# PEDESTRIAN WIND ENVIRONMENT STATEMENT

# LIVERPOOL HEALTH AND ACADEMIC PRECINCT

# MAIN WORKS

WF151-04F03(REV0)- WS REPORT

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Prepared for:

Health Infrastructure

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# DOCUMENT CONTROL

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## EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the proposed Liverpool Health and Academic Precinct development located within Liverpool Hospital, on the local wind environment at 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 Bankstown region; namely the north-easterly, southerly to south-easterly 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 was 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 subject development is relatively exposed to the three prevailing wind directions, affecting the site. As a result, there is a possible slight impact on the wind comfort within certain areas the development. 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:

- The retention of existing and proposed tree planting along Campbell and Elizabeth Street.
- The extension of the proposed awnings along the northern facades of the Cancer Clinic and EDU Conference Centre.
- The inclusion of densely foliating tree planting beneath any discontinuities in the proposed northern awnings.
- The retention of all proposed end-screen elements for awnings within the development.
- The inclusion of additional densely foliating vegetation of the evergreen variety in the 'usable green spaces' to the south of the New Emergency Department, to the west along Goulburn Street, and to the west of the New Reception area.
- The retention of the proposed tree planting to the north and south of the Emergency Drop-Off Zone, and in the 'usable green space' to the west of the New Emergency Department.
- The retention of the proposed awning over the western entrance to the new reception area and eastern entryways into the development.
- The retention of the proposed tree planting throughout the Forbes Street forecourt.

- The retention of the recessed western ground floor façade at the entryway to the New Emergency Department.

Further wind tunnel testing is recommended for later detailed design stages to verify the wind conditions and enable a more detailed feedback and design of the potential wind mitigation measures. This will provide a quantitative analysis of the wind conditions and determine the requirement for wind mitigation measures, including the optimum size and extent of treatments to ensure suitable conditions are provided for the trafficable areas throughout the development. Note that the inclusion of any additional landscaping or planting within and around the building is expected to be effective in improving local wind conditions.

## 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 was 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 was 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 Liverpool Health and Academic Precinct is a multi-storey development located at the western boundary of Liverpool Hospital. The development will be erected in conjunction with the new carpark development to the north-east of the site.

The development is bounded by mid-rise apartment buildings to the north, the Liverpool Hospital Campus to the east, Elizabeth Street to the south, and Goulburn Street to the west. A survey of the land topography indicates a slight elevation changes in the region surrounding the site, sloping downward from the north-east. An aerial image of the subject site and the local surroundings is shown in Figure 1.

The overall height of the development is seven storeys and consists of the Cancer Clinic, EDU Conference Centre, Radiation Oncology, Reception and New Emergency Department areas on the ground floor as shown in Figure 2. This assessment covers the various outdoor trafficable areas within and around the proposed development.

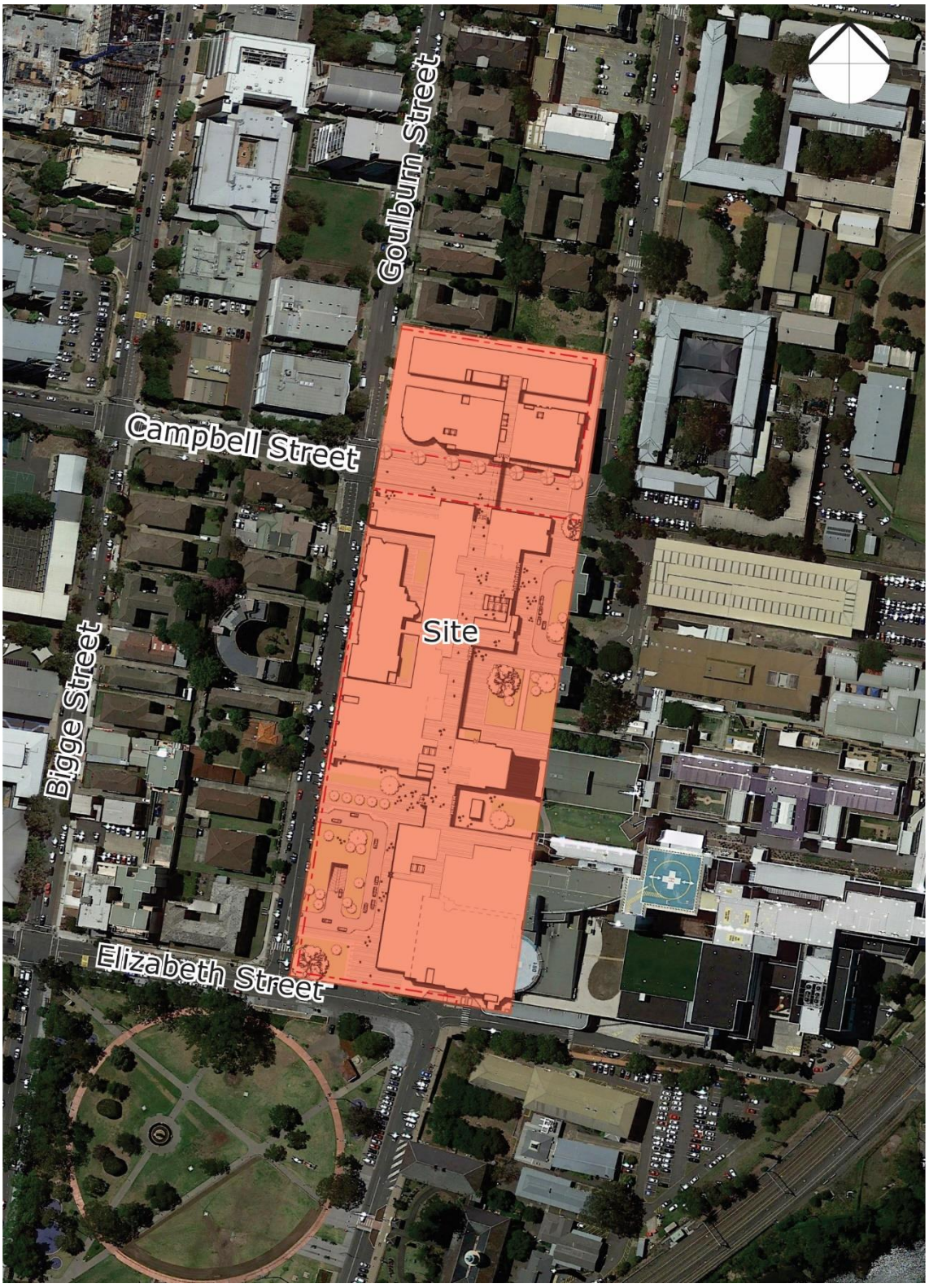


**Figure 1: Aerial Image of the Site Location**

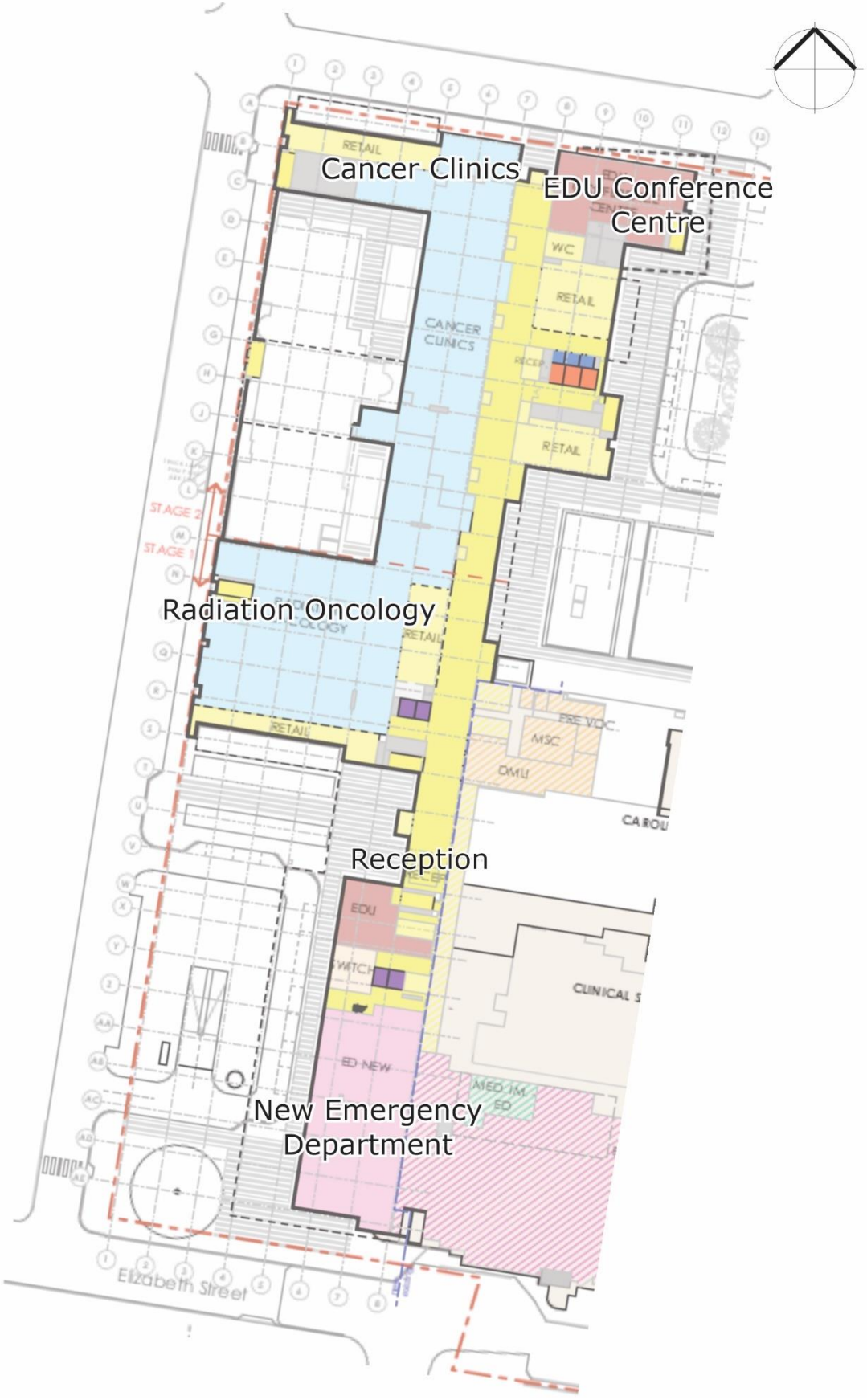


**Figure 2: Site plan with areas/buildings related to wind analysis identified.**

# 3 REGIONAL WIND

The Bankstown region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the north-east, south-east to south, and west. These wind directions were determined from an analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological station located at Bankstown Airport by the Bureau of Meteorology. The data has been collected from this station from 1993 to 2016 and corrected so that it represents winds over standard open terrain at a height of 10m above ground level. Figure 3 shows a summary of this analysis 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 determined and shown in Figure 3.

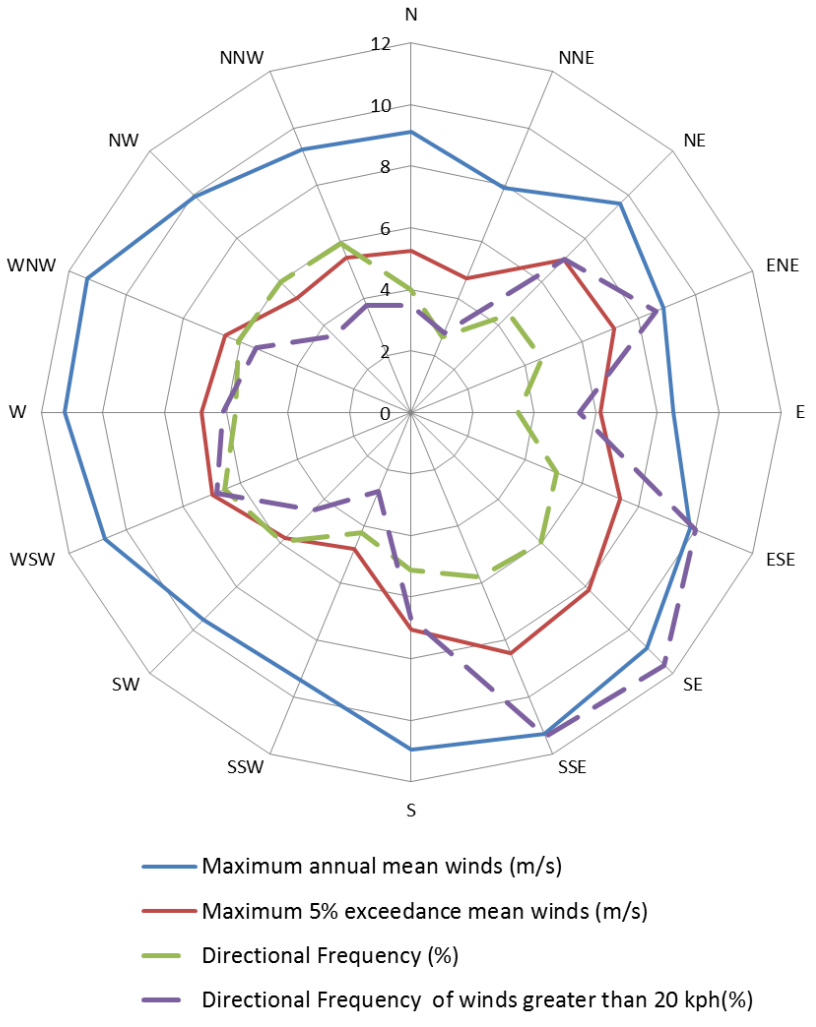


**Figure 3: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Bankstown Region (referenced to 10m above ground in standard open terrain)**

# 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 1 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 1: 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. 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.

The ground plane will be used primarily for circulation. However, there are potential seating areas in the 'usable green spaces' to the east of the development, as well as the main entryways along its western boundary. The recommended criterion for wind conditions for the circulation area is 7.5m/s with a 5% probability of exceedance, whereas the proposed seating areas will need to satisfy a more stringent comfort criterion of 5.5m/s with a 5% probability of exceedance. Although this assessment is of a qualitative nature, the abovementioned criteria are considered when assessing the wind environment impacts.

## 5.1 Pedestrian Footpaths Surrounding the Development

Generally, the pedestrian footpaths along Campbell, Elizabeth, and Goulburn Street are shielded by surrounding low to mid-rise residential apartment buildings. Furthermore, the recessed ground level façades will reduce the intensity of any side-streaming winds. The recommended comfort criterion for wind conditions for the ground floor areas is 7.5m/s with a 5% probability of exceedance.

The pedestrian footpath along the east-west aligned Campbell and Elizabeth Street footpaths may be exposed to the prevailing westerly winds directly. It is recommended to retain the existing tree planting along Elizabeth street. It is recommended to retain five of the existing trees at the corner of Campbell and Forbes Street. It is also recommended to retain the proposed tree planting along Campbell Street (see Figure 4).

The pedestrian footpath along the Campbell Street may be exposed to the prevailing north-easterly winds side-streaming along the building façade. It is recommended to extend the proposed awnings along the northern façades of the Cancer Clinic and EDU Conference Centre. It is recommended to include additional tree planting beneath any discontinuities in the awning. The end-screen on the proposed awning and abovementioned tree planting will also assist in the amelioration of any side-streamed winds (see Figure 4).

The pedestrian footpath along Goulburn Street may be directly exposed to the prevailing south to south-easterly winds. It is recommended to include additional densely foliating vegetation/hedging of the evergreen variety (capable of growing to 2m in height) in the 'usable green spaces' along Goulburn Street (see Figure 4).

## 5.2 Ground Level Areas

Generally, the Ground Level areas are shielded by surrounding low-rise residential apartment buildings and adjacent buildings within the Liverpool Hospital campus. The recommended comfort criterion for wind conditions for the majority of ground floor areas is 7.5m/s with a 5% probability of exceedance, however, a more stringent comfort criterion of 5.5m/s with a 5% probability of exceedance is recommended for the main entryways and outdoor seating spaces.

The south-western entryway into the new Emergency Department and the north-western entry points along Goulburn Street may be exposed to the prevailing south to south-easterly winds directly impacting these spaces. Additionally, the south to south-easterly winds may undergo corner accelerations at the south western corner of the development, and the south-western corner of the radiation oncology unit. It is recommended to retain the proposed tree planting to the west of the Emergency Department Drop-Off Zone. It is also recommended to retain the existing densely foliating vegetation in the 'usable green space' to the west of the New Emergency Department. It is also recommended to include additional densely foliating vegetation of the evergreen variety at the southern boundary of the new Emergency Department to further mitigate adverse wind conditions (See Figure 4).

All western entryways into the proposed development may be exposed to the prevailing westerly winds impacting the façade and side-streaming through the trafficable areas. The abovementioned densely foliating vegetation to the west of the Emergency Department Drop-Off Zone is also expected to mitigate the adverse wind effects due the prevailing westerly winds. It is also recommended to retain the proposed tree planting to the west of the new reception area. It is also recommended to include additional densely foliating vegetation of the evergreen variety (capable of growing to 2m in height) to the west of the new reception area (See Figure 4).

There is also the potential for the prevailing westerly winds to impact the western façade of the development and flow downward in the form of down-wash. It is recommended to include the proposed awning over the west facing entryway into the new reception area as well as retaining the awning and end-screens over the retail section in this space. It is also recommended to include the recessed ground floor façade at the entryway to the New Emergency Department (See Figure 4).

The outdoor 'usable green spaces' and the entryways from the Forbes Street forecourt are relatively exposed to the prevailing north-easterly winds. It is recommended to retain the proposed awnings with end-screen elements over the entryways. Furthermore, it is recommended to retain the existing and proposed tree planting in the 'usable green spaces' throughout the Forbes Street forecourt, as indicated in Figure 4.


**Figure 4: Suggested Treatments Ground Level Plan View**

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