WIND ANALYSIS

WINDTECH

PEDESTRIAN WIND ENVIRONMENT STATEMENT

APPLECROSS, CORNER OF KISHORN AND FORBES ROAD, PERTH

WE212-01F02(REV0)- WS REPORT

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Prepared for:

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EXECUTIVE SUMMARY

This report is in relation to the proposed development located on the corner of Kishorn and Forbes Road, Applecross and presents an opinion on the likely impact of the proposed design on the local wind environment on the critical outdoor areas within and around the subject development. The effect of wind activity is examined for the three predominant wind directions for the Perth region; namely the easterly, south-west, and westerly winds. The analysis of the wind effects relating to the proposed development was carried out in the context of the local wind climate, building morphology and land topography.

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. 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 is relatively exposed due to the minimal shielding from the three prevailing wind directions affecting the site; east, south-west, and west. As a result, there are expected adverse wind effects within certain areas of the development. It is expected that suitable wind conditions can be achieved through all trafficable areas within and around the site with the treatments recommended in this report, which are summarised below:

- Inclusion of densely foliating evergreen trees along the pedestrian footpath areas and shrubs within the planter areas along the southern and western aspects.
- An impermeable awning above the south-west ground floor seating area.
- A baffle screen design within the through site link on the ground floor.
- An awning over the exposed balcony areas on Level 1.
- An awning over the eastern and northern aspects of the podium on Level 2.
- Inclusion of screening (2.0m to full-height) along two aspects of the balcony areas on Level 16-19, with an impermeable balustrade along the perimeters.
- Inclusion of perimeter screening (1.5-2.0m high) along the communal area balcony on Level 15.
- Inclusion of perimeter screening (minimum 2.0m high) of the Roof terrace area, as well as densely foliating evergreen shrubs within the planter regions (capable of growing 1.5-2.0m).

It should be noted that for any tree planting and landscaping to be effective as a wind ameliorative device, the species selected should be of an evergreen variety and densely foliating. Trees should by planted in clusters with interlocking canopies to help absorb the wind as a tree in isolation can be impacted by stronger wind conditions.

Wind tunnel testing is recommended to be undertaken to assess the wind conditions within and around the subject development. This will provide a quantitative analysis of the wind conditions and determine the extent of the abovementioned wind mitigation treatments to ensure suitable wind conditions are achieved.

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.

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, and any recommendations in this report are made only in-principle.

2 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The development site is bounded by Forbes Road to the west, Kishorn Road to the south, and low-rise residential and retail to the north and east. The site is predominantly surrounded by low-rise residential/retail buildings, with the Swan River lying further to the east, north, and west. A survey of the land topography indicates there are no major elevation changes in the region surrounding the site, only a gentle slope down towards Swan River to the east. An aerial image of the subject site and the local surroundings is shown in Figure 1.

The proposed development is a mixed-use building comprising of retail on the Ground floor, residential apartments above, and communal floors on Level 15 and the Roof. The overall height of the development is twenty-one floors inclusive of Ground.

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

- Pedestrian footpaths and site entrances along Forbes Road and Kishorn Road,
- Ground floor seating area along the south-west corner of the development,
- Main entrance lobby area,
- Balcony and podium areas on Level 1-2,
- Private balcony areas on Level 3-14 and Level 16-19,
- Skygarden areas on Level 3, 6, 9, 12, 15, 16, and 19, and
- Outdoor communal areas on Level 15 and the Roof.

Figure 1: Aerial Image of the Site Location

3 REGIONAL WIND

The Perth region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the east, south-west and west. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1 below. This summary is based on an analysis of wind rose data obtained by the Bureau of Meteorology from Perth Airport, from 1944 to 2006.

Table 1 Principal Time of Occurrence of Winds for Perth

Month	Wind Direction		
	Easterly	South-Westerly	Westerly
January	X	X	
February	X	X	
March	X	X	X
April	X	X	X
May	X		X
June			X
July			X
August		X	X
September	X	X	X
October	X	X	X
November	X	X	X
December	X	X	

A directional plot of the annual and 5% exceedance winds for the Perth region, and the frequency of the winds are shown in Figure 2. Again, this plot has been produced based on an analysis of recorded wind speed data obtained from Perth Airport, from 1944 to 2006.

As shown in Figure 2, the easterly winds are the most frequent for the Perth region, and are also the strongest. The south-westerly winds occur most frequently during the warmer months of the year for the Perth region, and hence are usually welcomed within outdoor areas. South-westerly winds are also similar strength to the westerly winds, but not as strong as the easterly events. The south-westerly and westerly winds typically occur during the afternoon periods.

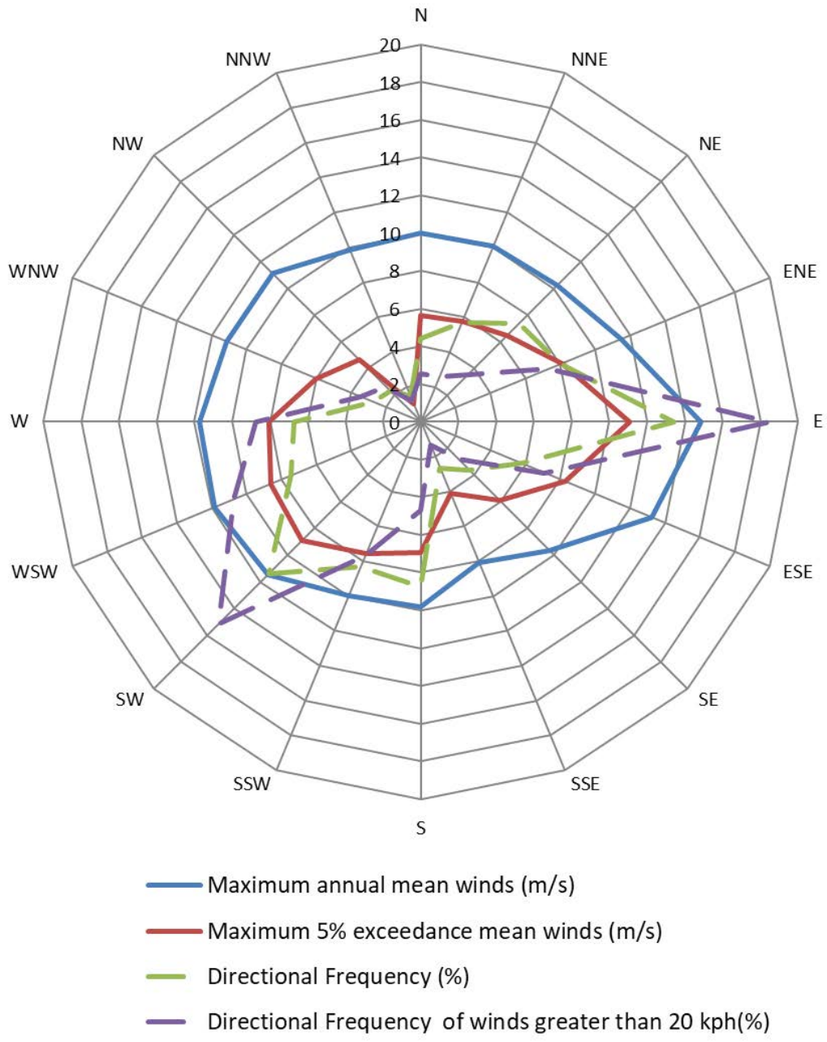

Figure 2: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Perth Region (referenced to 10m above ground in standard open terrain)

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 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 (rather than referencing specific wind speeds). 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 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.

Located in Applecross, the development site is surrounded by low-rise residential and retail buildings with some medium-rise buildings located a further distance away. As a result, the site receives minimal shielding and the prevailing winds will be relatively unobstructed upstream of the development, with the potential to cause adverse wind conditions.

5.1 Ground Level Areas

The wind conditions for the various pedestrian footpaths in close proximity to the tower are expected to be stronger than the existing conditions due to the increased height of the development in relation to the surrounding buildings. The existing building around the site to the north and the east have the potential to provide some shielding effects for the low level direct winds, however, due to their shorter height, their benefit will be minimal. The tower is expected to capture the prevailing winds and direct them downwards around the south-west corners along Kishorn and Forbes Road.

The tower setback along the northern and eastern aspects is expected to reduce the impact of the downwash winds from the tower onto the neighbouring areas by breaking up the flow pattern. The lack of a setback in the other areas is expected to allow the tower to capture the prevailing westerly and south-westerly winds and cause a potentially adverse downwash effect. It is recommended to include an impermeable awning above the seating area to prevent adverse downwash effects affecting the comfort of pedestrian and residents using the outdoor space.

The east-west alignment of Kishorn Road combined with minimal shielding will allow the predominant easterly, westerly and south-westerly winds to directly impact the pedestrian footpath areas along Kishorn and Forbes Road. There is the potential for these winds to interact with the building morphology and accelerate around the corner at the south-western aspect. It is recommended to include densely foliating evergreen trees along the pedestrian footpath areas and shrubs within the planter areas along the southern and western aspects, as shown in the drawings, to provide shielding against the prevailing winds.

The main lobby entrance receives shielding from direct winds and downwash, as the entrance is located centrally under Level 1. However, the adjacent through site link located south of the main lobby entrance has the potential to propagate the predominant westerly winds and funnel through the space, resulting in adverse wind conditions. It is recommended to consider a baffle screen design within the through site link to mitigate any funnelling effects.

5.2 Podium and Balcony Areas

The majority of the balcony floor area on Level 1 is shielded from downwash effects, however the southern and western balconies do consist of areas exposed to potential downwash winds from the tower. It is recommended to consider an awning over these spaces to mitigate any adverse downwash wind effects. It is recommended to retain the impermeable balustrades around the balcony perimeters.

The Level 2 podium areas along the northern and eastern aspects are potentially exposed to downwash wind effects captured by the building tower above. It is recommended to consider an awning over these areas to mitigate any downwash wind effects.

The centrally located private balcony areas on Levels 3-14 are expected to be suitable for their intended use as the areas incorporate a recessed design with balustrades in place, as well as exposure limited to only a single aspect. This design will ensure the winds are not able to accelerate across the balcony areas. The corner balconies are also recessed within the floor plan, however they have the potential to be exposed to wrap around winds due to minimal shielding and the impact of the predominant winds interacting with the building form.

The large corner private balconies located on Level 16-19 will be exposed to the prevailing winds due to their elevation, and the lack of upstream shielding. They will be particular prone to direct winds streaming across the open space of the balcony areas, interacting with the building form and accelerating around the corners. To ensure comfortable wind conditions is it recommended to include screening (2.0m to full-height) along two aspects of these balcony areas, with an impermeable balustrade along the perimeters.

The Sky Garden areas located on Levels 3, 6, 9, 12, 15, 16, and 19 are expected to be suitable for their intended use as the areas incorporate a recessed design with balustrades in place. The inclusion of densely foliating evergreen vegetation within these spaces is expected to provide further mitigation.

5.3 Outdoor Communal Areas

The outdoor communal area on Level 15 is partially shielded from the predominant easterly and south-westerly winds due to the floorplan design. The proposed seating features on the north-western aspect are expected to be suitable for their intended use due to their enclosed design. However, the communal are is exposed to the direct westerly winds with the potential for the south-westerly and easterly winds to wrap around into the area. To mitigate these effects it is recommended to consider perimeter balustrades of 1.5-2.0m high. This can be glazed to preserve the view of the surroundings.

The outdoor areas on the Roof include a Playground, Garden, and seating features. The area is exposed to the three prevailing wind directions due to limited shielding, which will result in

adverse wind conditions. The Playground is expected to be suitable for its intended use as it is enclosed with a canopy above. This design will stagnate flow in the area. The Roof Garden also consist of a canopy constructed on pillars in an elliptical shape. It is recommended that perimeter screening with a minimum height of 2.0m be considered around the perimeter of the Roof Level. It is also recommended to include densely foliating evergreen shrubs within the planter regions capable of growing to a height of 1.5-2.0m high above the floor slab.

Wind tunnel testing is recommended to be undertaken to assess the wind conditions within and around the subject development. This will provide a quantitative analysis of the wind conditions and determine the extent of the abovementioned wind mitigation treatments to ensure suitable wind conditions are achieved.

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