



Ref: WA637-04F02(rev0)- Memo

Date: July 23, 2010

To: Rice Daubney

By email

Pages: 24

Attn: Mr Darren Tims

Cc: Mr Bob Shin (Eastmark Holdings)
Mr Paul Reidy (Rice Daubney)
Mr Stefano Cottini (Rice Daubney)

From: Kevin Peddie

Re: 88 Walker Street & 77-81 Berry Street, North Sydney

Update to the Pedestrian Wind Environment Study

1.0 Introduction

This memo presents the results of a detailed investigation into the wind environment conditions for the latest design of the development known as 88 Walker Street & 77-81 Berry Street, North Sydney. Note that this technical memo is to be read in conjunction with the original Pedestrian Wind Environment Study report for this project (report reference number WA637-03F03(rev1), dated October 7, 2009).

The areas of the development investigated in this study and presented in this technical memo include testing for the areas affected by the design changes to the two towers of the development. The design changes are summarised as follows:

- For the 77-81 Berry Street office tower; reduction in the overall height of the tower, alterations to the façade design, and changes to the ground level façade design along Spring and Little Spring Streets.
- For the 88 Walker Street hotel tower; inclusion of a through-site link between Little Spring Street and Walker Street, changes to the façade of the tower section, and changes to the western ground level areas of the development.

2.0 Model Description

Wind tunnel testing of was undertaken using a 1:400 scale model of the subject development. Testing was undertaken for two surrounds cases, detailed as follows:

- The existing wind conditions around the development site (the results of this case was discussed in the previous report).
- With the inclusion of the proposed development, with the inclusion of the proposed 100 Mount Street development located to the south of the subject development site.

Photographs of the wind tunnel model used for this study are shown in Figures 1a to 1c. The proposed office tower is bound by Little Spring Street to the east, Spring Street to the south, Denison Street to the west, and the Beau Monde residential building to the north. The proposed hotel tower is bound by Walker Street to the east and Little Spring Street to the west.

Compared to the previous study, the changes to the design of the 77-81 Berry Street office tower include the following:

- Inclusion of a vehicle entry off Little Spring Street.
- Alteration in the ground level building façade profile on Spring Street.
- Reduction in the overall height of the development to 119.45m above Denison Street.
- Minor changes to the façade elements for the tower section of the development.

The changes to the design of the 88 Walker Street hotel tower compared to the previous study include the following:

- Inclusion of a through-site link between Little Spring Street and Walker Street.
- Minor changes to the façade elements for the tower section of the development.

An image of the updated design of the 77-81 Berry Street office tower is shown in Figure 2.

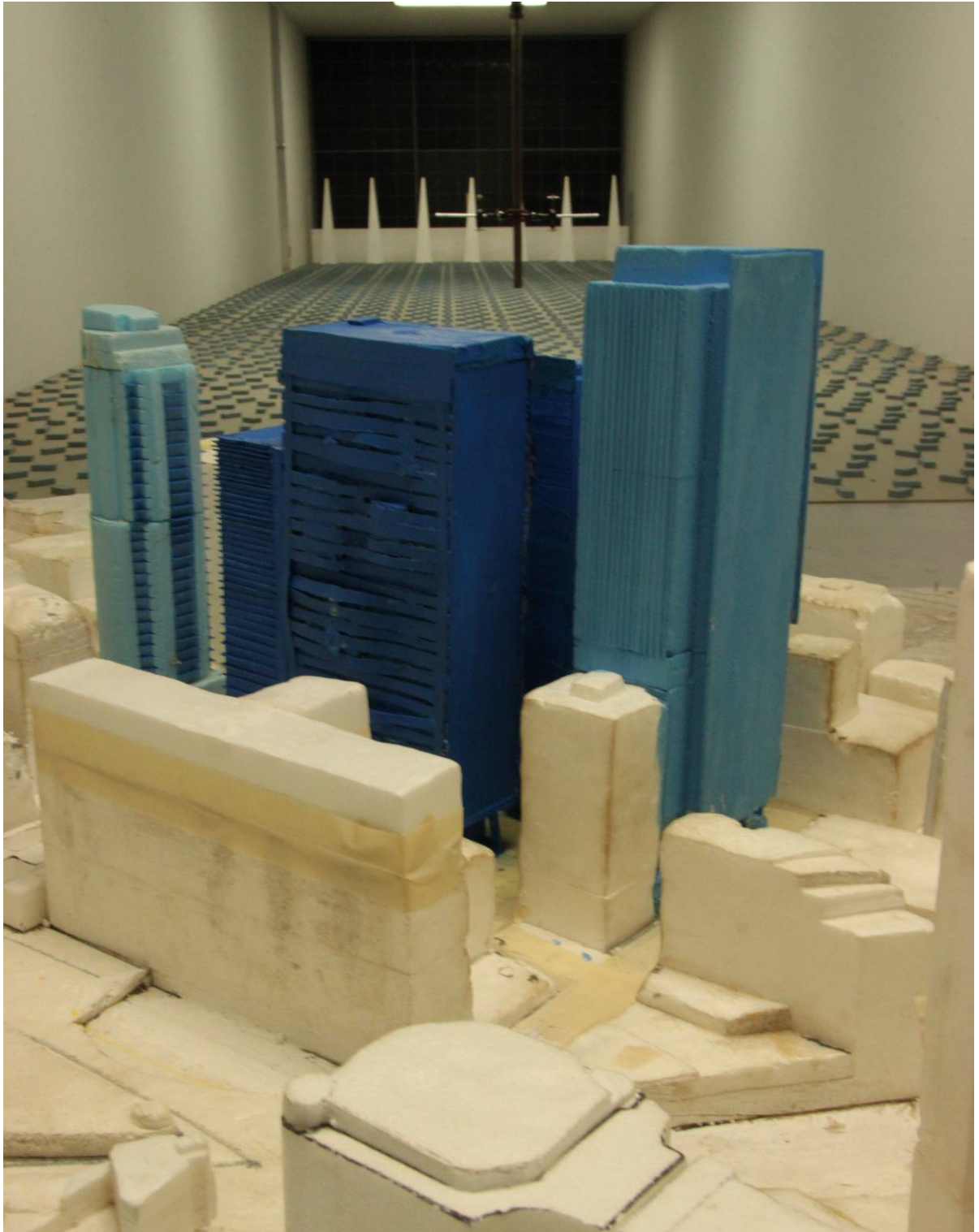


Figure 1a: Photograph of the Model in the Wind Tunnel



Figure 1b: Photograph of the Model in the Wind Tunnel



Figure 1c: Photograph of the Model in the Wind Tunnel



**Figure 2: Perspective Image of the Updated Design of the
77-81 Berry Street Office Tower**

3.0 Test Procedure

Testing was performed using Windtech's boundary layer wind tunnel facility, which has a 3.0m wide working section and has a fetch length of 14m. Peak gust and mean wind speeds were measured and related to reference velocities at a height of 200m upstream of the proximity model. Wind speed velocity coefficients representing the local wind speeds are derived from the wind tunnel results and are combined with the meteorological data for the Sydney region to provide the equivalent full-scale wind speeds for the critical outdoor locations tested for this study. The reference wind climate data used in this study is based on an analysis of 70 years of continuously recorded 10 minute mean wind speeds, obtained at the meteorological recording station at Kingsford Smith Airport from 1939 to 2008. The data is corrected to the reference height used in this study of 200m above ground.

The model was placed in a suburban terrain boundary layer wind flow based on the standard Deaves and Harris model (1978). The reference wind speeds were corrected for changes in the upstream building morphology and land topography. More details on this methodology are presented in the original report.

The layout of the ground level study points used for this study is presented in Figure 3. The measured wind speeds obtained at each study point are compared to the wind speed criteria presented in the North Sydney DCP. More details of the appropriate wind speed criteria for various types of activities are presented in the original report.



Figure 3: Study Point Locations - Ground Level areas

4.0 Results of the Study

A detailed study of wind conditions within and around the various ground level outdoor areas of the proposed development affected by the changes in the design of the two towers was carried out. A total of 12 study locations were selected for detailed analysis. This included testing for the pedestrian accessible areas along Spring Street, Little Spring Street and Walker Street.

Initially the existing wind conditions were measured around the subject development sites. These tests included the effect of the existing vegetation. The wind conditions within and around the proposed development sites were then measured and, where applicable, compared with the existing results. It should be noted that the initial tests of the proposed tower developments were undertaken without the effect of any form of wind ameliorating devices such as balustrades or screens not shown in the architectural design. The initial tests with the proposed developments also ignored the effect of existing and/or proposed vegetation. For areas not achieving appropriate wind conditions retesting was undertaken with various forms of ameliorative treatments until an effective outcome was reached.

Plots of results of the local directional wind speeds for the various test locations, as derived from the wind tunnel tests, are presented in the attached Appendix A. These results were assessed using the annual maximum peak wind speed criteria as required by the North Sydney Development Control Plan (DCP), for the public areas of the development. For the street level areas, if existing conditions already exceed the criteria of the North Sydney DCP of 13m/s for the annual maximum peak wind speeds, then wind conditions for the subject proposed developments are not to result in an exceedence of the existing wind speeds.

4.1 Ground Level Areas

The Study Points

Test Points 7, 9, 12, 15, 20 to 25 and 81 are used to monitor wind conditions within and around the various trafficable ground level areas of the site which will be affected by the proposed changes to the design of the two towers of the development. The location of the various study points are summarised as follows:

- Points 1, 9, 12, 13 and 15 are located at the entry area and open public space on the south aspect of the development along Spring Street.
- Points 20 to 23 and 81 are located on the pedestrian footpath areas along Little Spring Street between the two towers of the development.
- Points 24 and 25 are located on the pedestrian footpath areas along Walker Street

The locations of these points are also shown in Figure 3.

Applicable Criteria

The wind speed criterion presented in the North Sydney DCP requires that the annual maximum gust wind speeds for all ground level areas around the development site be within 13m/s. If this can not be achieved, then wind conditions should not exceed the existing wind conditions for those areas.

Results and Recommendations – Spring Street

The results of the study indicate that all of the pedestrian accessible areas on the southern aspect of the office tower on Spring Street would still be exposed to adverse wind conditions. This was found to be due to the predominant north-easterly side-streaming around the south-eastern corner of the development and westerly winds coming over the lower upstream buildings, and being captured and directed to the public accessible area on Spring Street by the development. Retests were undertaken with the inclusion of the densely foliating trees similar to that indicated in the architectural drawings, which are also indicated in Figure 4. The results of the retests indicate that, with the inclusion of these densely foliating trees, wind conditions for the areas represented by these Study Points will all be within the required 13m/s for the annual maximum gust wind speeds. Wind conditions for these areas will also be better than, or equivalent to, the existing wind conditions for the pedestrian accessible area along Spring Street.

Results and Recommendations – Little Spring Street

The results of the study indicate that all of the pedestrian accessible areas between the two towers of the development along Little Spring Street would be within the required 13m/s for the annual maximum gust wind speeds, except for Study Point 21. Study Point 21 was found to be exposed to adverse south-westerly winds which side-stream around the south-eastern corner of the office tower. Retests were undertaken with the inclusion of densely foliating trees at the corner of Spring and Little Spring Streets, similar to that indicated in the architectural drawings and also indicated in Figure 4. The results of the retests indicate that with the inclusion of these densely foliating trees, wind conditions for the areas will all be within the required 13m/s for the annual maximum gust wind speeds. Wind conditions for these areas will also be equivalent to the existing wind conditions for the pedestrian accessible area along Little Spring Street.

Results and Recommendations – Walker Street

The results of the study indicate that the pedestrian accessible area represented by Study Point 24 would be exposed to adverse south-westerly winds. This is due to the interaction of the south-westerly winds with the downstream buildings as well as being downwashed off the southern aspect of the hotel tower to the pedestrian footpath below. Retests were conducted with the inclusion of an L-shaped awning along the eastern aspect of the hotel tower, and the existing trees along Walker Street, similar to that indicated in the architectural drawings and Figure 4. With the inclusion of the awning and existing trees, wind conditions for all pedestrian accessible areas along Walker Street, including the pedestrian through link, will be within the required 13m/s for the annual maximum

gust wind speeds and suitable for their intended uses. Wind conditions for these areas will also be better than the existing wind conditions for the pedestrian accessible area along Walker Street.

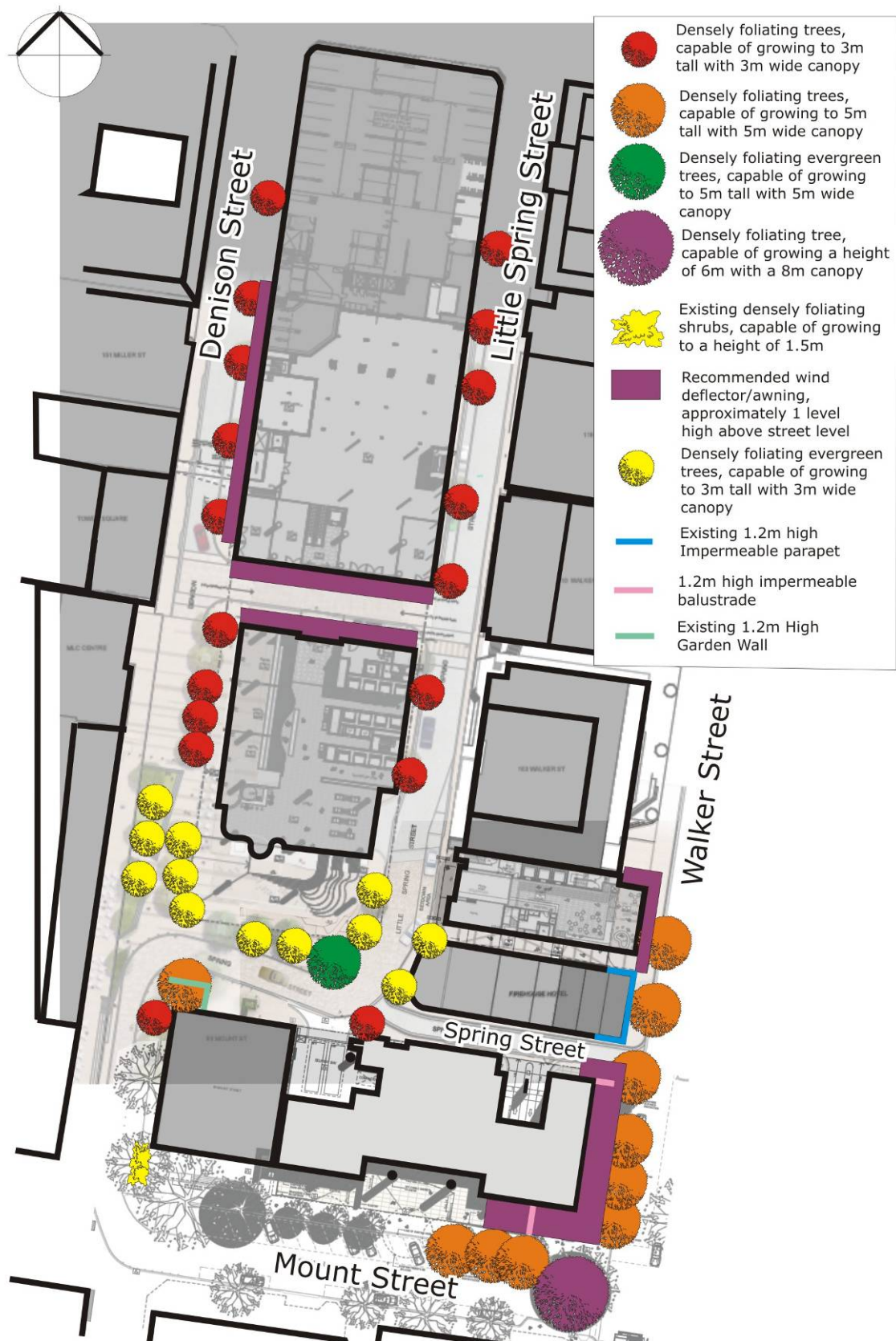


Figure 4: Recommended Treatments for the Ground Level Areas

4.0 Conclusion

A detailed investigation has been undertaken into the wind environment impact in relation to the updated design to the development known as 88 Walker Street & 77-81 Berry Street, North Sydney. The results of the study indicate that with the inclusion of the proposed design changes for the two towers of the development, some of the pedestrian accessible outdoor areas are exposed to adverse wind conditions. To achieve appropriate wind conditions for the outdoor trafficable areas affected by the updated design of the development, the following ameliorative treatments have been recommended in this study:

- The inclusion of densely foliating trees in the public accessible areas along Spring Street and Little Spring Street. Note that a similar layout of densely foliating trees in these areas has already been proposed and shown in the architectural drawings.
- Retention of the existing trees along Walker Street.
- An L-shaped awning at on the eastern aspect of the hotel tower of the development. Note that a similar design awning has already been proposed and shown in the architectural drawings.

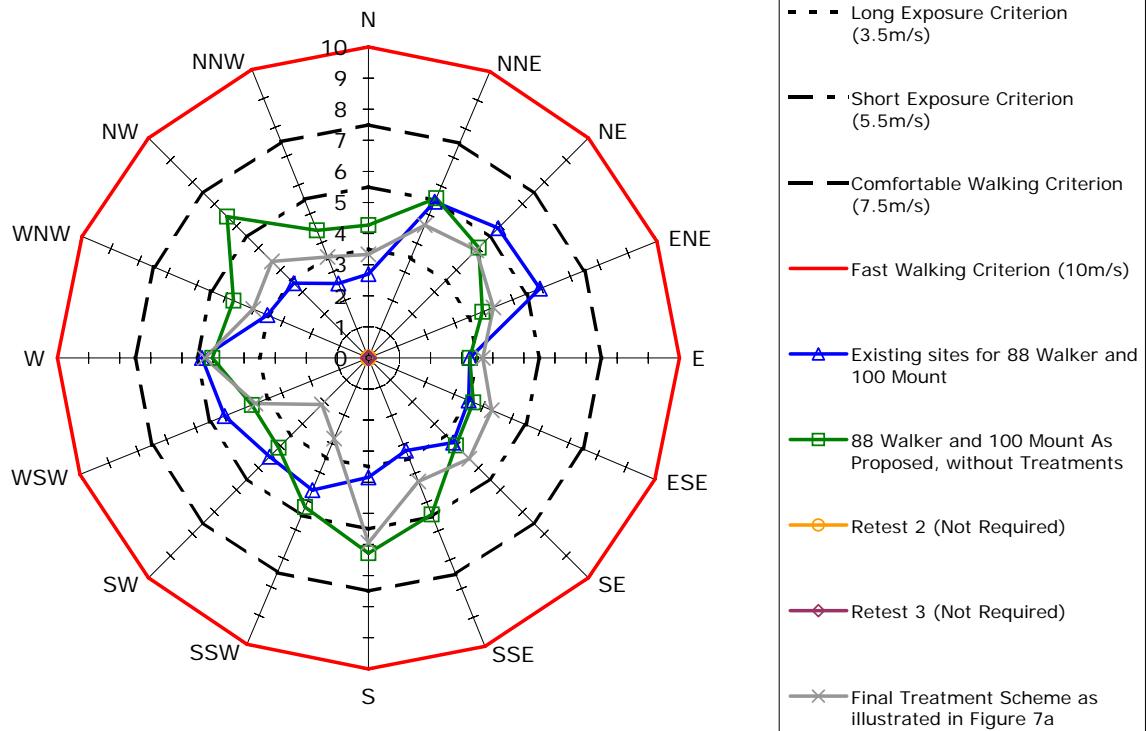
The abovementioned treatments have been tested in the wind tunnel to verify their effectiveness in wind mitigation. Hence, with the abovementioned treatments incorporated into the final design, all trafficable outdoor areas within and around the development site will satisfy the appropriate wind comfort criteria. Wind conditions for all areas will also be similar to, or better than, the existing wind conditions for the ground level areas.

Appendix A

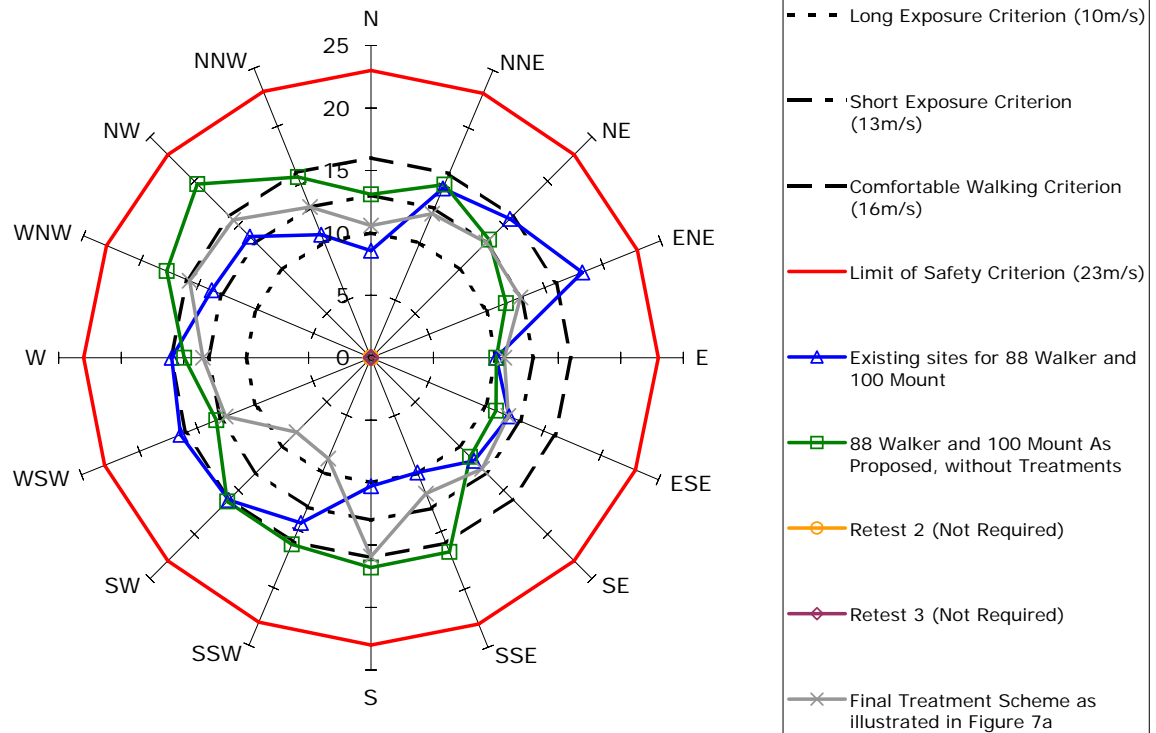
Plots of Wind Tunnel Results

Measured Wind Speeds at Point 07

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

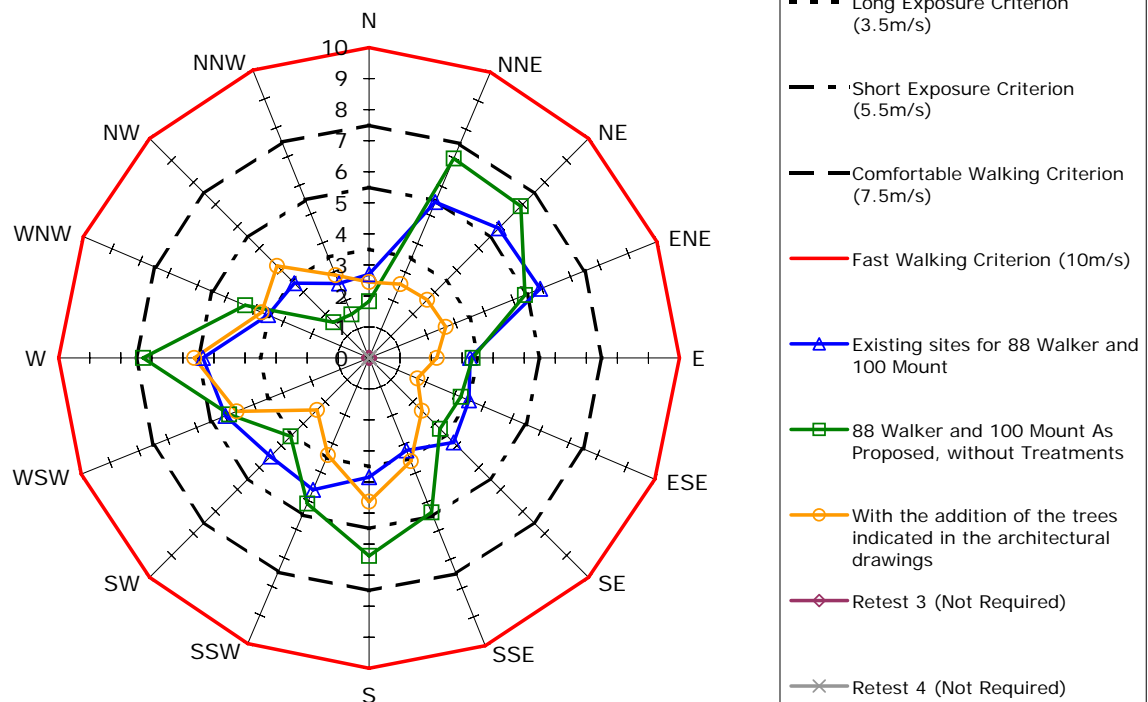


Annual Maximum Gust Wind Speeds (m/s)

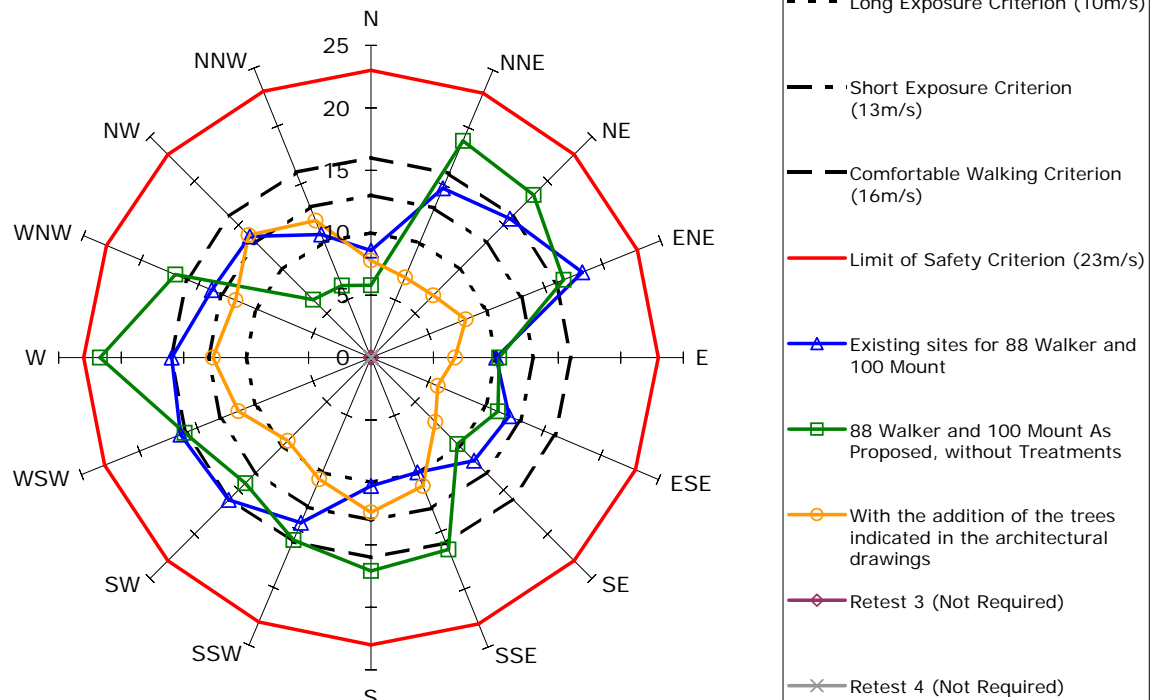


Measured Wind Speeds at Point 09

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

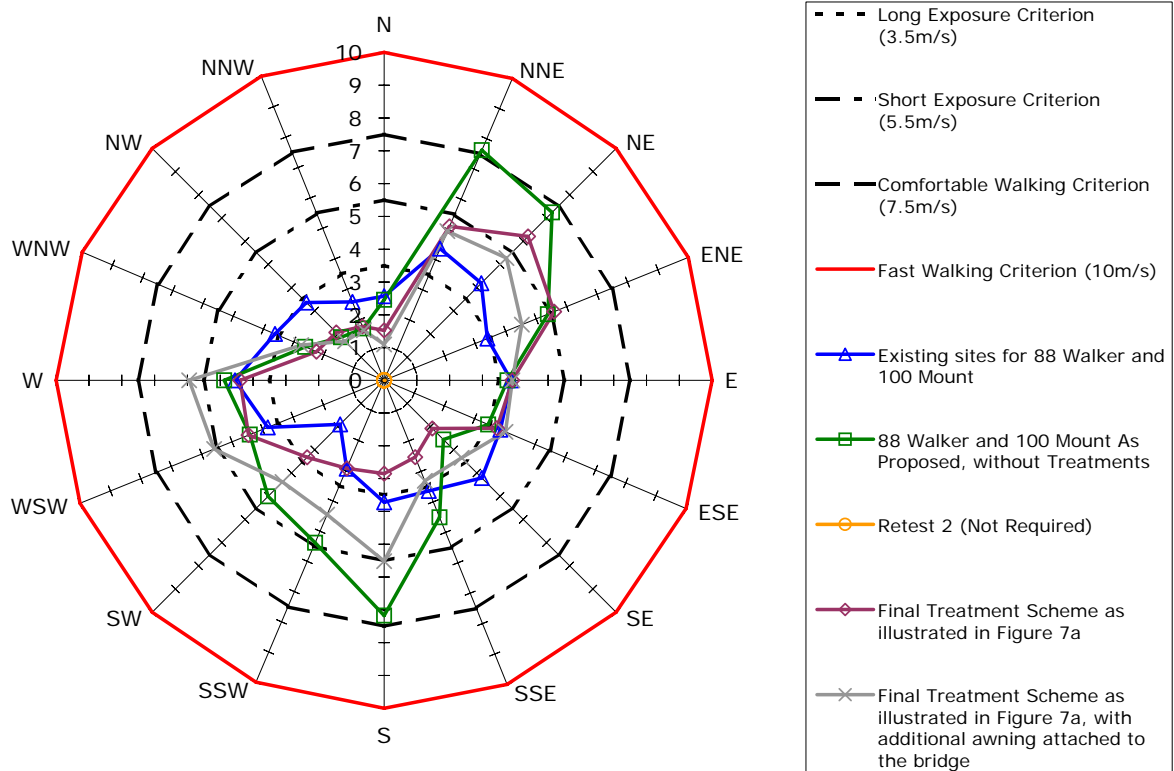


Annual Maximum Gust Wind Speeds (m/s)

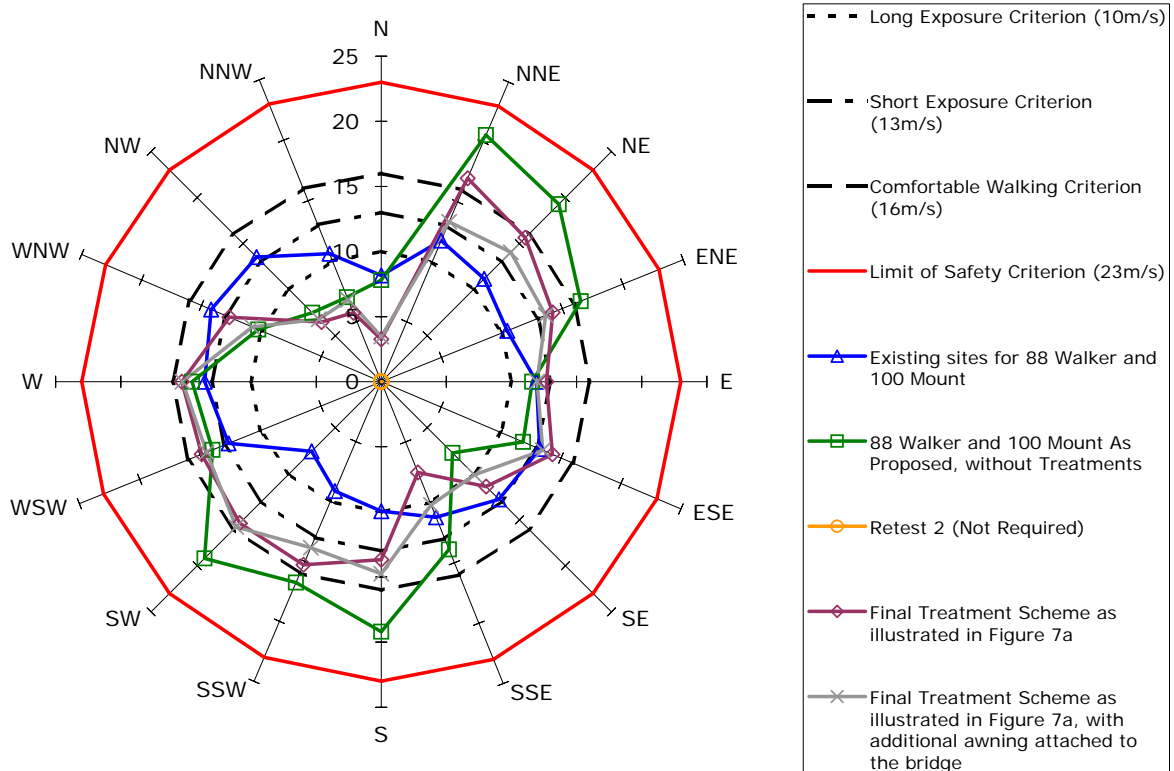


Measured Wind Speeds at Point 12

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

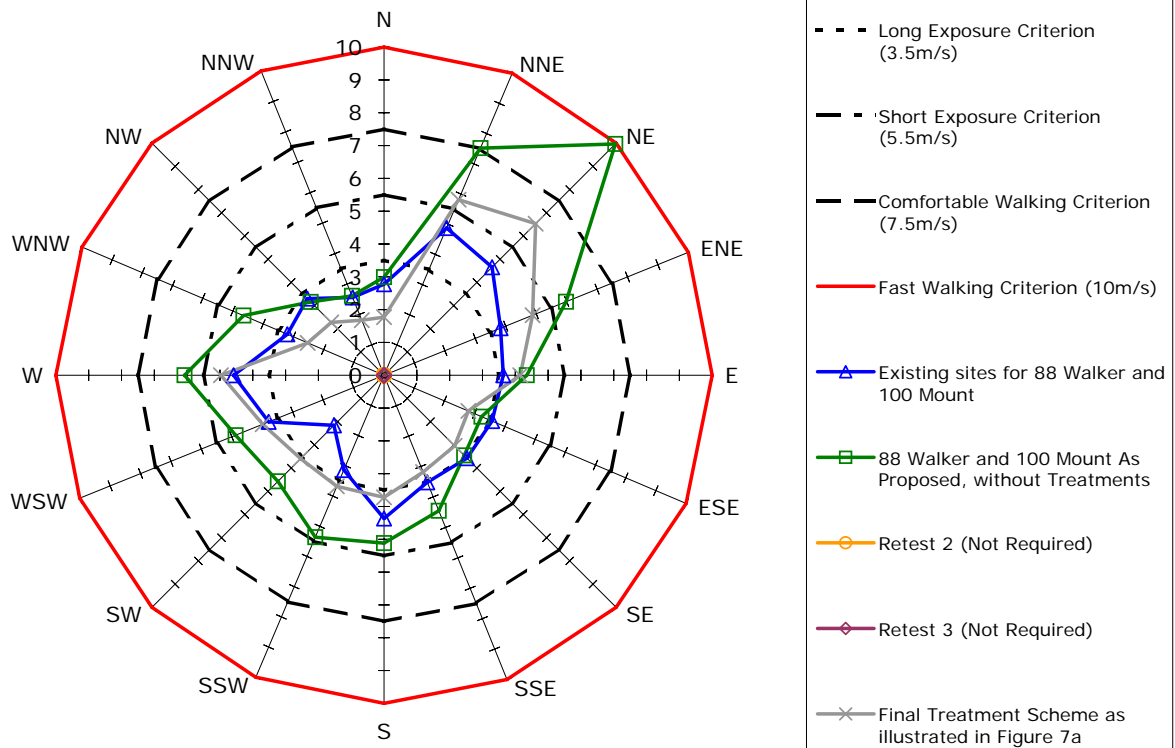


Annual Maximum Gust Wind Speeds (m/s)

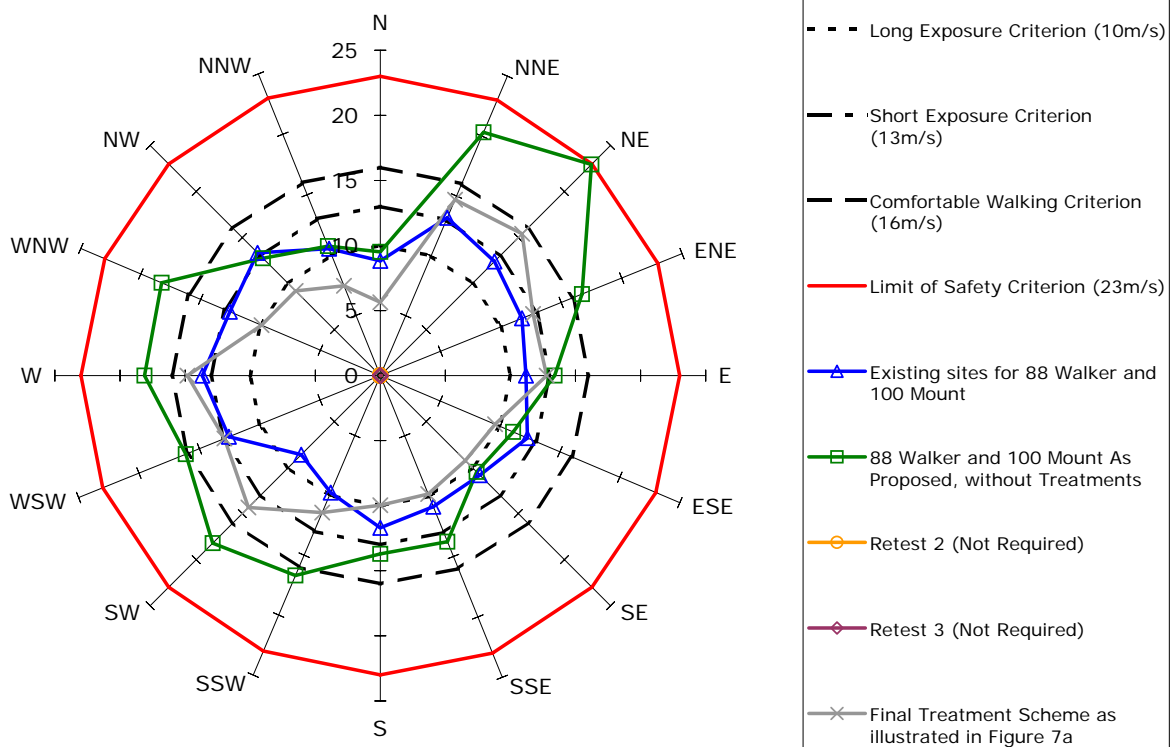


Measured Wind Speeds at Point 13

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

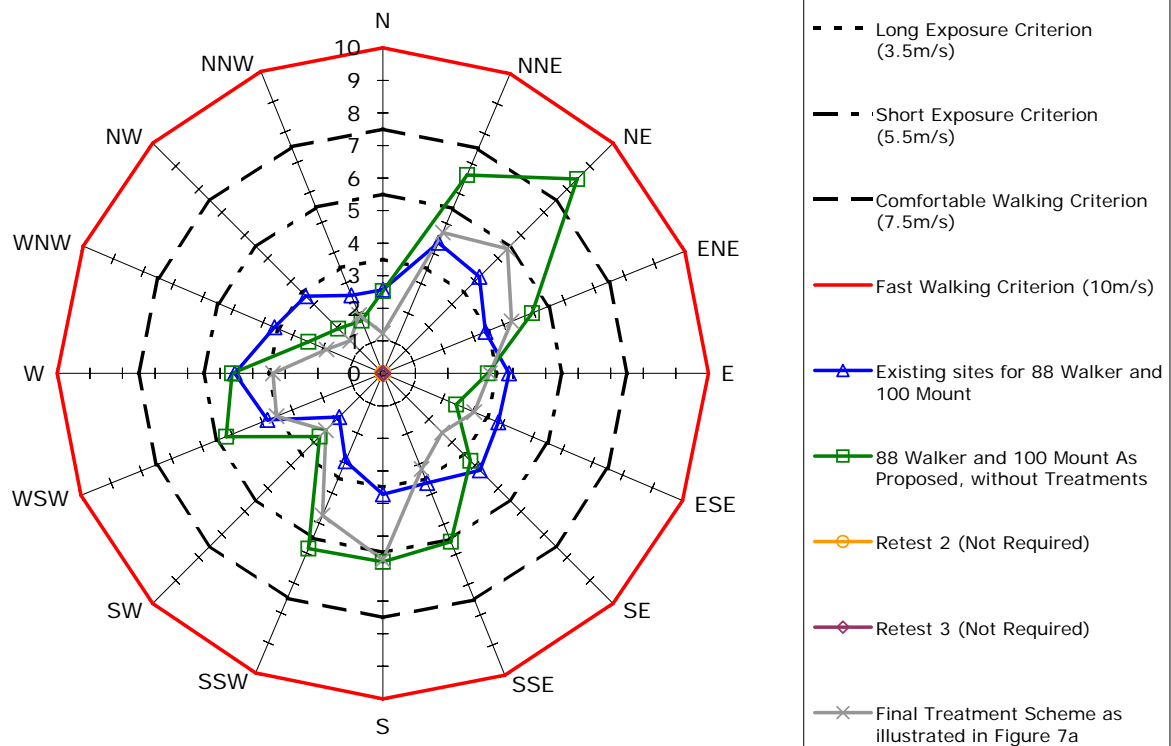


Annual Maximum Gust Wind Speeds (m/s)

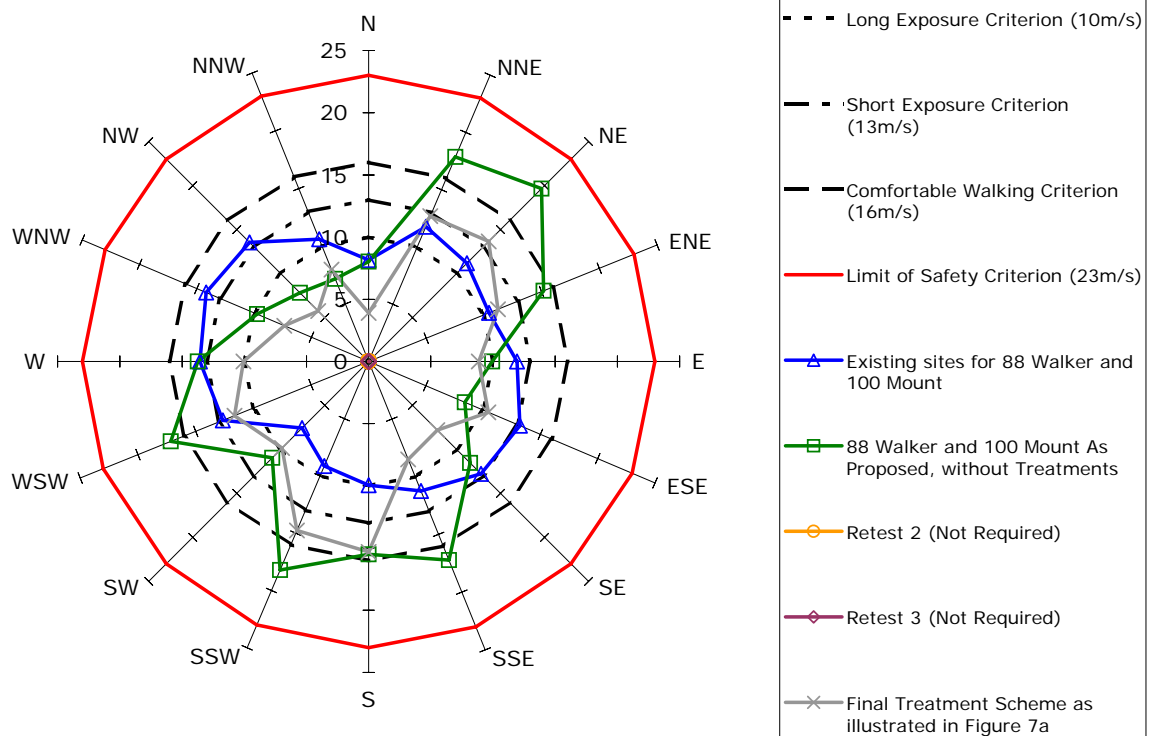


Measured Wind Speeds at Point 15

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

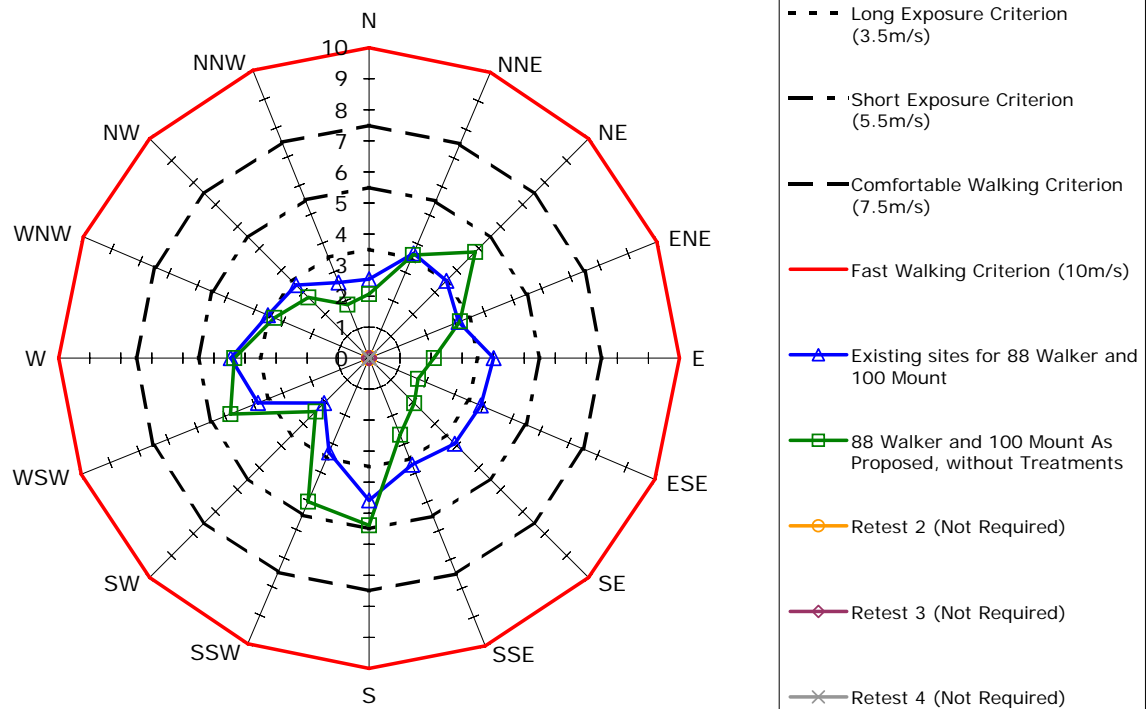


Annual Maximum Gust Wind Speeds (m/s)

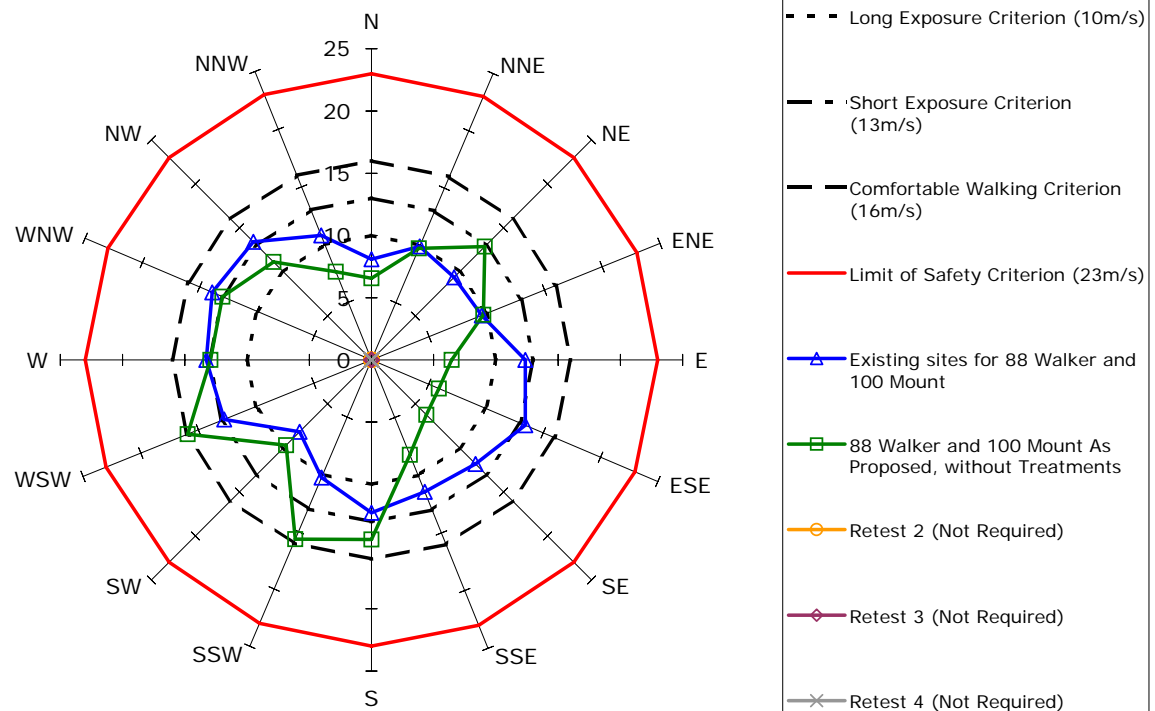


Measured Wind Speeds at Point 20

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

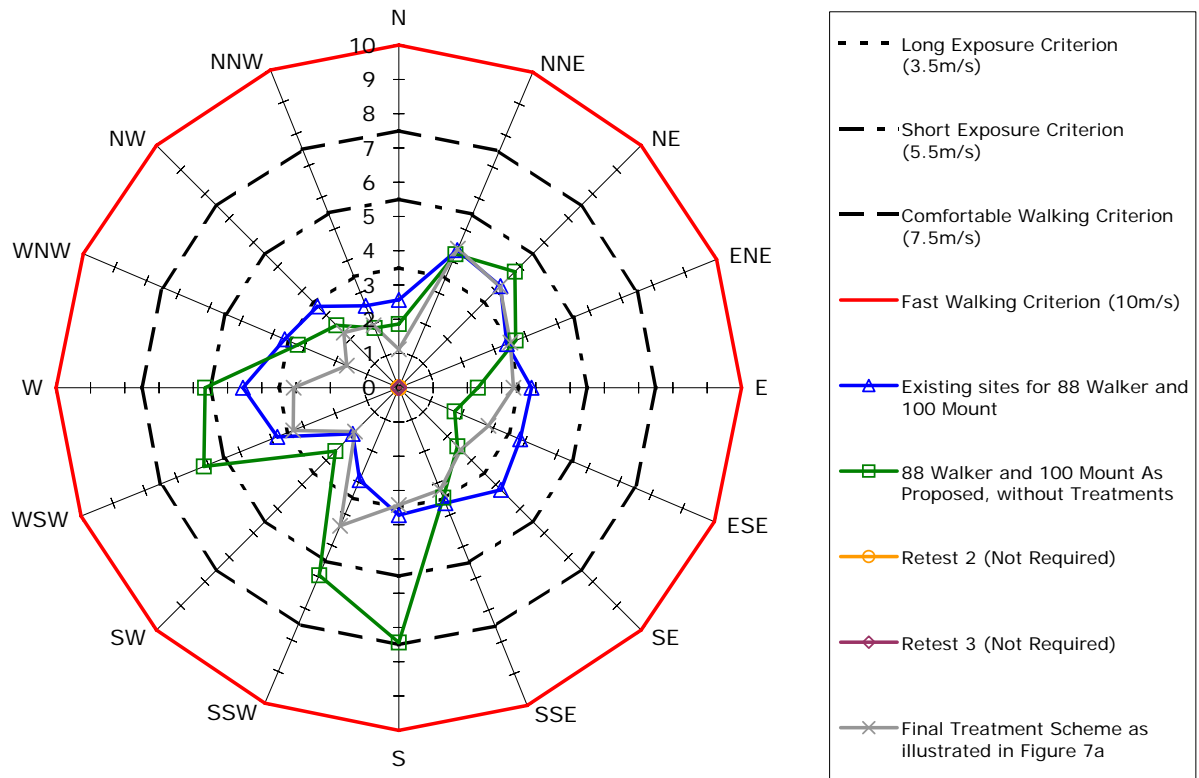


Annual Maximum Gust Wind Speeds (m/s)

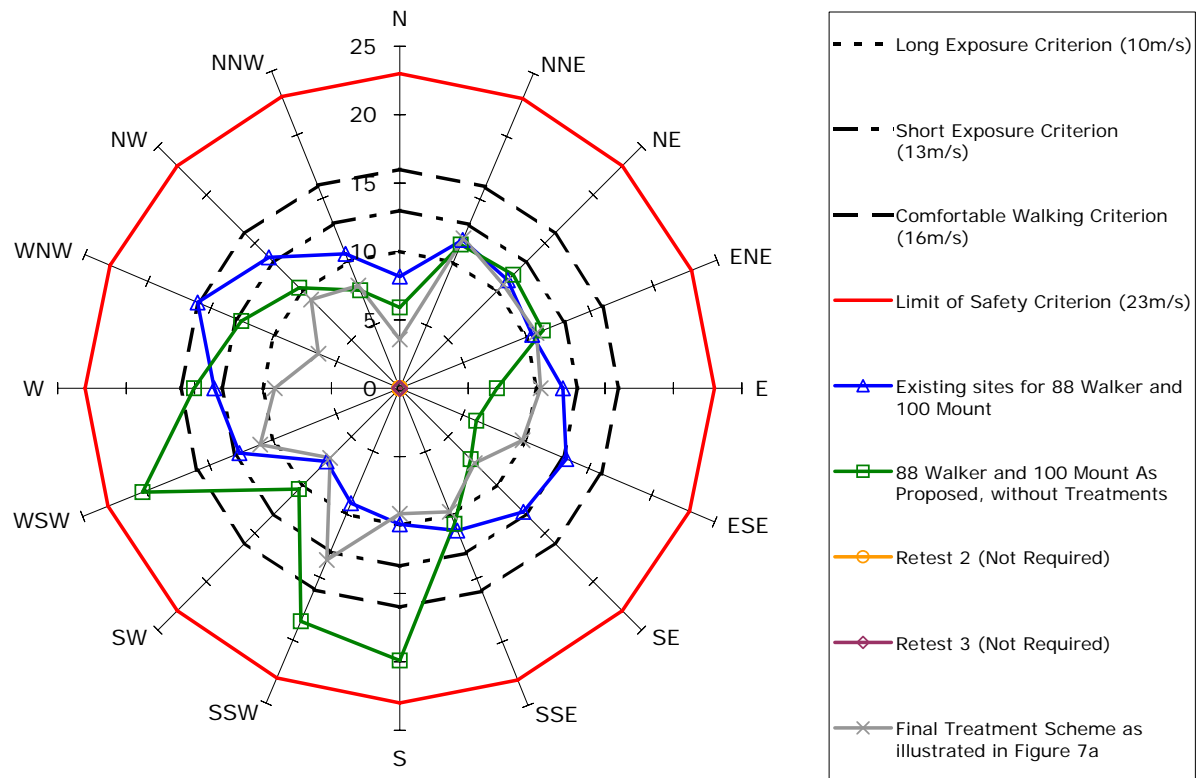


Measured Wind Speeds at Point 21

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

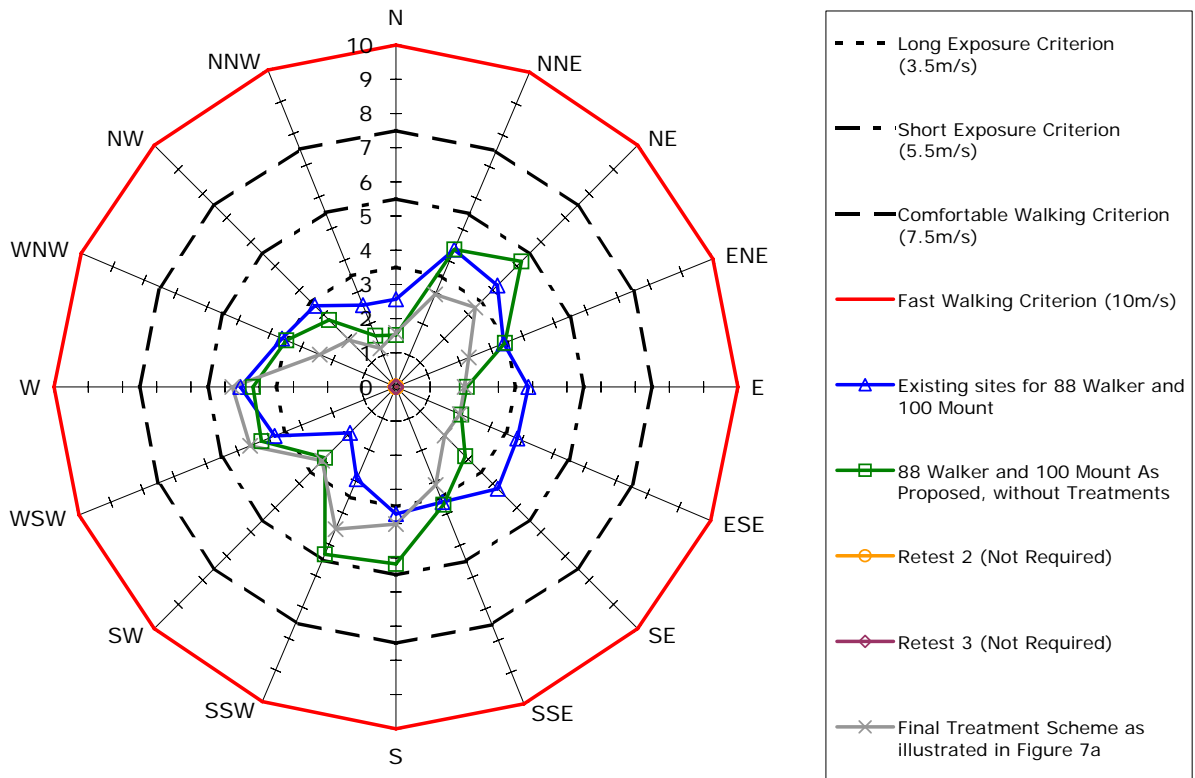


Annual Maximum Gust Wind Speeds (m/s)

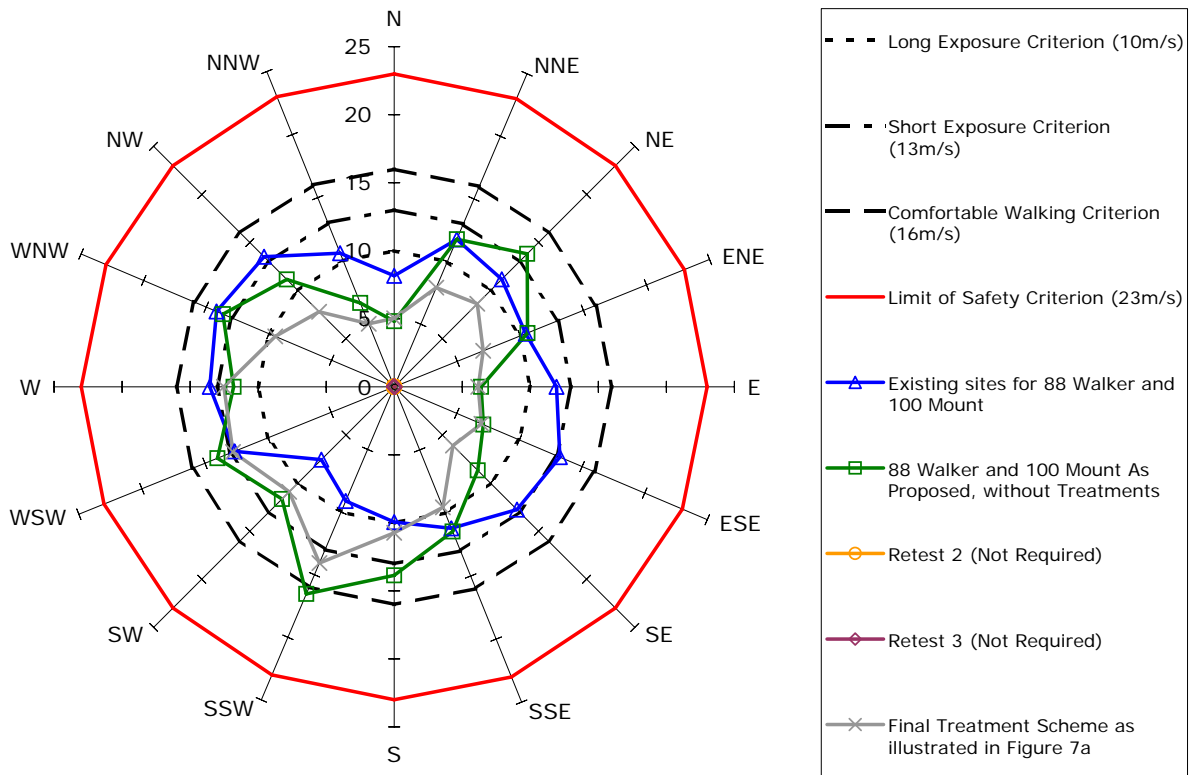


Measured Wind Speeds at Point 22

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

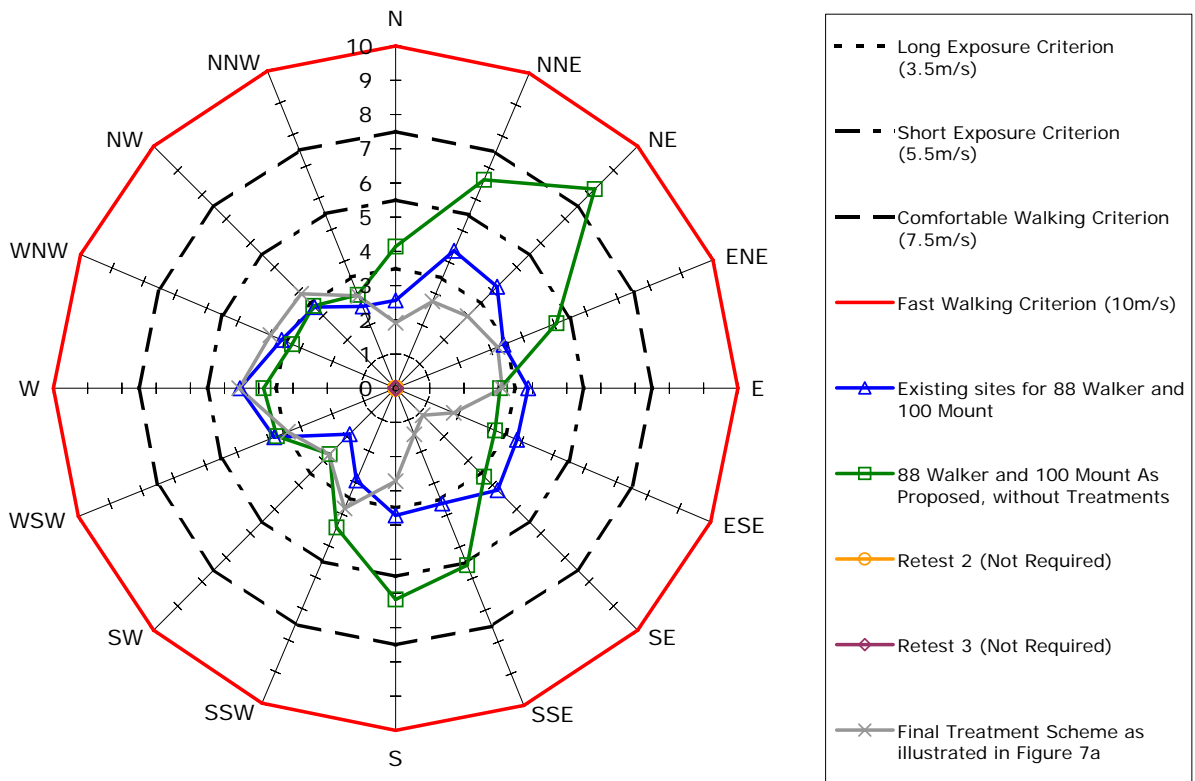


Annual Maximum Gust Wind Speeds (m/s)

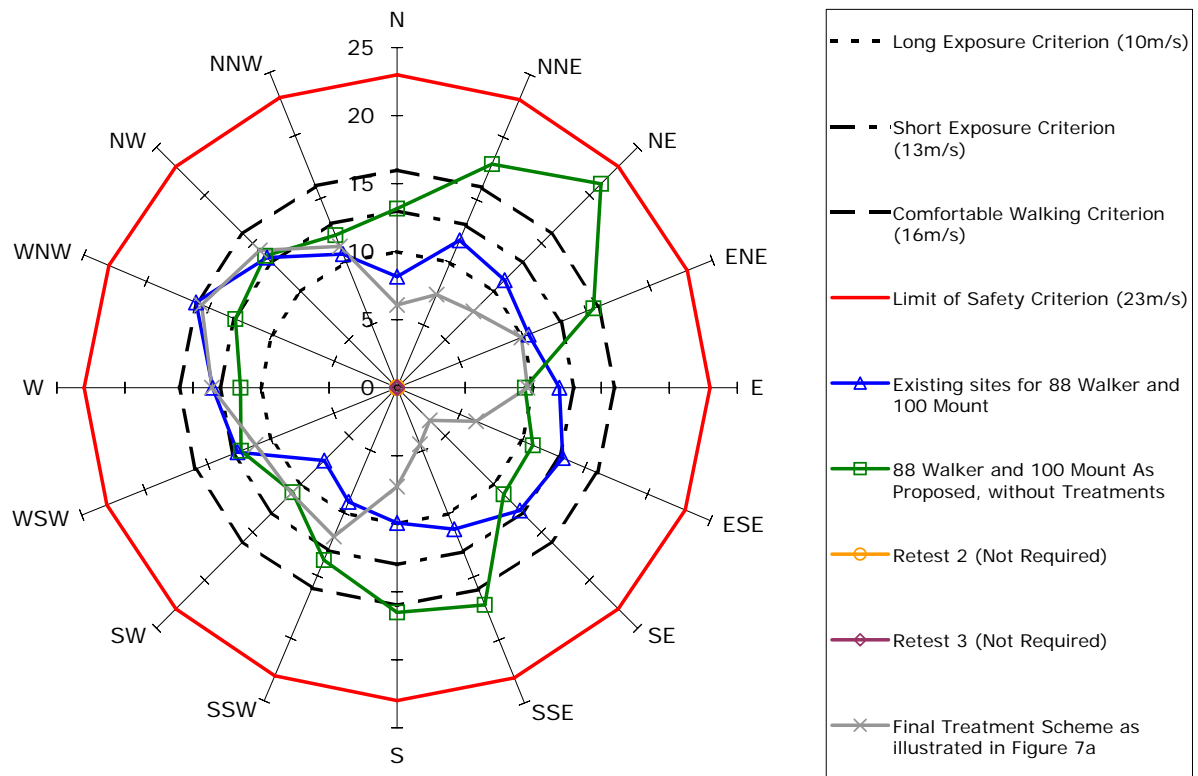


Measured Wind Speeds at Point 23

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

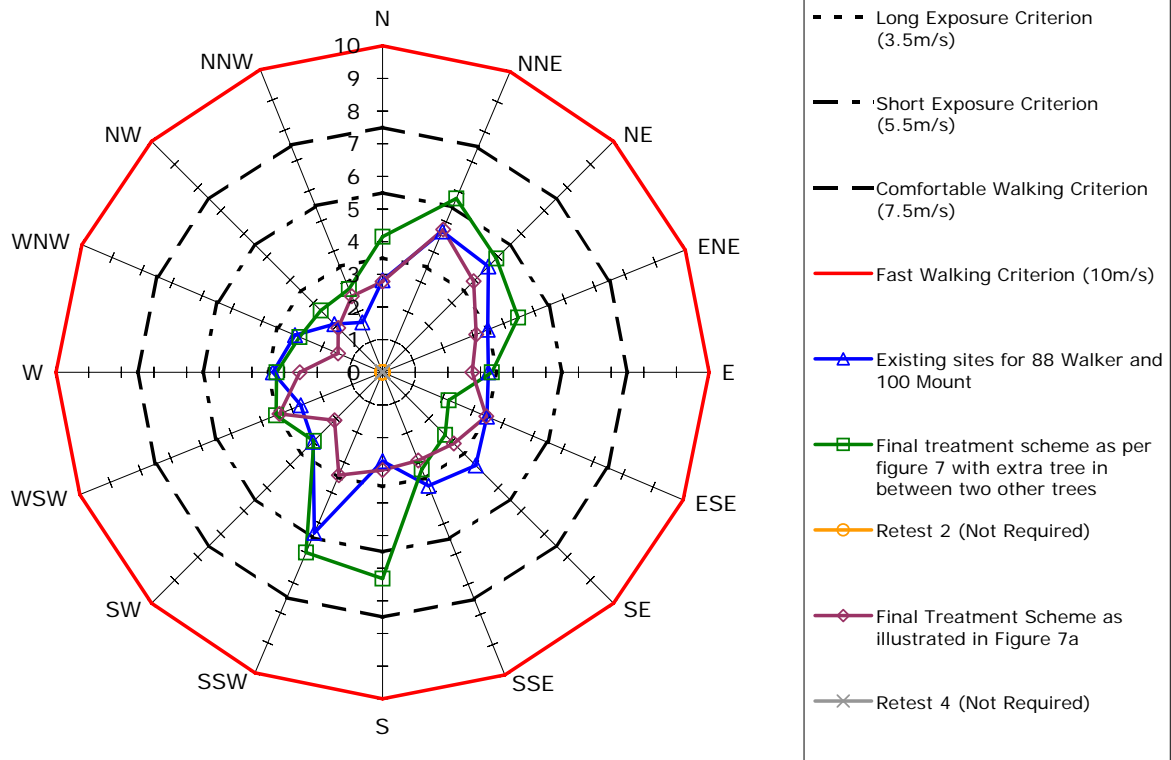


Annual Maximum Gust Wind Speeds (m/s)

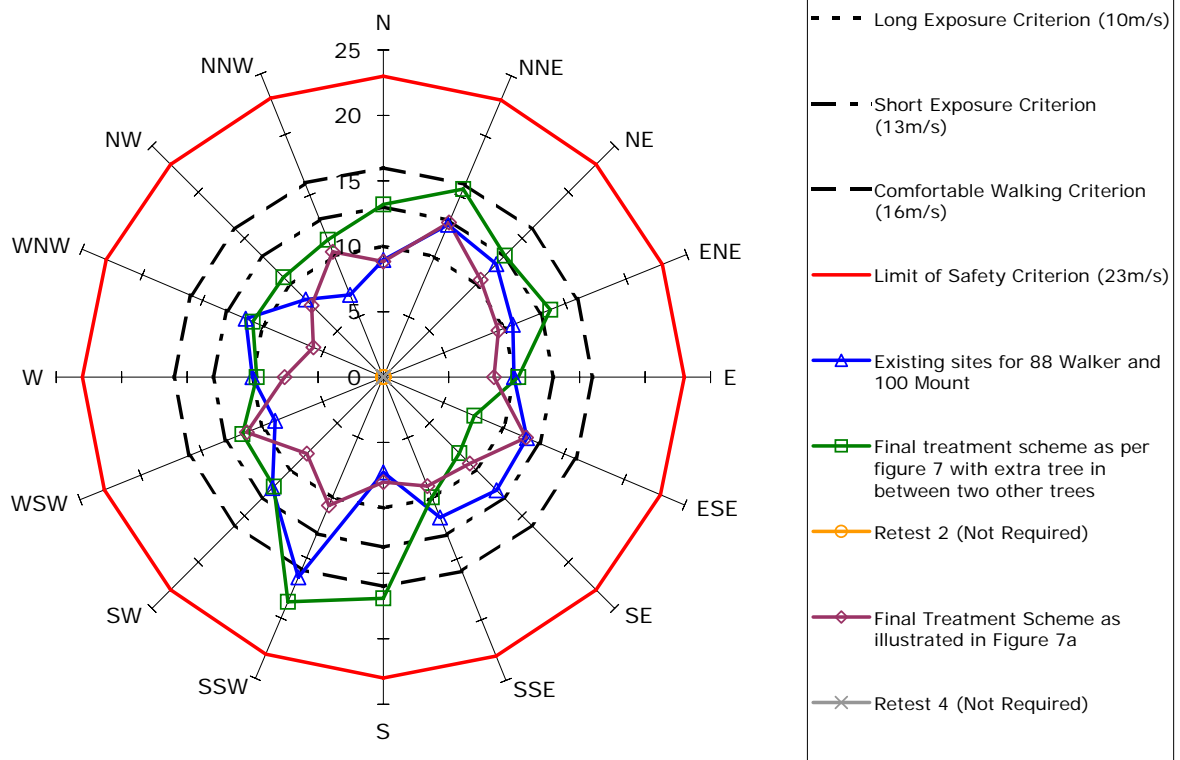


Measured Wind Speeds at Point 24

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

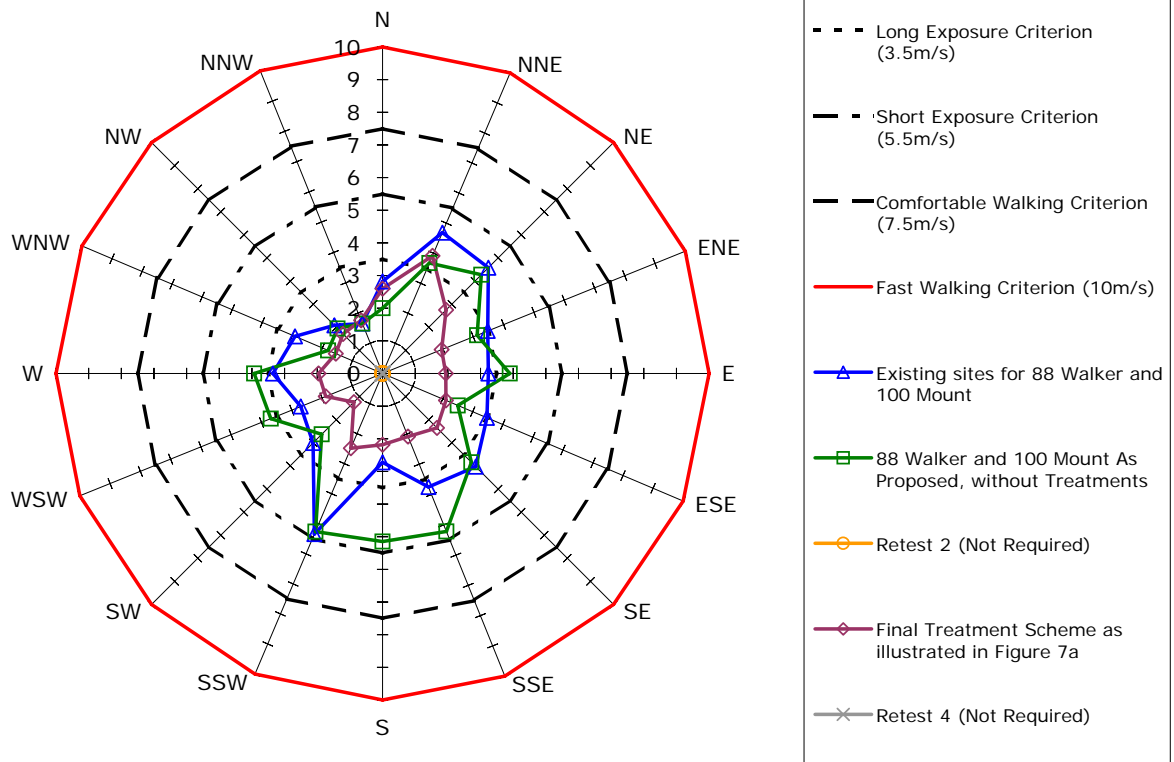


Annual Maximum Gust Wind Speeds (m/s)

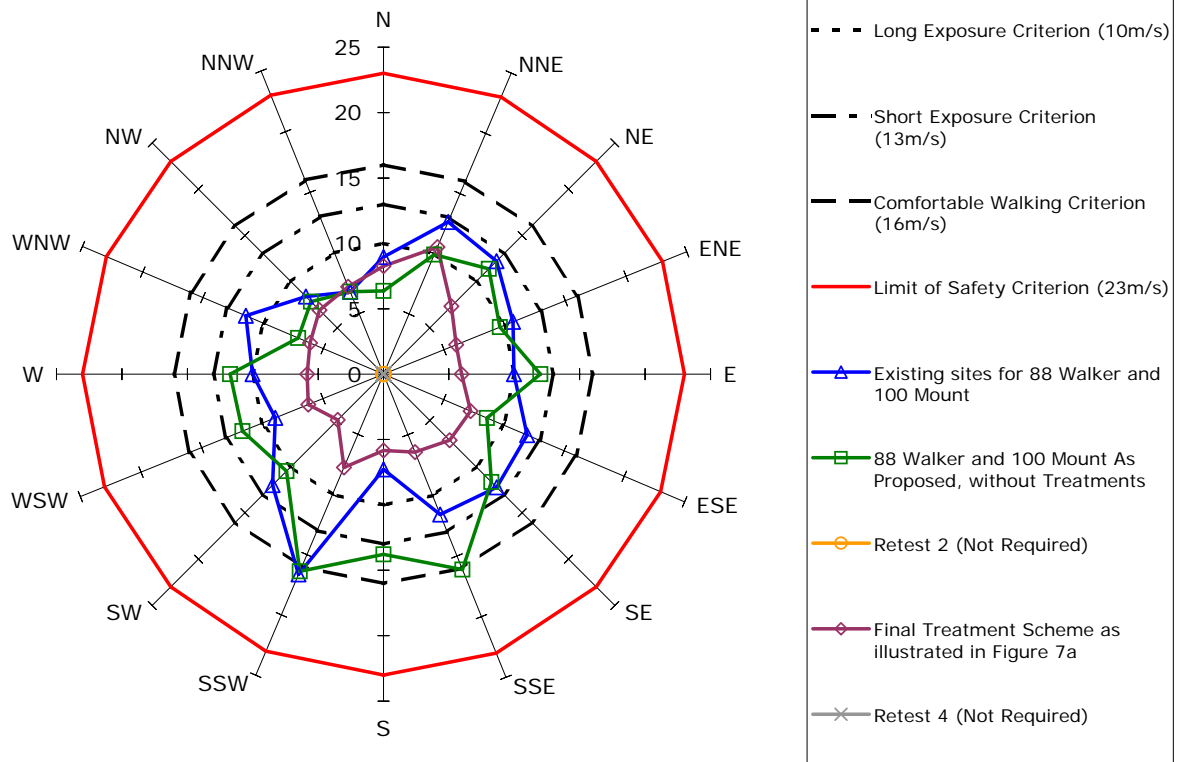


Measured Wind Speeds at Point 25

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)

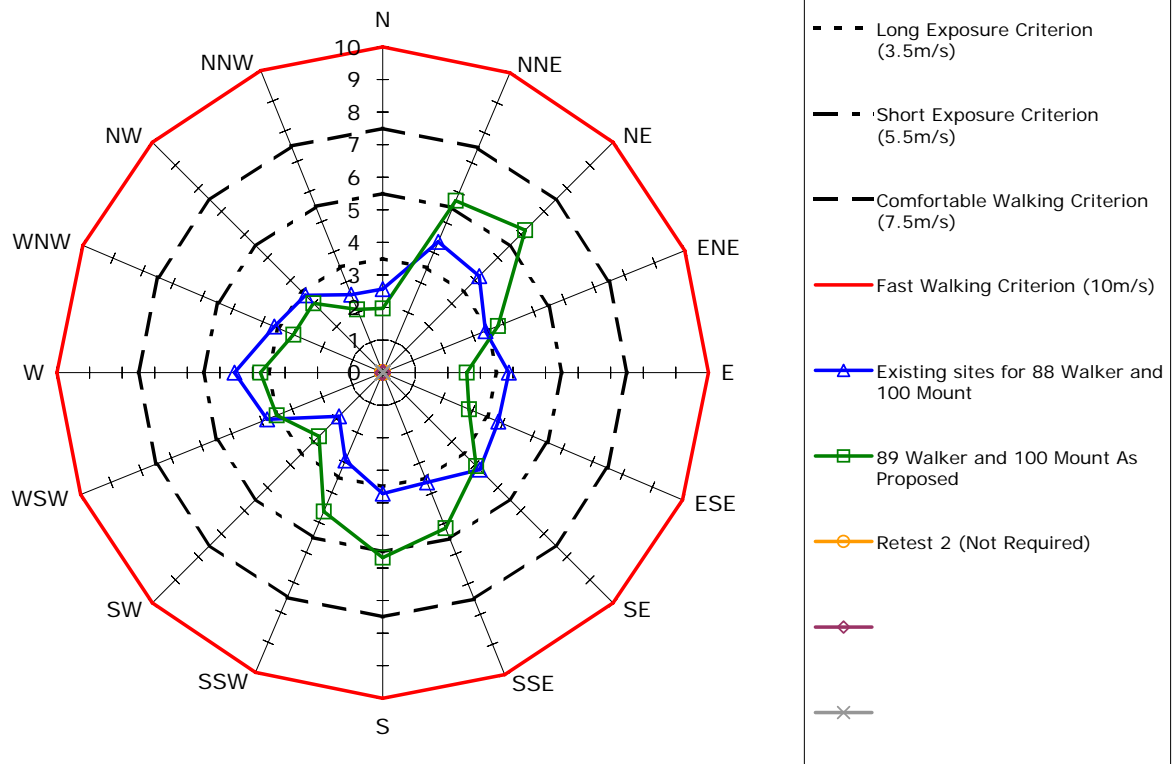


Annual Maximum Gust Wind Speeds (m/s)



Measured Wind Speeds at Point 81

Weekly Maximum Gust Equivalent Mean Wind Speeds (m/s)



Annual Maximum Gust Wind Speeds (m/s)

