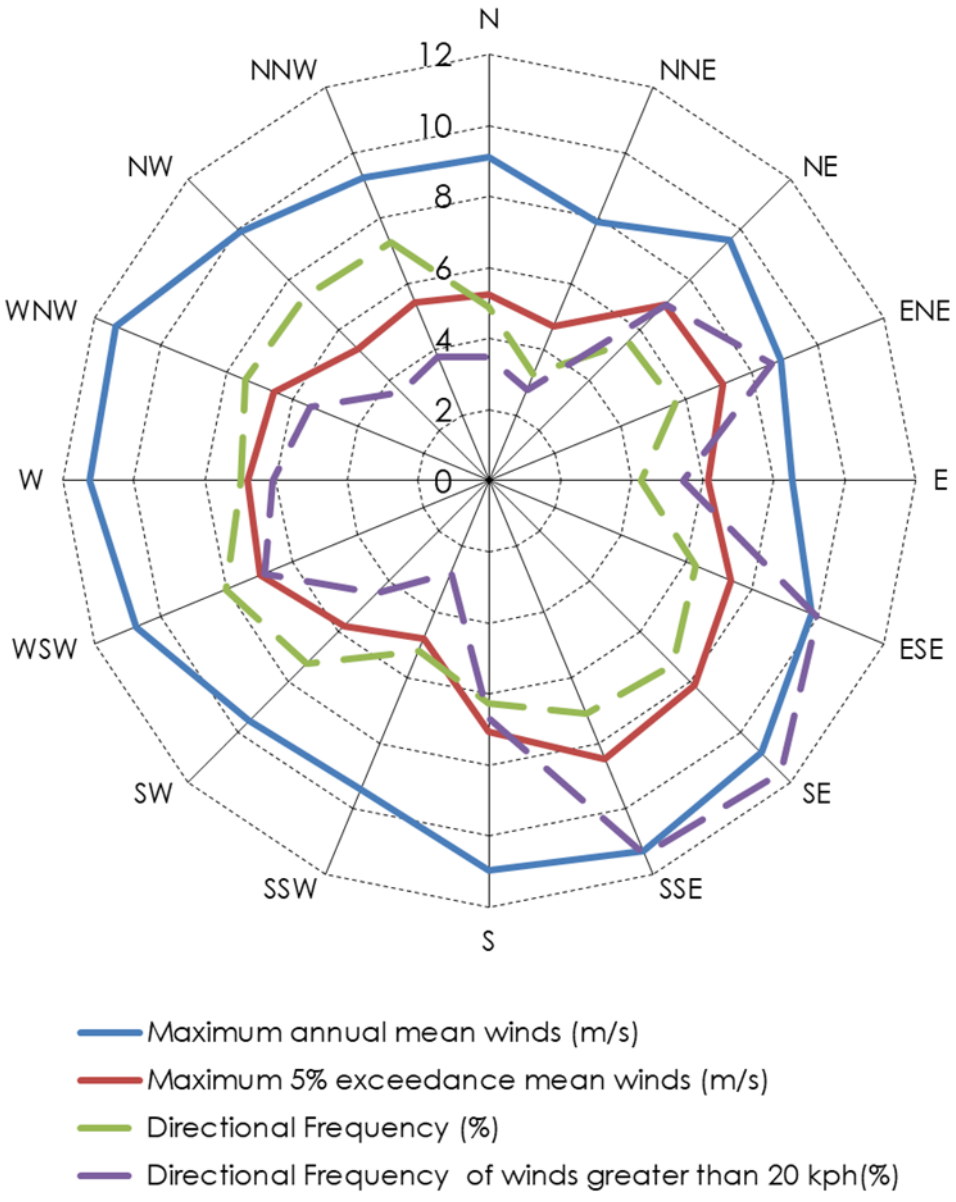

Figure 2: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Epping Region

4 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking, or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Various other researchers, such as A.G. Davenport, T.V. Lawson, W.H. Melbourne, and A.D. Penwarden, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. Some Councils and Local Government Authorities have adopted elements of some of these into their planning control requirements.

For example, A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table 2 presents the modified Beaufort scale. Note that the effects listed in this table refers to wind conditions occurring frequently over the averaging time (a probability of occurrence exceeding 5%). Higher ranges of wind speeds can be tolerated for rarer events.

Table 2: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Mean Wind Speed (m/s)	Effects
Calm	0	Less than 0.3	Negligible.
Calm, light air	1	0.3 – 1.6	No noticeable wind.
Light breeze	2	1.6 – 3.4	Wind felt on face.
Gentle breeze	3	3.4 – 5.5	Hair is disturbed, clothing flaps, newspapers difficult to read.
Moderate breeze	4	5.5 – 8.0	Raises dust, dry soil and loose paper, hair disarranged.
Fresh breeze	5	8.0 – 10.8	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.8 – 13.9	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant.
Near gale	7	13.9 – 17.2	Inconvenience felt when walking.
Gale	8	17.2 – 20.8	Generally impedes progress, difficulty balancing in gusts.
Strong gale	9	Greater than 20.8	People blown over.

It should be noted that wind speeds affecting this particular development can only be accurately quantified with a wind tunnel study. This assessment addresses only the general wind effects and any localised effects that are identifiable by visual inspection and the acceptability of the conditions for outdoor areas are determined based on their intended use. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

5 RESULTS AND DISCUSSION

The expected wind conditions affecting the development are discussed in the following sub-sections of this report for the various outdoor areas within and around the subject development. The interaction between the wind and the building morphology in the area is considered and important features taken into account including the distances between the surrounding buildings and the proposed building form, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report. A glossary of the different wind effects described in this report included in Appendix A.

For this assessment, the wind speed criteria for pedestrian comfort that are considered are listed as follows:

- Comfortable Walking Criterion (7.5m/s to 8m/s with a 5% probability of exceedance) for general circulation and pedestrian thoroughfares, e.g. footpaths, private balconies/terraces, through-site links etc.

- Short Exposure Criterion (5.5m/s to 6m/s with a 5% probability of exceedance) for stationary activities generally less than an hour, e.g. waiting areas, communal terraces, main entries, café seating etc.

Note that the lower end of the above ranges reflect the Davenport (1972) criteria and the upper end of these ranges reflect a modified Lawson (1975) criteria. Although this assessment is qualitative in nature, the abovementioned criteria for pedestrian comfort are considered when assessing the wind environment impacts. However, all areas are also assessed with consideration to a pedestrian safety criterion of 23m/s for the annual maximum gust.

5.1 Ground Level Areas

The pedestrian footpath along Carlingford Road is primarily exposed to the north-easterly and westerly prevailing winds. The strength of these winds flowing along Carlingford Road is expected to be reduced due to the setback of the Tower A from the podium along the northern aspect. The western aspect of Tower A is expected to cause some downwash flows from the prevailing westerly winds while the downwash from the northern aspect from north-easterly winds is deflected by the proposed setback of the tower along the Carlingford Road aspect. As a result, the wind conditions along Carlingford Road are expected to remain suitable and/or equivalent to the existing conditions. It is recommended to retain the Tower A setback along the Carlingford Street frontage.

The pedestrian footpath along Rawson Street is exposed to the north-easterly and south to south-easterly prevailing winds. Due to the open area to the south of Tower A and arcade entrances at the north-east of the site, the north-easterly winds are expected to flow directly across Rawson Street and into the connecting central communal area. The inclusion of Tower B is also expected to increase the strength of the north-easterly and south to south-easterly winds flowing along Rawson Street by increasing the funnelling effect. The prevailing south to south-easterly winds are also expected to impact the southern aspect of Tower B and downwash into the southern aspect pedestrian footpath. Downwash winds are also expected to impact the footpath along the Rawson Street frontage. It is recommended to include an impermeable awning along the southern aspect of Tower B and along the eastern podium at the ground level to deflect these down washed winds.

The arcade entrances into the central plaza are aligned to the prevailing wind directions and as such exposed to direct and funnelled winds. The western entrance into the central plaza area is exposed to the direct westerly winds. The proposed landscaped area at the north-western corner of the site on the lower ground level and the plaza at ground level is expected to assist in mitigating these winds as they flow towards the communal spaces and arcades. It is recommended to retain these proposed landscaping areas and to include densely foliating evergreen tree and hedge planting within them to slow winds flowing through the entrance and into the central communal area.

The north-eastern, and south-eastern arcade entrances are also similarly exposed to the direct prevailing north-easterly and south to south-easterly winds which are expected to flow directly through the entrances into the central plaza area creating adverse wind conditions within the entrances. Due to the height of the building form above and the alignment of these arcades, it is recommended to include a combination of densely foliating evergreen planting, baffle screening within the arcade to reduce the funnelling winds.

The central plaza area is exposed to direct winds and funnelling winds from the north-eastern, south-eastern, and western entrances leading into it. The abovementioned treatments recommended to mitigate the expected adverse winds within the arcades is also expected to assist the wind conditions at the central plaza area.

The abovementioned treatments are shown in Figures 3 and 4 below.

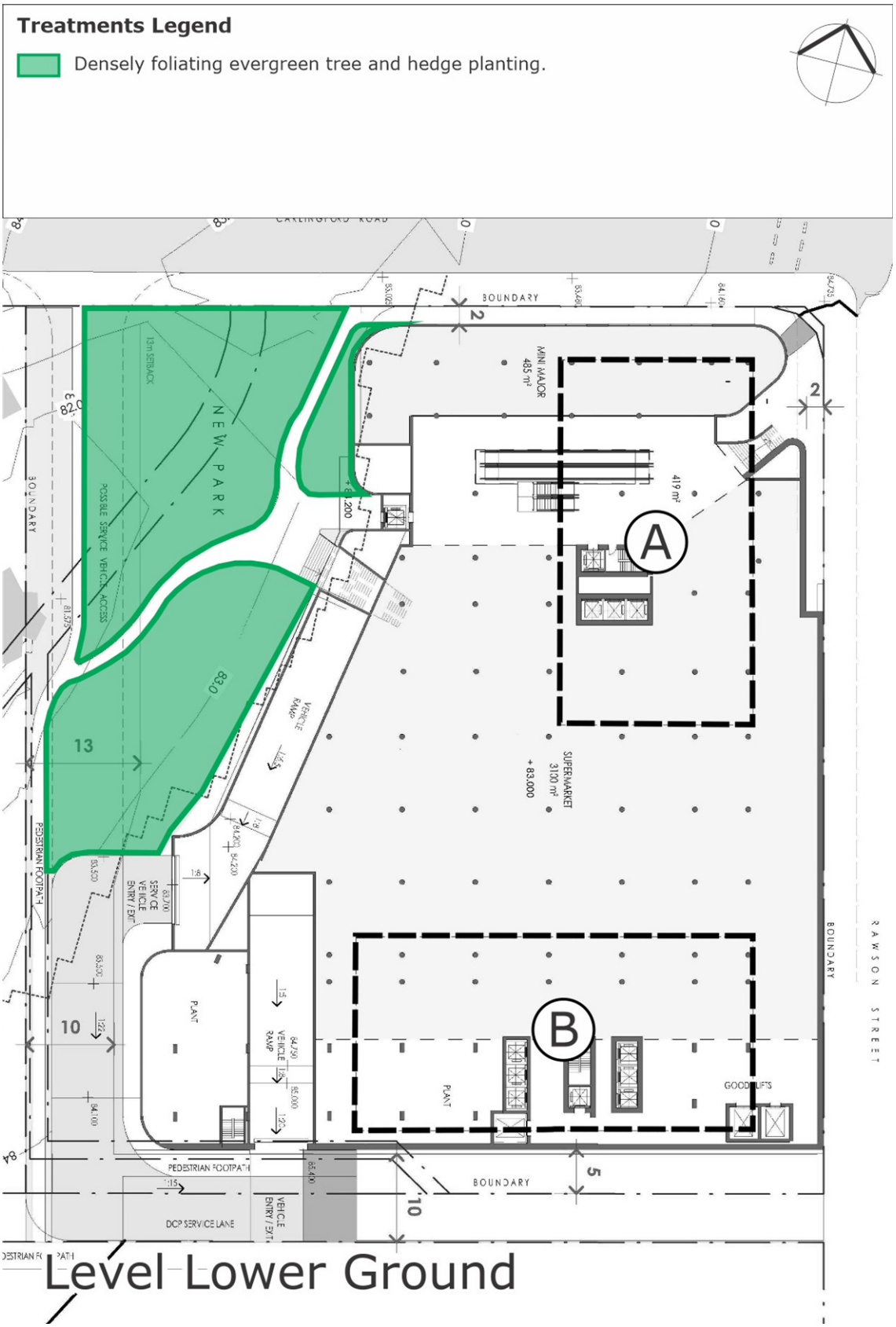

Figure 3: Recommended Treatment for the Lower Ground Level

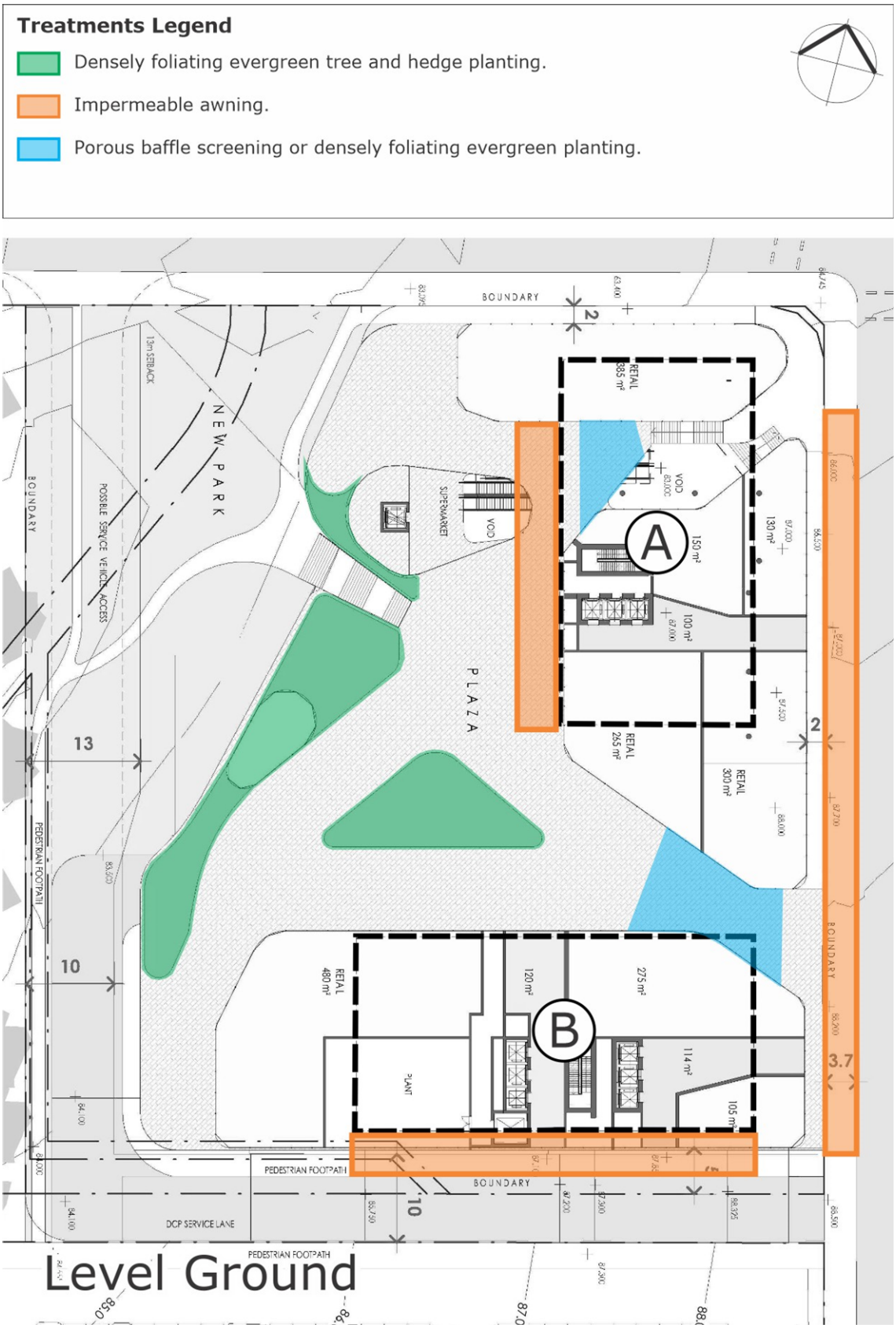

Figure 4: Recommended Treatment for Ground Level

5.2 Elevated Communal Open Spaces

The communal open spaces are located in between Tower A and B on Level 1, the westerns side of Tower B on Level 2 and the eastern aspect of the development on Level 4. These communal open spaces are exposed to direct prevailing winds, which are expected to funnel between the towers. The proposed landscaping within these areas is expected to assist in mitigating these wind effects however, the perimeter screening is minimal and the direct and funnelling winds are expected to flow over and through these spaces, notably in between Towers A and B on Level 4. It is recommended to retain the proposed landscaping areas and to include within these areas densely foliating evergreen tree and hedge planting to slow winds flowing through the area. Additionally, it is recommended to include a 2-2.5m high impermeable screen along the perimeter in between Towers A and B on Level 4 to deflect winds up and over this open spaces.

For the proposed landscaping to be effective as a wind mitigation device, they should be of a densely foliating variety. The planting should be spaced such that the foliage is able to interlock between plants (where possible) to ensure its effectiveness during stronger winds. The abovementioned treatments are shown in Figures 5, 6 and 7 below.

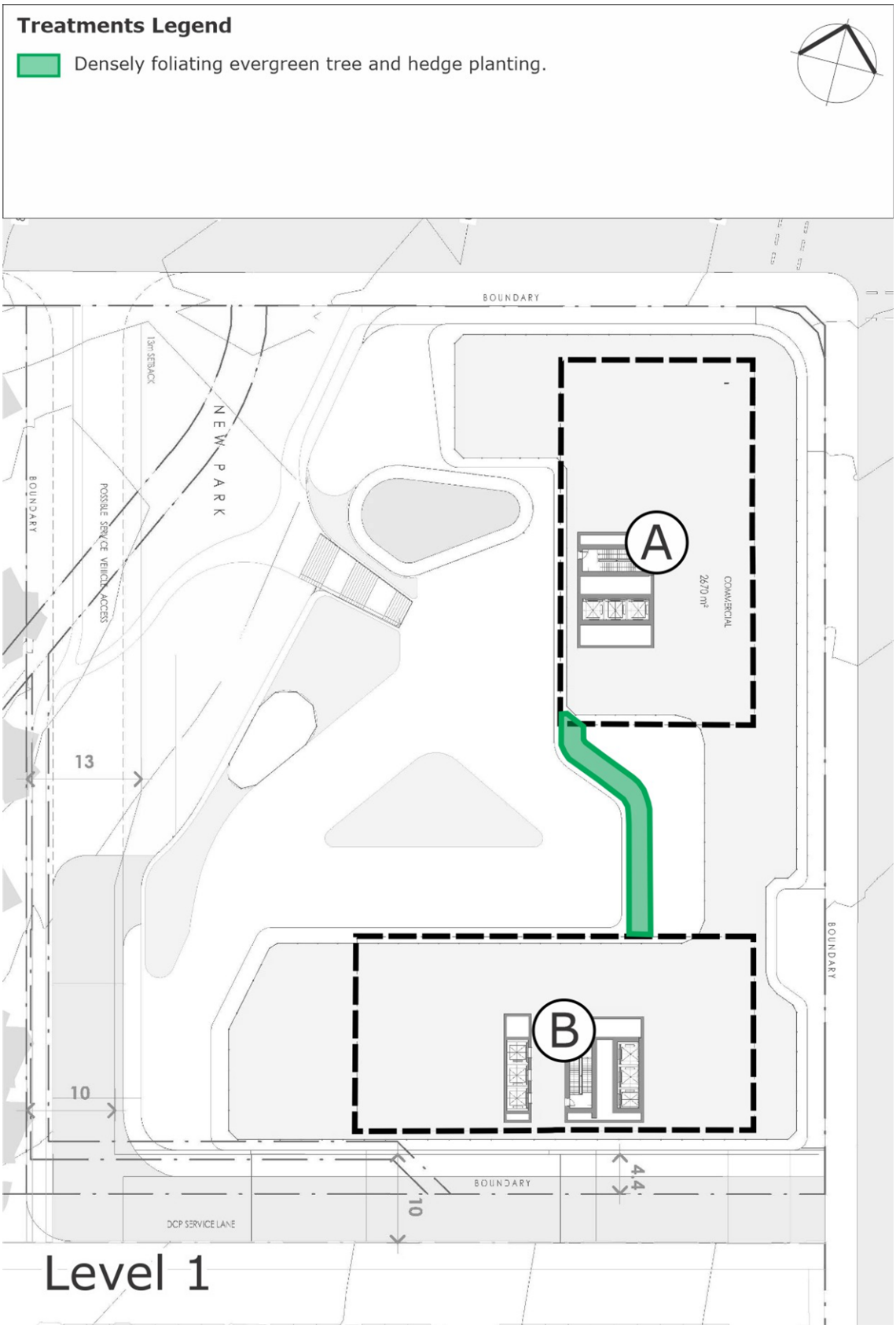

Figure 5: Recommended Treatment for Level 1

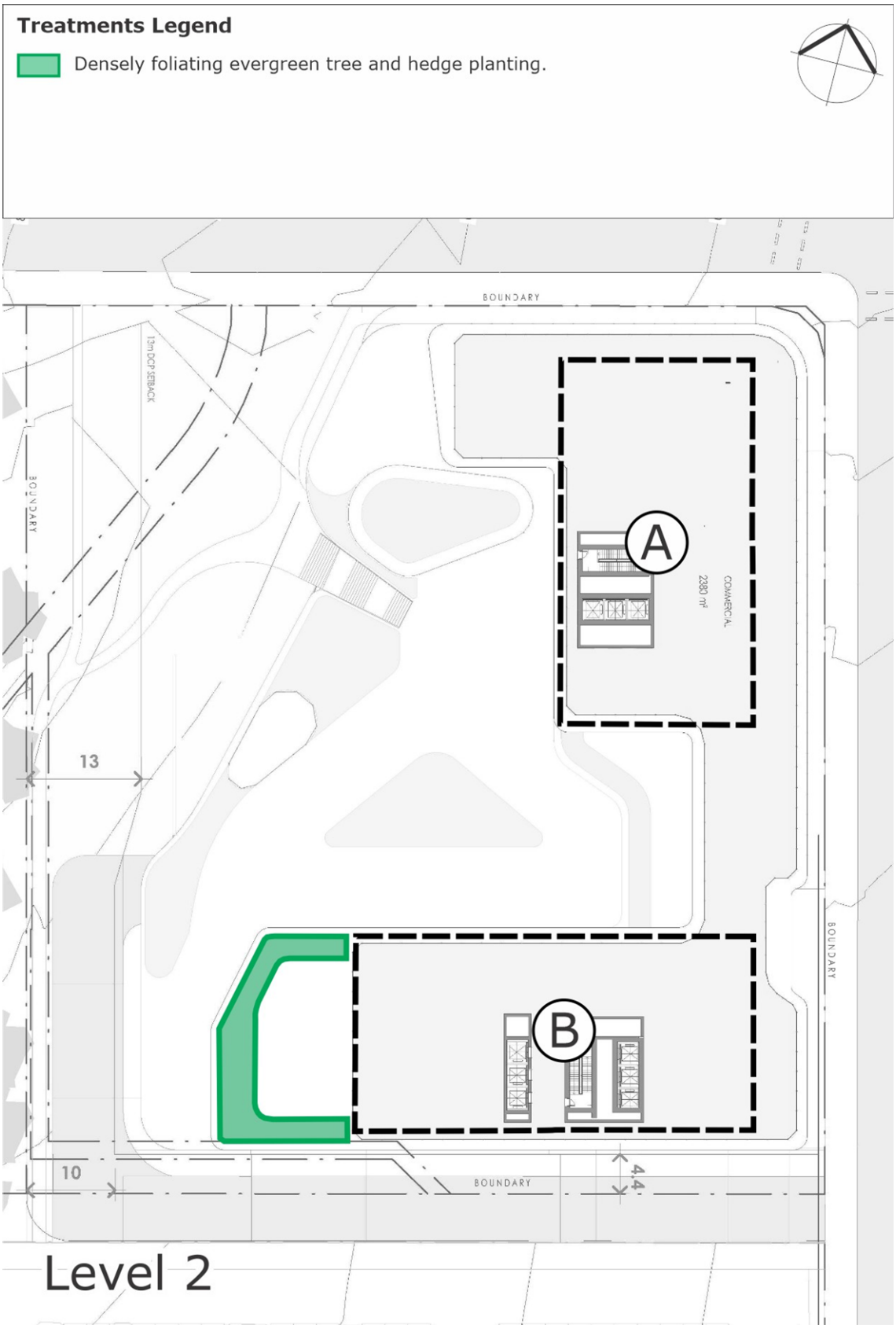

Figure 6: Recommended Treatment for Level 2

Figure 7: Recommended Treatment for Level 4

5.3 Private Balconies and Terraces

The majority of the private balconies residential towers within the development are expected to be suitable for their intended use due to their overall recessed design and inclusion of impermeable balustrades. These features should be retained in the final design. The balconies located on the corners of the towers however are exposed to corner accelerated flows from side streaming winds along the adjacent façade aspects and direct winds due to the lack of shielding provided by upstream buildings. To mitigate the corner effects, it is recommended to include full height impermeable screens or full height louvres along one of the exposed aspects of the balcony to deflect and stagnate flows that have the potential to corner accelerate. This feature aims to convert the balcony into a single aspect design, beneficial for wind mitigation purposes.

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for the various trafficable outdoor areas within and around the development will be suitable for their intended uses. The abovementioned treatments are shown in Figure 7 above.

5.4 Future Developments

Future developments are planned to the north-east and south to south-east of the site which are of similar height to the development. Once built these developments are expected to provide significant shielding to the predominant winds to the trafficable areas within the development from the prevailing north-east and south-south-east winds. The future developments to the south to south-east are expected to shield Tower B from the south to south-easterly winds, reducing downwash flows onto the southern aspect pedestrian footpath. The future developments to the north-east of the site are expected to provide shielding to the pedestrian footpaths along Rawson Street from the direct north-easterly winds.

6 REFERENCES

Davenport, A.G., 1972, "An approach to human comfort criteria for environmental conditions". Colloquium on Building Climatology, Stockholm.

Lawson, T.V., 1973, "The wind environment of buildings: a logical approach to the establishment of criteria". Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1975, "The determination of the wind environment of a building complex before construction". Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1980, "Wind Effects on Buildings - Volume 1, Design Applications". Applied Science Publishers Ltd, Ripple Road, Barking, Essex, England.

Melbourne, W.H., 1978, "Criteria for Environmental Wind Conditions". *Journal of Wind Engineering and Industrial Aerodynamics*, vol. 3, pp241-249.

Penwarden, A.D. (1973). "Acceptable Wind Speeds in Towns", Building Science, vol. 8: pp259–267.

Penwarden, A.D., Wise A.F.E., 1975, "Wind Environment Around Buildings". Building Research Establishment Report, London.

APPENDIX A WIND EFFECTS GLOSSARY

A.1 Downwash and Upwash Effects

The downwash wind effect occurs when wind is deflected down the windward face of a building, causing accelerated winds at pedestrian level. This can lead to other adverse effects as corner acceleration as the wind attempts to flow around the building, as seen in Figure A.1.

This can also lead to recirculating flow in the presence of a shorter upstream building, causing local ground level winds to move back into the prevailing wind.

The upwash effect occurs near upper level edge of a building form as the wind flows over the top of the building. This has the potential to cause acceleration of winds near the leading edge, as well as potentially reattaching onto the roof area. This effect causes wind issues particularly near the leading edges of tall building and on the rooftop areas if there is sufficient depth along the wind direction. Upwash is more apparent in taller towers and podia.

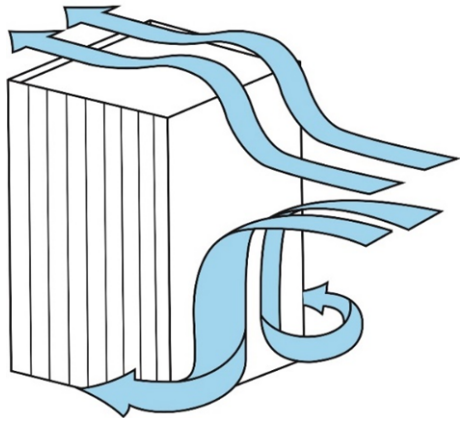

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

A.2 Funnelling/Venturi Effect

Funnelling occurs when the wind interacts with two or more buildings which are located adjacent to each other, which results in a bottleneck, as shown in Figure A.2. This causes the wind to be accelerated through the gap between the buildings, resulting in adverse wind conditions and pedestrian discomfort within the constricted space. Funnelling effects are common along pedestrian links and thoroughfares generally located between neighbouring buildings that have moderate gaps between them.

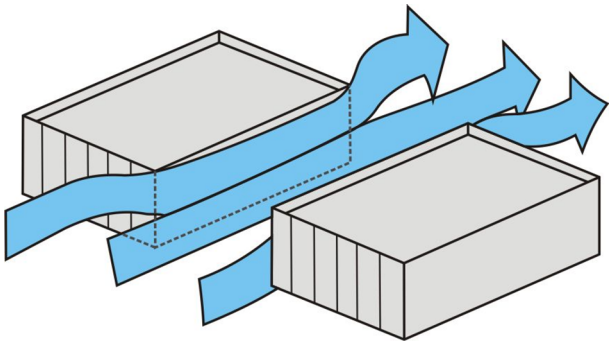

Figure A.2: Funnelling/Venturi Wind Effect

A.3 Gap Effect

The gap effect occurs in small openings in the façade that are open to wind on opposite faces, as seen in Figure A.3. This can involve a combination of funnelling and downwash effects. Presenting a small gap in the façade on the windward aspect as the easiest means through which the wind can flow through can result in wind acceleration through this gap. The pressure difference between the windward façade and the leeward façade also tends to exacerbate the wind flow through this gap.

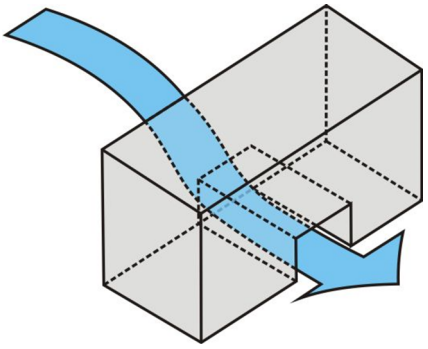

Figure A.3: Gap Wind Effect

A.4 Sidestream and Corner Effects

The sidestream effect is due to a gradual accumulation of wind shearing along the building façade that eventuates in an acceleration corner effect. The flow is parallel to the façade and can be exacerbated by downwash effects as well, or due to corner effect winds reattaching on the façade.

This is shown in Figure A.4. The corner refers to the acceleration of wind at the exterior vertical edge of a building, caused by the interaction of a large building massing with the incident wind, with the flow at the corner being accelerated due to high pressure differentials sets up between the windward façade and the orthogonal aspects. It can be further exacerbated by downwash effects that build up as the flow shears down the façade.

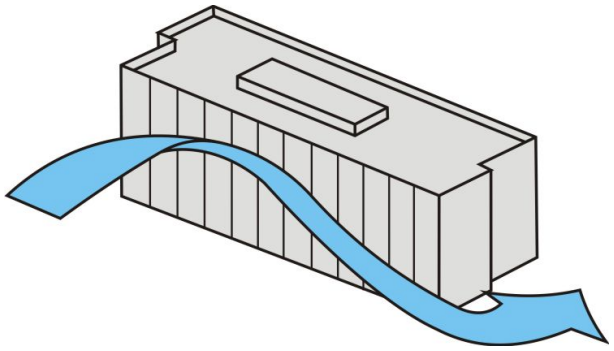

Figure A.4: Sidestream and Corner Wind Effect

A.5 Stagnation

Stagnation in a region refers to an area where the wind velocity is significantly reduced due to the effect of the flow being impeded by the bluff body. For a particular prevailing wind direction, this is typically located near the middle of the windward face of the building form or over a short distance in front of the windward face of a screen or fence. Concave building shapes tend to create an area of stagnation within the cavity, and wind speeds are generally low in these areas.