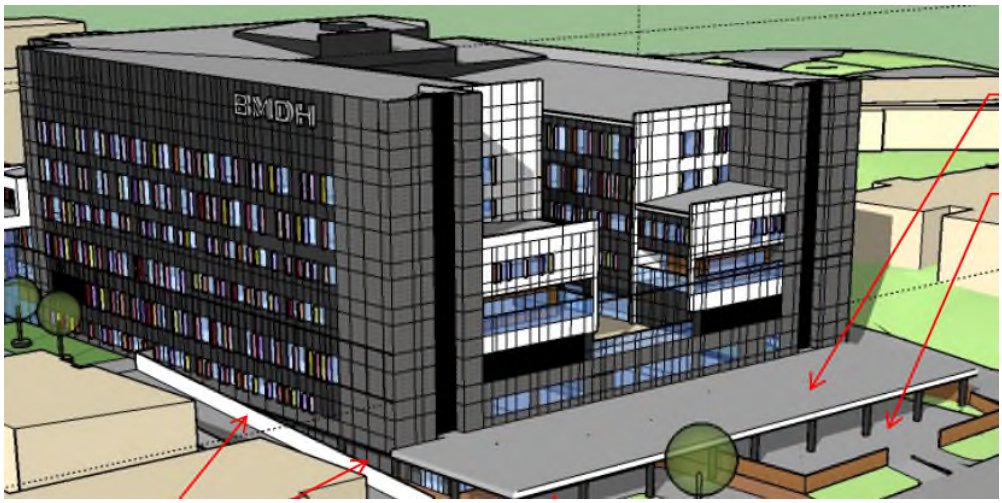

PEDESTRIAN WIND ENVIRONMENT STATEMENT

STAGE 2 DEVELOPMENT - BLACKTOWN HOSPITAL

WC994-01F02(REV1)- WS REPORT

20 JUNE 2016

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report is in relation to the proposed Stage 2 development of the Blacktown Hospital redevelopment, and presents an opinion on the likely impact of the proposed design on the local wind environment to 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 Blacktown region. These winds prevail from the north to north-easterly, south to south-easterly and westerly winds. The analysis of the wind effects relating to the proposal 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 architectural drawings which have been prepared by the project architect Jacobs, received April 6 2016. A desktop study 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 the assessment indicate that tolerable wind conditions are expected to be achieved for the pedestrian footpaths along the northern and western boundaries of the subject development site, due to the shielding provided by subject development and neighbouring existing hospital and Stage 1 Clinical Services Buildings, and the inclusion of effective wind mitigation devices into the design. These include the inclusion of an impermeable awning and the façade louver screens along the western and northern aspects of the development respectively.

However, the analysis indicates that there are remaining outdoor areas along the southern and eastern boundaries of the development site that may be potentially exposed to adverse wind conditions. It is expected tolerable wind conditions can be achieved for all trafficable outdoor areas within and around the site, with the inclusion of the following set of recommended treatments, summarised as follows:

- The inclusion of the proposed ground level impermeable canopy along the western aspect of the subject development.
- The inclusion of a recommended densely foliating hedge planting capable of growing to a height of 2m along the northern perimeter of the colonnade access way.
- The inclusion of the proposed densely foliating trees along the boundary of the ED Carpark.
- The inclusion of the proposed screens around the new ambulance bay located along the western boundary of the subject development.
- The inclusion of recommended densely foliating trees within and around the forecourt area along the eastern aspect of the subject development.

- The inclusion of recommended densely foliating trees within the north-western and south-eastern corners of the subject development.
- The inclusion of 1.5m high impermeable screens along the perimeter edge of the Link Bridge between the subject development and the multi-level carpark to the south of the site.

Hence, with the inclusion of the abovementioned recommendations within the final design of the development, it is expected the wind conditions for all outdoor trafficable areas within and around the development to be acceptable for its intended uses. The wind conditions and effectiveness of the recommended treatments can be verified through wind tunnel modelling.

The densely foliating trees should be capable of growing to a height of at least 4m with a 4m wide canopy and is recommended to be of an evergreen species to ensure their effectiveness in wind mitigation throughout the year. The inclusion of additional densely foliating vegetation such as trees and shrubs/hedge planting within and around the subject development; in particular within the forecourt area and along the various pedestrian footpaths is expected to further enhance the localised wind conditions.

Furthermore, it should be noted there may be potential wind entry effects into the Stage 1 Clinical Services Building due to a potential pressure difference between the exterior and interior environments. Airlock door systems has been provided to mitigate these potential wind entry effects.

1 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The subject development is bounded by private access roads within the Blacktown Hospital Site. Directly adjacent to the site along the northern boundary is the original Blacktown Hospital development and the Western Sydney University Clinical School varying up to four storeys in height above ground. Towards the east is the new six storey high above ground Clinical Services Building that was part of the Stage 1 redevelopment of the hospital. To the south is the single storey high Bungarribee House with low-rise private residential housing along the western boundary.

Further away from the site are predominantly low-rise private residential housing with the central business district of Blacktown located to the north-west and Blacktown Mega Centre to the south-east. A survey of the local land topography indicates a general rise towards the east and south of the site. An aerial image of the site and the surroundings is shown in Figure 1.

The proposed site is for the current ground level car-park and low-rise medical facilities to be redeveloped in an 9 storey high above the lowest ground level (Level 2) medical building as part of the Stage 2 redevelopment of the Blacktown Hospital.

The critical trafficable outdoor areas associated with the proposed development, which are the focus for pedestrian wind effects in this assessment, are detailed as follows:

- The ground level pedestrian footpath along the northern boundary of the site providing the colonnade access to the main entry of the hospital.
- The ground level pedestrian footpath along the western boundary of the site; adjacent to the new ED drop-off area.
- The ground level pedestrian footpath along the eastern boundary of the site; adjacent to the forecourt (main entry drop-off) area.
- The ground level pedestrian footpath along the southern boundary of the site.
- Link Bridge between the subject building and multi-level car-park extension.

Figure 1: Aerial Image of the Site Location

2 WIND CLIMATE OF THE BLACKTOWN REGION

The Blacktown region is governed by three principle wind directions, and these can potentially affect the subject development. These winds prevail from the north to north-easterly, south to south-easterly and west directions. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1. This summary is based on an analysis of wind rose data obtained by the Bureau of Meteorology from Penrith lakes AWS between 1995 and 2010.

For the Blacktown region, the north to north-easterly winds occur most frequently during the warmer months of the year. They are typically not as strong as the southerly winds, and are usually welcomed within outdoor areas since they typically occur when it can be quite warm during the summer. The south to south-easterly winds are by far the most frequent wind for the Blacktown region, and are also the strongest. Westerly winds occur most frequently during the winter season for the Blacktown region. These are usually a cold wind since they occur during the winter, and hence can be a cause for discomfort for outdoor areas.

Table 1: Principal Time of Occurrence of Winds for Blacktown

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

3 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 Davenport, Lawson, Melbourne, Penwarden, etc, 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 in Australia. The following table is an example, which was developed by Penwarden in 1975, and describes the effects of various wind intensities on people. Note that the applicability column relates to the indicated wind conditions occurring frequently (exceeded approximately once per week on average). Higher ranges of wind speeds can be tolerated for rarer events.

Table 2: Summary of Wind Effects on People (Penwarden, 1975)

Type of Winds	Mean Wind Speed (m/s)	Effects	Applicability
Calm, light air	0 - 1.5	Calm, no noticeable wind.	Generally acceptable for Stationary, long exposure activities such as in outdoor restaurants, landscaped gardens and open air theatres.
Light breeze	1.6 - 3.3	Wind felt on face.	
Gentle breeze	3.4 - 5.4	Hair is disturbed, Clothing flaps.	
Moderate breeze	5.5 - 7.9	Raises dust, dry soil and loose paper. Hair disarranged.	Generally acceptable for walking & stationary, short exposure activities such as window shopping, standing or sitting in plazas.
Fresh breeze	8.0 - 10.7	Force of wind felt on body.	Acceptable as a main pedestrian thoroughfare
Strong breeze	10.8 - 13.8	Umbrellas used with difficulty, Hair blown straight, Difficult to walk steadily, Wind noise on ears unpleasant.	Acceptable for areas where there is little pedestrian activity or for fast walking.
Near gale	13.9 - 17.1	Inconvenience felt when walking.	
Gale	17.2 -20.7	Generally impedes progress, Great difficulty with balance.	Unacceptable as a public accessway.
Strong gale	20.8 - 24.4	People blown over by gusts.	Completely unacceptable.

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.

4 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 for each of the three predominant wind directions for the Blacktown region. The interaction between the wind and the building morphology in the area was considered, and important features taken into account include the distances between the proposed building form, their overall heights and bulk, as well as the landform. Note that only the potentially critical wind effects are discussed in this report.

4.1 Ground Level pedestrian footpath along the northern boundary of the site

The colonnade access way located along northern boundary of the site benefits from the shielding provided by the subject development and the proposed concrete slab canopy above the ED drop-off on the western aspect to the prevailing westerly and south to south-easterly winds. However, it is potentially exposed to the north-easterly winds side-streaming along the northern building façade and accelerating under the building overhang. Hence it is recommended a densely foliating hedge planting capable of growing to a height of 2m is included along the northern boundary of the colonnade access way as indicated in Figure 2 to mitigate these adverse wind effects.

4.2 Ground Level pedestrian footpath along the western boundary of the site

The wind conditions along the pedestrian footpath along western boundary of the site; adjacent to the new ED drop-off area are expected to be acceptable for its intended uses due to the shielding provided by the proposed concrete slab canopy and screens along the new ambulance bay. Hence it is recommended to be retained in the final design of the development.

Furthermore, the subject development is not expected to have an effect upon the wind conditions within the ED car-park further west of the site. The proposed densely foliating trees within and around the car-park is expected to be effective in enhancing the localised wind conditions. Hence it is recommended to be retained in the final design of the development.

Note the densely foliating trees should be capable of growing to a height of at least 4m with a 4m wide canopy and is recommended to be of an evergreen species to ensure their effectiveness in wind mitigation throughout the year.

4.3 Ground Level pedestrian footpath along the eastern boundary of the site

The pedestrian footpath along eastern boundary of the site surrounding the new main entry and drop-off area benefits from the shielding provided by the subject development and the neighbouring Stage 1 Clinical Services Building from the prevailing westerly and northerly to north-easterly winds respectively. It is however, exposed to the direct southerly to south-easterly winds travelling over the proposed substation to the south and accelerating flows around the south-eastern corner of the subject development. The inclusion of the proposed

densely foliating trees around the forecourt area and the along the south-eastern corner of the site as indicated in Figure 3 is expected to be effective in mitigating the direct wind and accelerating flow effects along the pedestrian footpath.

Note the densely foliating trees should be capable of growing to a height of at least 4m with a 4m wide canopy and is recommended to be of an evergreen species to ensure their effectiveness in wind mitigation throughout the year. The inclusion of additional densely foliating vegetation such as trees and shrubs/hedge planting within and around the forecourt area is expected to further enhance the localised wind conditions.

Furthermore, it should be noted there may be potential wind entry effects into the Stage 1 Clinical Services Building due to a potential pressure difference between the exterior and interior environments. Airlock door systems has been provided to mitigate these potential wind entry effects.

4.4 Ground Level pedestrian footpath along the southern boundary of the site

The wind conditions along the pedestrian footpath along southern boundary of the site are expected to be acceptable for its intended uses due to the shielding provided by the subject development, the neighbouring buildings and densely foliating trees. Furthermore, the proposed concrete slab canopy and screens along the new ambulance bay and the recommended densely foliating trees at the south-eastern corner as indicated in Figure 3 is expected to be effective in ameliorating the potential accelerating flows around the corners of the building.

4.5 Link Bridge between the Subject Building and Multi-level Car-park Extension

The proposed Stage 3 redevelopment includes the construction of a suspended link bridge between subject building and the southern multi-level car-park extension (subject to a separate application). The link bridge benefits from the shielding provided by the subject building, the multi-level car-park extension and neighbouring Stage 1 Clinical Services Building to the prevailing northerly to north-easterly and southerly to south-easterly winds. However, the portion of the Link Bridge above the southern private access road is potentially exposed to the direct westerly winds side-streaming along the southern façade of the subject building and accelerating flow effects around the corners of the building. To ensure acceptable wind conditions are achieved along the Link Bridge, it is recommended a 1.5m impermeable screen is included along the exposed perimeter above the private access road. The wind conditions along the remaining areas can be further enhanced with the inclusion of the impermeable screens along the perimeter edges. Hence it is recommended to be included in the final design of the development.

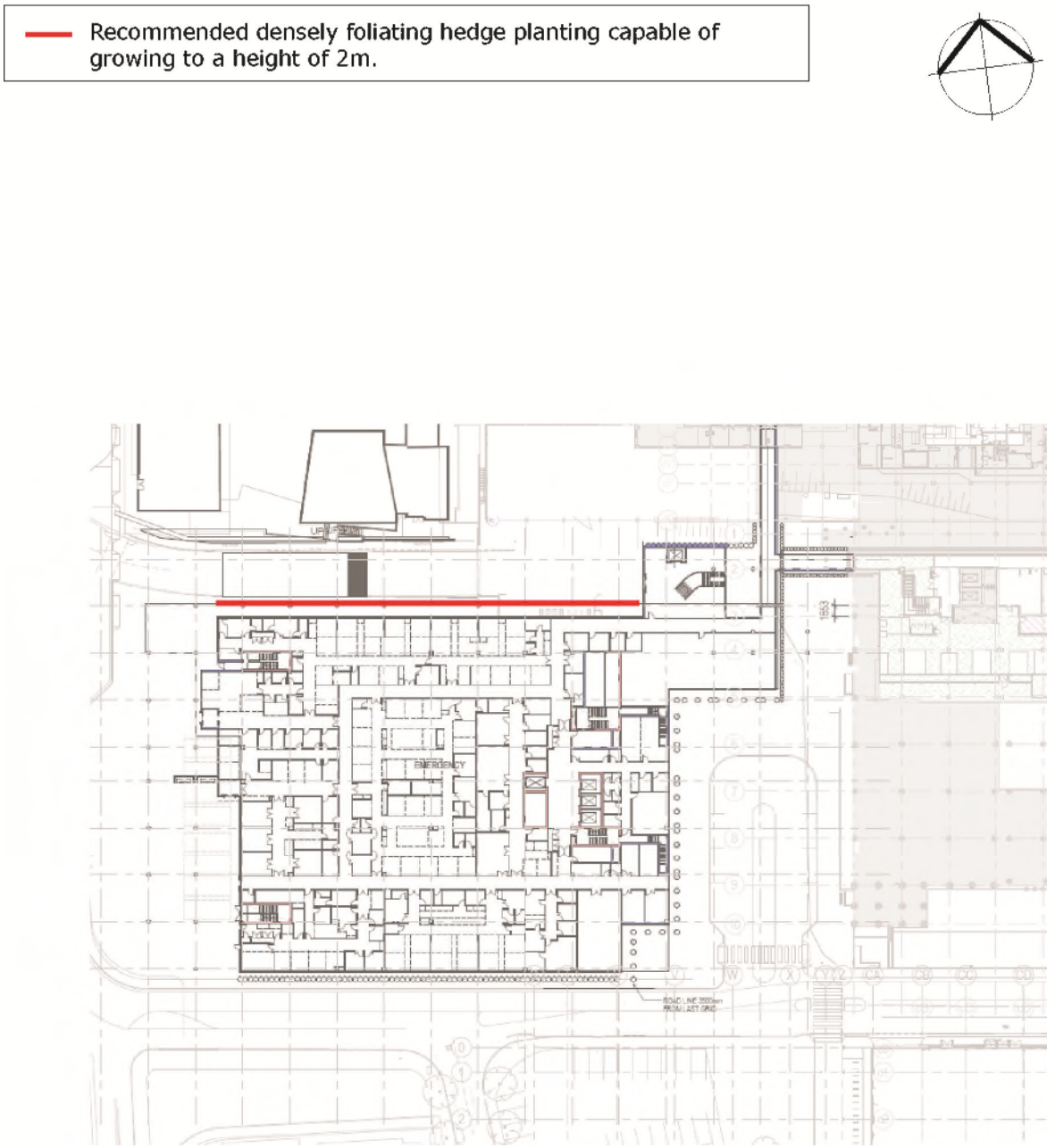

Figure 2: Recommended Treatments – Level 2

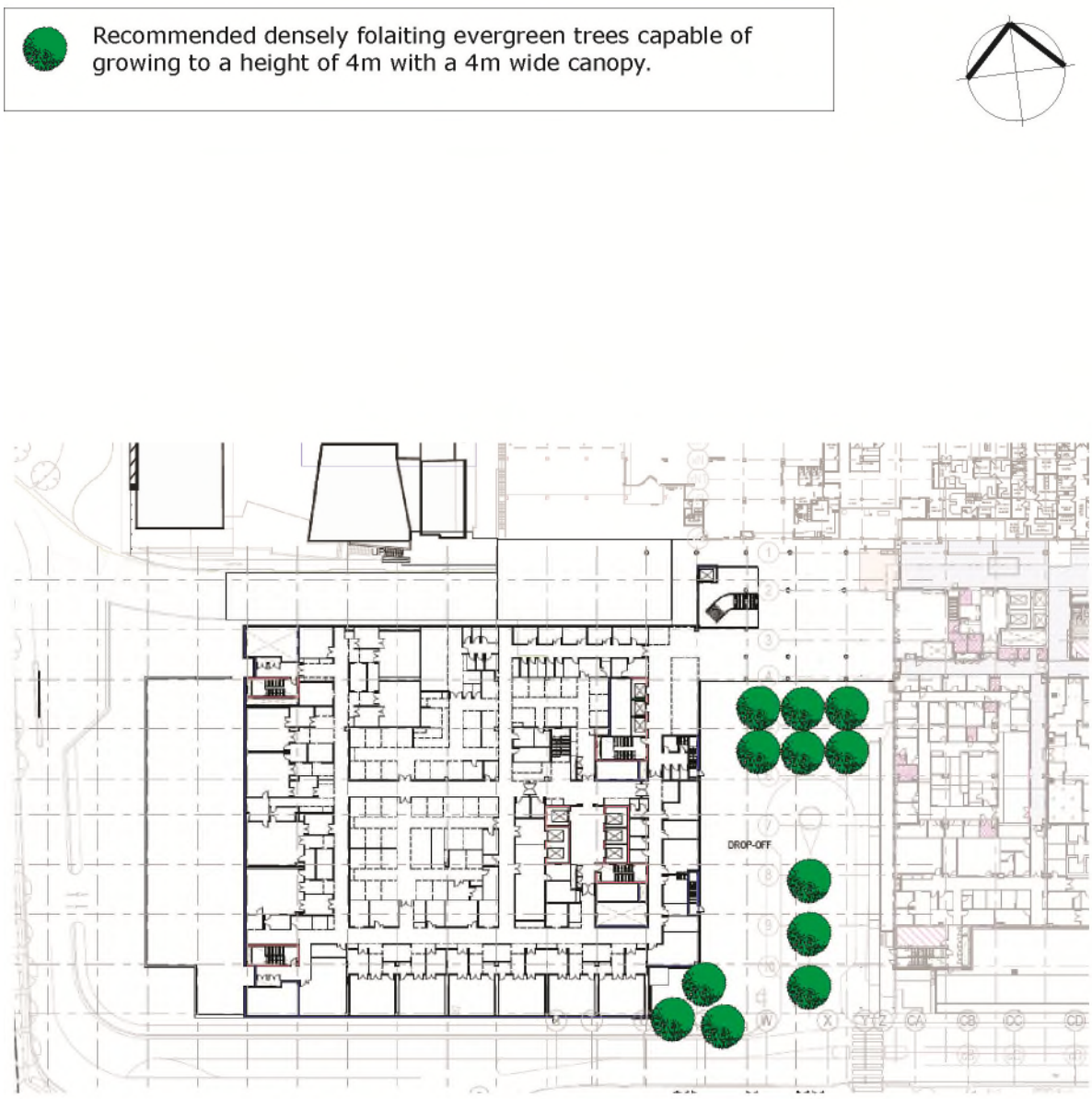

Figure 3: Recommended Treatments – Level 3