



PEDESTRIAN WIND ENVIRONMENT STATEMENT
HURLSTONE AGRICULTURAL HIGH SCHOOL
(HAWKESBURY)

WD849-01F02(REV0)- WS REPORT

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report is in relation to the proposed Hurlstone Agricultural High School development located at Maintenance Lane and Vines Drive in the Hawkesbury Region and presents an opinion on the likely impact of the proposed design 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 two principal wind directions for the Hawkesbury region; namely the southerly 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 architectural drawings which have been prepared by Conrad Gargett Ancher Mortlock Woolley, received September 1, 2017. 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 subject development may experience potentially adverse wind conditions. However, it is expected that suitable wind conditions can be achieved for all trafficable outdoor areas within and around the site with the treatments recommended within this report, which are summarised as follows:

Ground Level:

- Retain the proposed door at the end of the walkway of Building 01 in the final design of the development.
- Include a baffled arrangement of full height impermeable screens on the Ground Floor of Building 03.
- Include one of the following options in the area between the accommodation building and Building 02, the area between Buildings 02 and 03 and the area between Buildings 03 and 04:
 - Option 1: Include an arrangement of densely foliating evergreen trees with interlocking canopies.
 - Option 2: Include an arrangement of densely foliating evergreen shrubs. It is recommended that the height of the vegetation and planter box be a height of at least 1.5m in order to be effective in wind mitigation.
 - Option 3: Include a number of full height impermeable screens between each of the buildings mentioned above.

First Floor:

- Retain the proposed impermeable balustrades on the Outdoor Roof Garden of Building 01 in the final design of the development.
- Include some densely foliating evergreen foliage throughout the Outdoor Roof Garden of Building 01.
- Include 2m high impermeable screens on the southern and western aspects of the Central Ring Walkway.
- Retain the proposed impermeable balustrades on the remainder of the aspects on the Central Ring Walkway in the final design of the development.
- Retain the proposed impermeable balustrades on the south-western and north-western corners of Level 01 of Building 03 in the final design of the development.

Second Floor:

- Retain the proposed impermeable balustrades on the south-western and north-western corners of Level 02 of Building 03 in the final design of the development.
- Retain the proposed impermeable screen on the southern aspect of Level 02 of Building 02 in the final design of the development.

With the inclusion of the recommended treatments in this report, it is expected that the wind conditions for all outdoor trafficable areas within and around the subject development will be acceptable for their intended uses. Note that to be effective in wind mitigation, trees should be densely foliating and evergreen, with interlocking canopies where possible. The shrubs/hedge planting should be densely foliating and evergreen, at least 1.5m high.

1 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The development site is located along Maintenance Lane and Vines Drive in the Hawkesbury Region. The site is bounded by Vines Drive to the north-east, Maintenance Lane to the south-east, the University of Western Sydney Village to the north-west and open fields to the south-west. Further to the east, west and south of the site is open farmland with some scattered trees and sparse low-rise buildings. Further to the north of the site are number of low rise residential buildings.

A survey of the local land topography indicates that the terrain is relatively flat across the site. An aerial image of the subject site and the local surroundings is shown in Figure 1.

The proposed development is comprised of 4 buildings. Building 01 is to the north-east, Building 02 is to the south-west, Building 03 is to the west and Building 04 is to the north-west. Building 01 is 1 storey high with an almost rectangular planform. Building 01 has a walkway through the middle of the building. Building 02 is 3 storeys high with an almost rectangular planform with a wider south-western aspect. Building 03 is 3 storeys high and has a similar planform to Building 02 but is longer than Building 02. Building 04 is 1 storey high with a wide almost rectangular planform with a curved eastern aspect. 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:

- Ground Level areas within the campus grounds and within Buildings 01, 02 and 03.
- Ground Level pedestrian footpaths on Vines Drive and Maintenance Lane.
- The outdoor roof garden on Building 01.
- The Central Ring Walkway on Level 1.
- The circulation areas within Buildings 02 and 03.



Figure 1: Aerial Image of the Site Location

2 WIND CLIMATE OF THE HAWKESBURY REGION

The Hawkesbury region is governed by two principal wind directions, and these can potentially affect the subject development. These winds prevail from the southerly sector and the westerly sector. The north-easterly winds also have a high frequency of occurrence however, the winds from this direction are not very strong. A summary of the principal time of occurrence of these winds is presented in Table 1 below. This summary is based on a detailed analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological recording station located at Kingsford Smith Airport by the Bureau of Meteorology (recorded from 1939 to 2008). Consideration has been given to the prevailing winds for Richmond Airport which is located to the north-east of the site.

The southerly winds are by far the most frequent wind for the Hawkesbury region, and are also the strongest. The westerly winds occur most frequently during the winter season for the Hawkesbury region, and although they are typically not as strong as the southerly winds, they are usually a cold wind since they occur during the winter and hence can be a cause for discomfort for outdoor areas. North-easterly winds occur most frequently during the warmer months of the year for the Hawkesbury region, and are typically not as strong as the southerly or westerly winds.

Table 1: Principal Time of Occurrence of Winds for the Hawkesbury Region

Month	Wind Direction		
	North-Easterly	Southerly	Westerly
January	X	X	
February	X	X	
March	X	X	
April		X	X
May			X
June			X
July			X
August			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 Hawkesbury region. 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, their overall heights and bulk, as well as the surrounding landform. Note that to be effective in wind mitigation, trees should be densely foliating and evergreen, with interlocking canopies where possible.

4.1 Ground Level Pedestrian Footpaths on Vines Drive and Maintenance Lane

Wind conditions along the pedestrian footpath on Vines Drive are expected to benefit from the development being set back from the pedestrian foot path. As a result, it is expected that the wind conditions on the pedestrian footpath on Vines Drive will be similar to the existing wind conditions. Wind conditions along the pedestrian footpath on Maintenance Lane are expected to benefit from the development being setback from the pedestrian footpath. As a result, it is expected that the wind conditions on the pedestrian footpath on Maintenance Lane will be similar to the existing wind conditions.

4.2 Ground Level Ares within the Campus Grounds and within Buildings 01, 02 and 03

The ground level areas within the campus grounds, especially the area within the circle ring, are prone to adverse conditions as a result of the southerly and westerly winds being funnelled through the area between the accommodation building and building 02, the area between building 02 and building 03 and the area between building 03 and 04. It is expected that these winds will funnel through these areas and accelerate through to the area within the circle ring worsening wind conditions. In order to mitigate these adverse wind conditions, it is recommended that one of the following treatment options be included for the areas mentioned above, also shown in Figures 2a, 2b and 2c:

- Option 1: Include an arrangement of densely foliating evergreen trees with interlocking canopies, as indicated in Figure 2a.
- Option 2: Include an arrangement of densely foliating evergreen shrubs. It is recommended that the height of the vegetation and planter box be a height of at least 1.5m in order to be effective in wind mitigation, as indicated in Figure 2b.
- Option 3: Include a number of full height impermeable screens between each of the buildings mentioned above, as indicated in Figure 2c.

Furthermore, it is expected that the walkway on the ground floor of Building 01 could potentially experience adverse wind conditions, due to the north-easterly wind being funnelled and accelerating through this walkway. To mitigate these adverse wind conditions, it is recommended that the door at the end of the walkway be retained. To further enhance wind conditions in this area, it is recommended that another door be included towards the beginning of the walkway.

The ground level areas within Building 03 are prone to adverse wind conditions due to the direct impact of the westerly winds. It is expected that the westerly wind will funnel through the ground floor of Building 03 and accelerate through to the area within the circle ring worsening wind conditions. Furthermore, there may potential for pressure driven flow through the opening cavities of Building 03 due to the positively pressured ground floor area and the negatively pressured rooftop cavity. It is expected that this potential pressure differential will cause the westerly wind to accelerate through the circulation areas on Levels 01 and 02. To mitigate these adverse wind conditions, it is recommended that a baffled arrangement of full height impermeable screens be included on the Ground Floor of Building 03, as indicated in Figures 2a, 2b and 2c. It is expected that the impermeable screens will cause the westerly wind to stagnate enhancing the wind conditions throughout the circulation areas on Levels 01 and 02 and the area within the circle ring.

Treatments Legend

- Proposed Door
- Impermeable Full Height Screen
- Densely foliating shrubs, capable of growing to at least 1.5m tall.

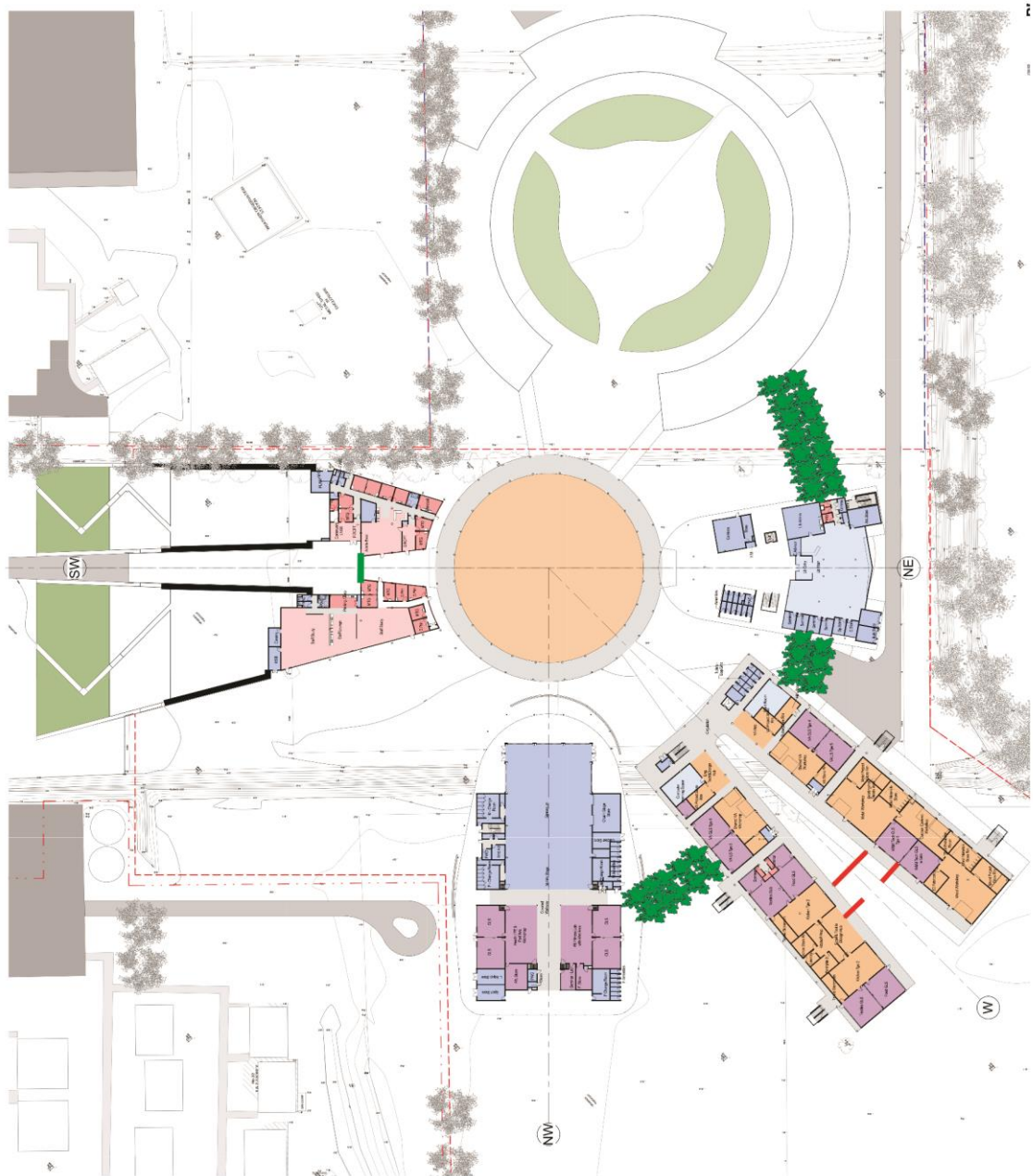


Figure 2a: Recommended Treatments – Ground Level Plan – Option 1

Treatments Legend

- Proposed Door
- Impermeable Full Height Screen
- Densely foliating tree planting

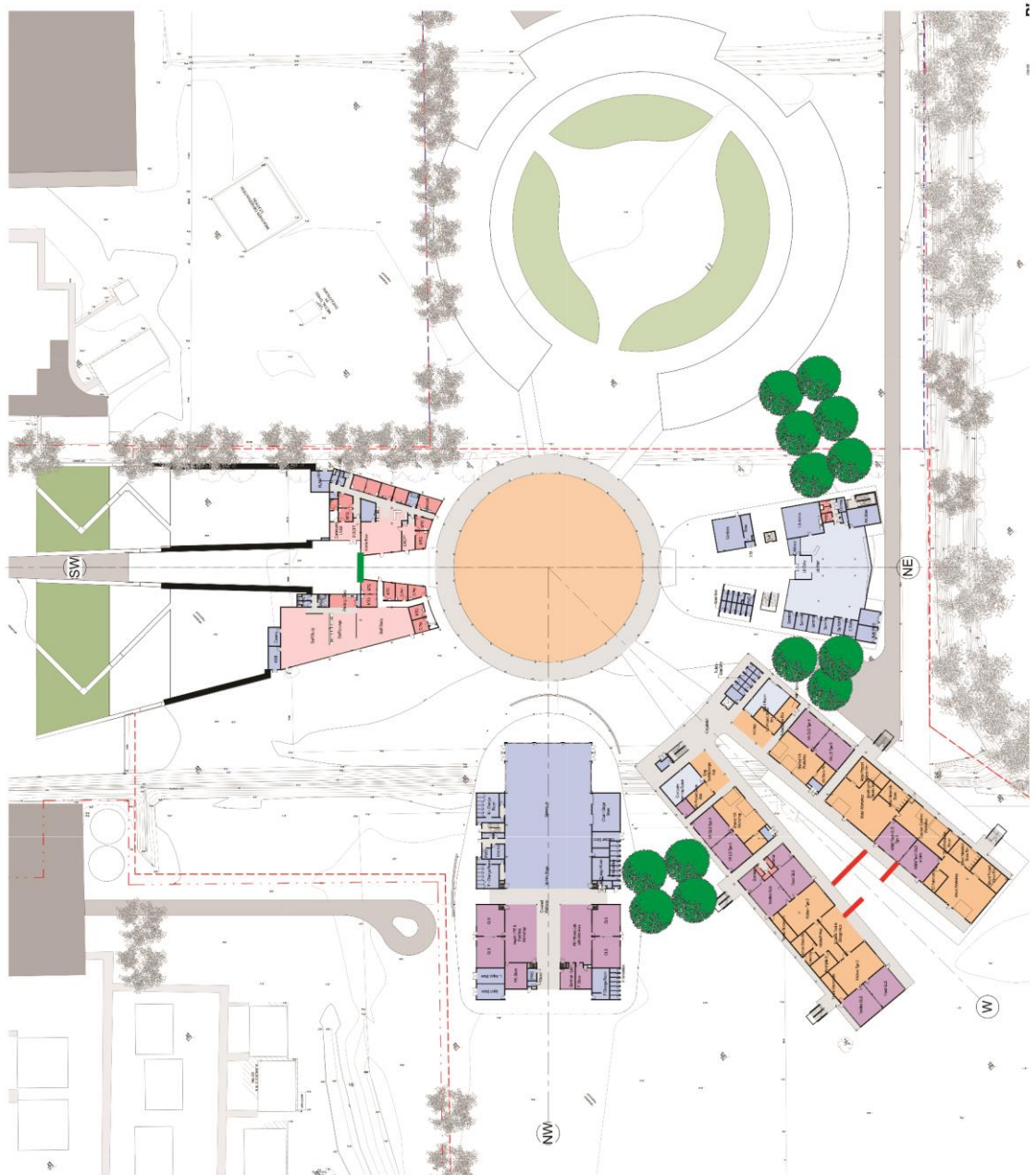


Figure 2b: Recommended Treatments – Ground Level Plan – Option 2

Treatments Legend

- Proposed Door
- Impermeable Full Height Screen

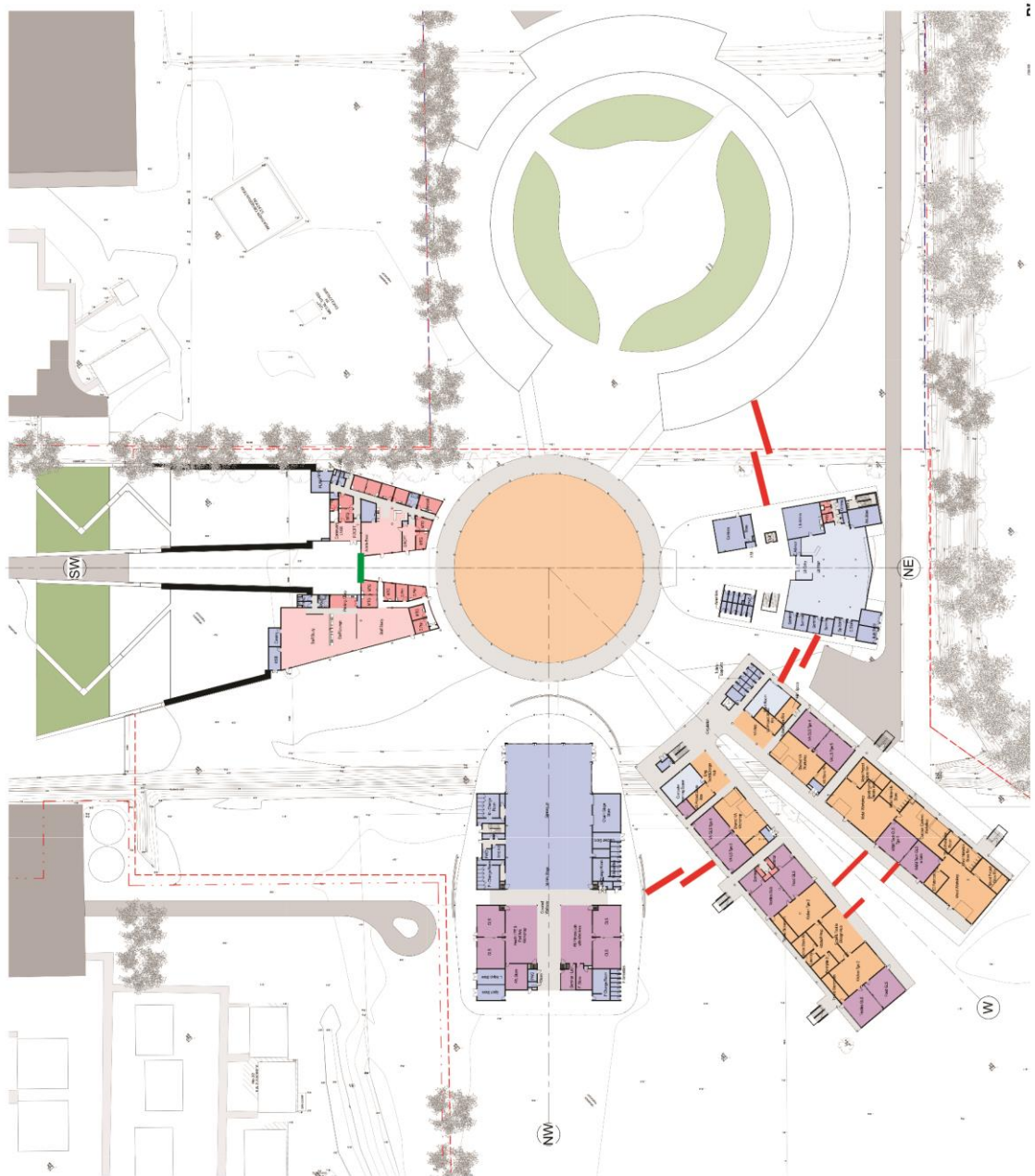


Figure 2c: Recommended Treatments – Ground Level Plan – Option 3

4.3 The Outdoor Roof Garden on Building 01

The outdoor roof garden on Building 01 is prone to adverse wind conditions as a result of the direct impact of the prevailing southerly and westerly winds. To mitigate these adverse wind conditions, it is recommended that the proposed impermeable balustrades be retained in the final design, as indicated in Figure 2d. Furthermore, in order to further enhance the wind conditions it is recommended that there be some foliage included throughout the roof garden. It is recommended that this foliage be densely foliating and evergreen in order to be effective in wind mitigation. The arrangement can be random.

4.4 The Central Ring Walkway on Level 1

The central ring walkway on Level 1 is prone to adverse wind conditions as a result of the direct impact of the southerly and westerly winds. Furthermore, this area is potentially prone to the southerly and westerly winds side streaming around Buildings 02 and 03 and impacting the central ring walkway. In order to mitigate these adverse wind conditions, it is recommended that 2m high impermeable screens be included on the western and southern aspects of the central ring walkway, as indicated in Figure 2d. It is also recommended that the proposed impermeable balustrades be retained on the remaining aspects.

4.5 The Circulation Areas within Buildings 02 and 03

The circulation areas on Levels 01 and 02 of Building 03 are prone to adverse wind conditions as a result of the direct impact of the westerly winds. Similarly the circulation areas on Level 02 of Building 02 are prone to adverse wind conditions due to the direct impact of the southerly winds. To mitigate these adverse wind conditions, it is recommended that the proposed impermeable screen on the southern aspect of Level 02 of Building 02 be retained in the final design of the development, as indicated in Figure 3e. Furthermore, to mitigate the adverse wind conditions for the circulation areas on Levels 01 and 02 of Building 03, it is recommended that the proposed impermeable balustrades on the north-western and south-western corners of Levels 01 and 02 of Building 03 be retained in the final design of the development, as indicated in Figures 2d and 2e.

The shrubs should be densely foliating and be an evergreen variety in order to remain effective throughout the year. It is recommended that the height of the vegetation and planter box be a height of at least 1.5m in order to be effective in wind mitigation.

Note that only the potentially critical wind effects are discussed in this report. With the inclusion of the recommended treatments in this report, it is expected that the wind conditions for all outdoor trafficable areas within and around the subject development will be acceptable for their intended uses.

Treatments Legend

- Proposed Impermeable Balustrade
- 2m High Impermeable Screen

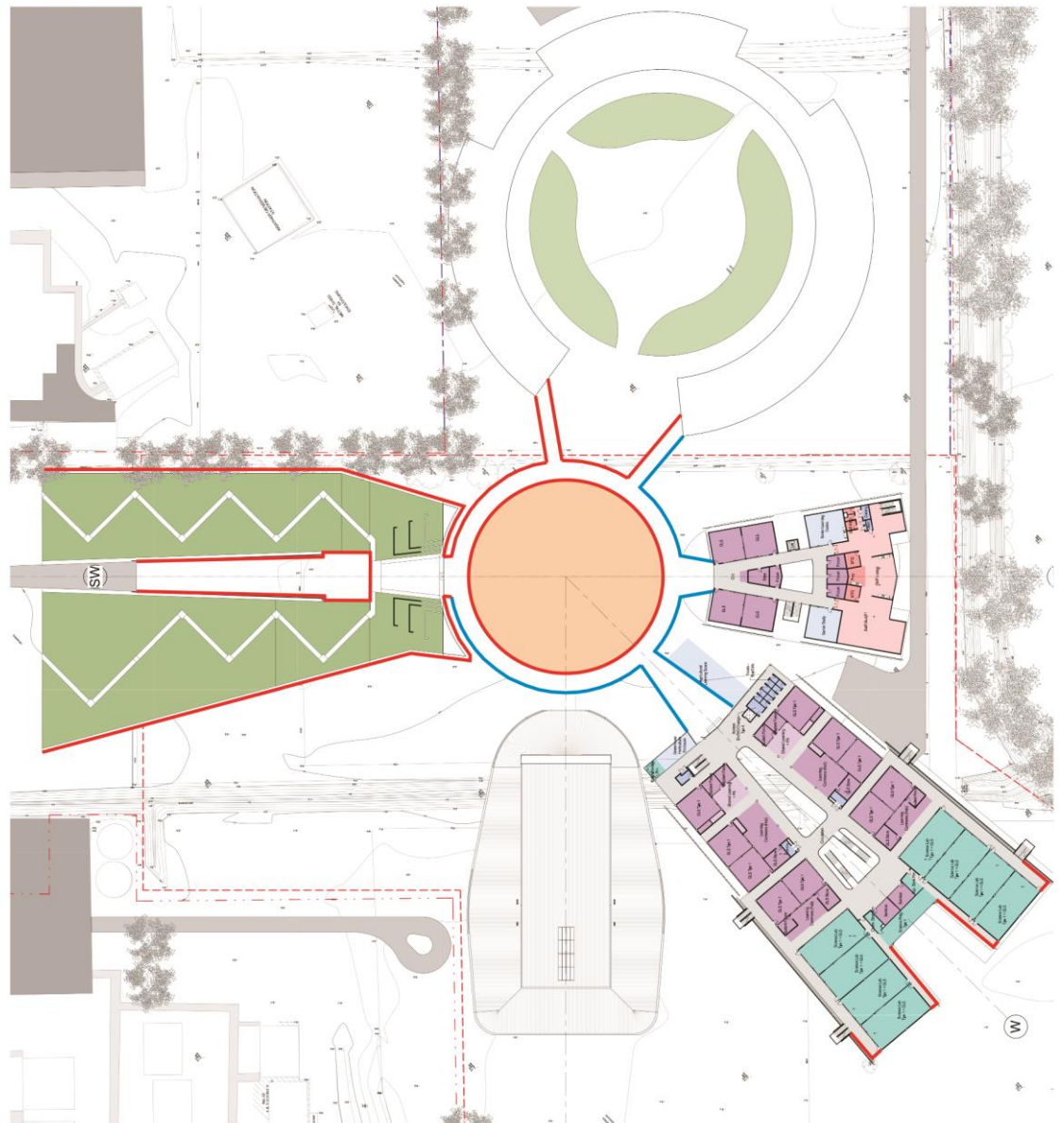


Figure 2d: Recommended Treatments – Level 01 Plan

Treatments Legend

- Proposed Impermeable Balustrade
- Proposed Impermeable Screen



Figure 2e: Recommended Treatments – Level 02 Plan