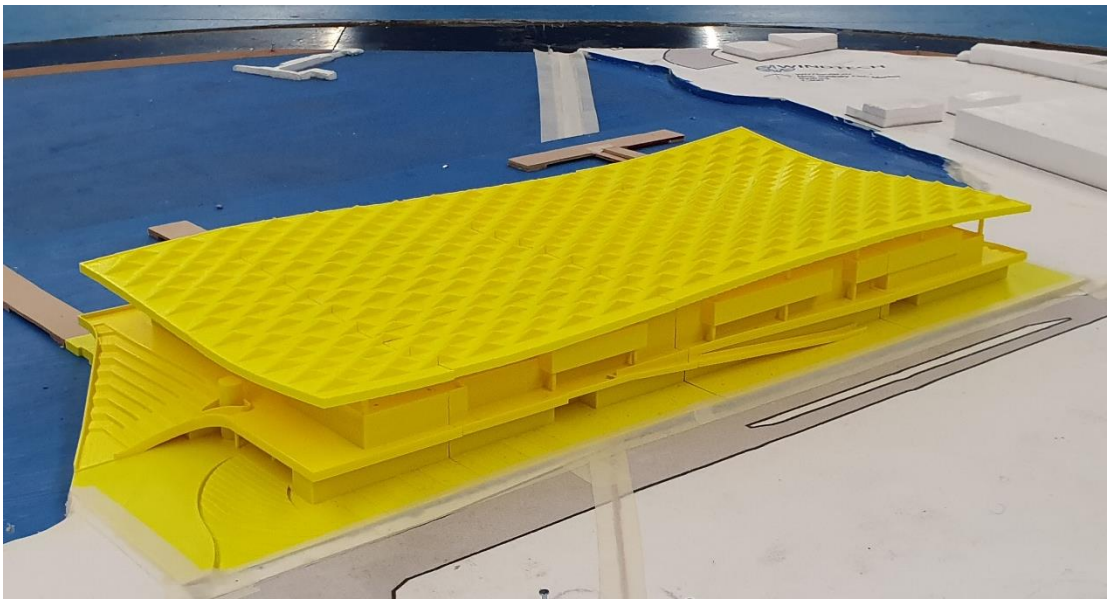

PEDESTRIAN WIND ENVIRONMENT STUDY

THE NEW SYDNEY FISH MARKET

CONCEPT AND STAGE 1 AND STAGE 2 MAIN WORKS

WD758-06F02(REV0)- WE REPORT

MAY 20, 2019

Prepared for:

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EXECUTIVE SUMMARY

Sydney Fish Market is the largest of its kind in the Southern Hemisphere and among the three largest seafood markets in terms of variety in the world. The market sources product both nationally and internationally and trades approximately 14,500 tonnes of seafood annually with up to one hundred sustainable seafood species traded every day and approximately 500 species traded annually. The site attracts over 3 million visits each year.

This report presents the results of a detailed investigation into the wind environment conditions for the proposed new Sydney Fish Market building, located in Blackwattle Bay, Sydney. This report addresses the Secretary's Environmental Assessment Requirements (SEARs) Item 7.3 for Stage 1 (Doc. Ref.: *SSD 8924*) and SEARs Item 7.4 for Stage 2 (Doc. Ref.: *SSD 8925*).

Testing was performed at Windtech's boundary layer wind tunnel facility. The wind tunnel has a 3.0m wide working section and a fetch length of 14m, and measurements were taken from 16 wind directions at 22.5 degree increments. Testing was carried out using a 1:300 detailed scale model of the development. The effects of nearby buildings and land topography have been accounted for through the use of a proximity model which represents an area with a radius of 375m.

The testing of the proposed new Sydney Fish Market building was undertaken with the inclusion of the existing surrounding buildings. The proposed development was initially tested without vegetation. A select number of points were later retested with the existing trees along Bridge Road. The existing site wind conditions were also measured, for comparison.

Peak gust and mean wind speeds were measured at selected critical outdoor trafficable locations within and around the subject development. velocity coefficients representing the local wind speeds are derived from the wind tunnel and are combined with a statistical model of the regional wind climate (which accounts for the directional strength and frequency of occurrence of the prevailing regional winds) to provide the equivalent full-scale wind speeds at the site. The wind speed measurements are compared with criteria for pedestrian comfort and safety, based on Gust-Equivalent Mean (GEM) and annual maximum gust winds, respectively.

The model was tested in the wind tunnel without the effect of any forms of wind ameliorating devices such as screens, balustrades, etc., which are not already shown in the architectural drawings. In-principle treatments have been recommended for any area exposed to strong winds.

The results of the study indicate that, without the implementation of any wind mitigation devices, wind conditions for the majority of trafficable outdoor locations within and around the development will not be suitable for their intended uses. Most areas will experience strong winds which will exceed the relevant criteria for comfort and/or safety. Suggested treatments are described as follows:

- Include trees along the Lower Ground Level southern promenade (as is already proposed in the design). It is recommended that the trees be densely foliating and of an evergreen variety, capable of growing 3-5m in height with a minimum canopy width of 4m.
- The north and east façade corners of the Lower Ground level to be made 30% porous.
- Inclusion of full-height impermeable screens along the Lower Ground western walkway. Screens may be made porous up to 25%.
- Include landscaping along the Civic Plaza and Western Plaza (as is already proposed in the design). It is recommended that this be in the form of elevated planters arranged in a baffle configuration, with the vegetation in the planters capable of growing to a height of 1.5m above the floor slab.
- Inclusion of 2m high screens, with 20-30% porosity, along the edges of each of the 3 north-western piers.
- The railing along the middle of the north-eastern and south-western Upper Ground staircases to be attached to an impermeable screen/balustrade.
- Inclusion of 1.2m high impermeable railing along the edges of the north-eastern, south-western and north-western staircases.
- North, east and west façade corners of the Upper Ground level to be made 30% porous.
- Inclusion of 1.2m high impermeable balustrades/screens adjacent to the north-east, south-west and north-west façade of the Upper Ground level.
- Inclusion of 3m high impermeable screens either side of the proposed seating at the southern corner of the development, at the Upper Ground level.
- Inclusion of impermeable screens to the Mezzanine Level at the four main corners of the development. The height of these screens should be such that they extend to the underside of the canopy above.
- Inclusion of 1.2m high impermeable balustrades along the north-western Mezzanine Level walkway (with gaps to allow for pedestrian movement).

With the inclusion of these treatments to the final design, it is expected that wind conditions for all outdoor trafficable areas within and around the development will be suitable for their intended uses.

CONTENTS

1 INTRODUCTION

1.1 Background

Sydney Fish Market is the largest of its kind in the Southern Hemisphere and among the three largest seafood markets in terms of variety in the world. The market sources product both nationally and internationally and trades approximately 14,500 tonnes of seafood annually with up to one hundred sustainable seafood species traded every day and approximately 500 species traded annually. The site attracts over 3 million visits each year. In November 2016 the NSW Premier announced a new fish market would be built at the head of Blackwattle Bay, adjacent to the existing Fish Market. In June 2017 the Premier of NSW announced the appointment of Danish architects 3XN to lead the design team that includes Sydney firms BVN and Aspect Studios. They have been working with key stakeholders, including UrbanGrowth NSW Development Corporation (UGDC UrbanGrowth NSW) and Sydney Fish Market Pty Ltd (SFM), to develop the design for the new Sydney Fish Market. As announced by the NSW Premier, works are planned to commence in 2019.

1.2 Site and Context

The site is located at the head of Blackwattle Bay between the Pyrmont Peninsula and the foreshore of Glebe, situated less than 2km west of Sydney's CBD and is partially within the City of Sydney Local Government Area.

The land to which the development application relates comprises Lots 3 - 5 in DP 1064339 part of lot 107 in DP 1076596 and part Lot 1 in DP835794. Works to connect to the existing waterfront promenade to the west of the site are located on Lot 3 in DP1018801. The development footprint is irregular in shape and has an area of approximately 36,800m^2. The site is partly on land above mean high water mark and partly on water below mean high water mark.

The site has a frontage to Bridge Road to the south and Blackwattle Bay to the north. Pyrmont Bridge Road is an arterial road that links to the Anzac Bridge to the north west of the site. Sydney Secondary College Blackwattle Bay Campus is immediately south west of the site and the existing fish market immediately north east. Located directly opposite the site to the south is Wentworth Park, separated by Bridge Road.

Located approximately 400m walking distance from the site are the Fish Market, Wentworth Park, and Glebe Light Rail stops which are serviced by the Dulwich Hill Line which is a 23 stop, 12.8-kilometre route running from Dulwich Hill to Central station via Pyrmont.

The site contains one heritage item being the heritage stormwater culvert. The site is also near a number of heritage items.

The site's current uses include a concrete batching plant at the Western end and concrete hardstand and wharf area at the Eastern end, which is currently vacant. The site includes

wharves and land-based structures. Part of the site is the water of Blackwattle Bay. Works will be undertaken on Bridge Road and its intersections with Wattle Street and Wentworth Park Road.

1.3 Approval Strategy

Pursuant to the provisions of the *Environmental Planning and Assessment Act 1979* and *State Environmental Planning Policy (State and Regional Development) 2011* ("SEPP SRD") the new fish market development is State Significant Development and the Minister for Planning is the consent authority.

To deliver the new fish market, the following applications will be lodged:

- A concept development application seeking approval for concept proposals for the new fish market. This is to meet the requirements for a master plan contained in clause 40 of SREP26. This concept development application will also set out details of the first stage of the development being the demolition of land and water-based structures on the site including removal of marine piles and any resulting repairs to the existing sea wall;
- A development application for the construction of the new fish market;
- An application to amend the planning controls applying to the site to enable the proposed development to be a permissible use on all of the site. This is to be achieved by an amendment to Sydney Regional Environmental Plan No 26—City West ("SREP26").

These applications are lodged concurrently.

1.4 Summary of the Development

The proposal is to build a new fish market with a contemporary urban design, provide unique experiences for visitors and world-class auction and wholesale facilities. The new facility will be set within an improved public domain including the creation of a waterfront promenade with improved access to Blackwattle Bay and linking to surrounding areas and to public transport.

The development will expand and improve the functions of the existing in a new setting designed to achieve design excellence, functional performance and environmental sustainability.

The new fish market will include retail and food and beverage premises, wholesale facilities and auction rooms, offices and commercial space, Sydney Seafood Schools, back-of-house facilities and car, truck and coach parking spaces. The new facility is to include a new foreshore promenade and wharves. The new fish market will be purpose built and will be supported by a state of the art back-of-house plant and recycling/waste management facilities.

1.4.1 Concept Development Application

The Concept development application seeks approval for:

1. the use of the site for the fish market including waterfront commercial and tourist facilities and ancillary uses and the distribution of uses;
2. a gross floor area of up to 30,000m2 contained within a defined building envelope;
3. waterfront structures such as wharves;
4. concepts for improvements to the public domain including promenades, access to Blackwattle Bay and landscaping;
5. pedestrian cycle and road access and circulation principles;
6. principles for infrastructure provision and waste management.
7. This concept development application will also set out details of the first stage of the development being the demolition of land and water-based structures on the site including removal of marine piles and any resulting repairs to the existing sea wall, and related services relocations.

1.4.2 Main Works Development Application

The Main Works development application seeks approval for:

1. the construction of a new fish market including land and water-based structures.
2. the use of the site for the fish market including waterfront commercial and tourist facilities and ancillary uses and the distribution of uses;
3. a gross floor area of approximately26,000m^2 as calculated according to the definition of GFA under SREP 26 (approximately 25,600m^2 as calculated according to the definition of GFA under the Standard Instrument).
4. public domain works including promenades access to Blackwattle Bay and landscaping;
5. pedestrian, cycle and road access and circulation;
6. infrastructure provision and waste management;
7. associated works as required.

The proposed uses comprise:

Below Ground Level

1. Parking for service and delivery, and private vehicles up to approximately 417 vehicles;
2. Plant and storage;
3. Waste Management facilities; and
4. End of journey facilities.

Ground Level - Outside of Building Envelope

1. Up to three operational wharves for fishing fleet servicing and product unloading/loading, multi-purpose wharf space, private-operated ferry stop, recreational vehicles and the like;
2. Vehicular access driveways; and
3. Publicly accessible promenade.

Ground Level - Within Building Envelope

1. Wholesale services space including product storage and processing; and
2. Auction floor and associated refrigeration and handling space.
3. Loading dock including time-limited delivery and service vehicle parking area;
4. Waste management facilities;
5. Office space including buyers room;
6. Staff amenities, plant and storage.

Upper Ground Level (L1)

1. Retail premises including fresh food retail, food and drink premises including harbourside dining;
2. External/shared dining space;
3. Ancillary back of house space and staff amenities; and
4. Circulation areas.

Upper Level 2 (Mezzanine)

1. Catering space;
2. The Sydney Seafood School;
3. Tenant and subtenant office space; and
4. Plant and storage space.

1.5 Purpose of this Report

This report presents the results of a detailed investigation into the wind environment conditions for the proposed new Sydney Fish Market building, located in Blackwattle Bay, Sydney. This report addresses the Secretary's Environmental Assessment Requirements (SEARs) Item 7.3 for Stage 1 (Doc. Ref.: *SSD 8924*) and SEARs Item 7.4 for Stage 2 (Doc. Ref.: *SSD 8925*) for a wind impact report that includes the following detail:

- Demonstrate existing wind characteristics of the precinct
    - See Section 2, Section 5.3, Section 6, Appendix A.
- Advice on measures to ensure the suitability of areas for their intended use with regard to the impact of wind on comfort and safety, in particular this is to focus on outdoor public space areas.
    - See Section 5.3, Section 6.
- Advise on placement, orientation, shape and external design of the building and relevant wind mitigation devices
    - See Section 6.
- Identify areas surrounding the development that will be wind affected because of the development
    - See Section 5.3, Section 6.

2 WIND TUNNEL MODEL

Wind tunnel testing was carried out using a 1:300 scale model of the development and surroundings. The study model incorporates all necessary architectural features on the façade of the development to ensure an accurate wind flow is achieved around the model, and was constructed using a Computer Aided Manufacturing (CAM) process to ensure that a high level of detail and accuracy is achieved. The effect of nearby buildings and land topography has been accounted for through the use of a proximity model, which represents a radius of 375m from the development site.

The testing of the proposed new Sydney Fish Market building was undertaken with the inclusion of the existing surrounding buildings. The existing site wind conditions were also measured, for comparison.

Photographs of the wind tunnel model are presented in Figures 1. Plans of the proximity model are provided in Figures 2.

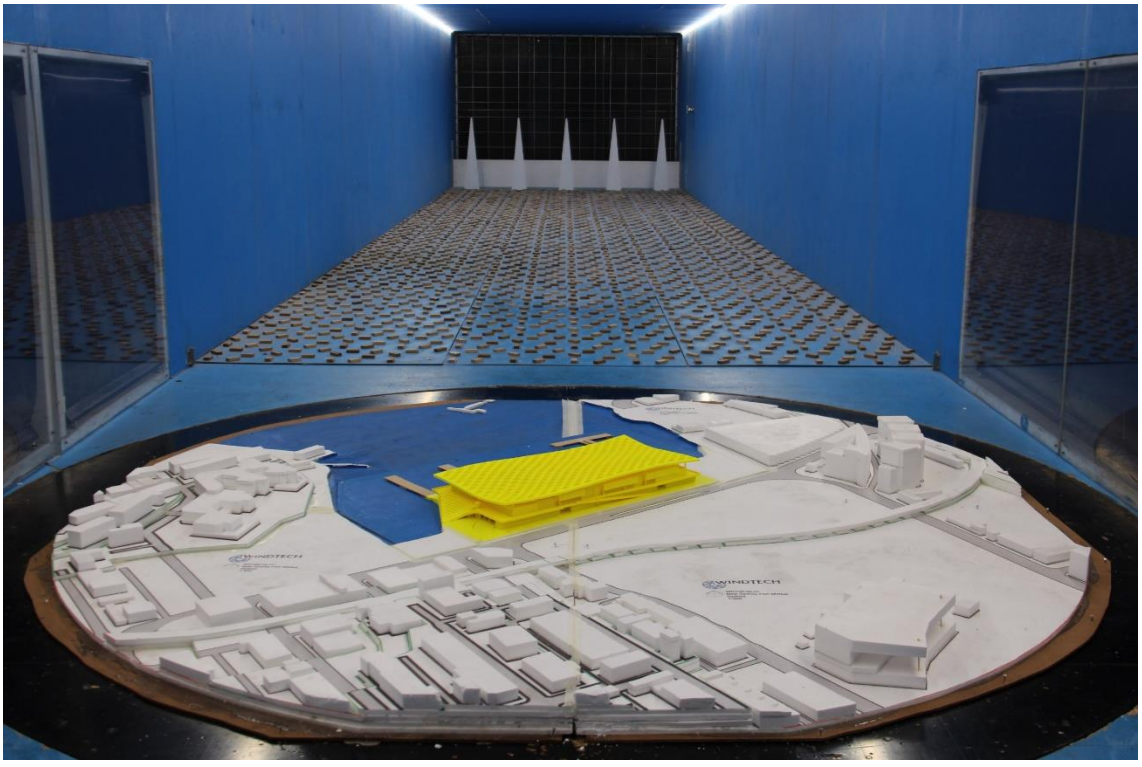

Figure 1a: Photograph of the Wind Tunnel Model (proposed scenario, view from the south)

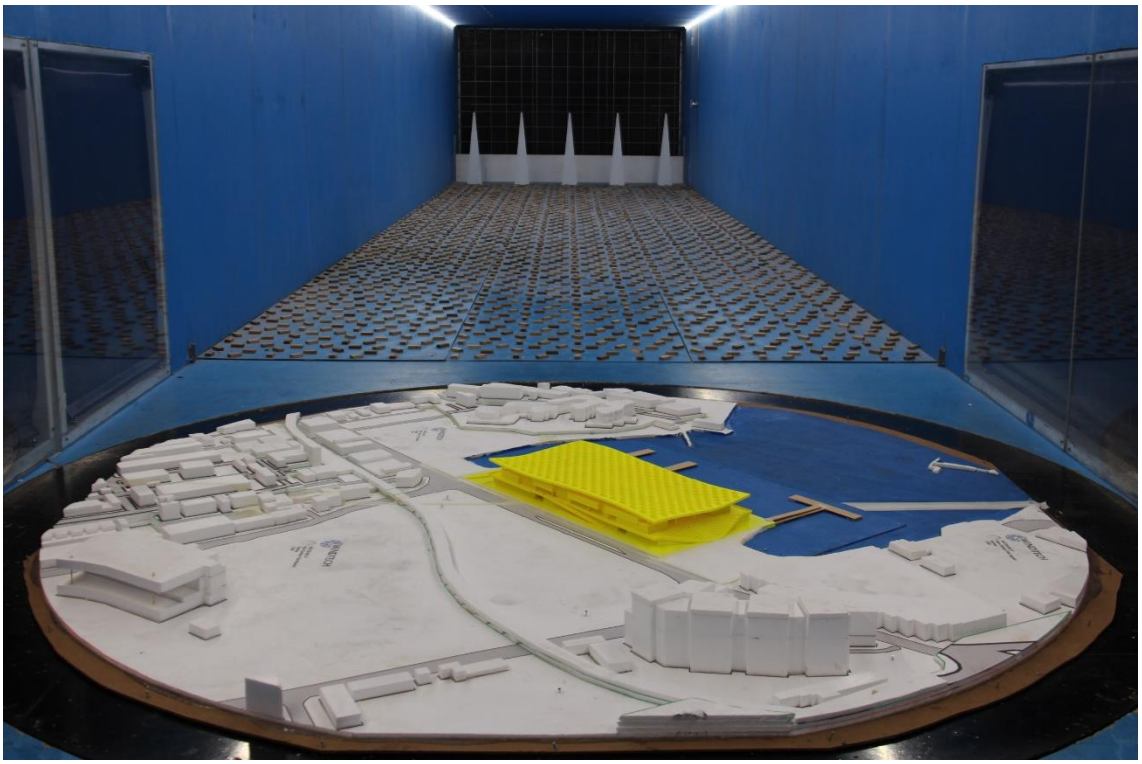

Figure 1b: Photograph of the Wind Tunnel Model
(proposed scenario, view from the east)

Figure 1c: Photograph of the Wind Tunnel Model
(proposed scenario, view from the north)

Figure 1d: Close up photograph of the Wind Tunnel Model (proposed scenario, view from the west)

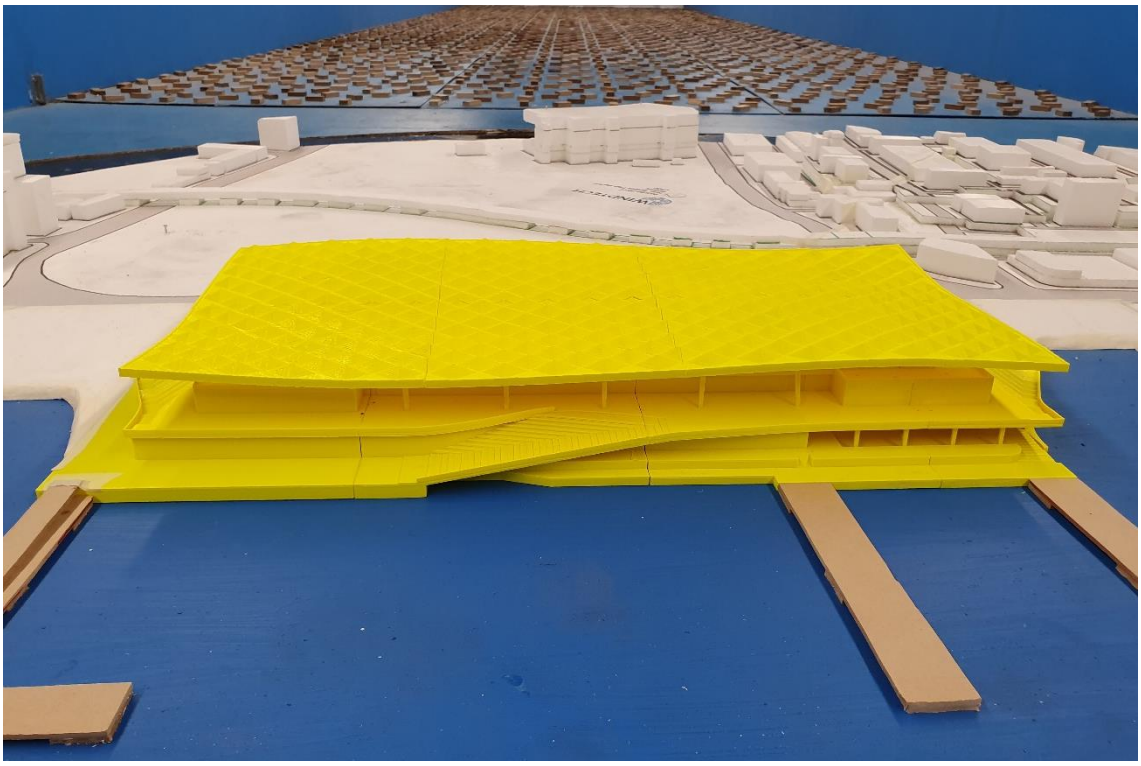

Figure 1e: Close up photograph of the Wind Tunnel Model (proposed scenario, view from the north-west)

Figure 1f: Photograph of the Wind Tunnel Model
(existing scenario, view from the south)

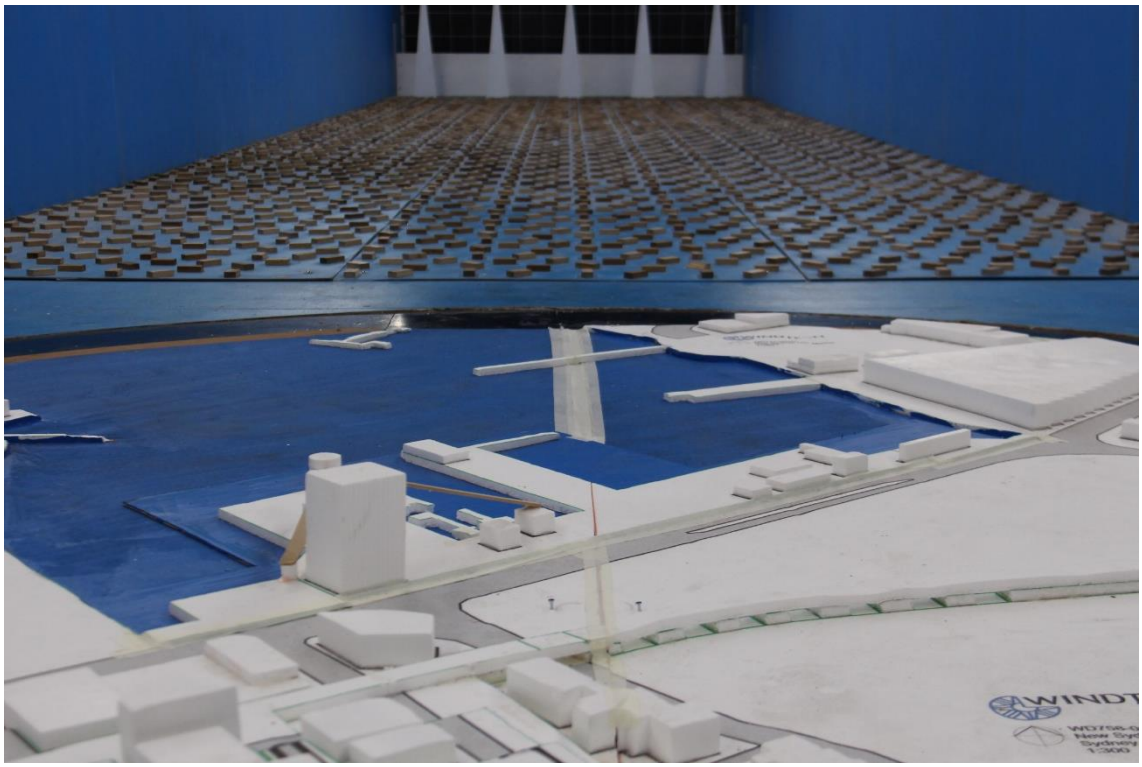

Figure 1g: Close up photograph of the Wind Tunnel Model
(existing scenario, view from the south)

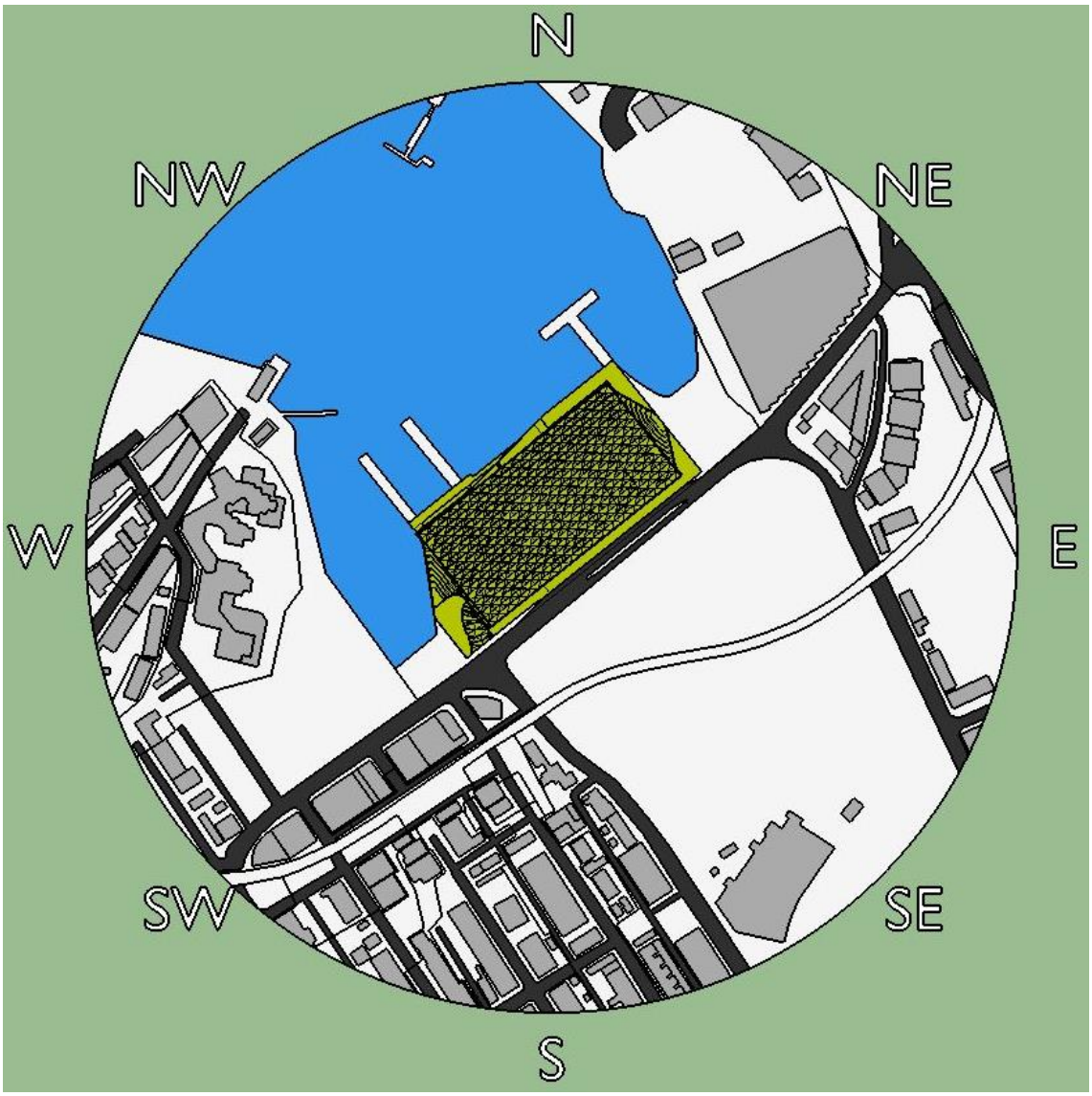

Figure 2a: Proximity Model Plan – Proposed Scenario

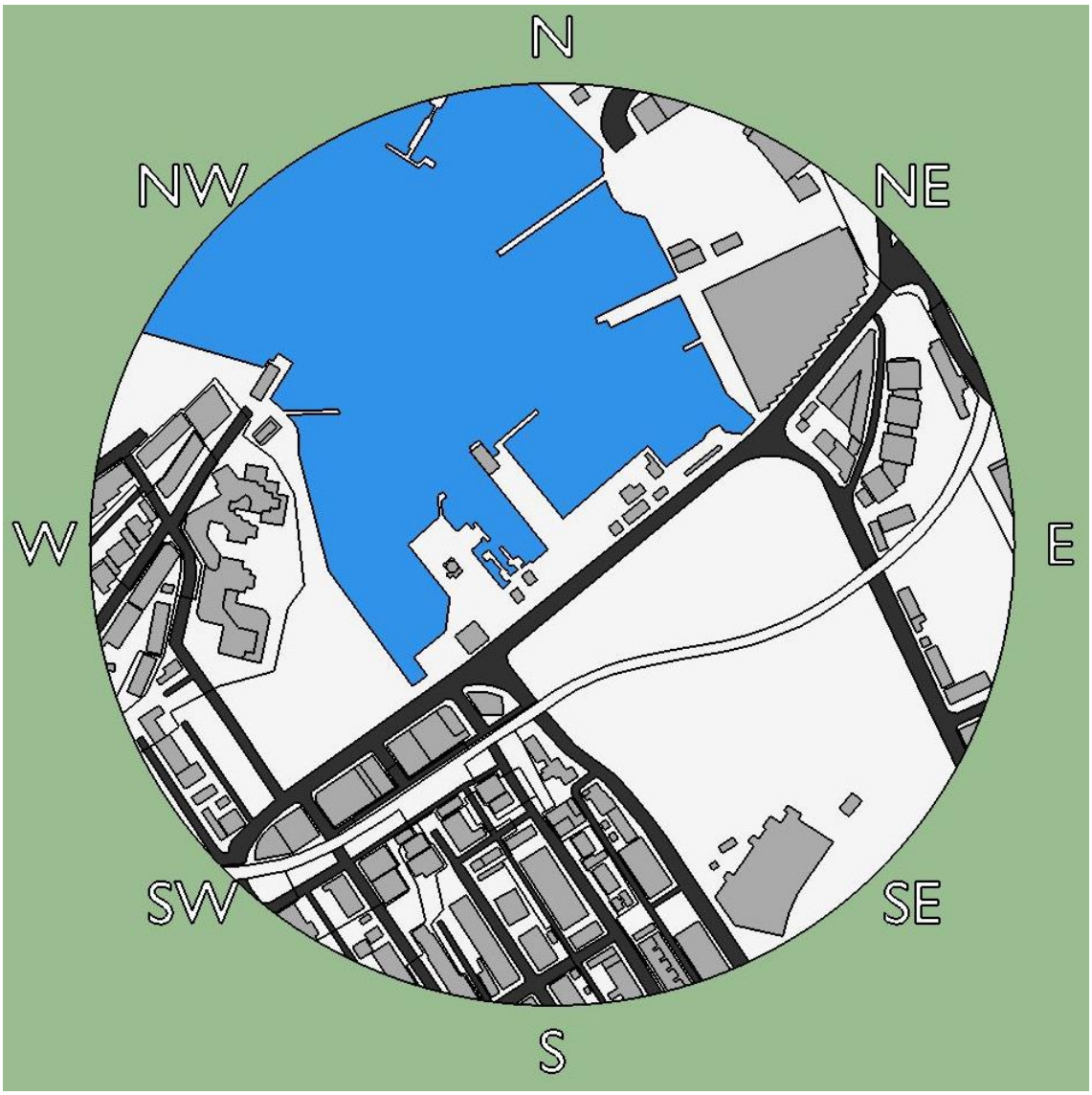

Figure 2b: Proximity Model Plan – Existing Scenario

3 BOUNDARY LAYER WIND PROFILES AT THE SITE

The roughness of the surface of the earth has the effect of slowing down the wind near the ground. This effect is observed up to the boundary layer height, which can range between 500m to 3km above the earth's surface depending on the roughness of the surface (ie: oceans, open farmland, etc). Within this range the prevailing wind forms a boundary layer wind profile.

Various wind codes and standards and other publications classify various types of boundary layer wind flows depending on the surface roughness z_0. Descriptions of typical boundary layer wind profiles, based on Deaves & Harris (1978), are summarised as follows:

- Flat terrain (0.002m < z_0 < 0.003m). Examples include inland water bodies such as lakes, dams, rivers, etc, and the open ocean.
- Semi-open terrain (0.006m < z_0 < 0.01m). Examples include flat deserts and plains.
- Open terrain (0.02m < z_0 < 0.03m). Examples include grassy fields, semi-flat plains, and open farmland (without buildings or trees).
- Semi-suburban/semi-forest terrain (0.06m < z_0 < 0.1m). Examples include farmland with scattered trees and buildings and very low-density suburban areas.
- Suburban/forest terrain (0.2m < z_0 < 0.3m). Examples include suburban areas of towns and areas with dense vegetation such as forests, bushland, etc.
- Semi-urban terrain (0.6m < z_0 < 1.0m). Examples include centres of small cities, industrial parks, etc.
- Urban terrain (2.0m < z_0 < 3.0m). Examples include centres of large cities with many high-rise towers, and also areas with many closely-spaced mid-rise buildings.

The boundary layer wind profile does not change instantly due to changes in the terrain roughness. It can take many kilometres (at least 100km) of a constant surface roughness for the boundary layer wind profile to achieve a state of equilibrium. Hence an analysis of the effect of changes in the upwind terrain roughness is necessary to determine an accurate boundary layer wind profile at the development site location.

For this study this has been undertaken based on the method given in AS/NZS1170.2:2011, which uses a "fetch" length of 60 times the study reference height. However, it should be noted that this "fetch" commences *beyond* a "lag distance" area, which has a length of 20 times the study reference height (in accordance with AS/NZS1170.2:2011), so the actual "fetch" of terrain analysed is the area between 20 and 60 times the study reference height away from the site. The proximity model accounts for the effect of the near field topographic effects as well as the influence of the local built forms.

An aerial image showing the surrounding terrain is presented in Figure 3 for a range of 1.5km from the edge of the proximity model used for the wind tunnel study. The resulting mean and gust terrain and height multipliers at the site location are presented in Table 1, referenced to the study reference height (which is approximately the height of the subject development). Details of the boundary layer wind profiles at the site are combined with the regional wind model (see Section 4) to determine the site wind speeds.

Table 1: Approaching Boundary Layer Wind Profile Analysis Summary (at the study reference height)

Wind Sector (degrees)	Terrain and Height Multiplier			Turbulence Intensity	Equivalent Terrain Category
	$k_{tr,T=1hr}$ *(hourly)*	$k_{tr,T=10min}$ *(10min)*	$k_{tr,T=3s}$ *(3sec)*	I_v	*(AS/NZS1170.2:2011 naming convention)*
0	0.72	0.75	1.09	0.175	2.2
30	0.71	0.74	1.09	0.179	2.3
60	0.50	0.54	0.92	0.286	3.4
90	0.39	0.44	0.84	0.386	3.8
120	0.45	0.50	0.89	0.323	3.6
150	0.54	0.58	0.96	0.262	3.2
180	0.59	0.63	1.00	0.231	3.0
210	0.59	0.63	1.00	0.231	3.0
240	0.59	0.63	1.00	0.231	3.0
270	0.62	0.66	1.02	0.216	2.8
300	0.68	0.72	1.07	0.190	2.5
330	0.72	0.76	1.10	0.174	2.2

For each of the 16 wind directions tested in this study, the approaching boundary layer wind profiles modelled in the wind tunnel closely matched the profiles listed in Table 1. Plots of the boundary layer wind profiles used for the wind tunnel testing are presented in Appendix D of this report.

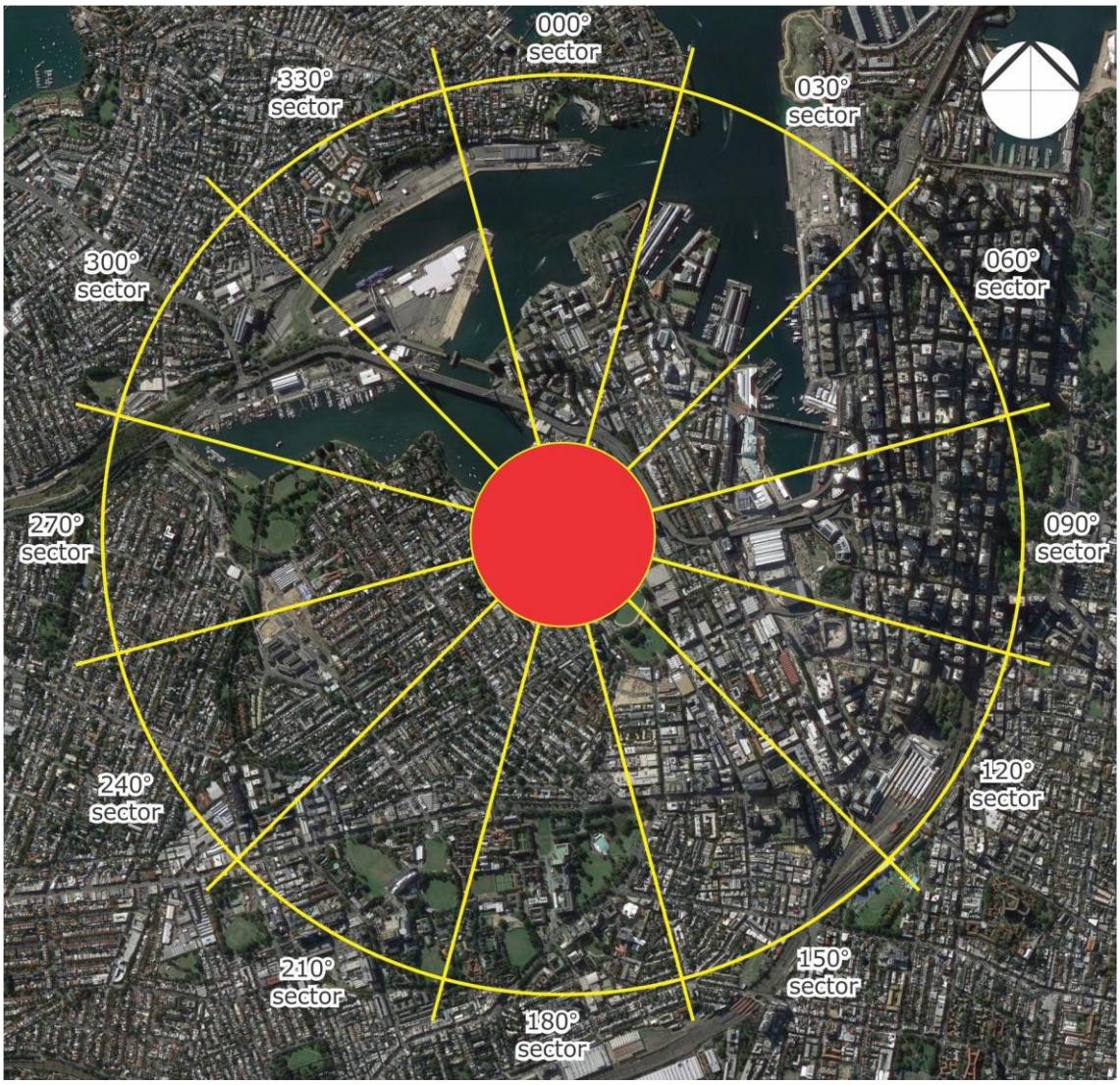

Figure 3: Aerial Image of the Surrounding Terrain
(radius of 1.5km from the edge of the proximity model, which is coloured red)

4 REGIONAL WIND MODEL

The regional wind model used in this study was determined from an analysis of measured directional mean wind speeds obtained at the meteorological recording station located at Kingsford Smith Airport (Sydney Airport). Data was collected from 1995 to 2016 between 6am to 10pm and corrected so that it represents wind speeds over standard open terrain at a height of 10m above ground for each wind direction. From this analysis, directional probabilities of exceedance and directional wind speeds for the region are determined. The directional wind speeds are summarised in

Table 2. The directional wind speeds and corresponding directional frequencies of occurrence are presented in Figure 4.

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

The recurrence intervals examined in this study are for exceedances of 5% (per 90 degree sector) for the pedestrian comfort criteria using Gust-Equivalent Mean (GEM) wind speeds, and annual maximum wind speeds (per 22.5 degree sector) for the pedestrian safety criterion. Note that the 5% probability wind speeds presented in

Table 2 are only used for the directional plot presented in Figure 4 and are not used for the integration of the probabilities.

Table 2: Directional Wind Speeds (m/s)

(hourly means, referenced to 10m above ground in standard open terrain)

Wind Direction	5% Exceedance	Annual Maximum
N	5.9	9.9
NNE	9.9	12.9
NE	9.7	12.3
ENE	7.5	10.0
E	6.3	9.3
ESE	6.2	9.1
SE	7.0	10.1
SSE	8.5	12.2
S	10.3	13.9
SSW	10.0	14.1
SW	6.9	11.9
WSW	9.3	13.6
W	9.8	14.4
WNW	8.8	14.3
NW	6.7	12.6
NNW	5.5	10.7

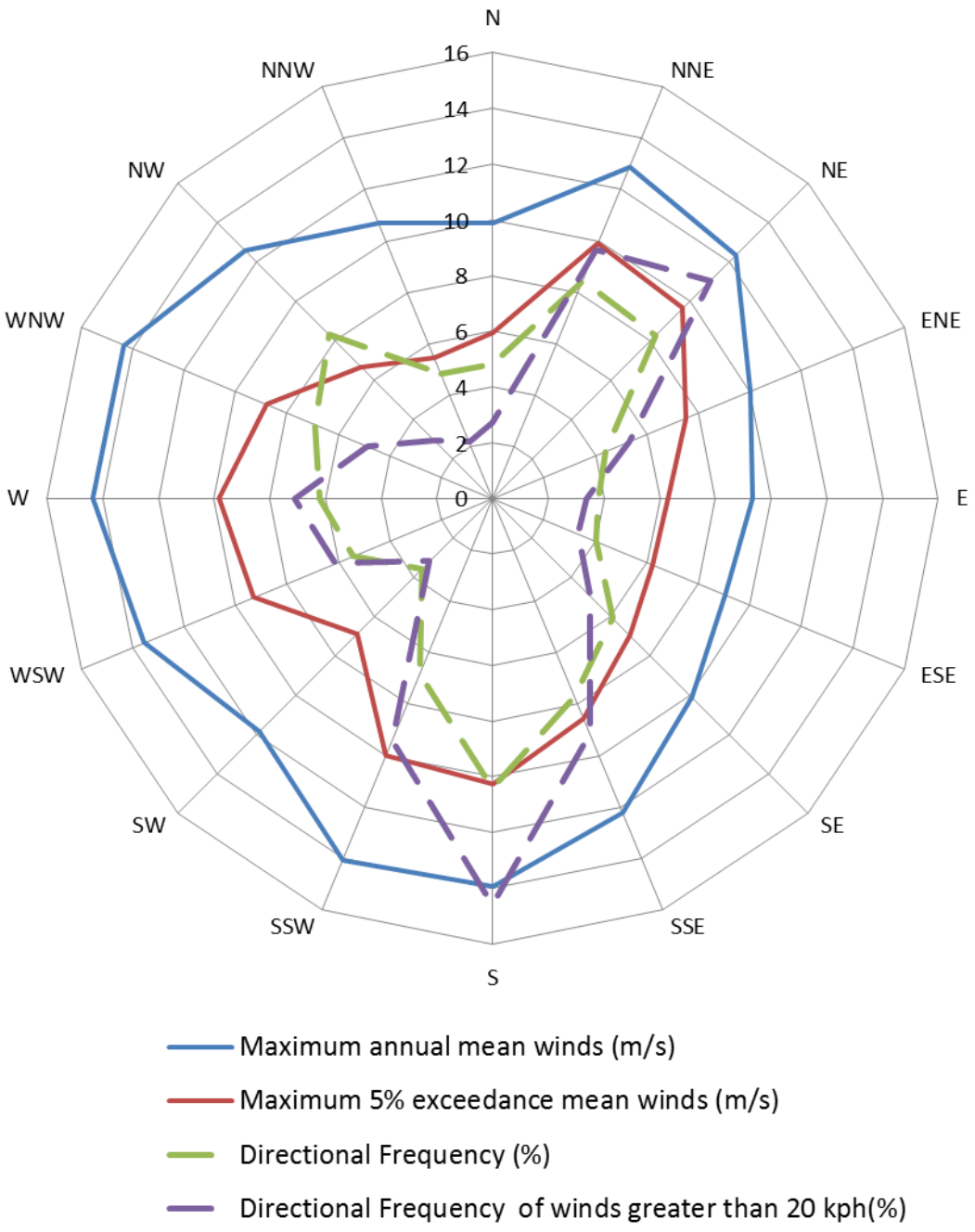

Figure 4: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (referenced to 10m above ground in standard open terrain)

5 PEDESTRIAN WIND COMFORT AND SAFETY

The acceptability of wind conditions of an area is determined by comparing the measured wind speeds against an appropriate criteria. This section outlines how the measured wind speeds were obtained, the criteria considered for the development, as well as the critical trafficable areas that were assessed and their corresponding criteria designation.

5.1 Measured Wind Speeds

Wind speeds were measured using Dantec hot-wire probe anemometers, positioned to monitor wind conditions at critical outdoor trafficable areas of the development. The reference mean free-stream wind speed measured in the wind tunnel, which is at a full-scale height of 200m and measured 3m upstream of the study model.

Measurements were acquired for 16 wind directions at 22.5 degree increments using a sample rate of 1,024Hz. The full methodology of determining the wind speed measurements at the site from the Dantec Hot-wire probe anemometers is provided in Appendix B. Based on the results of the analysis of the boundary layer wind profiles at the site (see Section 3), and incorporating the regional wind model (see Section 4), the data sampling length of the wind tunnel test for each wind direction corresponds to a full-scale sample length ranging between 30 minutes and 1 hour. Research by A.W. Rofail and K.C.S. Kwok (1991) has shown that, in addition to the mean and standard deviation of the wind being stable for sample lengths of 15 minutes or more (full-scale), the peak value determined using the upcrossing method is stable for sample lengths of 30 minutes or more.

5.2 Wind Speed Criteria Used for This Study

For this study, the measured wind conditions for the various critical outdoor trafficable areas around the subject development are compared against the criteria presented in the Draft Sydney Development Control Plan 2012 - Central Sydney Planning Review Amendment, which supersedes the criteria detailed in the City of Sydney Development Control Plan 2012 (SDCP2012).

For pedestrian comfort, the Draft Sydney DCP 2012 requires that the hourly mean wind speed, or Gust-Equivalent Mean (GEM) wind speed (whichever is greater for each wind direction), must not exceed 8m/s for walking, 6m/s for standing, and 4m/s for sitting. These are based on a 5% probability of exceedance.

For pedestrian safety, the Draft Sydney DCP 2012 defines a safety limit criterion of 24m/s, based on an annual maximum 0.5 second gust wind speed, which applies to all areas.

Furthermore, in accordance with the provisions of the Draft Sydney DCP 2012, the existing conditions for the pedestrian footpaths around the site are also analysed as part of this study to determine the impact of the subject development. If it is found that the existing conditions exceed the relevant criteria, then the target wind speed for that area with the inclusion of the proposed development is to at least match the existing site conditions.

In accordance with the provisions of the Draft Sydney DCP 2012, the wind speed assessment is undertaken for winds occurring between 6am and 10pm (AEST).

A more detailed comparison of published criteria for pedestrian wind comfort and safety is provided in Appendix A.

For this study the measured wind conditions of the selected critical outdoor trafficable areas are compared against two sets of criteria; one for pedestrian safety, and one for pedestrian comfort. The safety criterion is applied to the annual maximum gust winds, and the comfort criteria is applied to Gust Equivalent Mean (GEM) winds. In accordance with ASCE (2003), the GEM wind speed is defined as follows:

$$GEM = max\left(\bar{V}, \frac{\hat{V}}{1.85}\right) \tag{5.1}$$

Where:

$\bar{V}$ is the mean wind speed.

$\hat{V}$ is the gust wind speed.

The criteria considered in this study are summarised in Tables 3 and 4 for pedestrian comfort and safety, respectively. The results of the wind tunnel study are presented in the form of directional plots attached in Appendix C of this report. For each study point there is a plot of the GEM wind speeds using the comfort criteria, and a plot for the annual maximum gust wind speeds using the safety criterion.

Table 3: Pedestrian Comfort Criteria (Draft Sydney DCP 2012)

Classification	Description	Maximum 5% Exceedance GEM Wind Speed (m/s)
Sitting	Outdoor areas that involve seating such as parks, dining areas in restaurants, amphitheatres, etc.	4
Standing	Short duration stationary activities (generally less than 1 hour), including window shopping, waiting areas, etc.	6
Walking	For pedestrian thoroughfares, private swimming pools, most communal areas, private balconies and terraces, etc.	8

Table 4: Pedestrian Safety Criterion (Draft Sydney DCP 2012)

Classification	Description	Annual Maximum Gust Wind Speed (m/s)
Safety	Safety criterion applies to all trafficable areas.	24

5.3 Layout of Study Points

For this study a total of 115 study point locations were selected for analysis in the wind tunnel. This includes the following:

- 42 study points on the Ground floor.
- 49 study points on the Upper Ground Level.
- 24 study points on the Mezzanine Level.

The locations of the various study points tested for this study, as well as the target wind speed criteria for the various outdoor trafficable areas of the development, are presented in Figures 5 in the form of marked-up plans. It should be noted that only the most critical outdoor locations of the development have been selected for analysis.

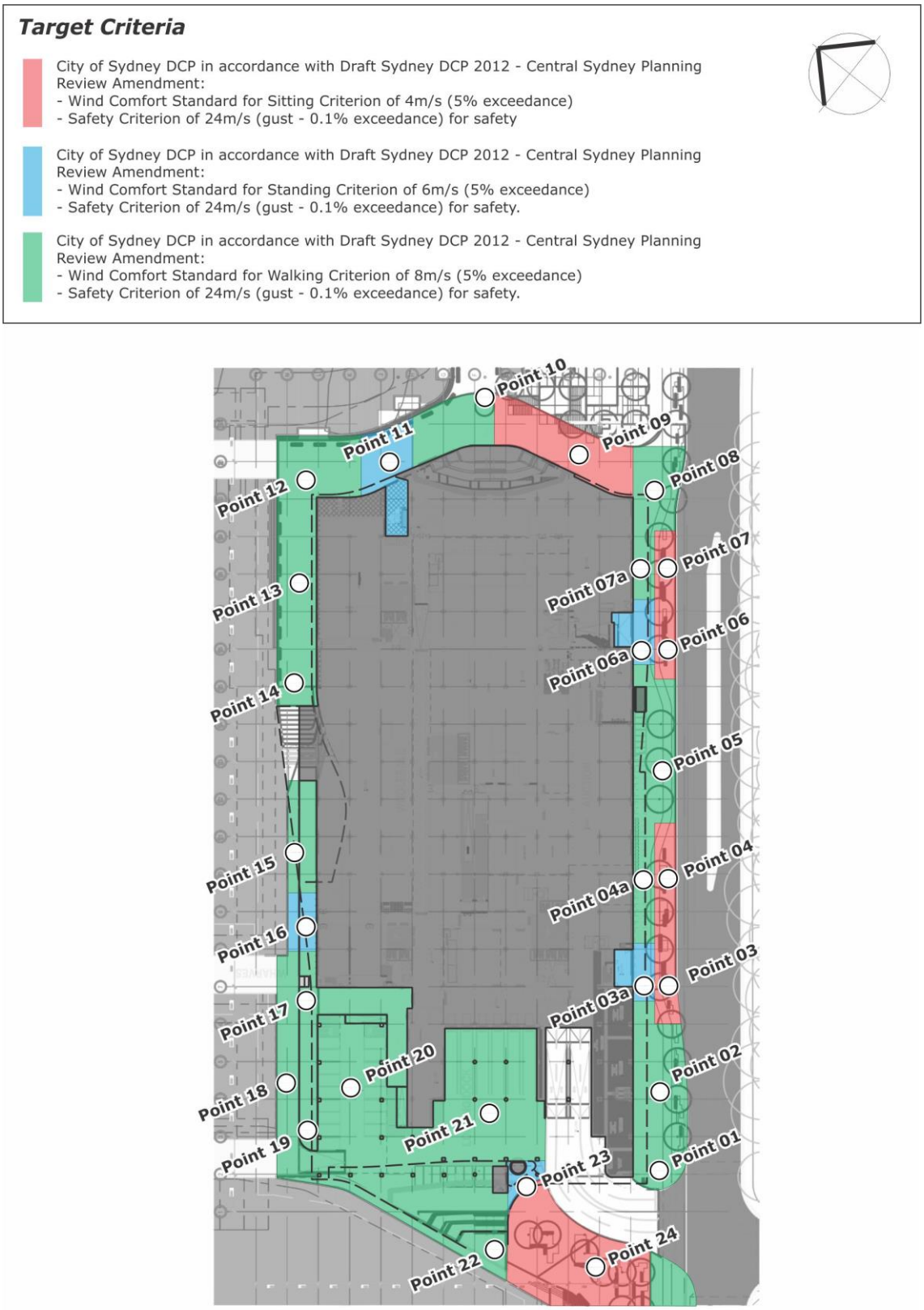

Figure 5a: Study Point Locations and Target Wind Speed Criteria - Lower Ground Level Plan

Figure 5b: Study Point Locations and Target Wind Speed Criteria - Landscaping areas around the site

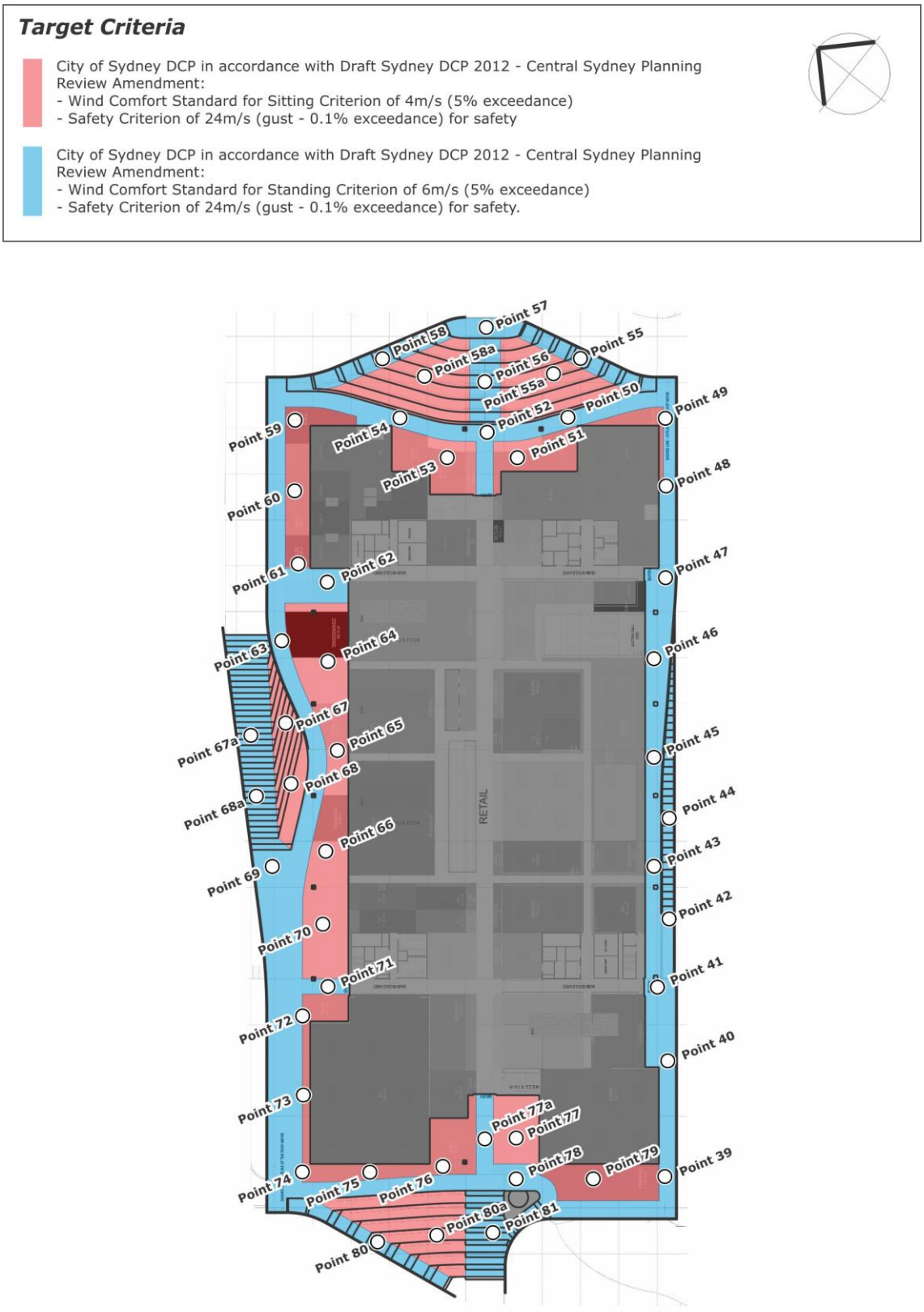

Figure 5c: Study Point Locations and Target Wind Speed Criteria - Upper Ground Level Plan

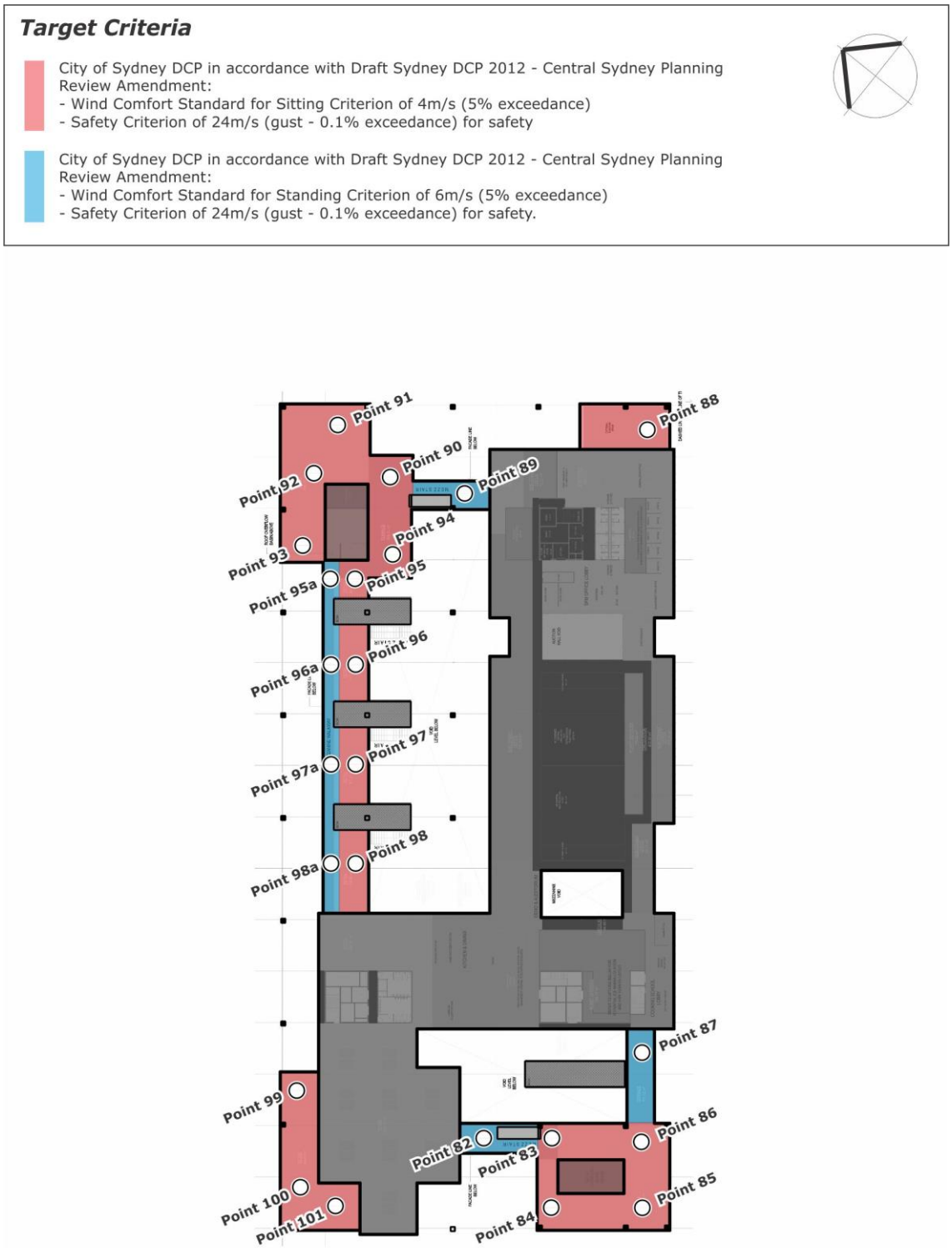

Figure 5d: Study Point Locations and Target Wind Speed Criteria - Mezzanine Level Plan

6 RESULTS AND DISCUSSION

The proposed development was initially tested without vegetation. A select number of points were later retested with the existing trees along Bridge Road. The existing site wind conditions were also measured, for comparison.

The results of the wind tunnel study are presented in the form of directional plots in Appendix C for all study points locations, summarised in Table 5, and shown on marked-up plans in Figures 6 and 7 respectively for the cases without and with the existing trees along Bridge Road. The wind speed criteria that the wind conditions should achieve are also listed in Table 5 for each study point location, as well as in Figures 5.

The results of the study indicate that, without the implementation of any wind mitigation devices, wind conditions for the majority of trafficable outdoor locations within and around the development will not be suitable for their intended uses. Most areas will experience strong winds which will exceed the relevant criteria for comfort, some which also exceed the safety criteria. Suggested treatments are described as follows:

- Include trees along the Lower Ground Level southern promenade (as is already proposed in the design). It is recommended that the trees be densely foliating and of an evergreen variety, capable of growing 3-5m in height with a minimum canopy width of 4m. This is also shown in Figure 8a.
- The north and east façade corners of the Lower Ground level to be made 30% porous. This is also shown in Figure 8a.
- Inclusion of full-height impermeable screens along the Lower Ground western walkway. Screens may be made porous up to 25%. This is also shown in Figure 8a.
- Include landscaping along the Civic Plaza and Western Plaza (as is already proposed in the design). It is recommended that this be in the form of elevated planters arranged in a baffle configuration, with the vegetation in the planters capable of growing to a height of 1.5m above the floor slab. This is also shown in Figure 8b.
- Inclusion of 2m high screens, with 20-30% porosity, along the edges of each of the 3 north-western piers. This is also shown in Figure 8b.
- The railing along the middle of the north-eastern and south-western Upper Ground staircases to be attached to an impermeable screen/balustrade. This is also shown in Figure 8c.
- Inclusion of 1.2m high impermeable railing along the edges of the north-eastern, south-western and north-western staircases. This is also shown in Figure 8c.
- North, east and west façade corners of the Upper Ground level to be made 30% porous. This is also shown in Figure 8c.

- Inclusion of 1.2m high impermeable balustrades/screens adjacent to the north-east, south-west and north-west façade of the Upper Ground level. This is also shown in Figure 8c.
- Inclusion of 3m high impermeable screens either side of the proposed seating at the southern corner of the development, at the Upper Ground level. This is also shown in Figure 8c.
- Inclusion of impermeable screens to the Mezzanine Level at the four main corners of the development. The height of these screens should be such that they extend to the underside of the canopy above. This is also shown in Figure 8d.
- Inclusion of 1.2m high impermeable balustrades along the north-western Mezzanine Level walkway (with gaps to allow for pedestrian movement). This is also shown in Figure 8d.

As a general note, the use of loose glass-tops and light-weight sheets or covers (including loose BBQ lids) is not appropriate on high-rise outdoor terraces and balconies. Furthermore, lightweight furniture is not recommended unless it is securely attached to the balcony or terrace floor slab.

With the inclusion of these treatments to the final design, it is expected that wind conditions for all outdoor trafficable areas within and around the development will be suitable for their intended uses.

Figure 6a: Wind Tunnel Results – Lower Ground Level Plan
(results shown without treatments applied)

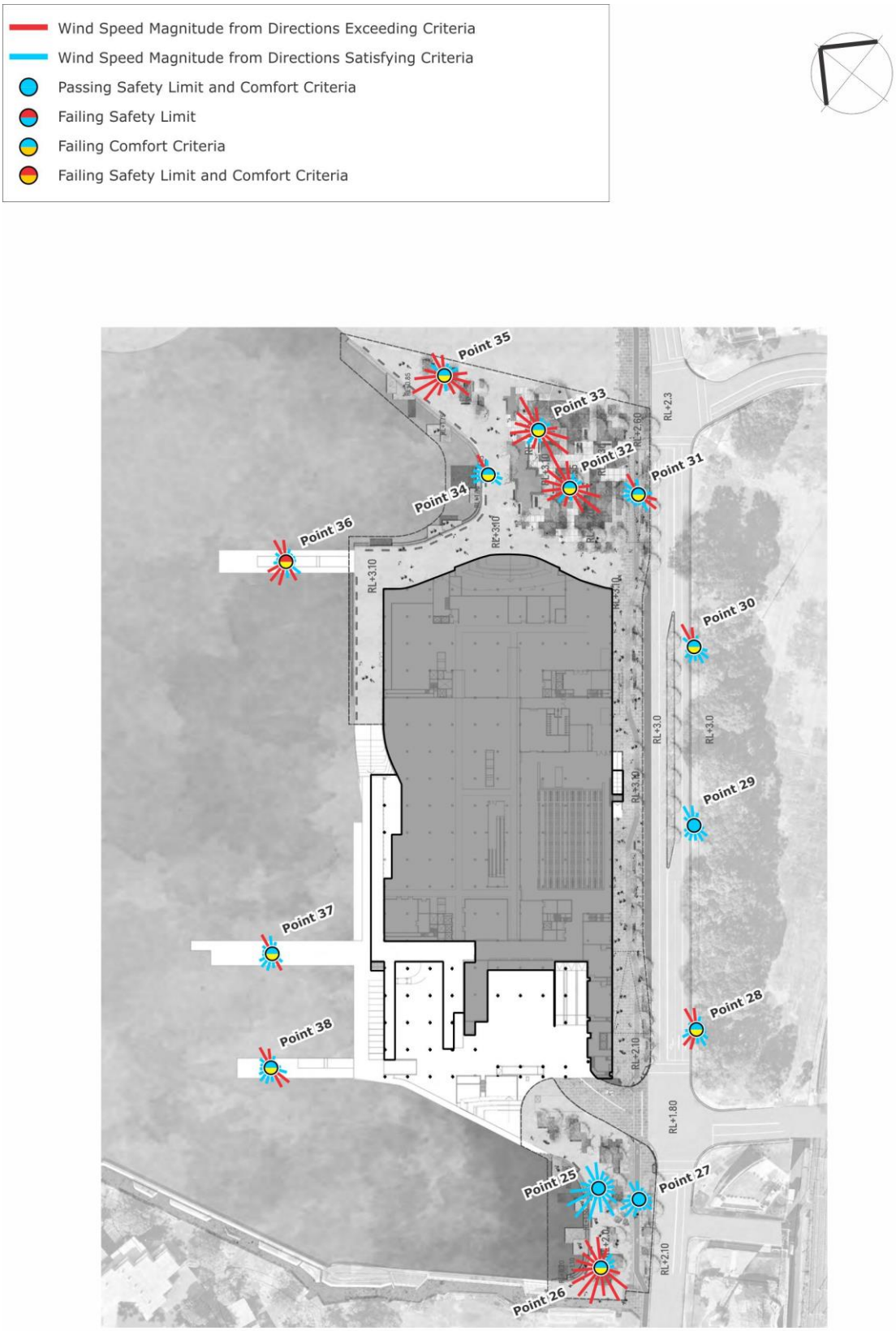

Figure 6b: Wind Tunnel Results – Landscaping areas around the site (results shown without treatments applied)

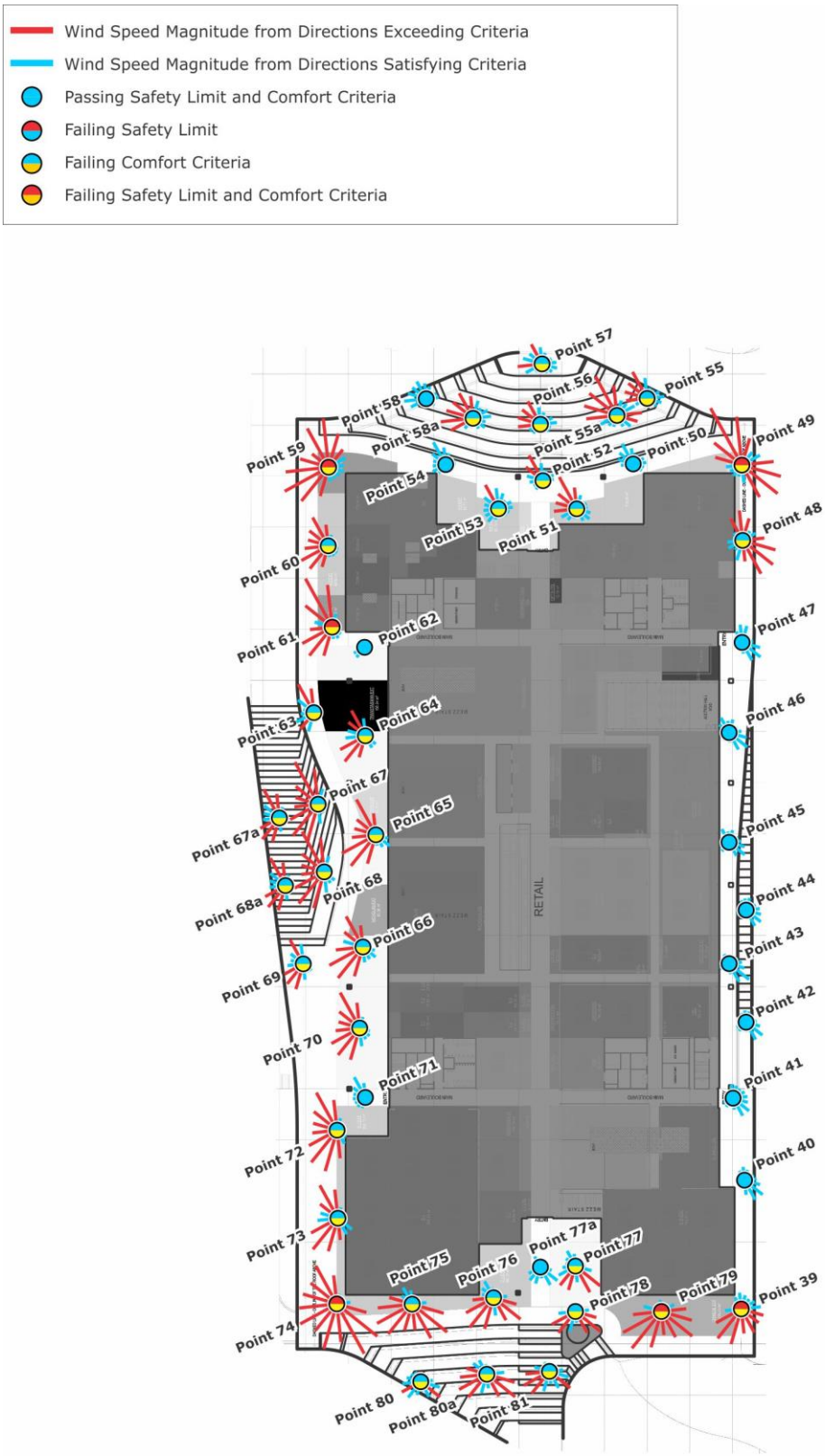

Figure 6c: Wind Tunnel Results – Upper Ground Level Plan
(results shown without treatments applied)

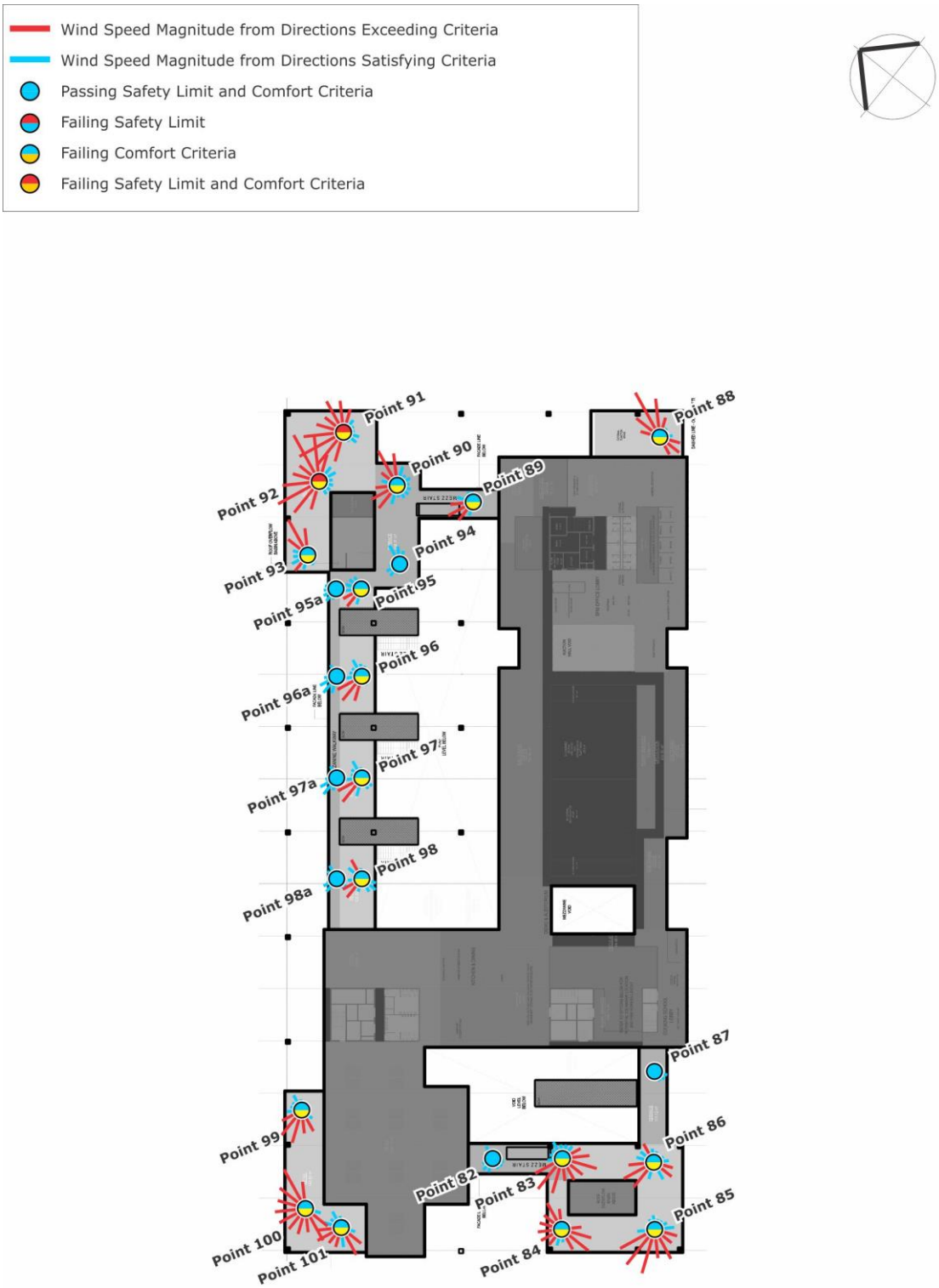

Figure 6d: Wind Tunnel Results – Mezzanine Level Plan
(results shown without treatments applied)

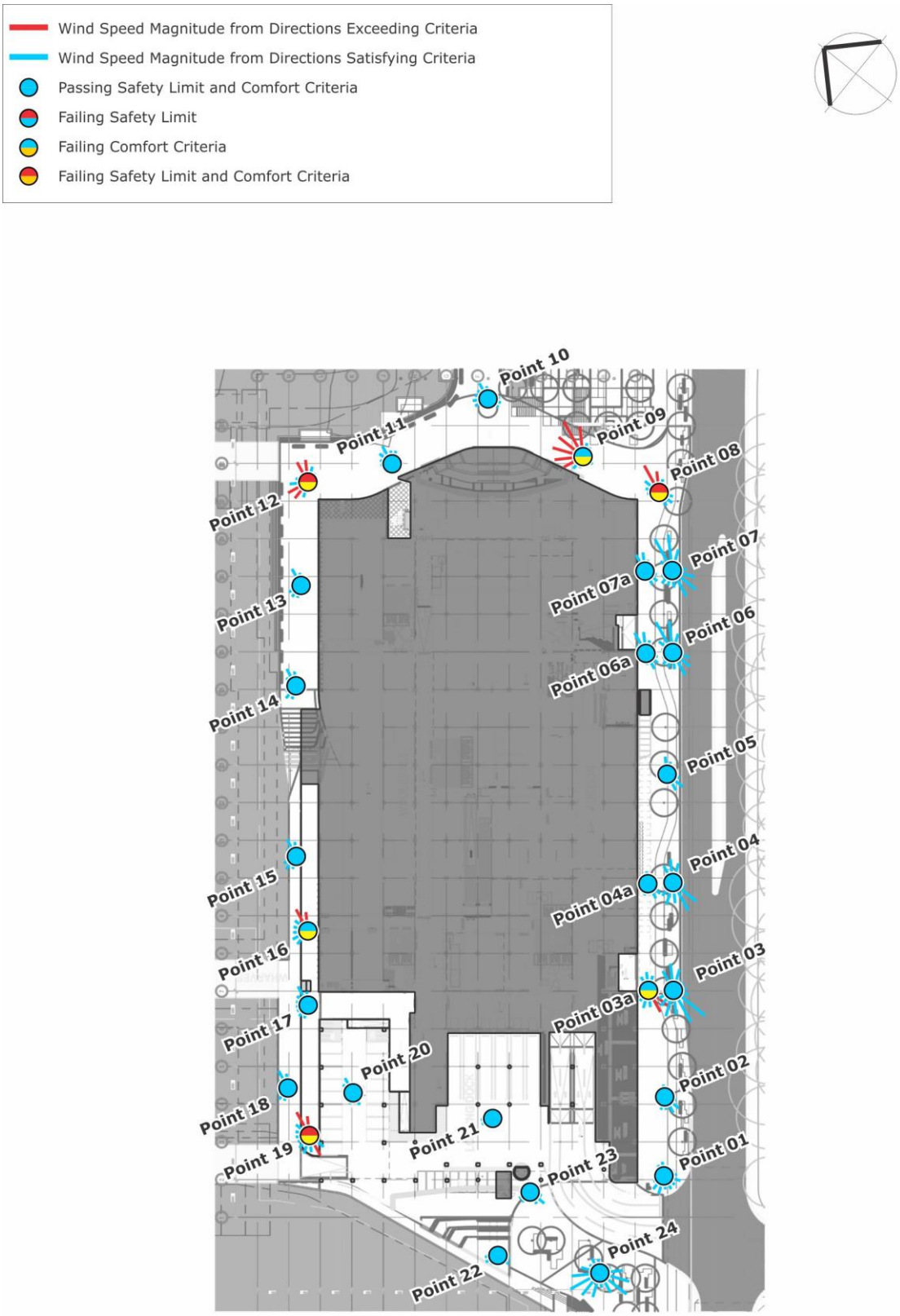

Figure 7a: Wind Tunnel Results – Lower Ground Level Plan
(results shown with the inclusion of the existing trees along Bridge Road)

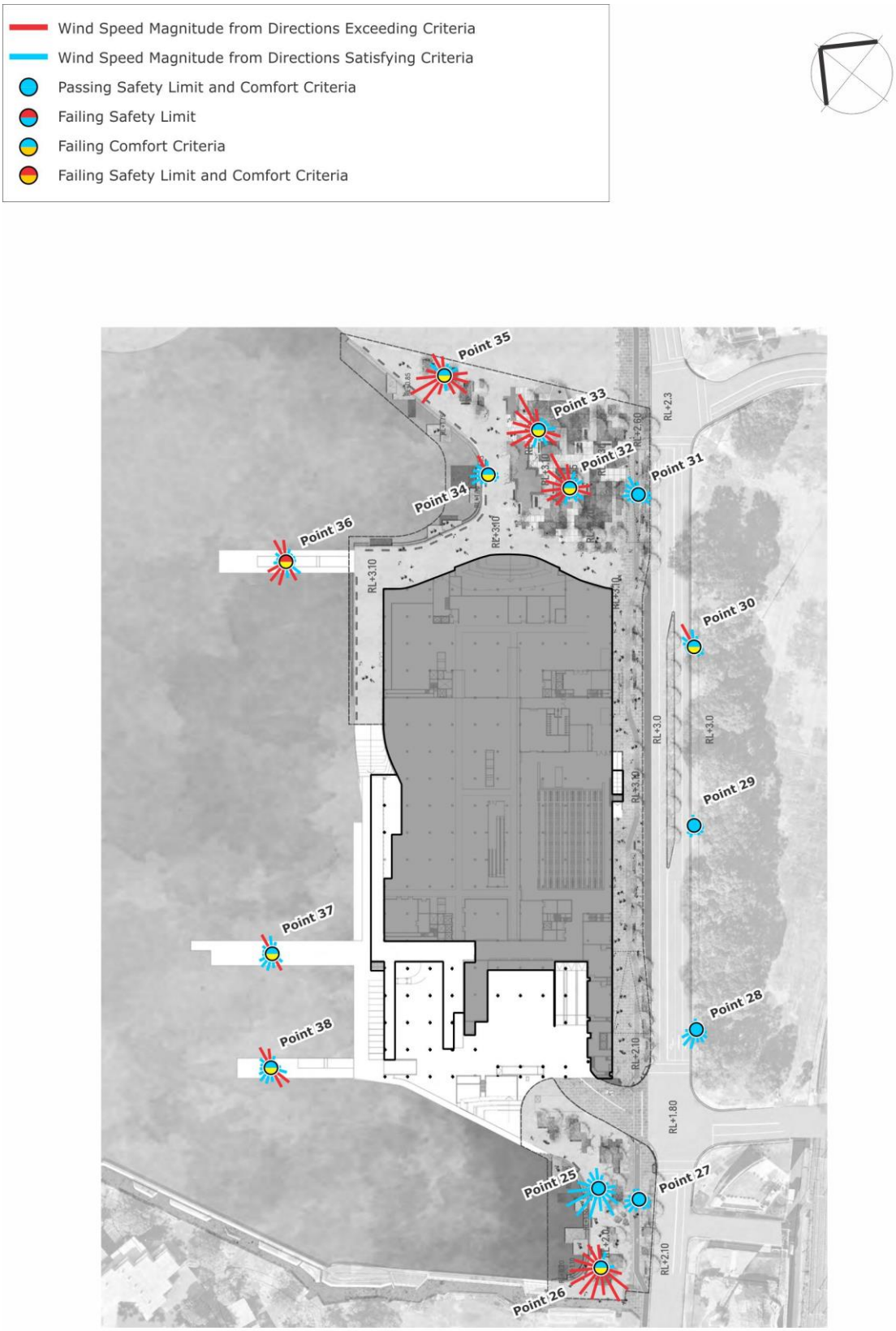

Figure 7b: Wind Tunnel Results – Landscaping areas around the site (results shown with the inclusion of the existing trees along Bridge Road)

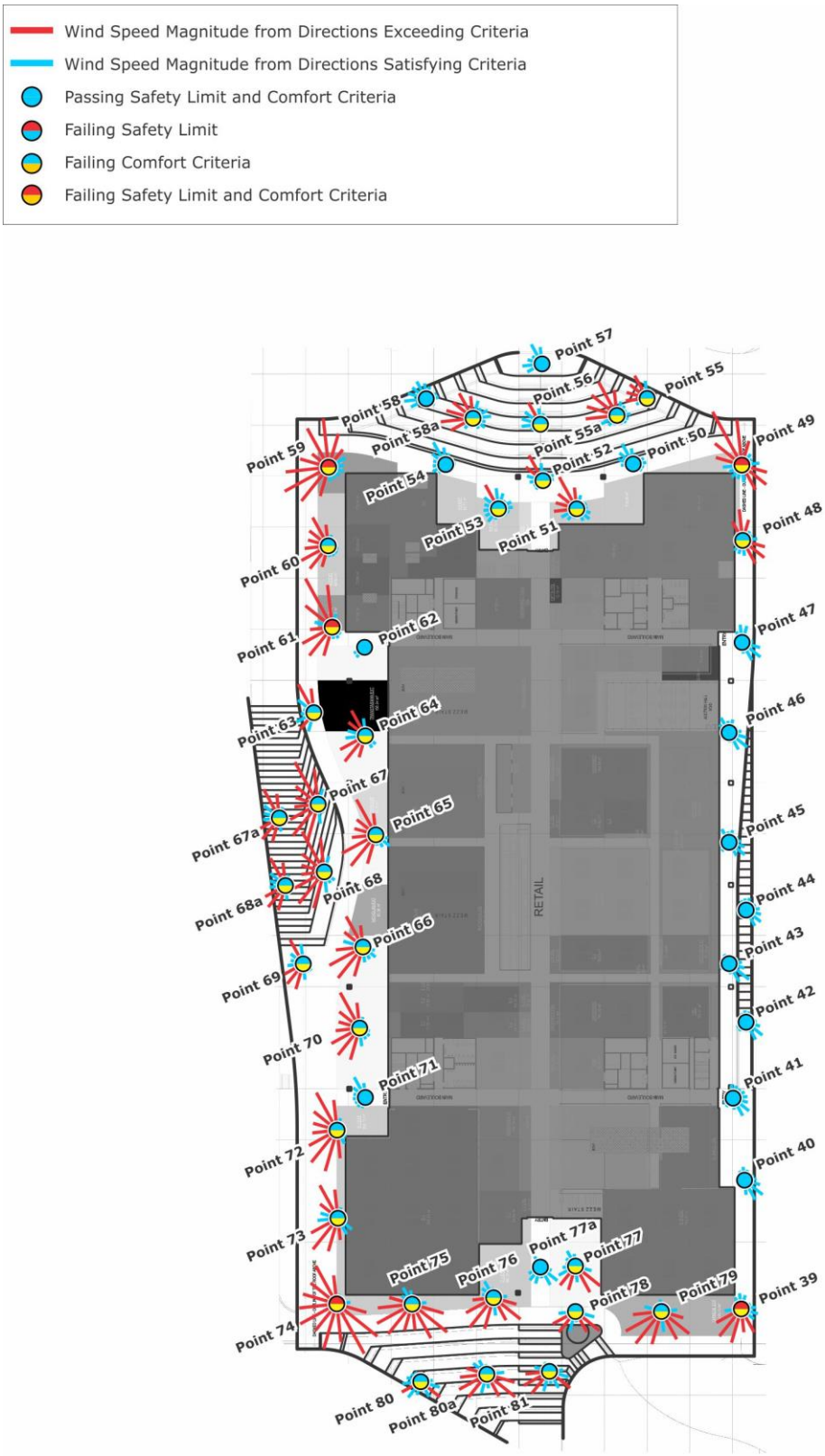

Figure 7c: Wind Tunnel Results – Upper Ground Level Plan
(results shown with the inclusion of the existing trees along Bridge Road)

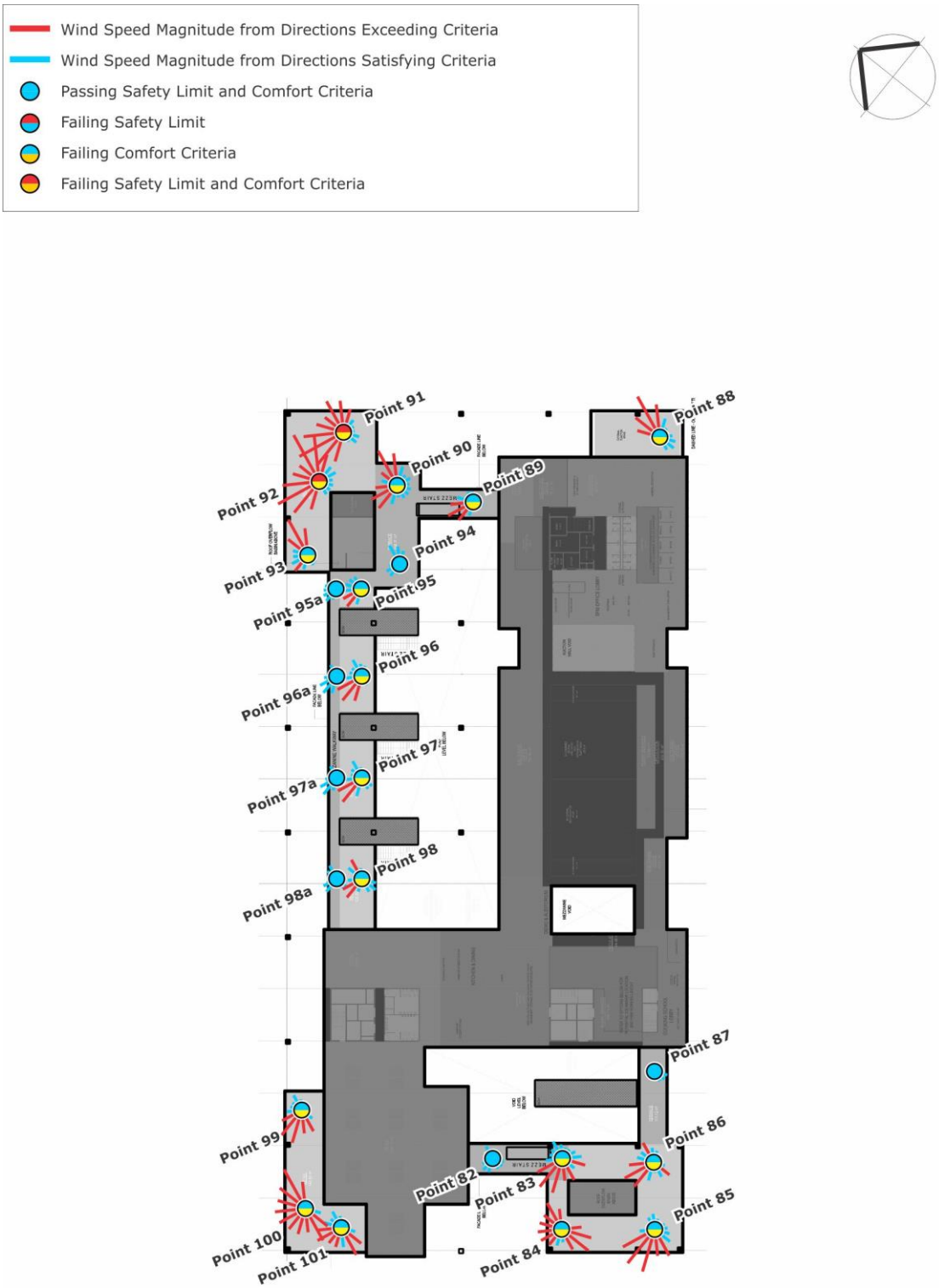

Figure 7d: Wind Tunnel Results – Mezzanine Level Plan
(results shown with the inclusion of the existing trees along Bridge Road)

Table 5: Wind Tunnel Results Summary

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Point 01	8.0	3%	Pass	24	20	Pass	Pass	
Point 02	8.0	2%	Pass	24	21	Pass	Pass	
Point 03	4.0	38%	Fail	24	24	Pass	Pass	Better than or equivalent to Existing Conditions.
Existing		46%	Fail		20	Pass	Fail	
Point 03a	6.0	17%	Fail	24	24	Pass	Fail	Refer to Figure 8a.
Existing		13%	Fail		20	Pass	Fail	
Point 04	4.0	28%	Fail	24	19	Pass	Pass	Better than or equivalent to Existing Conditions.
Existing		65%	Fail		24	Pass	Fail	
Point 04a	8.0	0%	Pass	24	18	Pass	Pass	
Existing		9%	Fail		24	Pass	Fail	
Point 05	8.0	3%	Pass	24	23	Pass	Pass	
Existing		6%	Fail		21	Pass	Fail	
Point 06	4.0	27%	Fail	24	16	Pass	Pass	Better than or equivalent to Existing Conditions.
Existing		49%	Fail		20	Pass	Fail	
Point 06a	6.0	9%	Fail	24	16	Pass	Pass	Better than or equivalent to Existing Conditions.
Existing		15%	Fail		20	Pass	Fail	
Point 07	4.0	40%	Fail	24	20	Pass	Pass	Better than or equivalent to Existing Conditions.
Existing		54%	Fail		21	Pass	Fail	
Point 07a	8.0	4%	Pass	24	23	Pass	Pass	
Existing		6%	Fail		21	Pass	Fail	
Point 08	8.0	11%	Fail	24	29	Fail	Fail	Refer to Figure 8a.
Existing		5%	Pass		21	Pass	Pass	
Point 09	4.0	28%	Fail	24	21	Pass	Fail	Refer to Figure 8b.
Point 10	8.0	3%	Pass	24	19	Pass	Pass	
Point 11	6.0	3%	Pass	24	17	Pass	Pass	
Point 12	8.0	14%	Fail	24	25	Fail	Fail	Refer to Figure 8a.
Point 13	8.0	2%	Pass	24	21	Pass	Pass	
Point 14	8.0	2%	Pass	24	21	Pass	Pass	
Point 15	8.0	2%	Pass	24	19	Pass	Pass	
Point 16	6.0	10%	Fail	24	18	Pass	Fail	Refer to Figure 8a.
Point 17	8.0	4%	Pass	24	20	Pass	Pass	
Point 18	8.0	2%	Pass	24	21	Pass	Pass	
Point 19	8.0	16%	Fail	24	25	Fail	Fail	Refer to Figure 8a.
Point 20	8.0	1%	Pass	24	17	Pass	Pass	
Point 21	8.0	0%	Pass	24	16	Pass	Pass	
Point 22	8.0	1%	Pass	24	17	Pass	Pass	
Point 23	6.0	1%	Pass	24	15	Pass	Pass	

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Point 24	4.0	44%	Fail	24	21	Pass	Pass	Better than or equivalent to Existing Conditions.
Existing		52%	Fail		21	Pass	Fail	
Point 25	4.0	43%	Fail	24	22	Pass	Pass	Better than or equivalent to Existing Conditions.
Existing		58%	Fail		21	Pass	Fail	
Point 26	4.0	60%	Fail	24	23	Pass	Fail	
Existing		54%	Fail		22	Pass	Fail	
Point 27	8.0	2%	Pass	24	20	Pass	Pass	
Existing		14%	Fail		24	Pass	Fail	
Point 28	8.0	5%	Pass	24	21	Pass	Pass	
Existing		6%	Fail		20	Pass	Fail	
Point 29	8.0	0%	Pass	24	14	Pass	Pass	
Existing		13%	Fail		24	Pass	Fail	
Point 30	8.0	7%	Fail	24	24	Pass	Fail	Refer to Figure 8b.
Existing		5%	Pass		21	Pass	Pass	
Point 31	8.0	4%	Pass	24	22	Pass	Pass	
Existing		3%	Pass		21	Pass	Pass	
Point 32	4.0	40%	Fail	24	22	Pass	Fail	Refer to Figure 8b.
Point 33	4.0	42%	Fail	24	22	Pass	Fail	Refer to Figure 8b.
Point 34	8.0	7%	Fail	24	23	Pass	Fail	Refer to Figure 8b.
Point 35	4.0	48%	Fail	24	23	Pass	Fail	Refer to Figure 8b.
Point 36	8.0	24%	Fail	24	25	Fail	Fail	Refer to Figure 8b.
Point 37	8.0	7%	Fail	24	22	Pass	Fail	Refer to Figure 8b.
Point 38	8.0	16%	Fail	24	23	Pass	Fail	Refer to Figure 8b.
Point 39	6.0	21%	Fail	24	26	Fail	Fail	Refer to Figure 8c.
Point 40	6.0	5%	Pass	24	18	Pass	Pass	
Point 41	6.0	2%	Pass	24	16	Pass	Pass	
Point 42	6.0	2%	Pass	24	15	Pass	Pass	
Point 43	6.0	5%	Pass	24	18	Pass	Pass	
Point 44	6.0	1%	Pass	24	14	Pass	Pass	
Point 45	6.0	1%	Pass	24	15	Pass	Pass	
Point 46	6.0	4%	Pass	24	18	Pass	Pass	
Point 47	6.0	5%	Pass	24	18	Pass	Pass	
Point 48	4.0	24%	Fail	24	14	Pass	Fail	Refer to Figure 8c.
Point 49	4.0	48%	Fail	24	26	Fail	Fail	Refer to Figure 8c.
Point 50	6.0	3%	Pass	24	17	Pass	Pass	
Point 51	4.0	14%	Fail	24	19	Pass	Fail	Refer to Figure 8c.
Point 52	6.0	8%	Fail	24	22	Pass	Fail	Refer to Figure 8c.
Point 53	4.0	8%	Fail	24	14	Pass	Fail	Refer to Figure 8c.
Point 54	6.0	5%	Pass	24	19	Pass	Pass	
Point 55	6.0	10%	Fail	24	23	Pass	Fail	Refer to Figure 8c.

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Point 55a	4.0	24%	Fail	24	23	Pass	Fail	Refer to Figure 8c.
Point 56	6.0	7%	Fail	24	19	Pass	Fail	Refer to Figure 8c.
Point 57	6.0	4%	Pass	24	18	Pass	Pass	
Point 58	6.0	5%	Pass	24	20	Pass	Pass	
Point 58a	4.0	21%	Fail	24	20	Pass	Fail	Refer to Figure 8c.
Point 59	4.0	50%	Fail	24	27	Fail	Fail	Refer to Figure 8c.
Point 60	4.0	23%	Fail	24	19	Pass	Fail	Refer to Figure 8c.
Point 61	4.0	35%	Fail	24	27	Fail	Fail	Refer to Figure 8c.
Point 62	6.0	0%	Pass	24	11	Pass	Pass	
Point 63	6.0	13%	Fail	24	23	Pass	Fail	Refer to Figure 8c.
Point 64	4.0	19%	Fail	24	19	Pass	Fail	Refer to Figure 8c.
Point 65	4.0	30%	Fail	24	24	Pass	Fail	Refer to Figure 8c.
Point 66	4.0	30%	Fail	24	24	Pass	Fail	Refer to Figure 8c.
Point 67	4.0	38%	Fail	24	24	Pass	Fail	Refer to Figure 8c.
Point 67a	6.0	20%	Fail	24	24	Pass	Fail	Refer to Figure 8c.
Point 68	4.0	39%	Fail	24	22	Pass	Fail	Refer to Figure 8c.
Point 68a	6.0	20%	Fail	24	22	Pass	Fail	Refer to Figure 8c.
Point 69	6.0	15%	Fail	24	20	Pass	Fail	Refer to Figure 8c.
Point 70	4.0	33%	Fail	24	21	Pass	Fail	Refer to Figure 8c.
Point 71	6.0	3%	Pass	24	17	Pass	Pass	
Point 72	4.0	39%	Fail	24	23	Pass	Fail	Refer to Figure 8c.
Point 73	4.0	33%	Fail	24	23	Pass	Fail	Refer to Figure 8c.
Point 74	4.0	67%	Fail	24	25	Fail	Fail	Refer to Figure 8c.
Point 75	4.0	48%	Fail	24	24	Pass	Fail	Refer to Figure 8c.
Point 76	4.0	33%	Fail	24	20	Pass	Fail	Refer to Figure 8c.
Point 77	4.0	21%	Fail	24	17	Pass	Fail	Refer to Figure 8c.
Point 77a	6.0	3%	Pass	24	17	Pass	Pass	
Point 78	6.0	20%	Fail	24	24	Pass	Fail	Refer to Figure 8c.
Point 79	4.0	40%	Fail	24	23	Pass	Fail	Refer to Figure 8c.
Point 80	6.0	8%	Fail	24	20	Pass	Fail	Refer to Figure 8c.
Point 80a	4.0	34%	Fail	24	20	Pass	Fail	Refer to Figure 8c.
Point 81	6.0	19%	Fail	24	24	Pass	Fail	Refer to Figure 8c.
Point 82	6.0	0%	Pass	24	13	Pass	Pass	
Point 83	4.0	29%	Fail	24	20	Pass	Fail	Refer to Figure 8d.
Point 84	4.0	38%	Fail	24	19	Pass	Fail	Refer to Figure 8d.
Point 85	4.0	26%	Fail	24	24	Pass	Fail	Refer to Figure 8d.
Point 86	4.0	20%	Fail	24	18	Pass	Fail	Refer to Figure 8d.
Point 87	6.0	0%	Pass	24	11	Pass	Pass	
Point 88	4.0	23%	Fail	24	22	Pass	Fail	Refer to Figure 8d.
Point 89	6.0	10%	Fail	24	22	Pass	Fail	Refer to Figure 8d.

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Point 90	4.0	29%	Fail	24	20	Pass	Fail	Refer to Figure 8d.
Point 91	4.0	47%	Fail	24	28	Fail	Fail	Refer to Figure 8d.
Point 92	4.0	49%	Fail	24	27	Fail	Fail	Refer to Figure 8d.
Point 93	4.0	19%	Fail	24	19	Pass	Fail	Refer to Figure 8d.
Point 94	4.0	3%	Pass	24	10	Pass	Pass	
Point 95	4.0	6%	Fail	24	13	Pass	Fail	Refer to Figure 8d.
Point 95a	6.0	1%	Pass	24	13	Pass	Pass	
Point 96	4.0	14%	Fail	24	18	Pass	Fail	Refer to Figure 8d.
Point 96a	6.0	3%	Pass	24	18	Pass	Pass	
Point 97	4.0	11%	Fail	24	19	Pass	Fail	Refer to Figure 8d.
Point 97a	6.0	3%	Pass	24	19	Pass	Pass	
Point 98	4.0	9%	Fail	24	14	Pass	Fail	Refer to Figure 8d.
Point 98a	6.0	1%	Pass	24	14	Pass	Pass	
Point 99	4.0	18%	Fail	24	19	Pass	Fail	Refer to Figure 8d.
Point 100	4.0	56%	Fail	24	24	Pass	Fail	Refer to Figure 8d.
Point 101	4.0	24%	Fail	24	18	Pass	Fail	Refer to Figure 8d.

NOTE: For any study points listed in this table with two rows of results data, the second row is for the existing site conditions. The test results shown in this table are without any treatments applied. If treatment is required, the treatment is described in this table.

Legend

Retention of proposed trees. It is recommended that the trees be densely foliating and of an evergreen variety, capable of growing 3-5m in height with a minimum canopy width of 4m.

Facade to be made 30% porous.

Inclusion of full-height impermeable screens or up to 25% porosity.

Figure 8a: Suggested Treatments – Lower Ground Level

Legend

Retention of proposed landscaping. It is recommended that the proposed planting be situated on elevated planters arranged in a baffle configuration with an effective height of 1.5m

Inclusion of 2m high screens between 20-30% porosity.

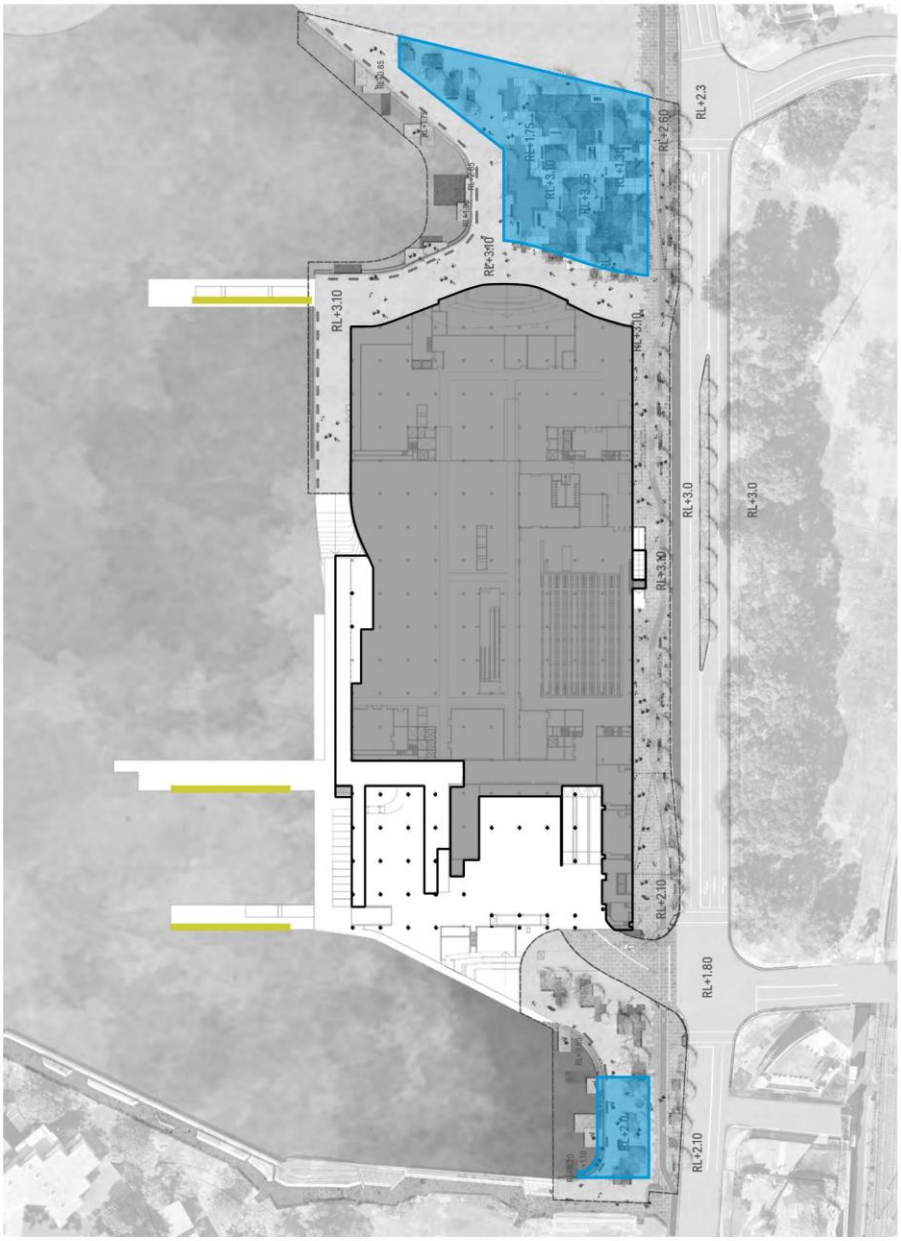

Figure 8b: Suggested Treatments – Landscaping areas around the site

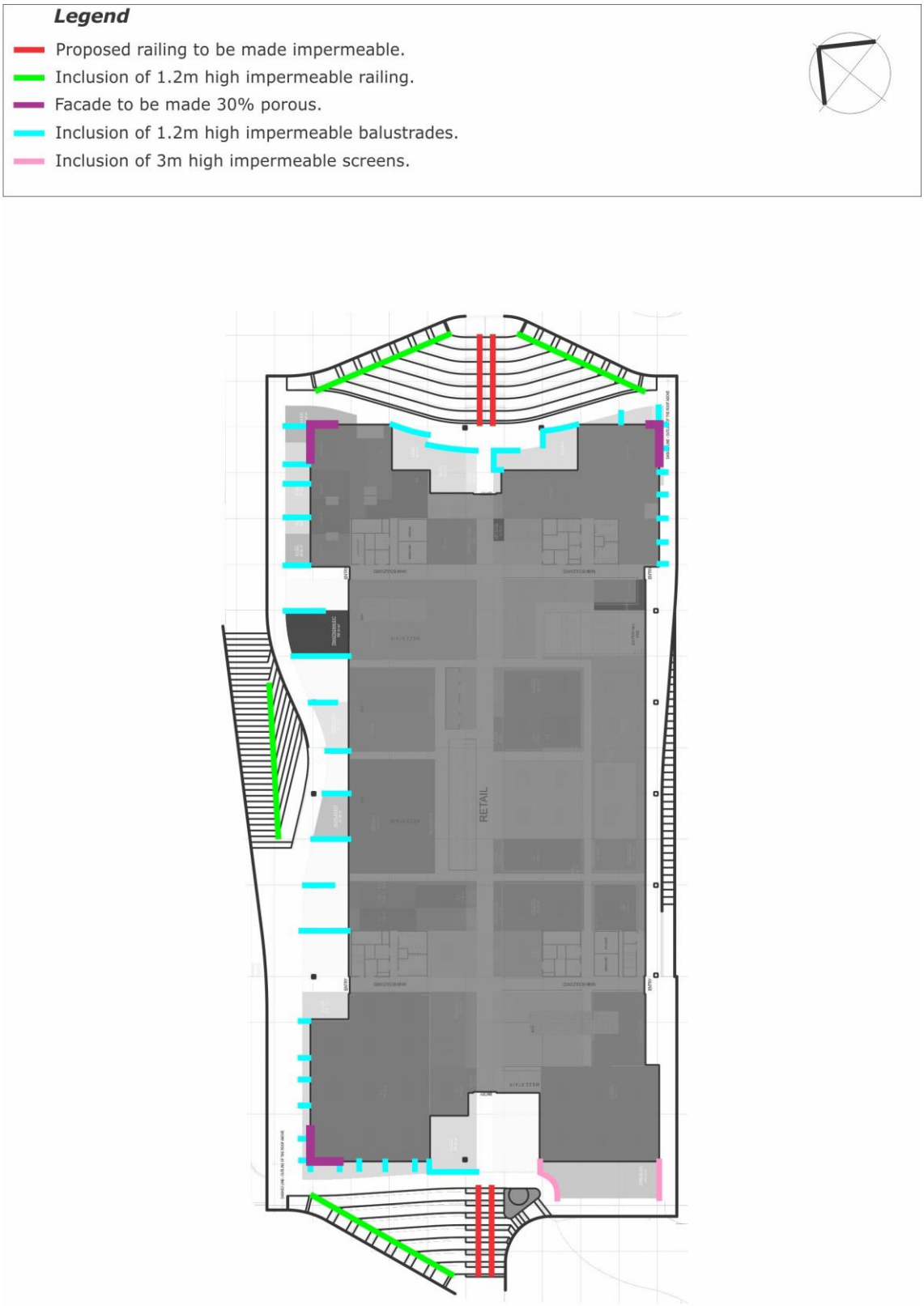

Figure 8c: Suggested Treatments – Upper Ground Level

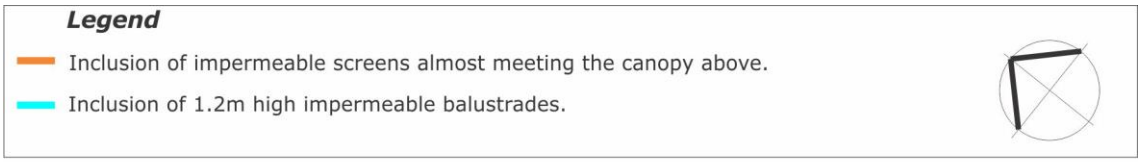

Figure 8d: Suggested Treatments – Mezzanine Level

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APPENDIX A PUBLISHED ENVIRONMENTAL CRITERIA

A.1 Wind Effects on People

The acceptability of wind in an area is dependent upon the use of the area. For example, people walking or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Quantifying wind comfort has been the subject of much research and many 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. This section discusses and compares the various published criteria.

A.1.1 A.D. Penwarden (1973) Criteria for Mean Wind Speeds

A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table A.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 A.1: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Hourly Mean Wind Speed (m/s)	Effects
Calm	0	0 - 0.25	
Calm, light air	1	0 25 - 1.55	No noticeable wind
Light breeze	2	1.55 - 3.35	Wind felt on face
Gentle breeze	3	3.35 - 5.45	Hair is disturbed, clothing flaps, newspapers difficult to read
Moderate breeze	4	5.45 - 7.95	Raises dust, dry soil and loose paper, hair disarranged
Fresh breeze	5	7.95 – 10.75	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.75 – 13.85	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant
Near gale	7	13.85 – 17.15	Inconvenience felt when walking
Gale	8	17.15 - 20.75	Generally impedes progress, difficulty balancing in gusts
Strong gale	9	20.75 – 24.45	People blown over

A.1.2 A.G. Davenport (1972) Criteria for Mean Wind Speeds

A.G. Davenport (1972) also determined a set of criteria in terms of the Beaufort scale and for various return periods. Table A.2 presents a summary of the criteria based on a probability of exceedance of 5%.

Table A.2: Criteria by A.G. Davenport (1972)

Classification	Activities	5% exceedance Mean Wind Speed (m/s)
Walking Fast	Acceptable for walking, main public accessways.	7.5 - 10.0
Strolling, Skating	Slow walking, etc.	5.5 - 7.5
Short Exposure Activities	Generally acceptable for walking & short duration stationary activities such as window-shopping, standing or sitting in plazas.	3.5 - 5.5
Long Exposure Activities	Generally acceptable for long duration stationary activities such as in outdoor restaurants & theatres and in parks.	0 - 3.5

A.1.3 T.V. Lawson (1975) Criteria for Mean Wind Speeds

In 1973, T.V. Lawson, while referring to the Beaufort wind speeds of A.D. Penwarden (1973) (as listed in Table A.1), quoted that a Beaufort 4 wind speed would be acceptable if it is not exceeded for more than 4% of the time, and that a Beaufort 6 wind speed would be unacceptable if it is exceeded more than 2% of the time. Later, in 1975, T.V. Lawson presented a set of criteria very similar to those presented in A.G. Davenport (1972) (as listed in Table A.2). These criteria are presented in Table A.3 and Table A.4 for safety and comfort respectively.

Table A.3: Safety Criteria by T.V. Lawson (1975)

Classification	Activities	Annual Mean Wind Speed (m/s)
Safety (all weather areas)	Accessible by the general public.	0 – 15
Safety (fair weather areas)	Private areas, balconies/terraces, etc.	0 – 20

Table A.4: Comfort Criteria by T.V. Lawson (1975)

Classification	Activities	5% exceedance Mean Wind Speed (m/s)
Business Walking	Objective Walking from A to B.	8 - 10
Pedestrian Walking	Slow walking, etc.	6 - 8
Short Exposure Activities	Pedestrian standing or sitting for short times.	4 – 6
Long Exposure Activities	Pedestrian sitting for a long duration.	0 - 4

A.1.4 W.H. Melbourne (1978) Criteria for Gust Wind Speeds

W.H. Melbourne (1978) introduced a set of criteria for the assessment of environmental wind conditions that were developed for a temperature range of 10°C to 30°C and for people suitably dressed for outdoor conditions. These criteria are presented in Table A.5, and are based on maximum gust wind speeds with a probability of exceedance of once per year.

Table A.5: Criteria by W.H. Melbourne (1978)

Classification	Human Activities	Annual Gust Wind Speed (m/s)
Limit for Safety	Completely unacceptable: people likely to get blown over.	23
Marginal	Unacceptable as main public accessways.	16 - 23
Comfortable Walking	Acceptable for walking, main public accessways	13 - 16
Short Exposure Activities	Generally acceptable for walking & short duration stationary activities such as window-shopping, standing or sitting in plazas.	10 - 13
Long Exposure Activities	Generally acceptable for long duration stationary activities such as in outdoor restaurants & theatres and in parks.	0 - 10

A.2 Comparison of the Published Wind Speed Criteria

W.H. Melbourne (1978) presented a comparison of the criteria of various researchers on a probabilistic basis. Figure A.1 presents the results of this comparison, and indicates that the criteria of W.H. Melbourne (1978) are comparatively quite conservative. This conclusion was also observed by A.W. Rofail (2007) when undertaking on-site remedial studies. The results of A.W. Rofail (2007) concluded that the criteria by W.H. Melbourne (1978) generally overstates the wind effects in a typical urban setting due to the assumption of a fixed 15% turbulence intensity for all areas. It was observed in A.W. Rofail (2007) that the 15% turbulence intensity assumption is not real and that the turbulence intensities at 1.5m above ground is at least 20% and in a suburban or urban setting is generally in the range of 30% to 60%.

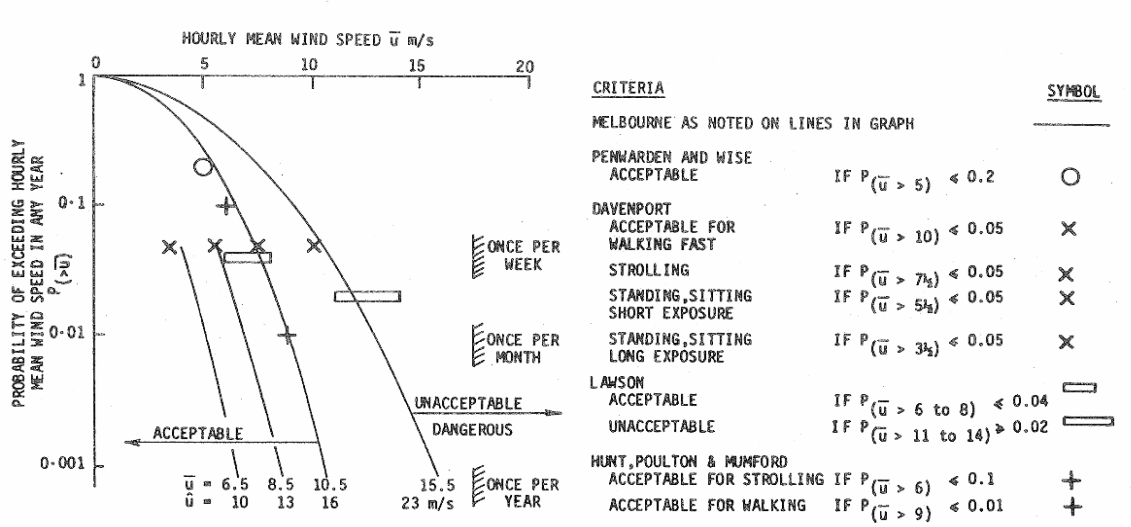


Figure A.1: Comparison of Various Mean and Gust Wind Environment Criteria, assuming 15% turbulence and a Gust Factor of 1.5 (W.H. Melbourne, 1978)

A.3 References relating to Pedestrian Comfort Criteria

Davenport, A.G., 1972, "An approach to human comfort criteria for environmental conditions". Colloquium on Building Climatology, Stockholm.

Davenport, A.G., 1977, "The prediction of risk under wind loading", 2nd International Conference on Structural Safety and Reliability, Munich, Germany, pp511-538.

Lawson, T.V., 1973, "The wind environment of buildings: a logical approach to the establishment of criteria". Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1975, "The determination of the wind environment of a building complex before construction". Bristol University, Department of Aeronautical Engineering.

Melbourne, W.H., 1978, "Criteria for Environmental Wind Conditions". Journal of Wind Engineering and Industrial Aerodynamics, vol. 3, pp241-249.

Penwarden, A.D. (1973). "Acceptable Wind Speeds in Towns", Building Science, vol. 8: pp259–267

Penwarden, A.D., Wise A.F.E., 1975, "Wind Environment Around Buildings". Building Research Establishment Report, London.

Rofail, A.W., 2007, "Comparison of Wind Environment Criteria against Field Observations". 12th International Conference of Wind Engineering, Cairns, Australia.

APPENDIX B DATA ACQUISITION

The wind tunnel testing procedures for this study were based on the guidelines set out in the Australasian Wind Engineering Society Quality Assurance Manual (AWES-QAM-1-2019), ASCE 7-16 (Chapter C31), and CTBUH (2013).

The wind speed measurements for the wind tunnel study were acquired as coefficients by Dantec hot-wire anemometers and converted to full-scale wind speeds using details of the regional wind climate obtained from an analysis of directional wind speed recordings from the local meteorological recording station(s).

B.1 Measurement of the Velocity Coefficients

The study model and proximity model were setup within the wind tunnel which was configured to the appropriate boundary layer profile, and the wind velocity measurements were monitored using Dantec hot-wire probe anemometers at selected critical outdoor locations. The anemometers were positioned at each study location at a full-scale height of approximately 1.5m above ground/slab level. The support of the probe was mounted such that the probe wire was vertical as much as possible to ensure that the measured wind speeds are independent of wind direction along the horizontal plane. In addition, care was taken in the alignment of the probe wire and in avoiding wall-heating effects.

Wind speed measurements were made in the wind tunnel for 16 wind directions, at 22.5° increments. The output from the hot-wire probes was obtained using a National Instruments 12-bit data acquisition card. The data was acquired for each wind direction using a sample rate of 1024Hz. The sample length was determined to produce a full-scale sample time that is sufficient for this type of study.

The mean, gust and standard deviation velocity coefficients were measured in the wind tunnel. The gust velocity coefficients were also derived for each wind direction from by the following relation:

$$\hat{C}_V = \bar{C}_V + g \cdot \sigma_{C_V} \qquad \text{B.1}$$

Where:

$\hat{C}_V$ is the gust coefficient.

$\bar{C}_V$ is the mean coefficient.

g is the peak factor, taken as 3.0 for a 3s gust and 3.4 for a 0.5s gust.

σ_{C_V} is the standard deviation of coefficient measurement.

B.2 Calculation of the Full-Scale Results

The full-scale results determine if the wind conditions at a study location satisfy the designated criteria of that location. More specifically, the full-scale results need to determine the probability of exceedance of a given wind speed at a study location. To determine the probability of exceedance, the measured velocity coefficients were combined with a statistical model of the local wind climate that relates wind speed to a probability of exceedance. Details of the wind climate model are outlined in Section 4 of the main report.

The statistical model of the wind climate includes the impact of wind directionality as any local variations in wind speed or frequency with wind direction. This is important as the wind directions that produce the highest wind speed events for a region may not coincide with the most wind exposed direction at the site.

The methodology adopted for the derivation of the full-scale results for the maximum gust and the GEM wind speeds are outlined in the following sub-sections.

B.2.1 Maximum Gust Wind Speeds

The full-scale maximum gust wind speed at each study point location is derived from the measured coefficient using the following relationship:

$$V_{study} = V_{ref,RH}\left(\frac{k_{200m,tr,T=1hr}}{k_{RH,tr,T=1hr}}\right)C_V \qquad \text{B.2}$$

Where:

V_{study} is the full-scale wind speed at the study point location, in m/s.

$V_{ref,RH}$ is the full-scale reference wind speed, measured 3m upstream at the study reference height. This value is determined by combining the directional wind speed data for the region (detailed in Section 4) and the upwind terrain and height multipliers for the site (detailed in Section 3).

$k_{200m,tr,T=1hr}$ is the standard deviation of the wind speed.

$k_{RH,tr,T=1hr}$ is the hourly mean terrain and height multiplier at the study reference height (see Section 3).

C_V is the velocity coefficient measurement obtained from the hot-wire anemometer, which is derived from the following relationship:

$$C_V = \frac{C_{V,study}}{C_{V,200m}} \qquad \text{B.3}$$

Where:

$C_{V,study}$ is the coefficient measurement obtained from the hot-wire anemometer at the study point location.

$C_{V,200m}$ is the coefficient measurement obtained from the hot-wire anemometer at the free-stream reference location at 200m height upwind of the model in the wind tunnel.

The value of $\mathrm{V_{ref,RH}}$ varies with each prevailing wind direction. Wind directions where there is a high probability that a strong wind will occur have a higher directional wind speed than other directions. To determine the directional wind speeds, a probability level must be assigned for each wind direction. These probability levels are set following the approach used in AS/NZS1170.2:2011, which assumes that the major contributions to the combined probability of exceedance of a typical load effect comes from only two 45 degree sectors.

B.2.2 Maximum Gust-Equivalent Mean Wind Speeds

The contribution to the probability of exceedance of a specified wind speed (ie: the desired wind speed for pedestrian comfort, as per the criteria) was calculated for each wind direction. These contributions are then combined over all wind directions to calculate the total probability of exceedance of the specified wind speed. To calculate the probability of exceedance for a specified wind speed a statistical wind climate model was used to describe the relationship between directional wind speeds and the probability of exceedance. A detailed description of the methodology is given by T.V. Lawson (1980).

The criteria used in this study is referenced to a probability of exceedance of 5% of a specified wind speed.

B.3 References relating to Data Acquisition

American Society of Civil Engineers (ASCE), ASCE-7-16, 2016, "Minimum Design Loads for Buildings and Other Structures".

Australasian Wind Engineering Society, QAM-1, 2019, "Quality Assurance Manual: Wind Engineering Studies of Buildings", edited by Rofail A.W., *et al*.

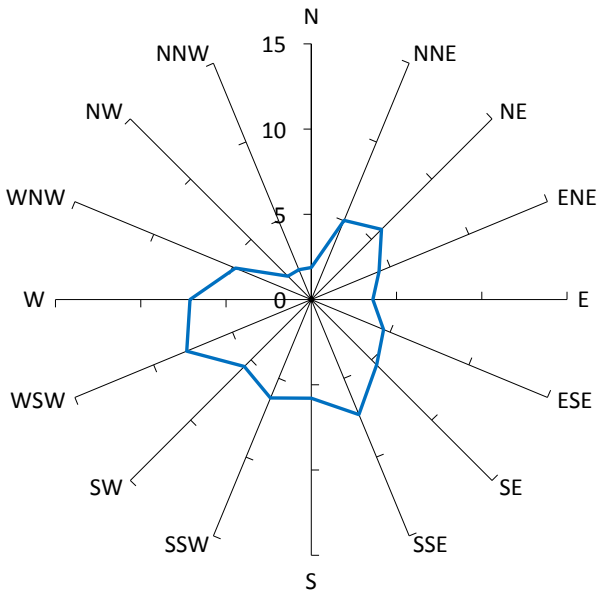
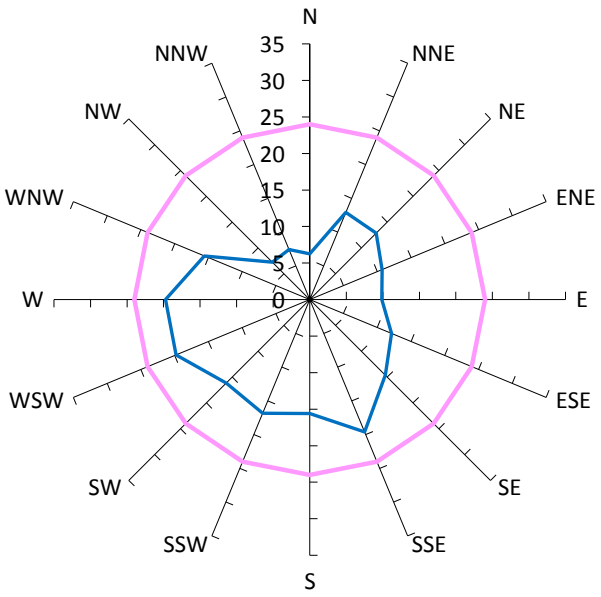
Council on Tall Buildings and Urban Habitat (CTBUH), 2013, "Wind tunnel testing of high-rise buildings", CTBUH Technical Guides.

Lawson, T.V., 1980, "Wind Effects on Buildings - Volume 1, Design Applications". Applied Science Publishers Ltd, Ripple Road, Barking, Essex, England.

Standards Australia and Standards New Zealand, AS/NZS 1170.2, 2011, "SAA Wind Loading Standard, Part 2: Wind Actions".

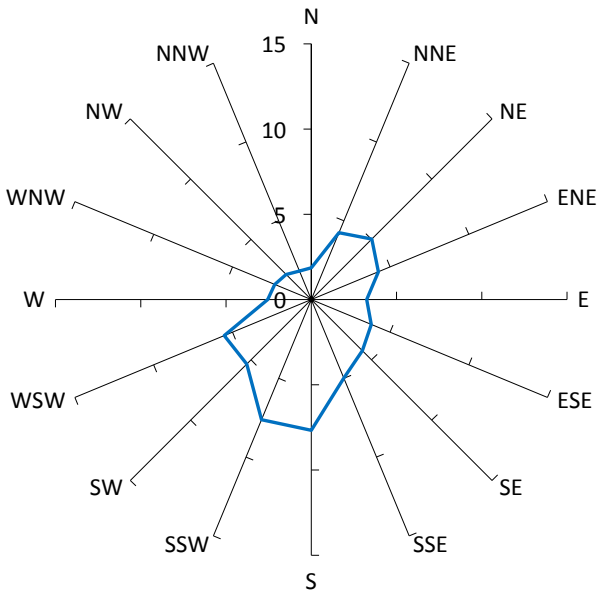
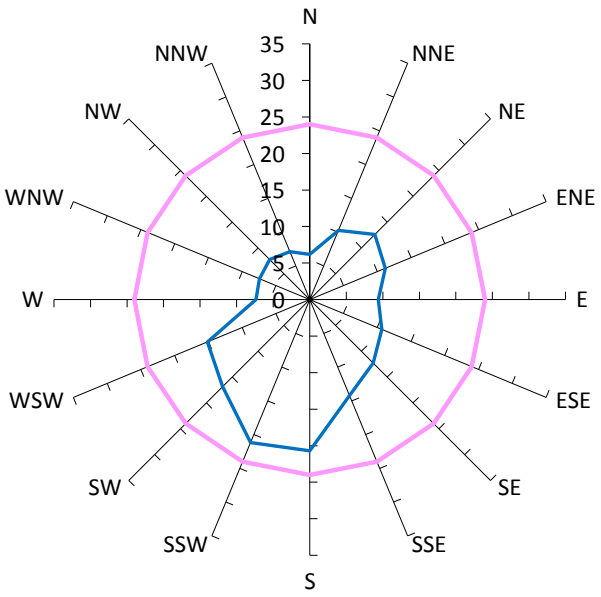
APPENDIX C DIRECTIONAL PLOTS OF WIND TUNNEL RESULTS

Results for Point 01

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

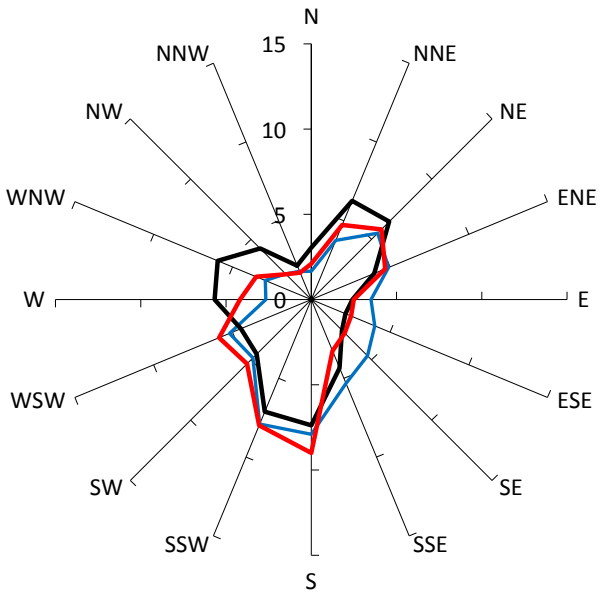
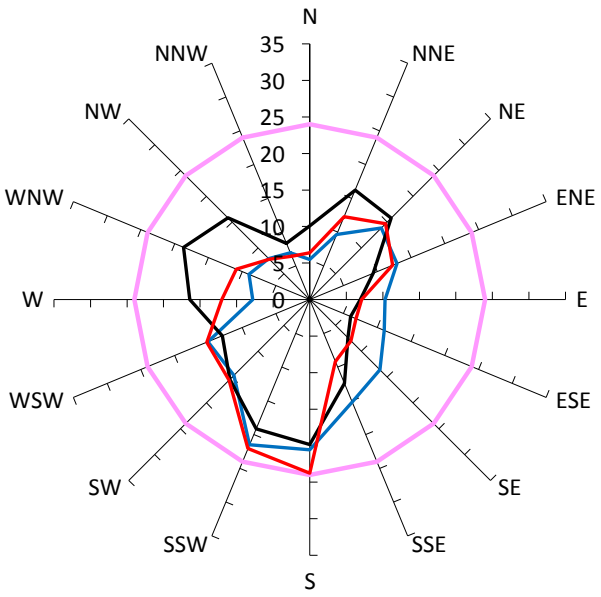
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	20

Results for Point 02

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

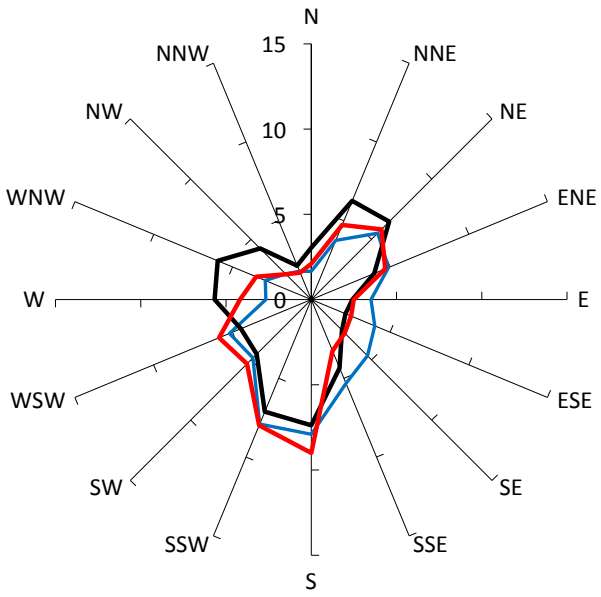
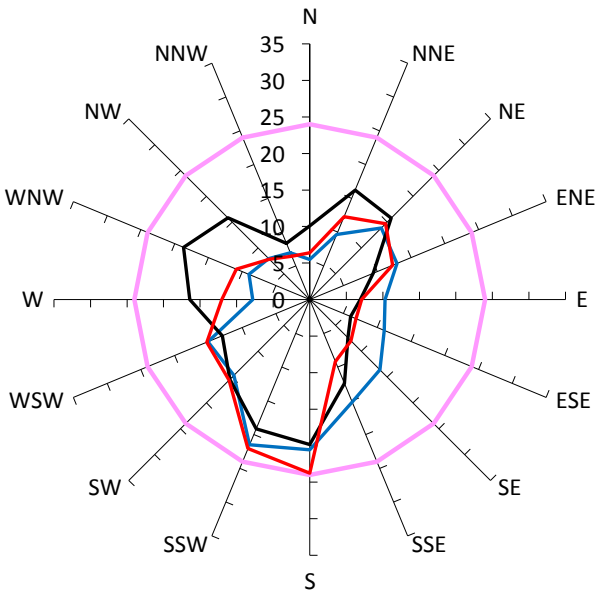
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	2%	21

Results for Point 03

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	42%	22
Existing site, no vegetation or other treatments.	46%	20
With development "as proposed", existing trees along Bridge Road included.	38%	24

Results for Point 03a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	14%	22
Existing site, no vegetation or other treatments.	13%	20
With development "as proposed", existing trees along Bridge Road included.	17%	24

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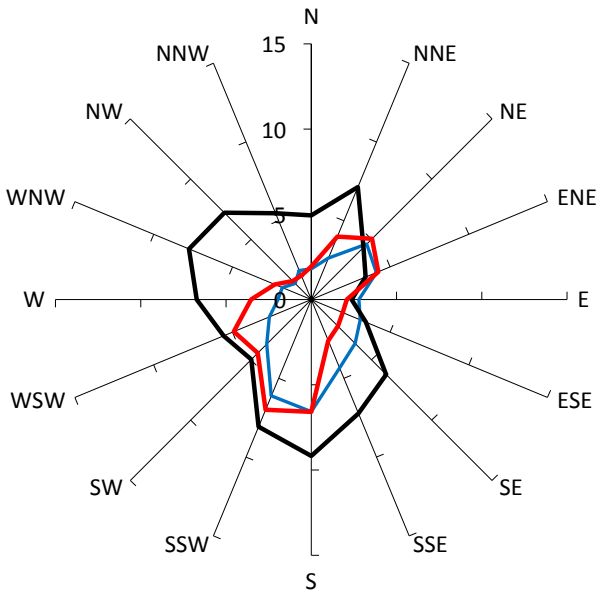
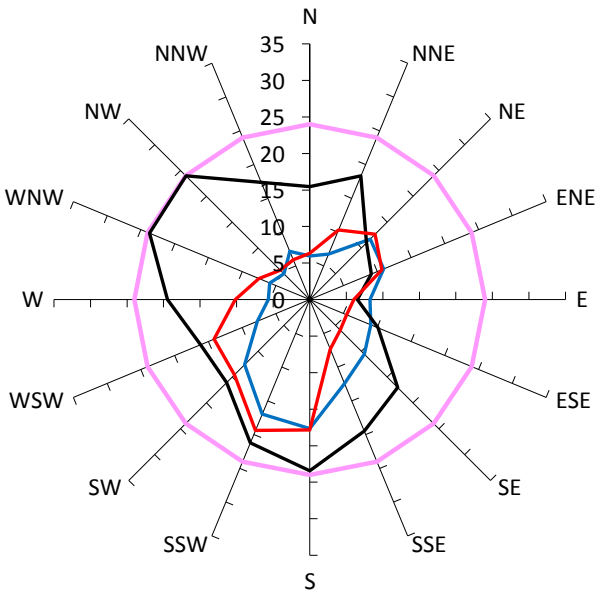
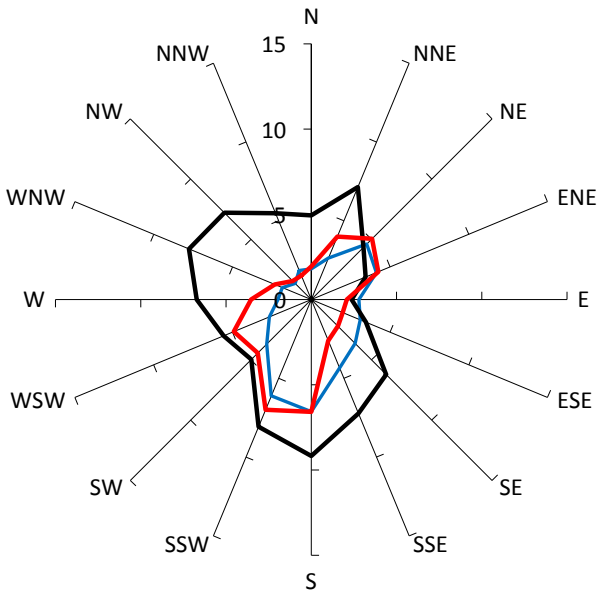
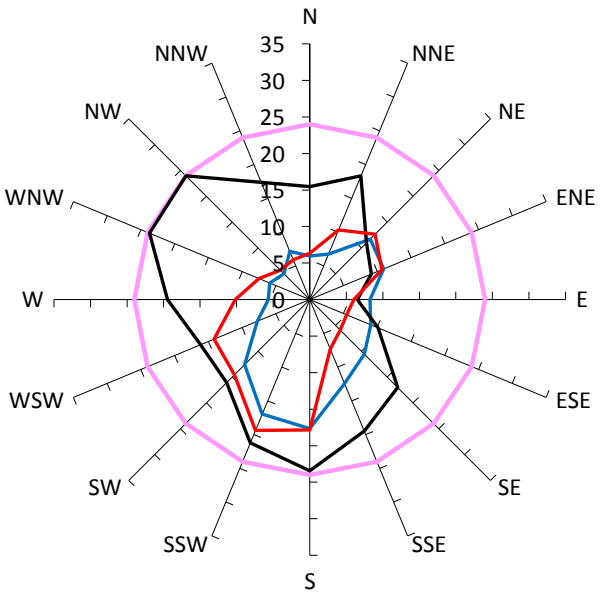
Results for Point 04

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

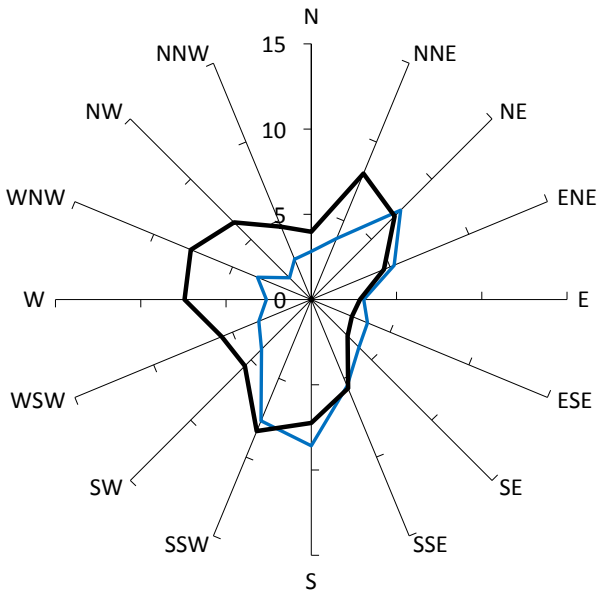
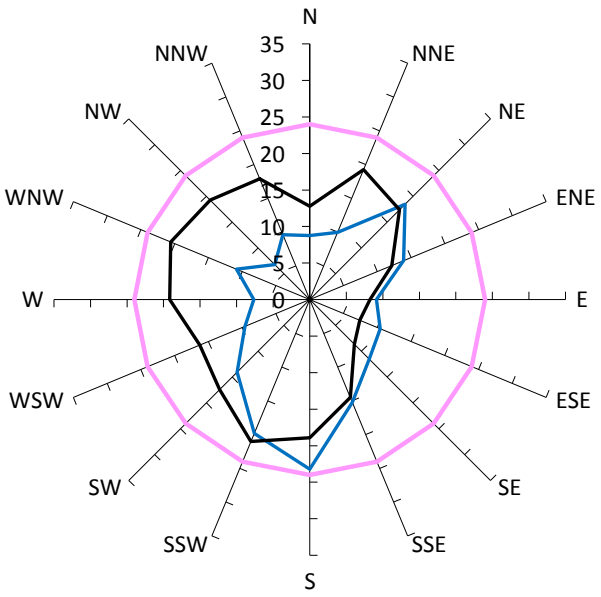
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	24%	18
Existing site, no vegetation or other treatments.	65%	24
With development "as proposed", existing trees along Bridge Road included.	28%	19

Results for Point 04a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

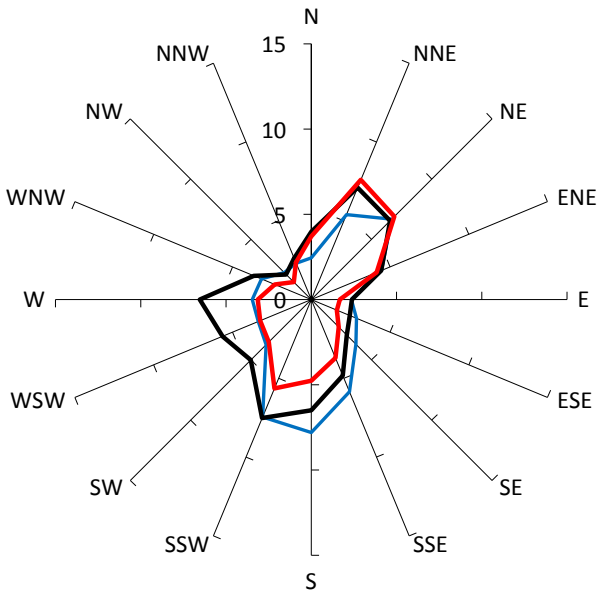
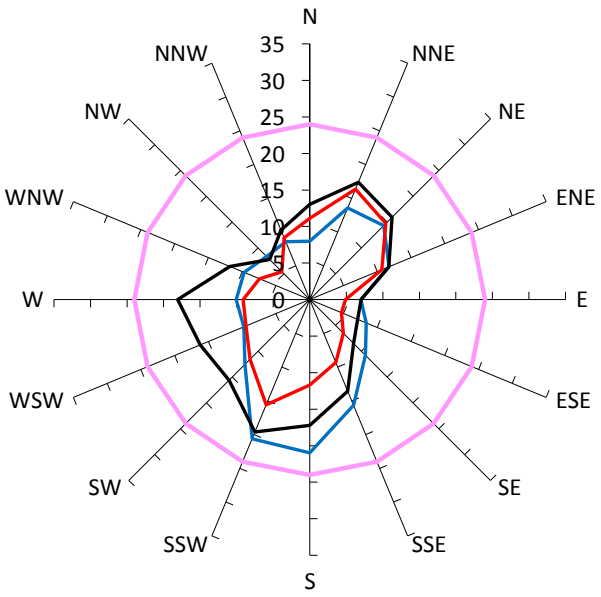
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	0%	18
Existing site, no vegetation or other treatments.	9%	24
With development "as proposed", existing trees along Bridge Road included.	1%	19

Results for Point 05

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

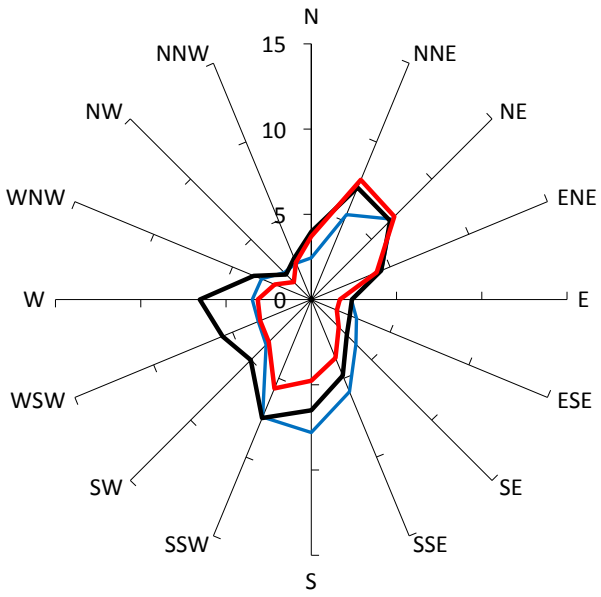
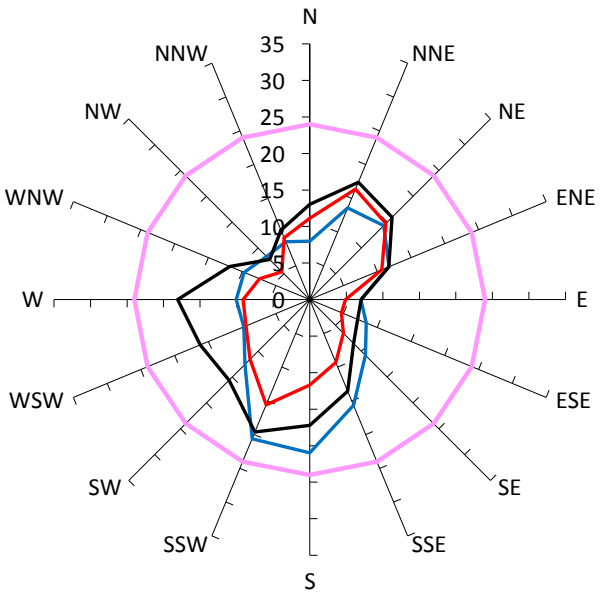
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	23
Existing site, no vegetation or other treatments.	6%	21

Results for Point 06

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

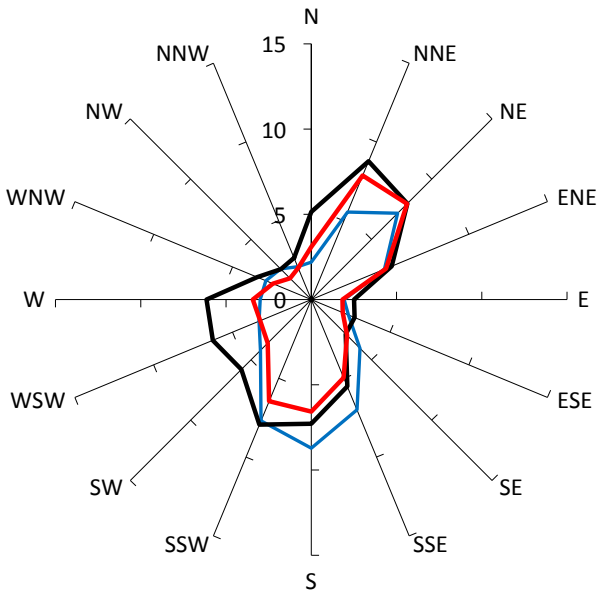
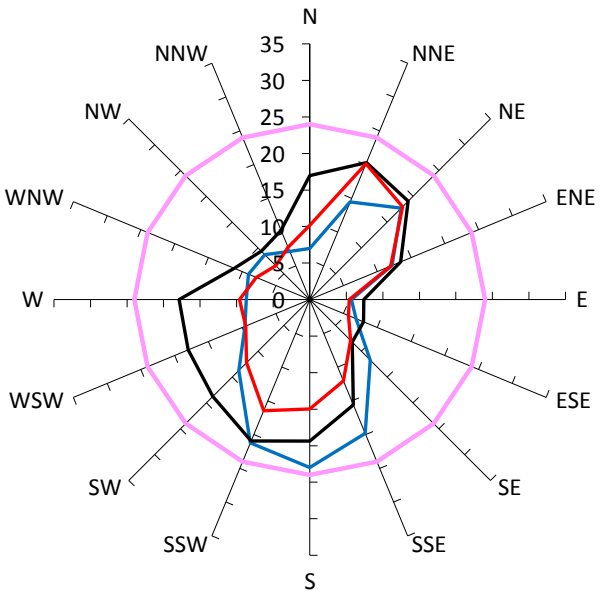
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	40%	21
Existing site, no vegetation or other treatments.	49%	20
With development "as proposed", existing trees along Bridge Road included.	27%	16

Results for Point 06a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

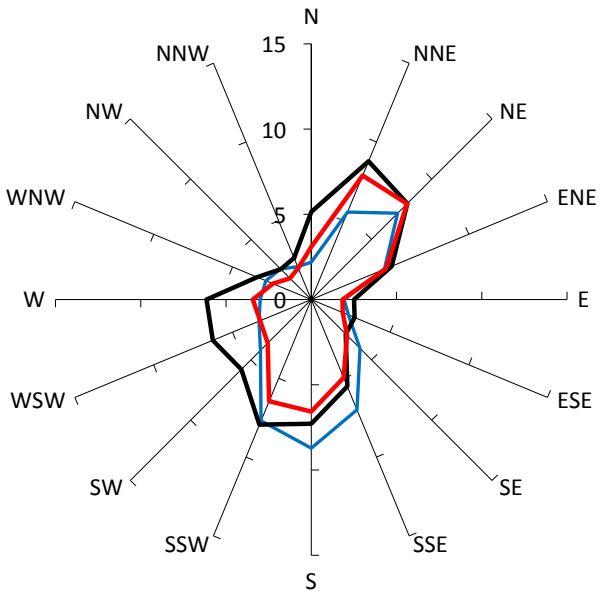
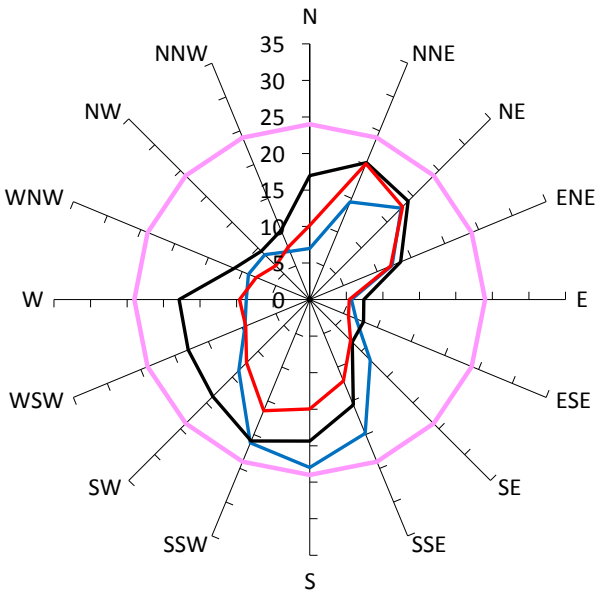
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	14%	21
Existing site, no vegetation or other treatments.	15%	20
With development "as proposed", existing trees along Bridge Road included.	9%	16

Results for Point 07

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

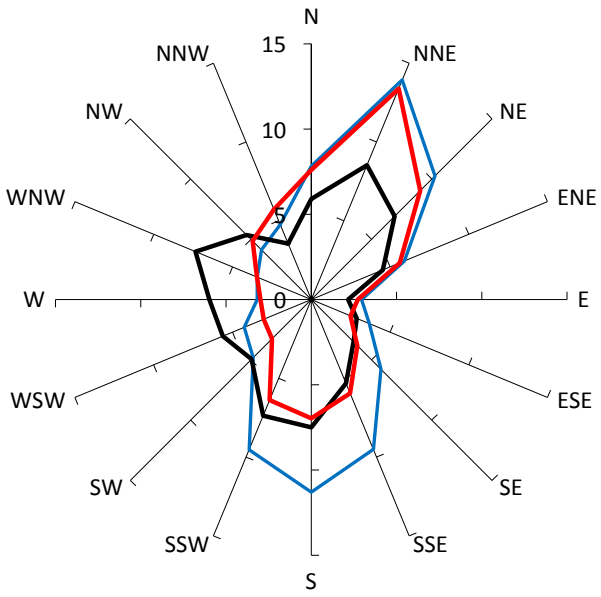
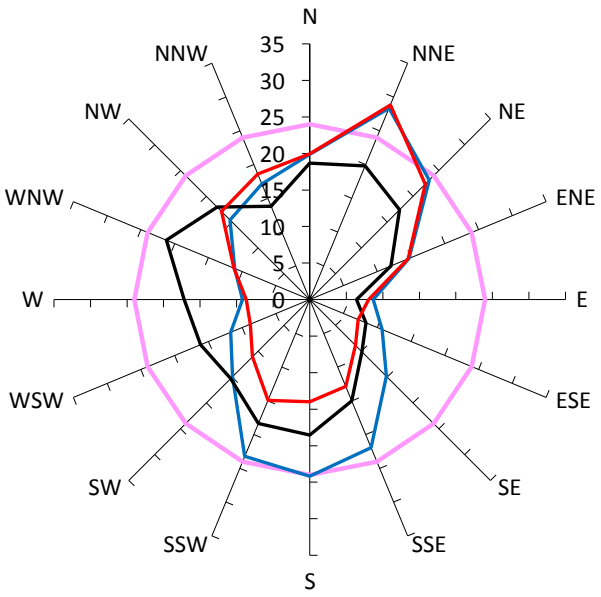
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	41%	23
Existing site, no vegetation or other treatments.	54%	21
With development "as proposed", existing trees along Bridge Road included.	40%	20

Results for Point 07a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

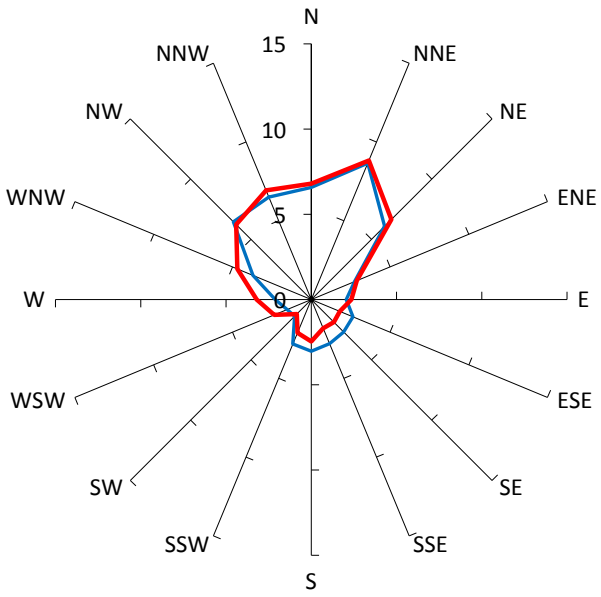
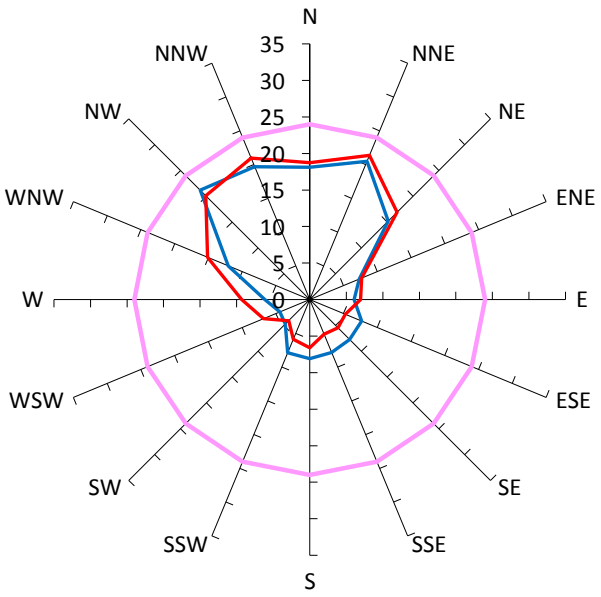
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	4%	23
Existing site, no vegetation or other treatments.	6%	21
With development "as proposed", existing trees along Bridge Road included.	2%	20

Results for Point 08

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

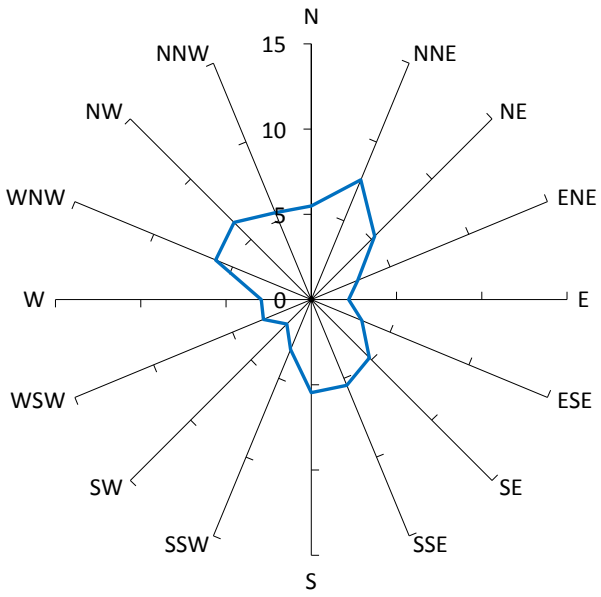
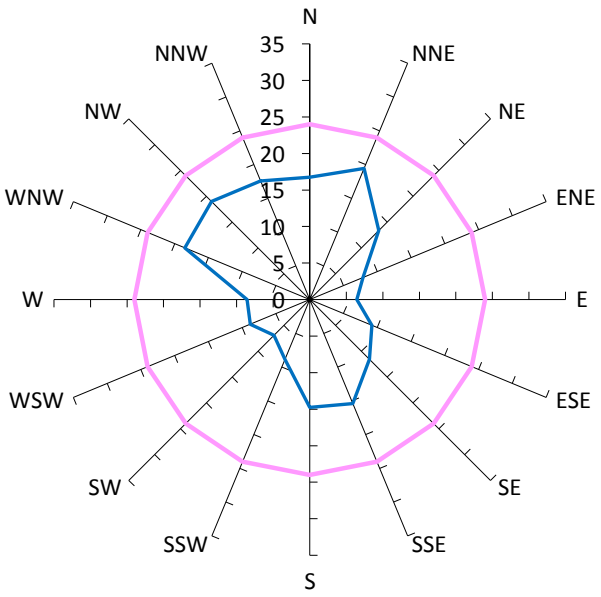
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	30%	28
Existing site, no vegetation or other treatments.	5%	21
With development "as proposed", existing trees along Bridge Road included.	11%	29

Results for Point 09

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

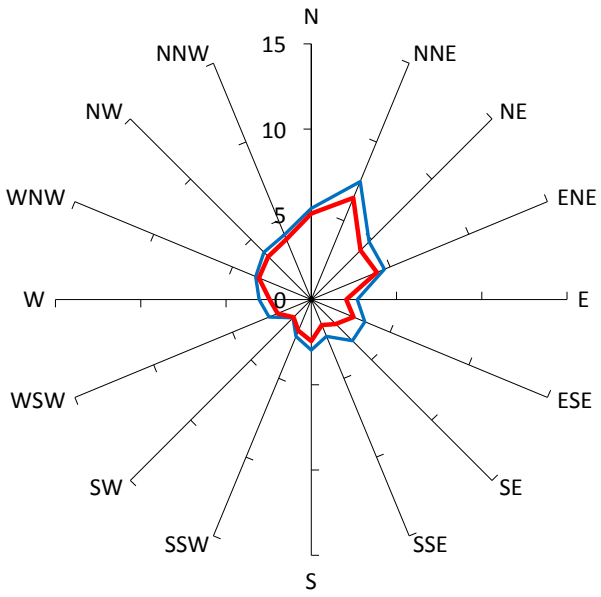
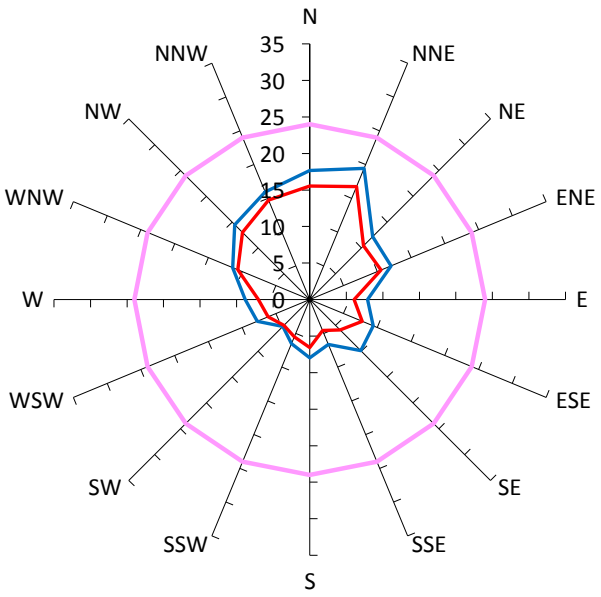
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	27%	21
With development "as proposed", existing trees along Bridge Road included.	28%	21

Results for Point 10

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

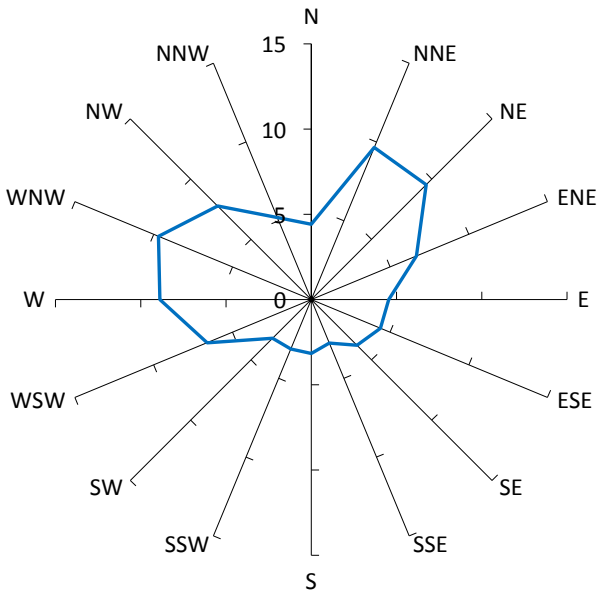
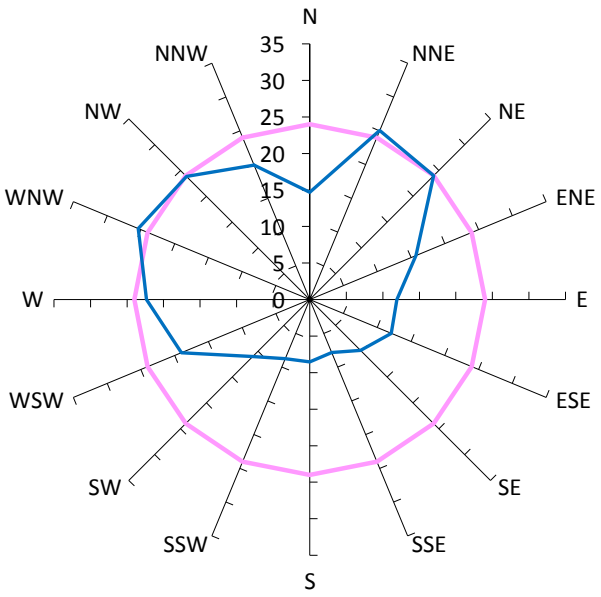
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	19

Results for Point 11

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

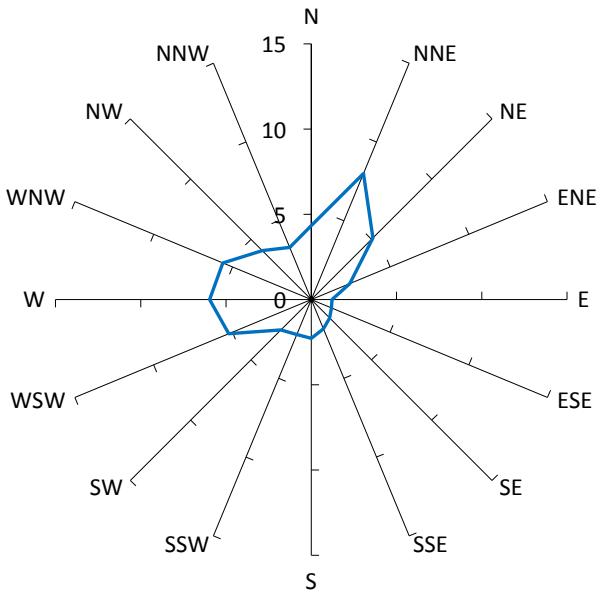
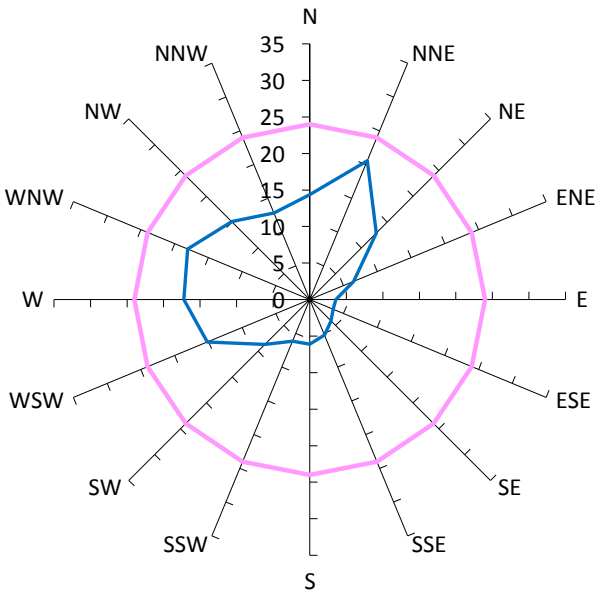
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	6%	19
With development "as proposed", existing trees along Bridge Road included.	3%	17

Results for Point 12

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

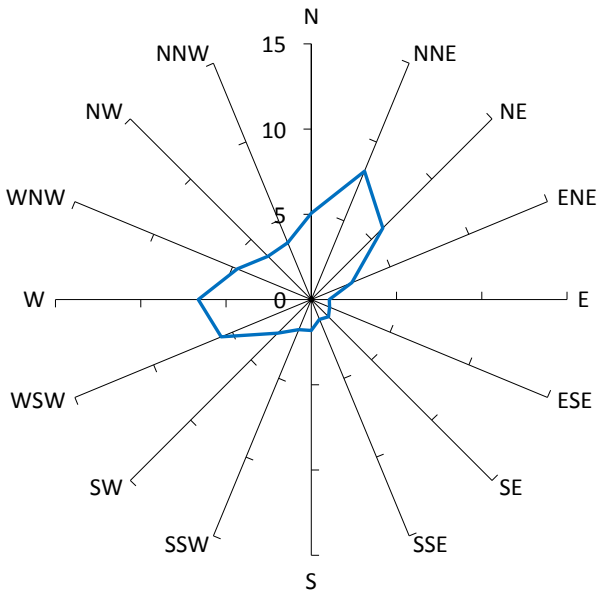
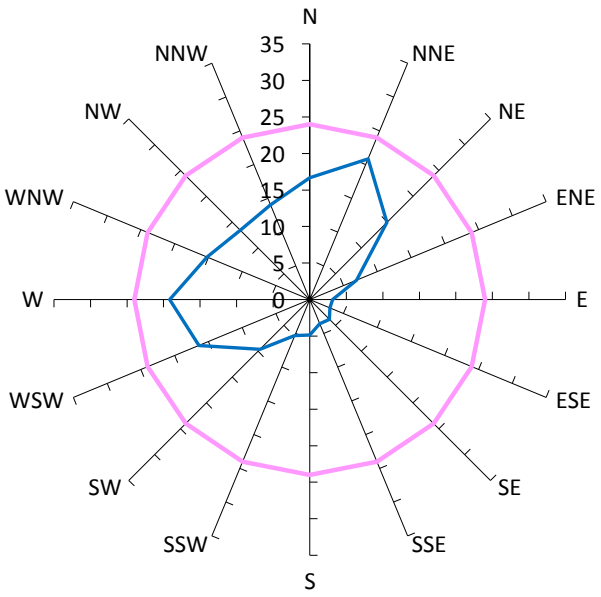
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	14%	25

Results for Point 13

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

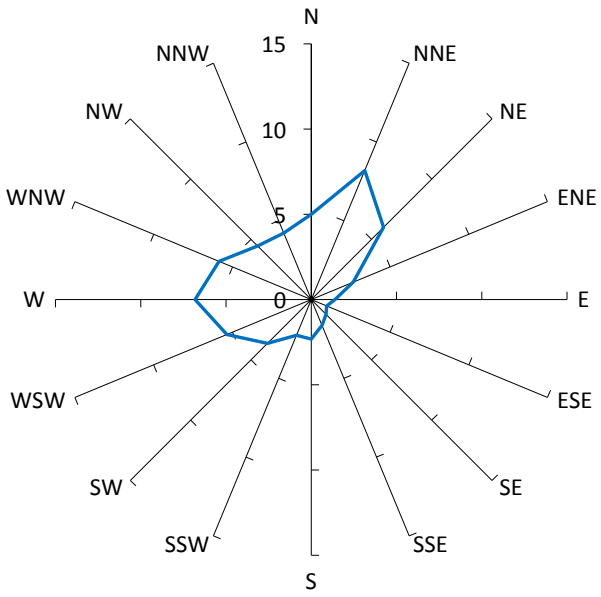
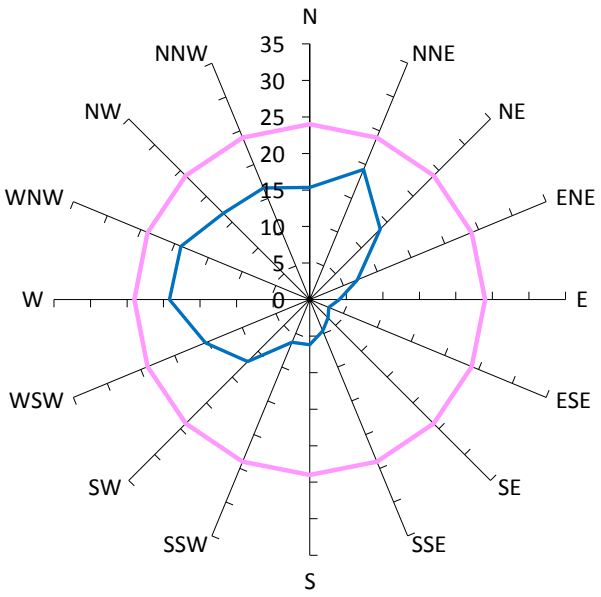
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	2%	21

Results for Point 14

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

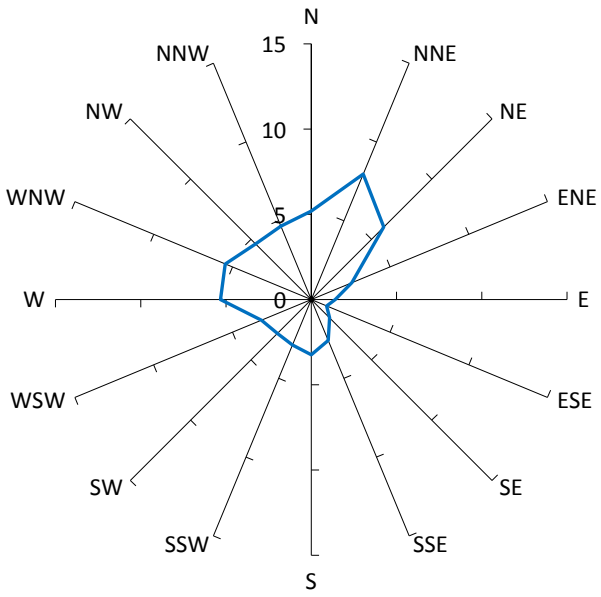
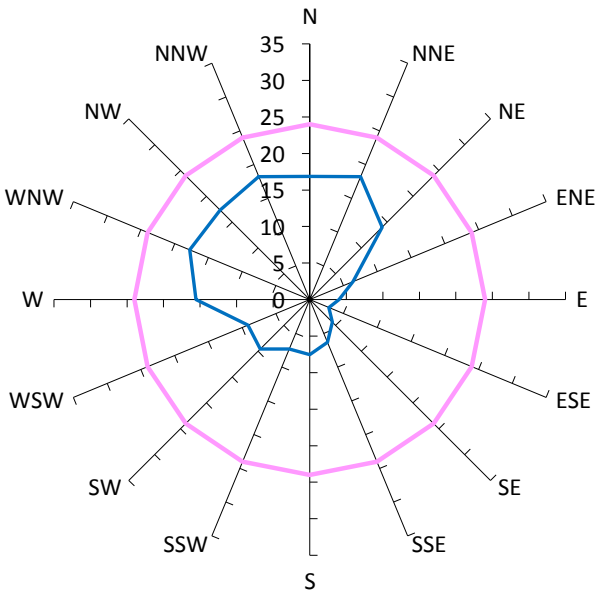
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	2%	21

Results for Point 15

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	2%	19

Results for Point 16

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	10%	18

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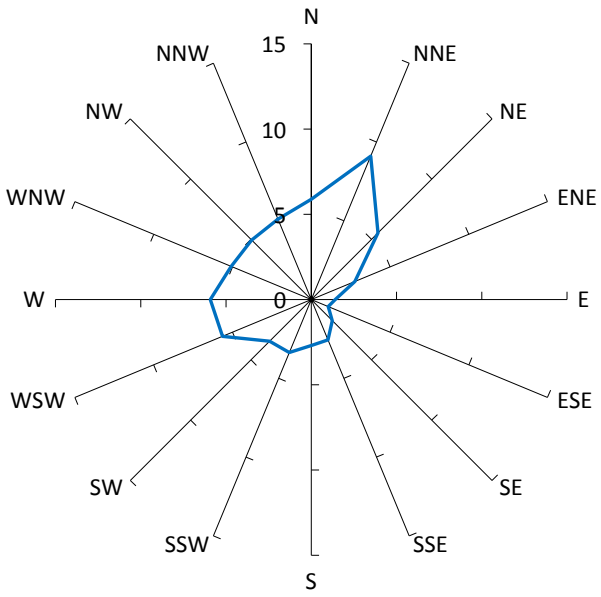
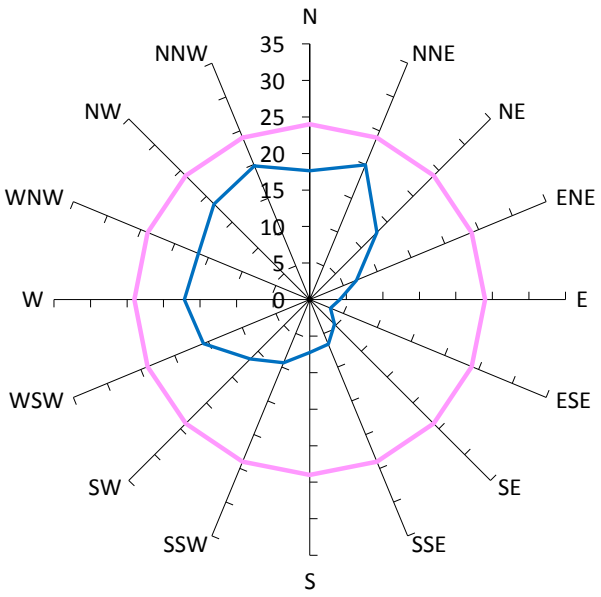
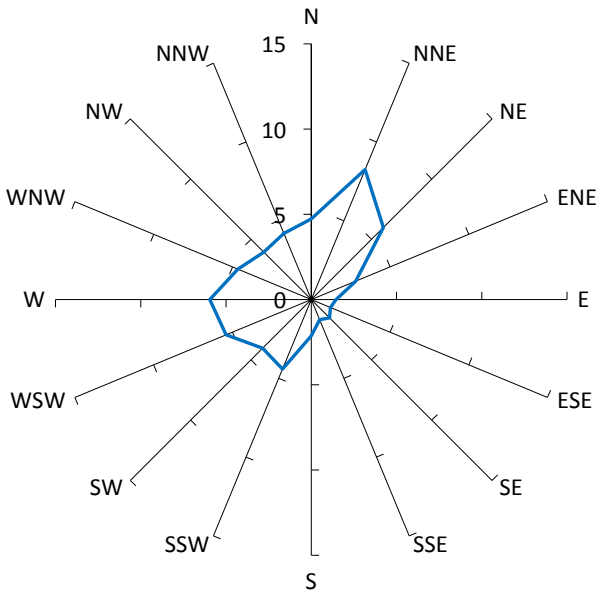
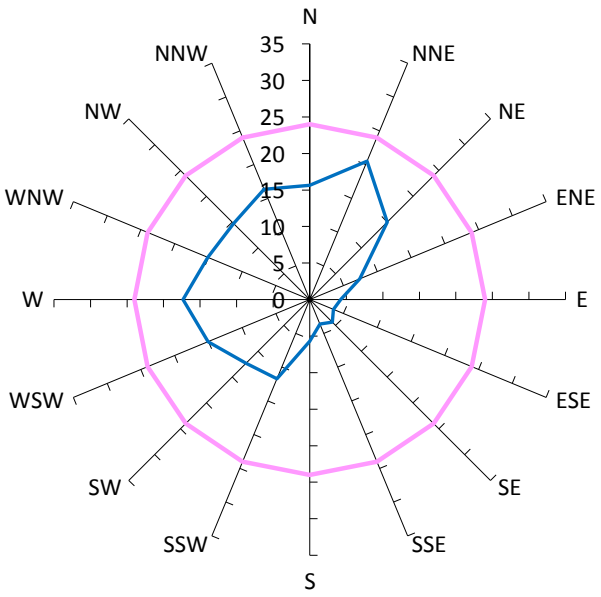
Results for Point 17

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

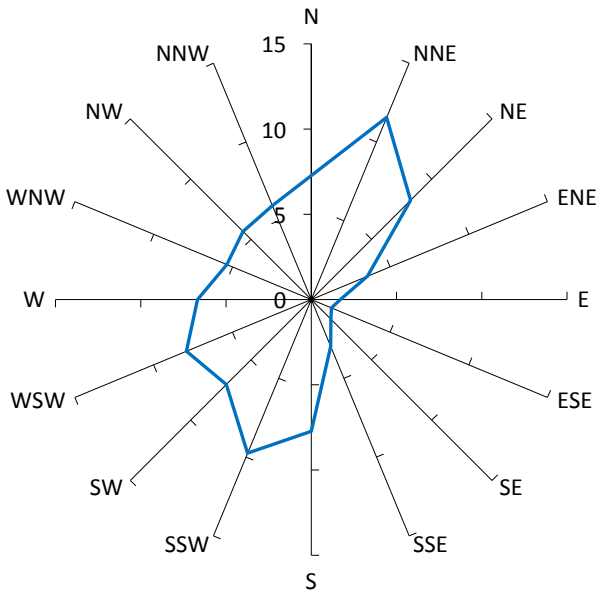
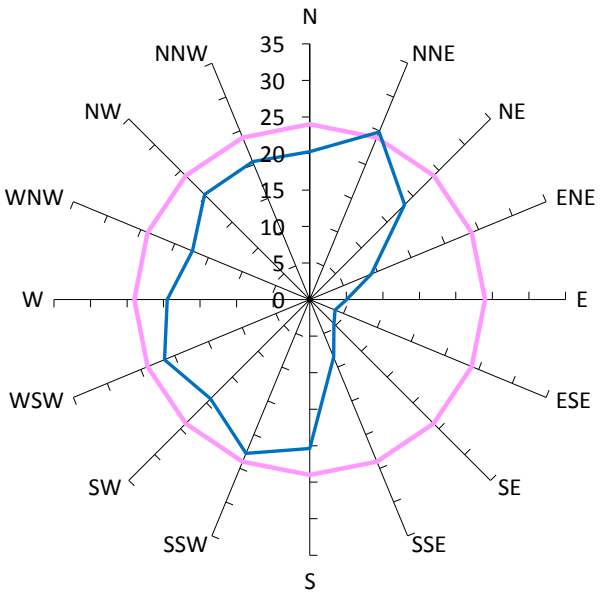
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	4%	20

Results for Point 18

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

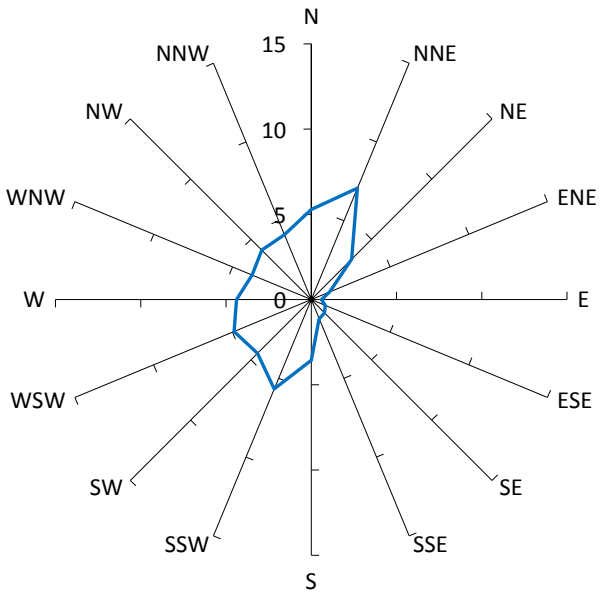
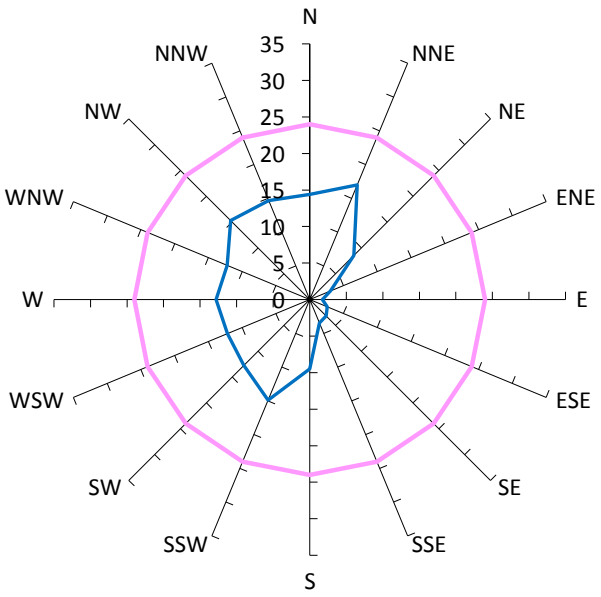
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	2%	21

Results for Point 19

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

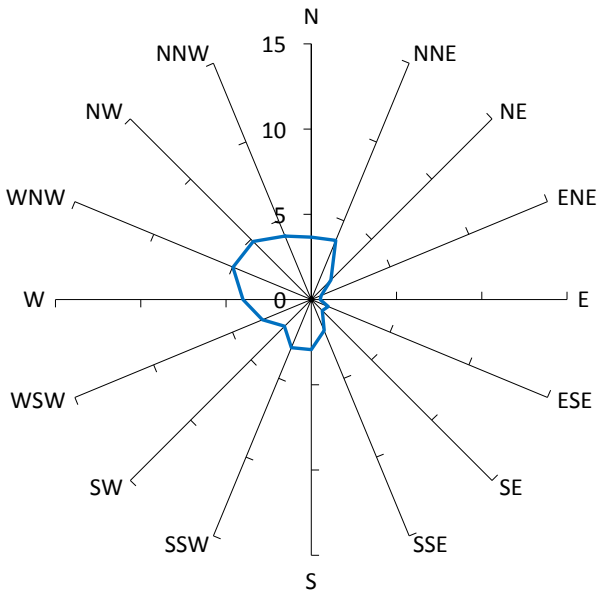
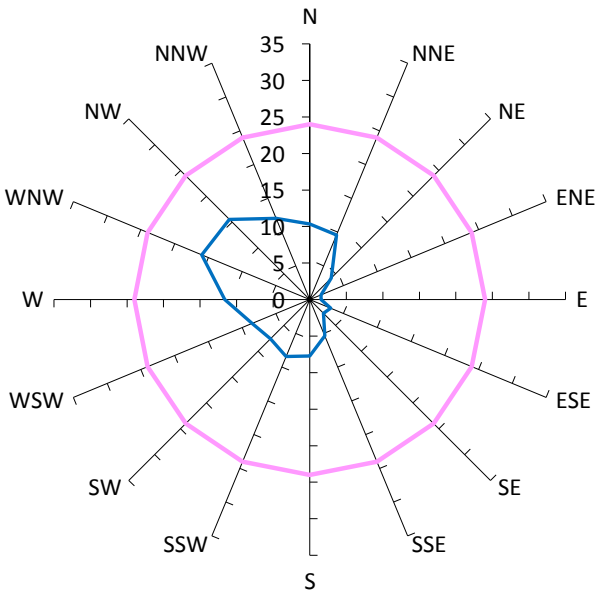
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	16%	25

Results for Point 20

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

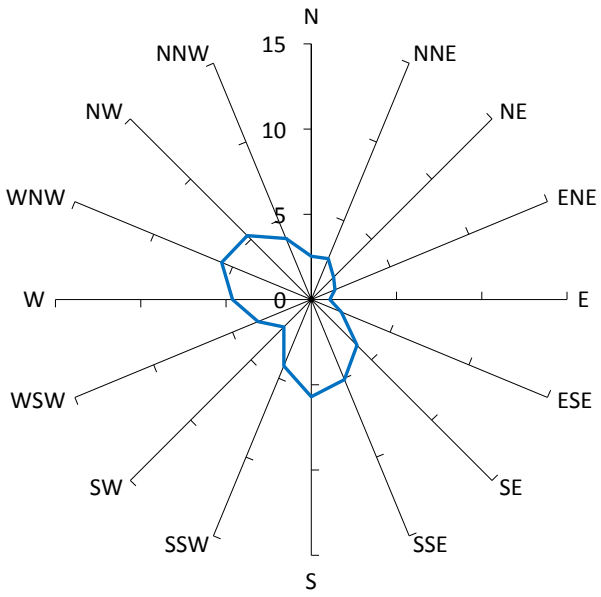
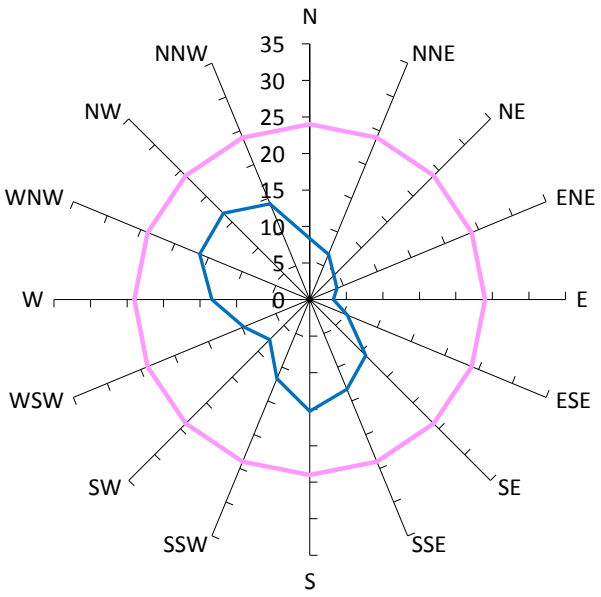
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	1%	17

Results for Point 21

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

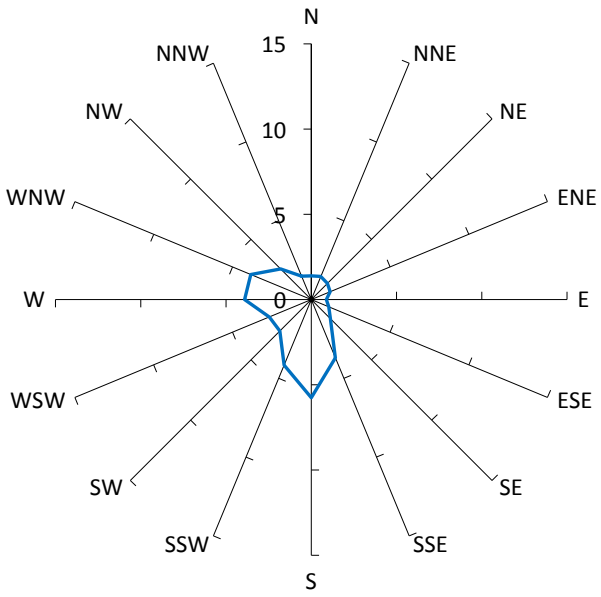
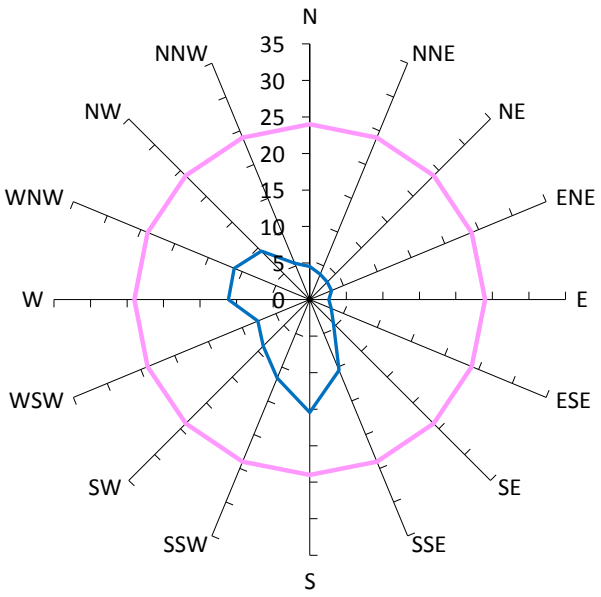
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	0%	16

Results for Point 22

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

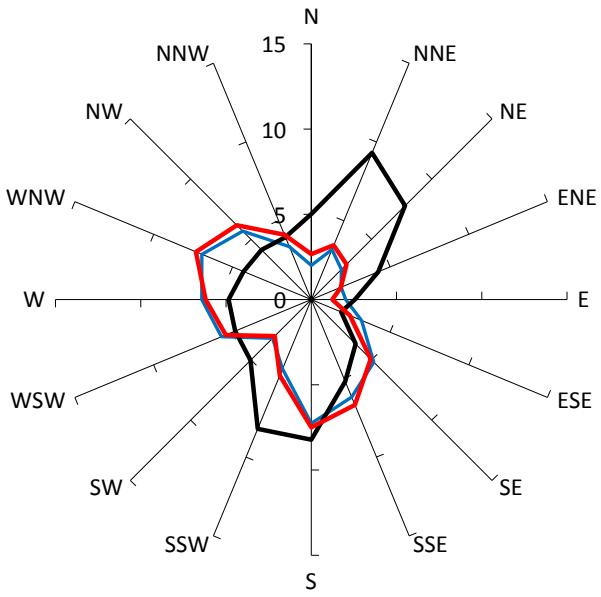
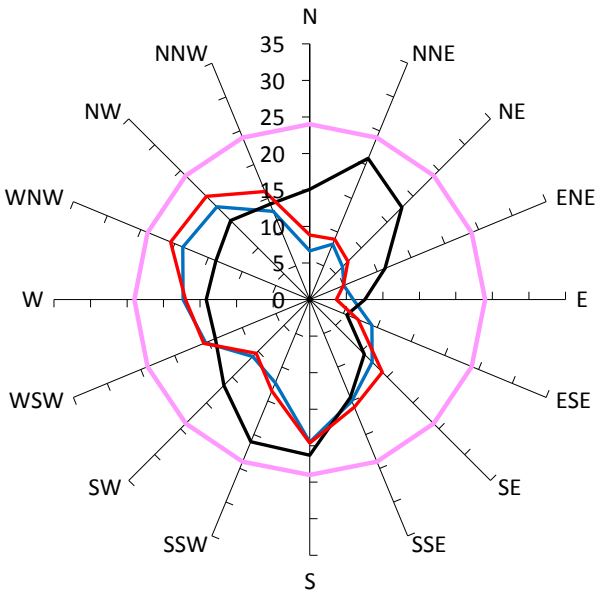
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	1%	17

Results for Point 23

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

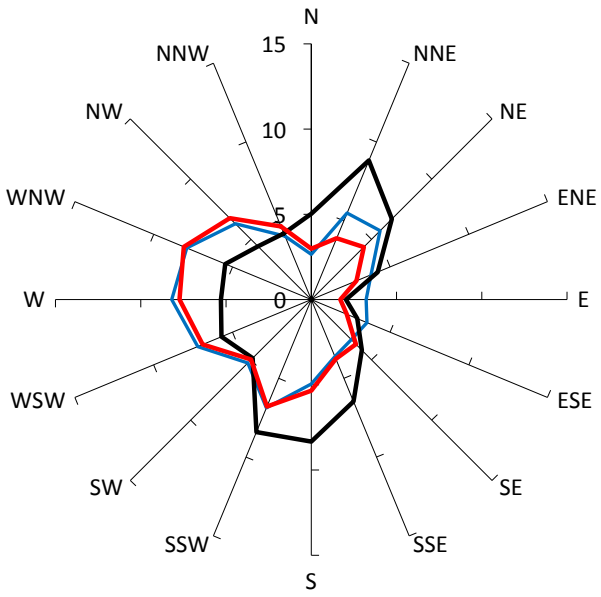
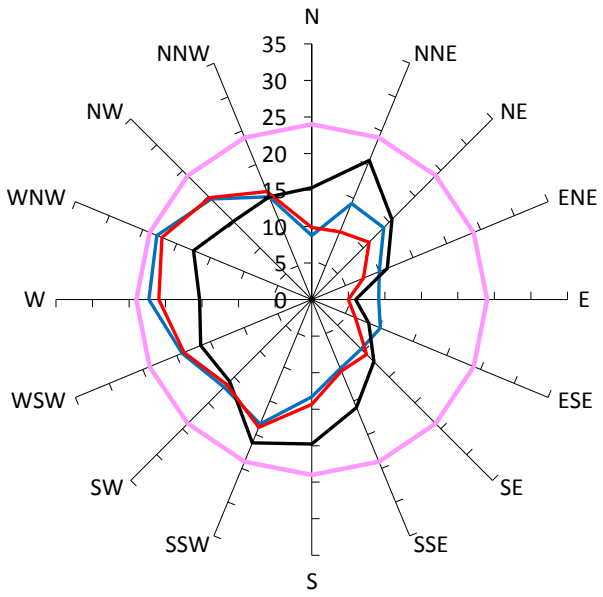
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	1%	15

Results for Point 24

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

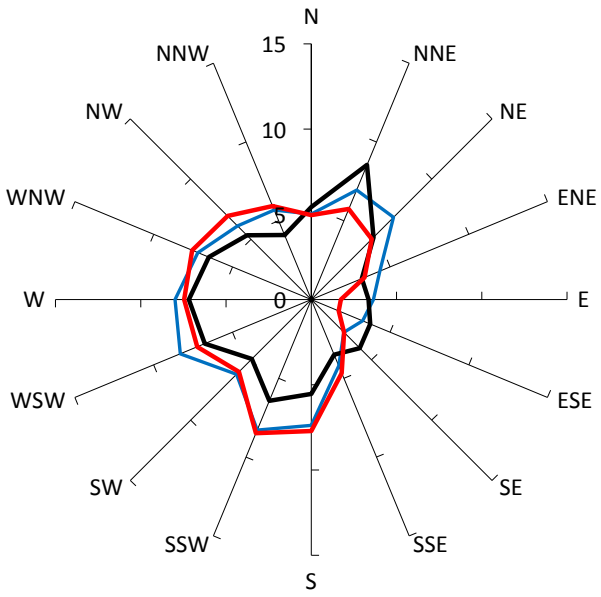
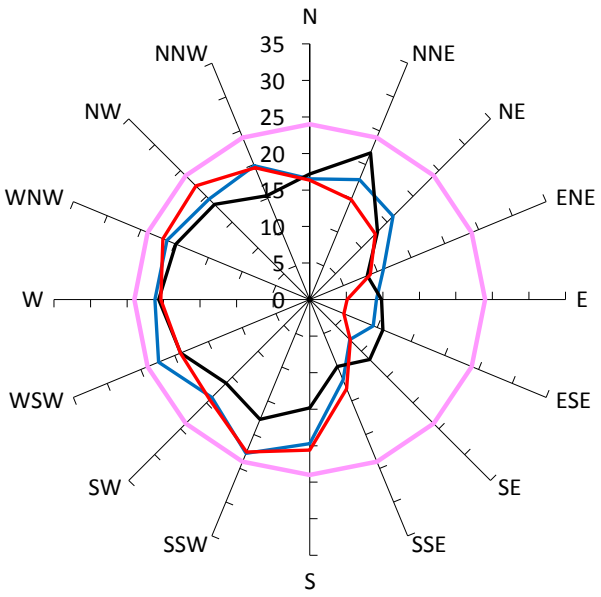
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	41%	20
Existing site, no vegetation or other treatments.	52%	21
With development "as proposed", existing trees along Bridge Road included.	44%	21

Results for Point 25

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

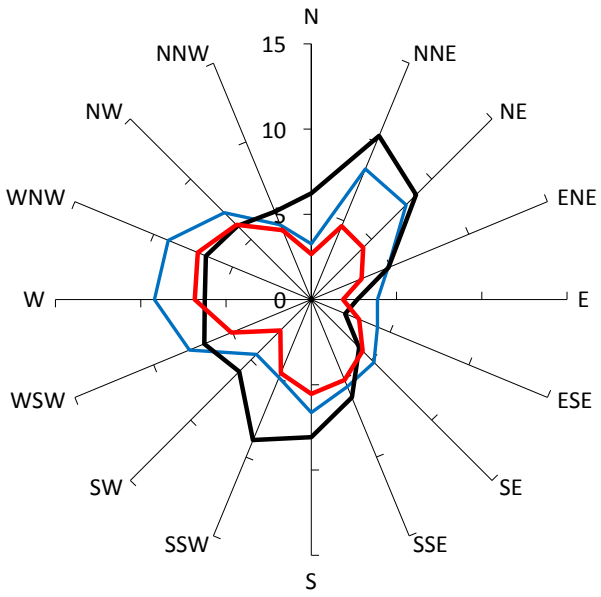
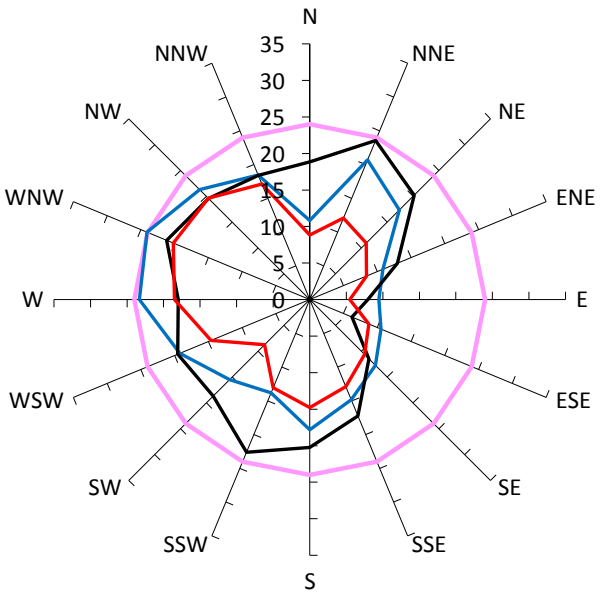
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	50%	23
Existing site, no vegetation or other treatments.	58%	21
With development "as proposed", existing trees along Bridge Road included.	43%	22

Results for Point 26

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

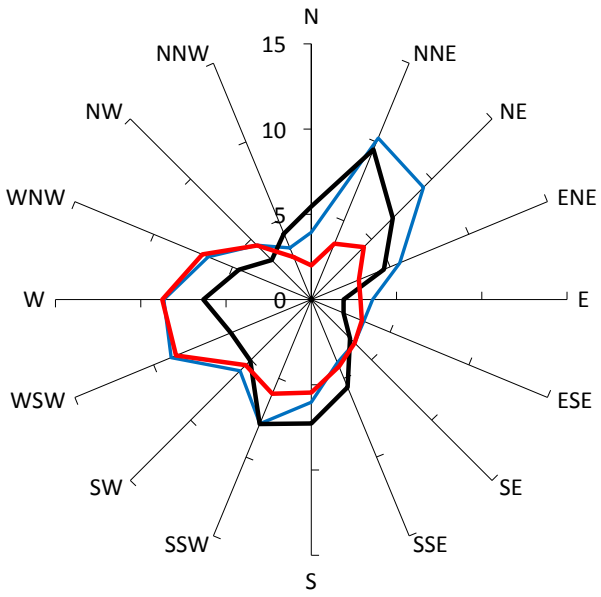
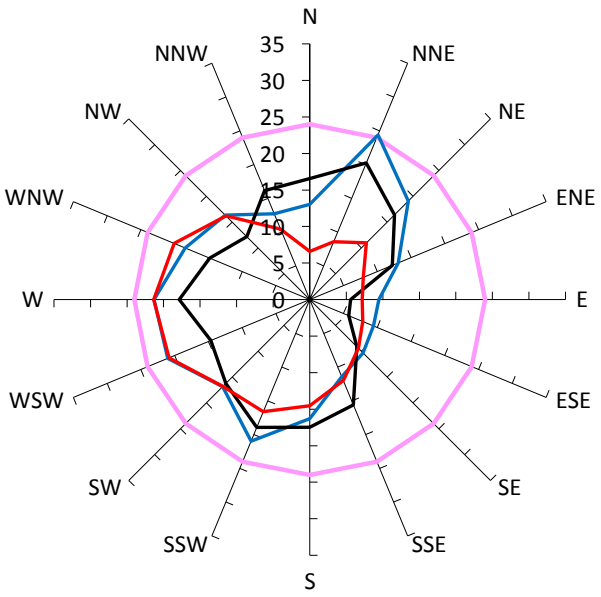
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	62%	23
Existing site, no vegetation or other treatments.	54%	22
With development "as proposed", existing trees along Bridge Road included.	60%	23

Results for Point 27

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

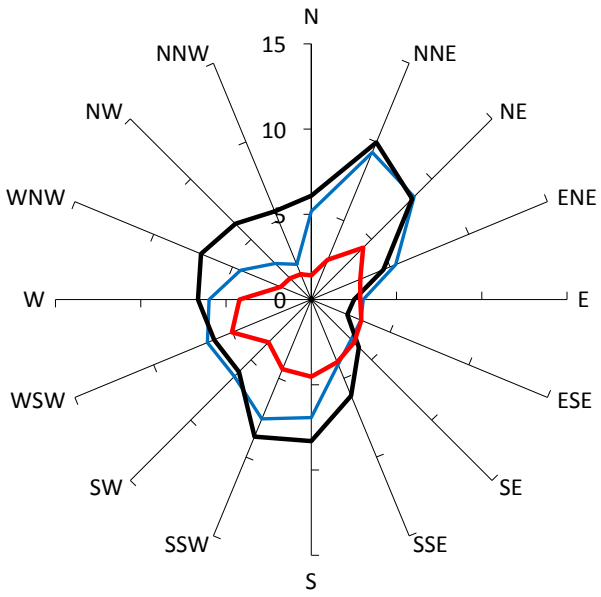
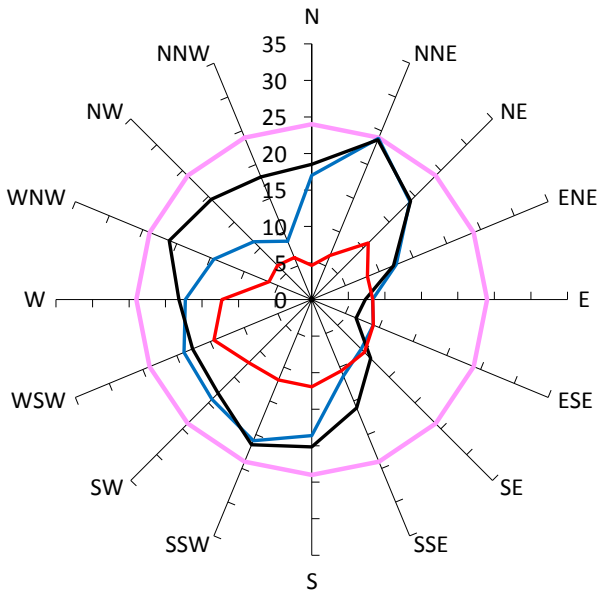
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	9%	24
Existing site, no vegetation or other treatments.	14%	24
With development "as proposed", existing trees along Bridge Road included.	2%	20

Results for Point 28

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

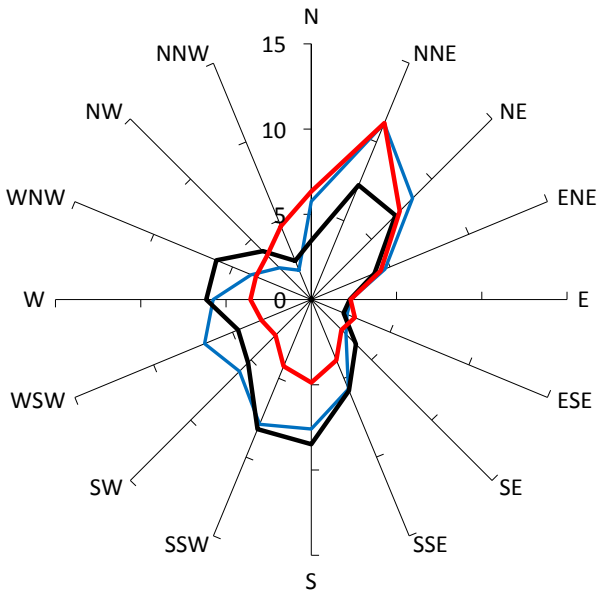
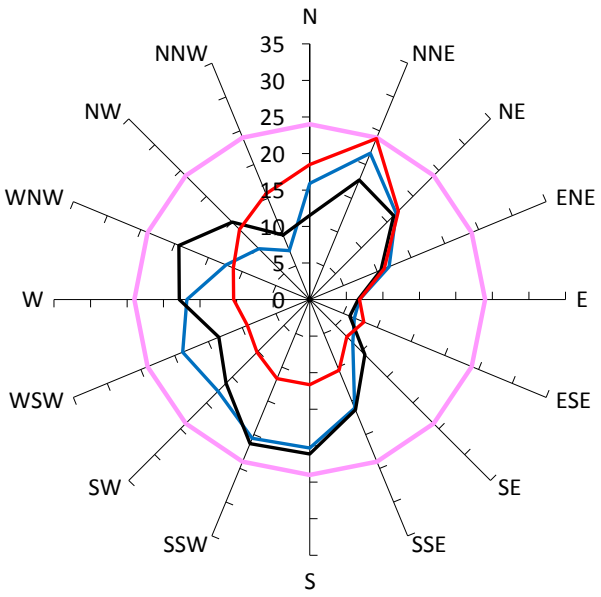
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	14%	24
Existing site, no vegetation or other treatments.	6%	20
With development "as proposed", existing trees along Bridge Road included.	5%	21

Results for Point 29

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

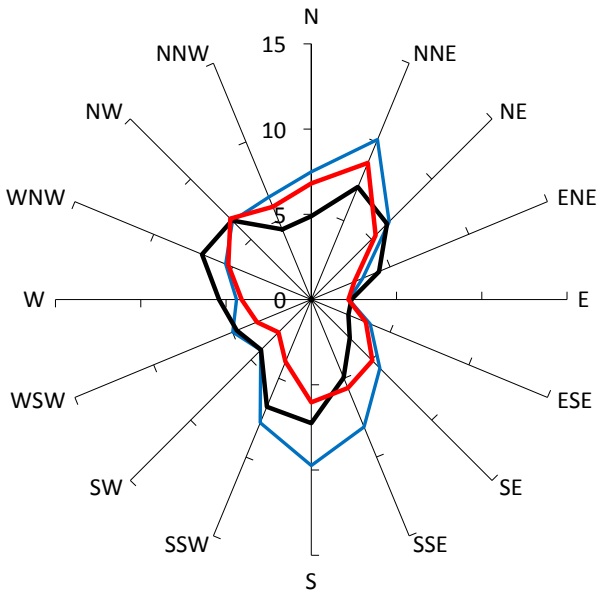
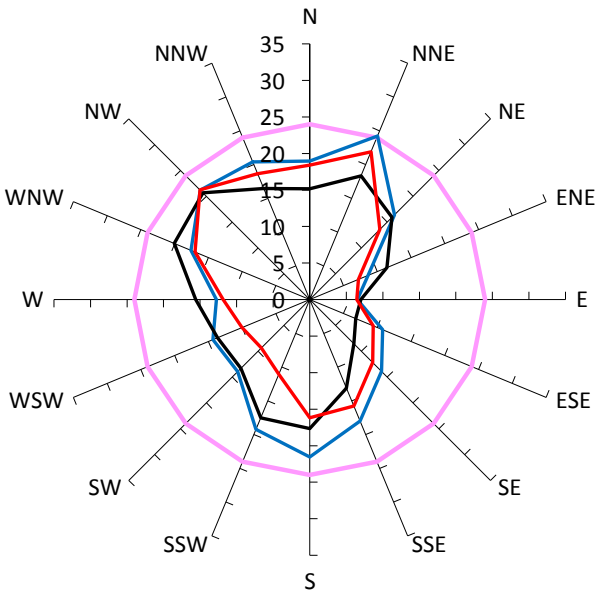
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	7%	24
Existing site, no vegetation or other treatments.	13%	24
With development "as proposed", existing trees along Bridge Road included.	0%	14

Results for Point 30

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

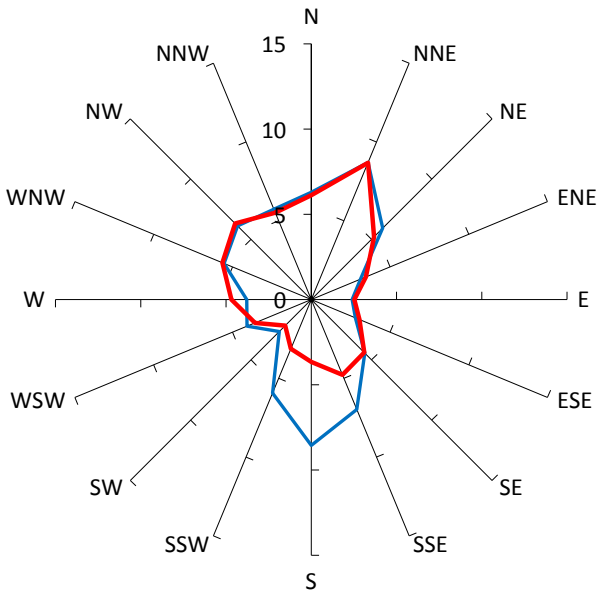
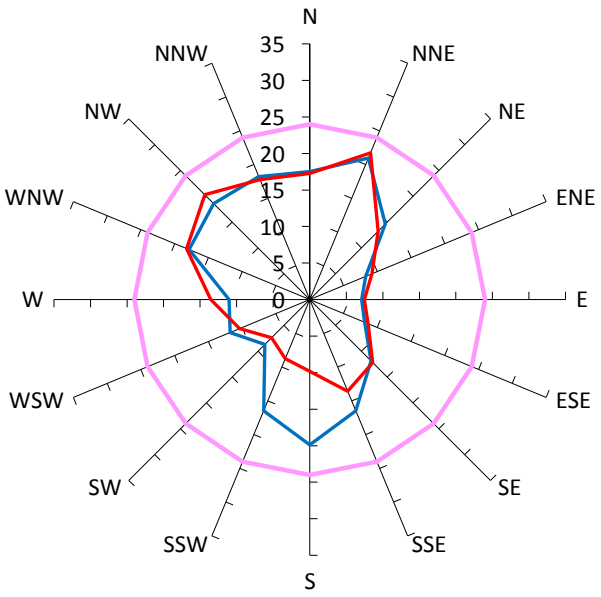
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	10%	22
Existing site, no vegetation or other treatments.	5%	21
With development "as proposed", existing trees along Bridge Road included.	7%	24

Results for Point 31

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

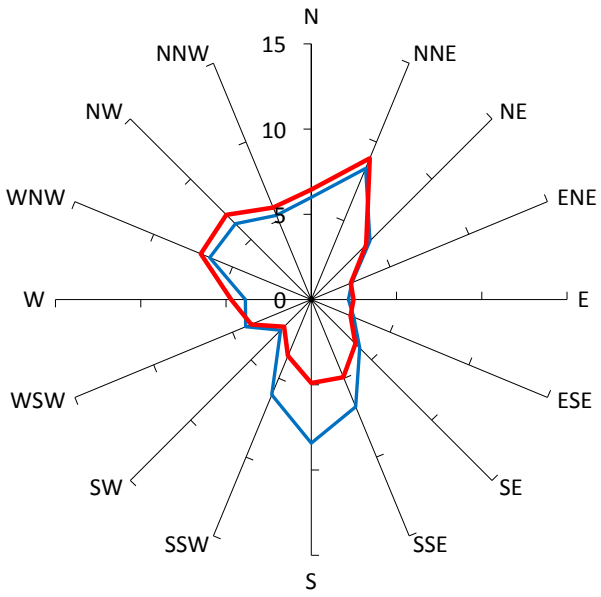
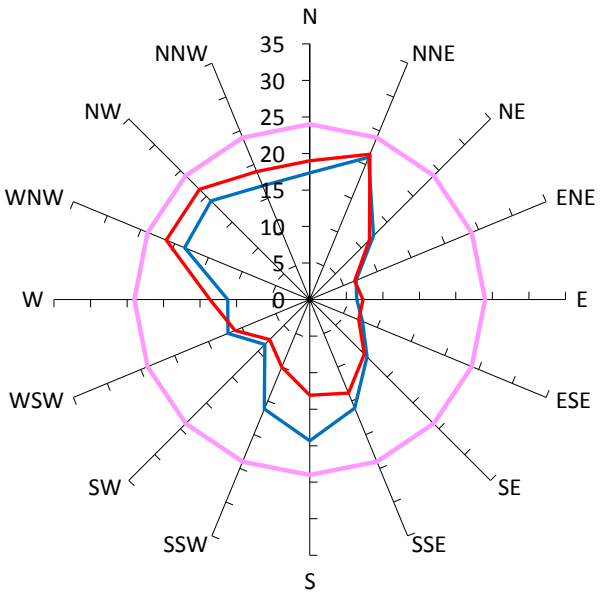
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	15%	24
Existing site, no vegetation or other treatments.	3%	21
With development "as proposed", existing trees along Bridge Road included.	4%	22

Results for Point 32

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	53%	21
With development "as proposed", existing trees along Bridge Road included.	40%	22

Results for Point 33

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	52%	21
With development "as proposed", existing trees along Bridge Road included.	42%	22

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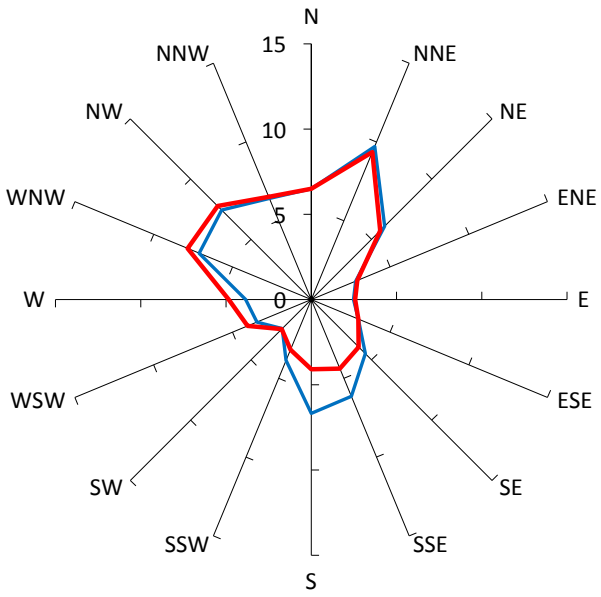
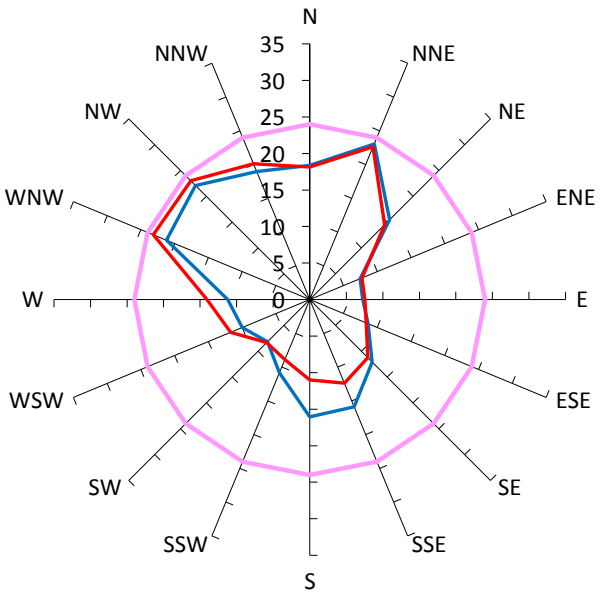
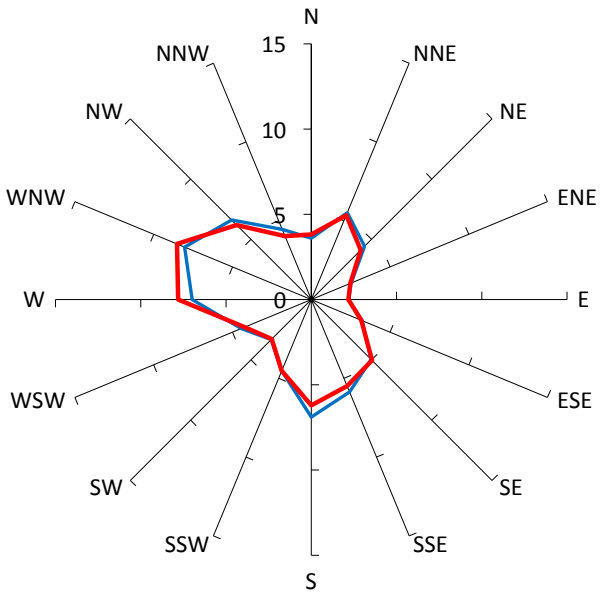
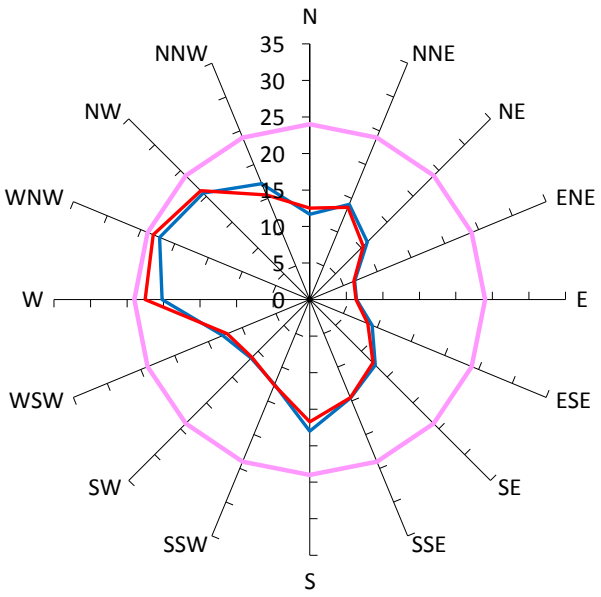
Results for Point 34

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

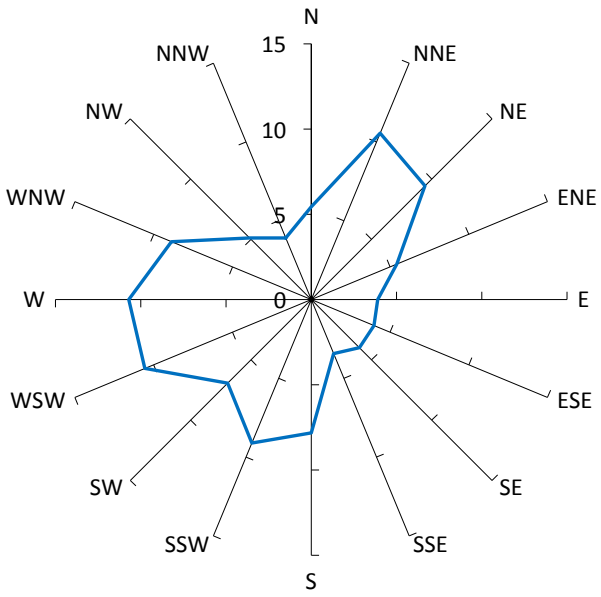
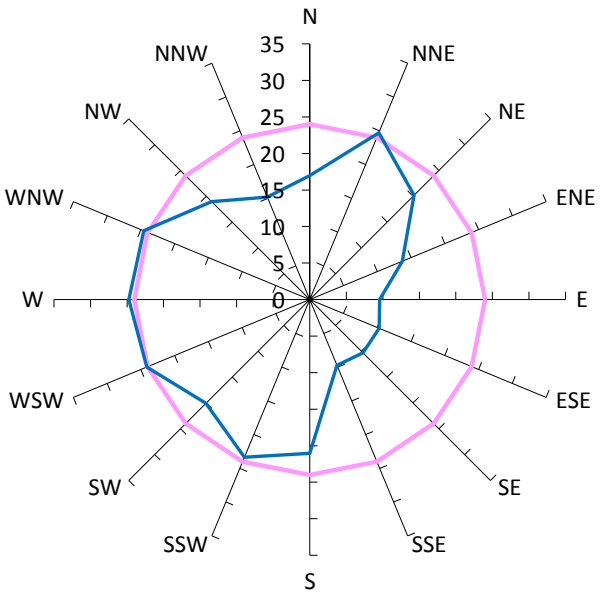
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	8%	23
With development "as proposed", existing trees along Bridge Road included.	7%	23

Results for Point 35

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

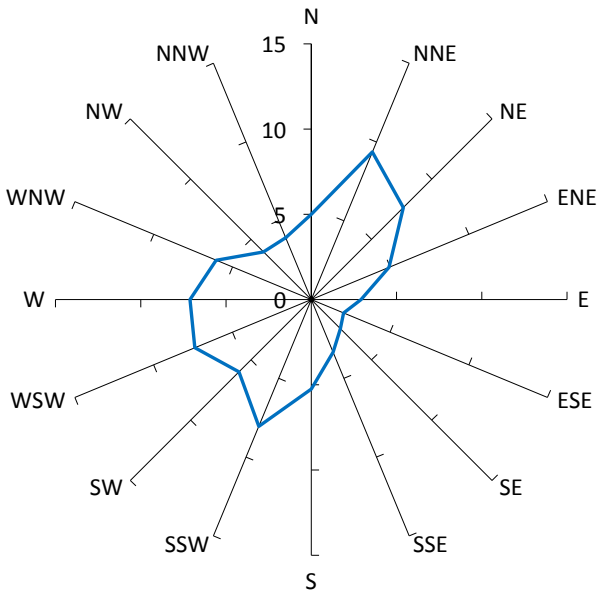
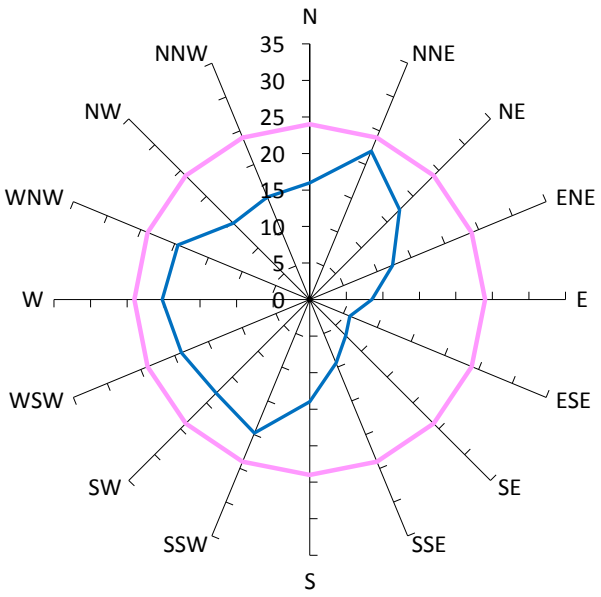
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	50%	22
With development "as proposed", existing trees along Bridge Road included.	48%	23

Results for Point 36

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

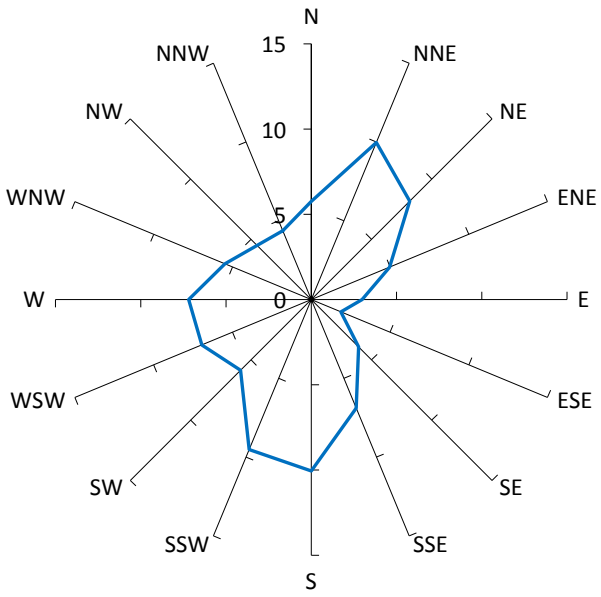
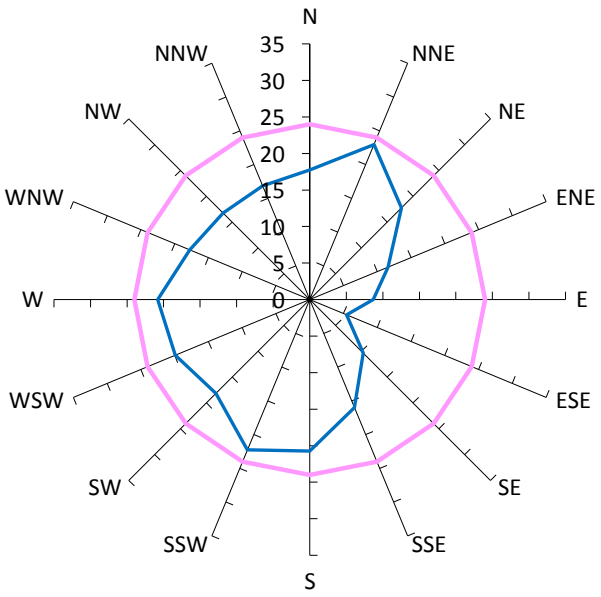
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	24%	25

Results for Point 37

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

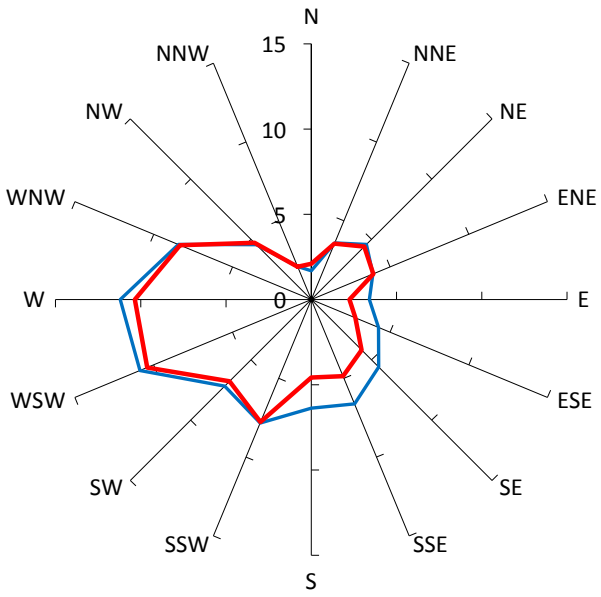
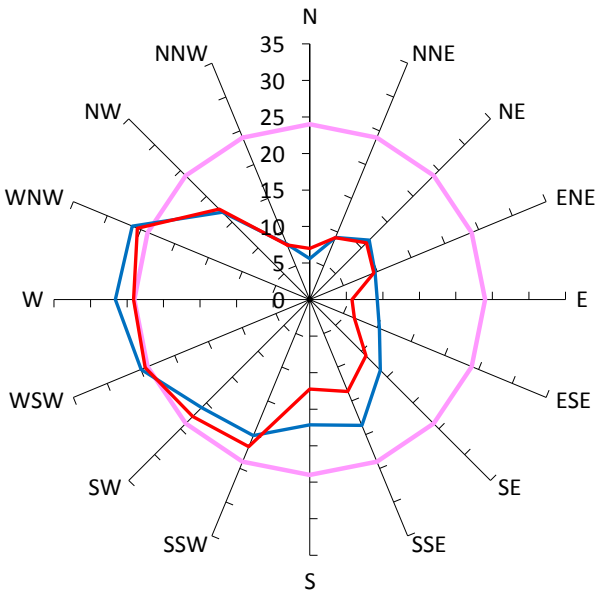
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	7%	22

Results for Point 38

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 8m/s with 5% probability of exceedence	Safety Limit: 24m/s

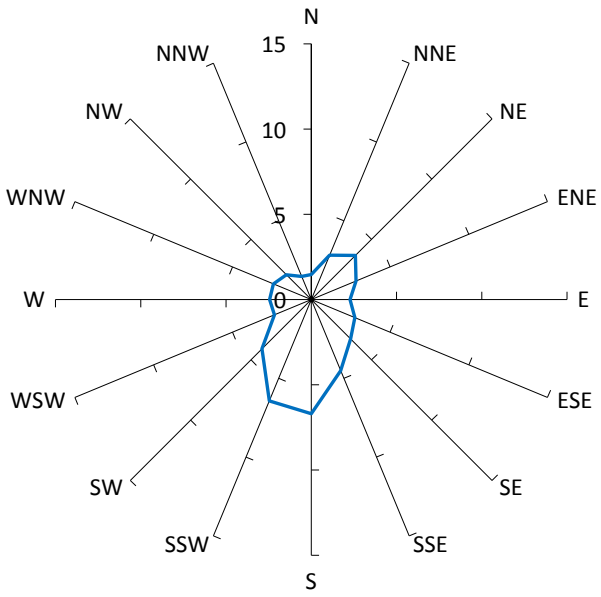
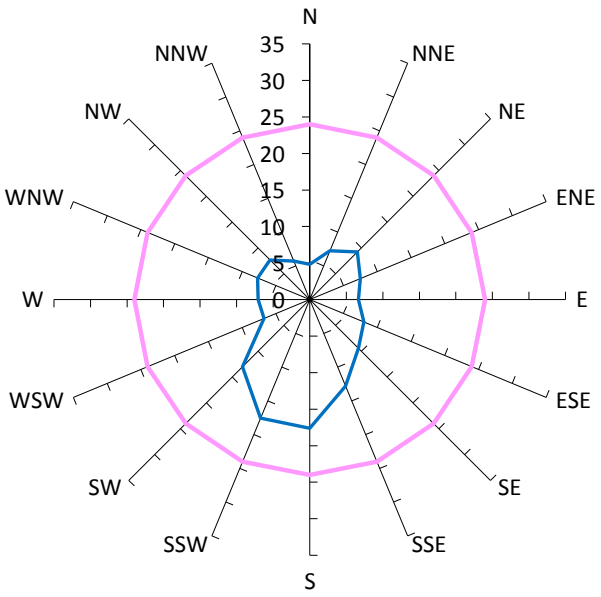
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standard for Walking (8m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	16%	23

Results for Point 39

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	26%	27
With development "as proposed", existing trees along Bridge Road included.	21%	26

Results for Point 40

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	5%	18

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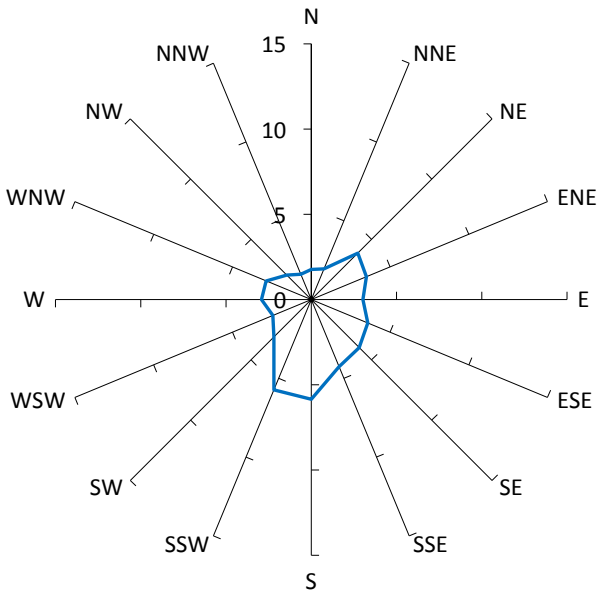
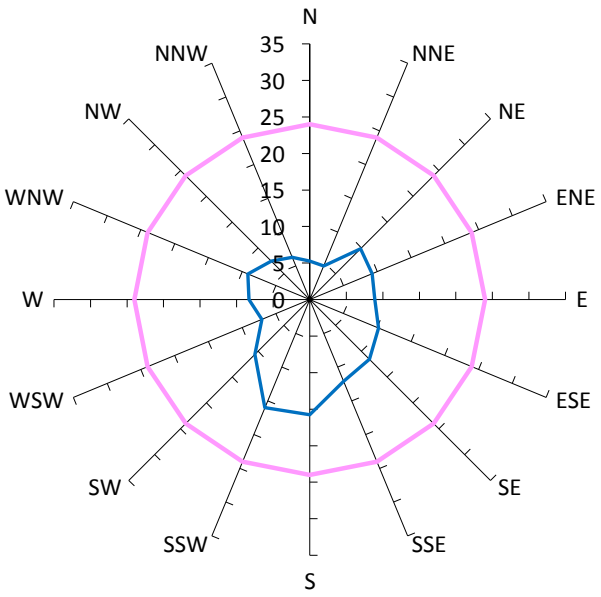
Results for Point 41

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	2%	16

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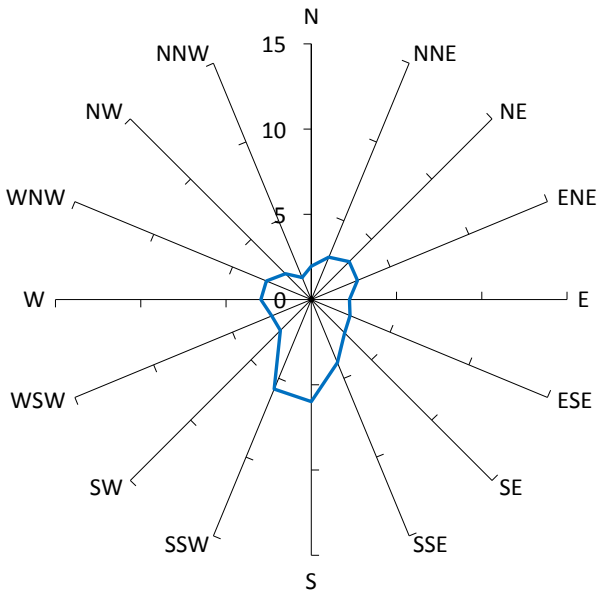
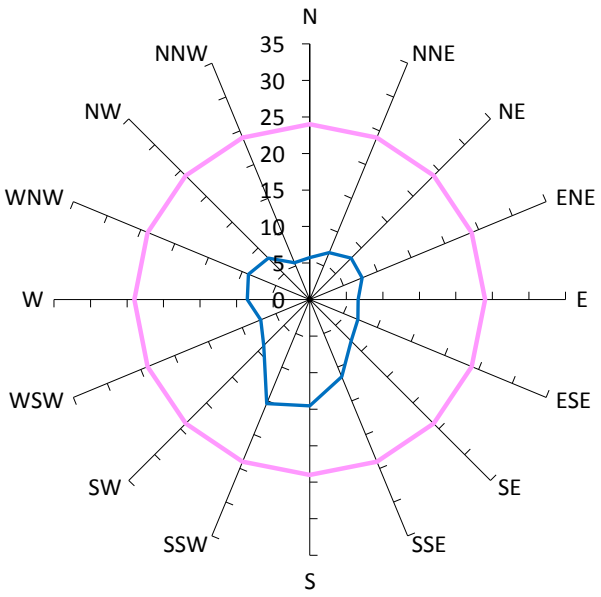
Results for Point 42

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	2%	15

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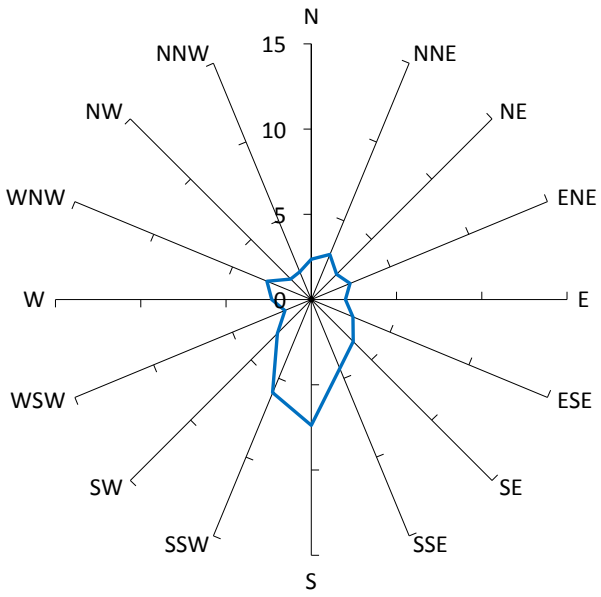
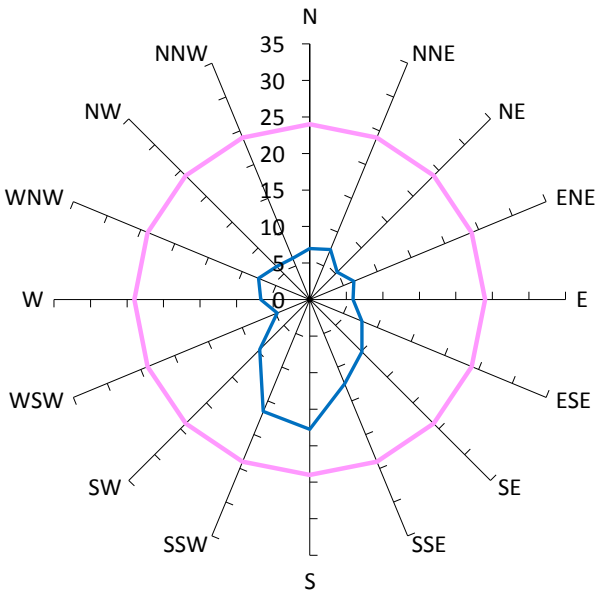
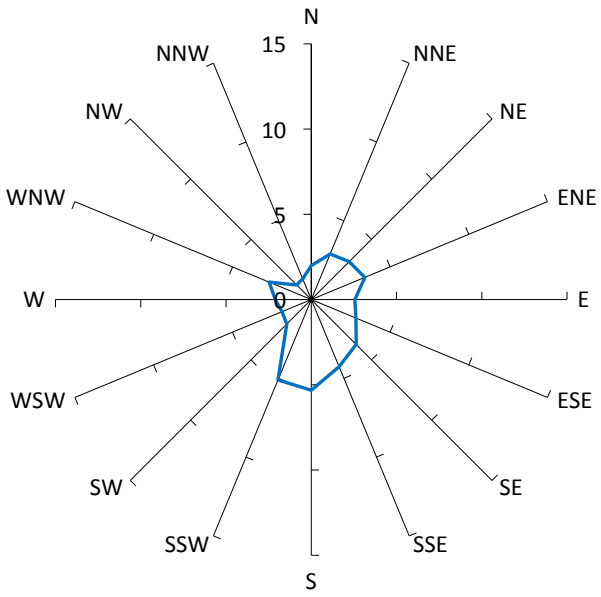
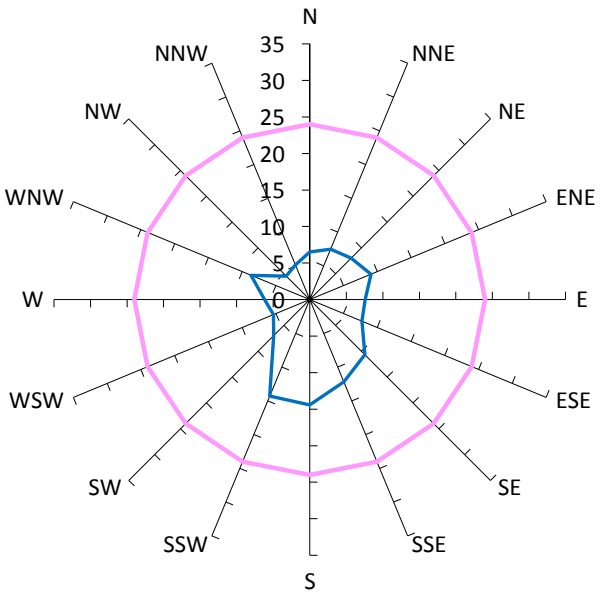
Results for Point 43

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

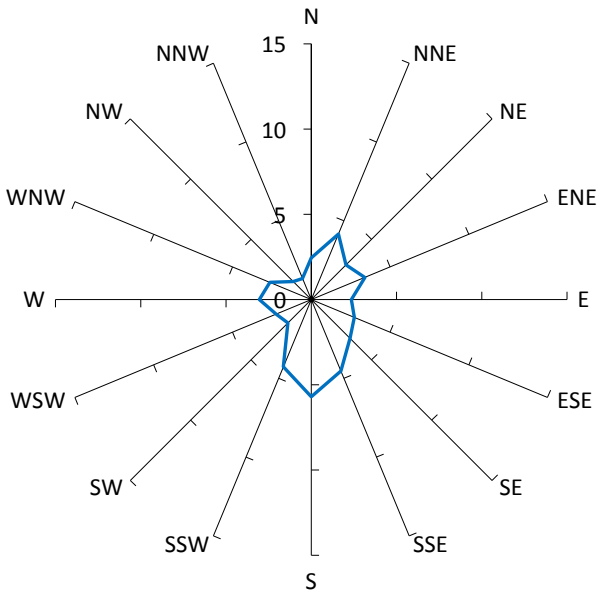
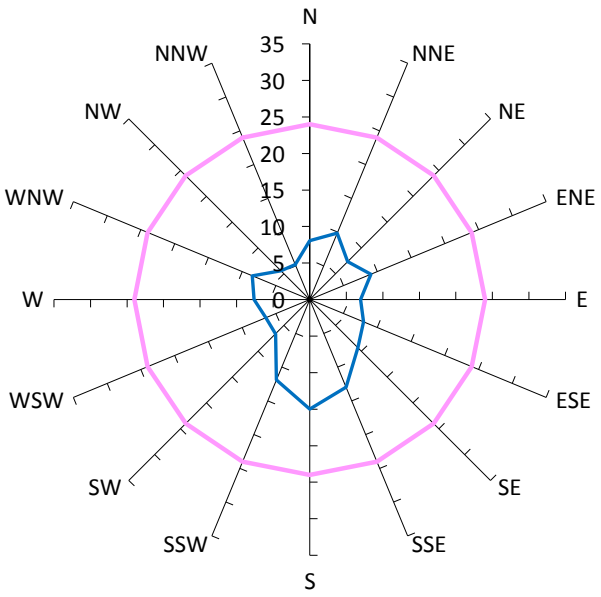
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	5%	18

Results for Point 44

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	1%	14

Results for Point 45

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	1%	15

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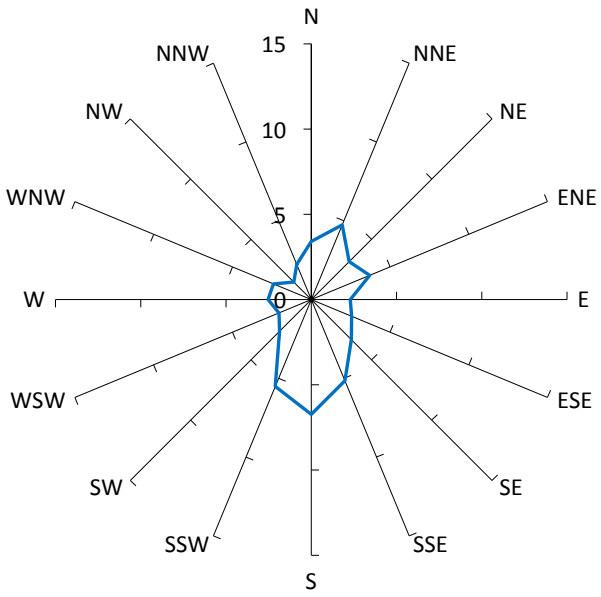
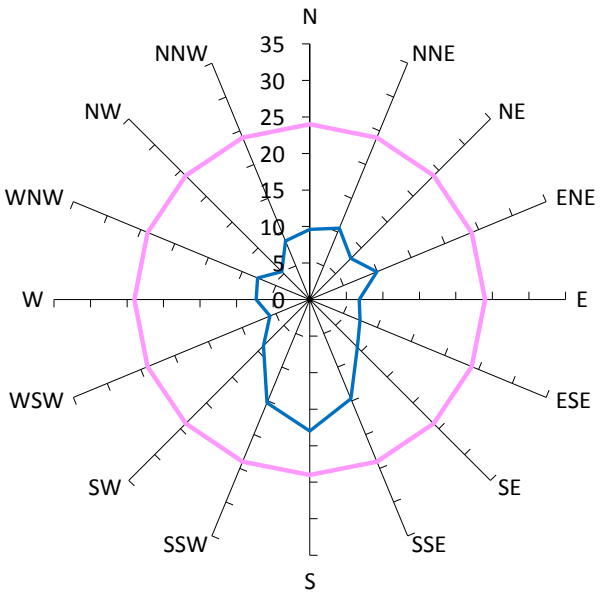
Results for Point 46

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	4%	18

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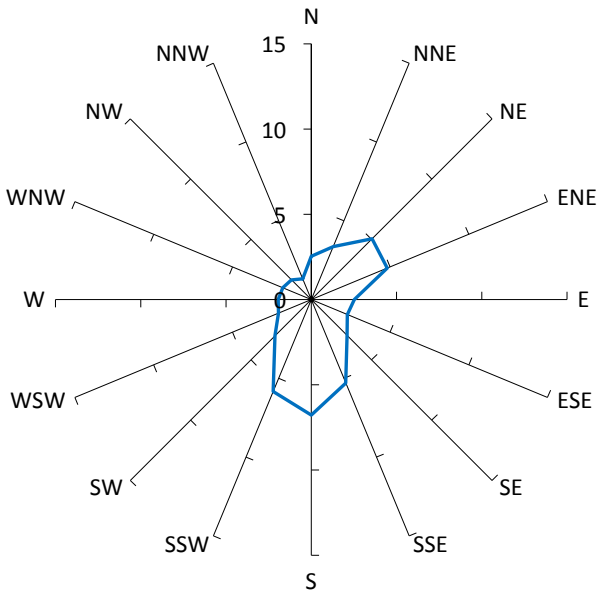
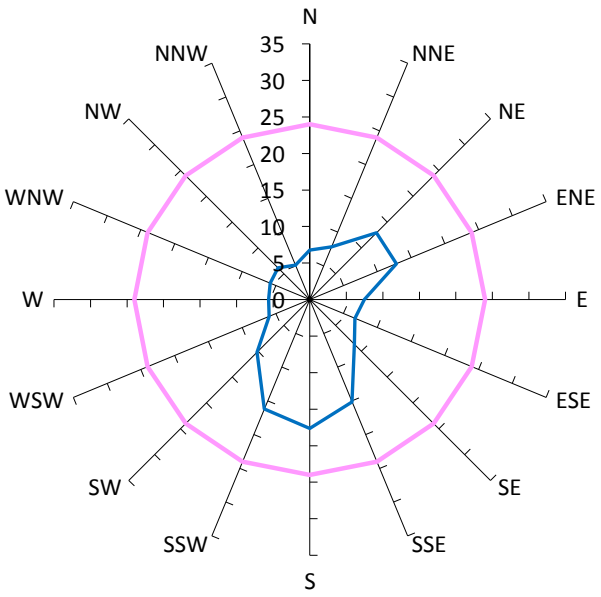
Results for Point 47

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	5%	18

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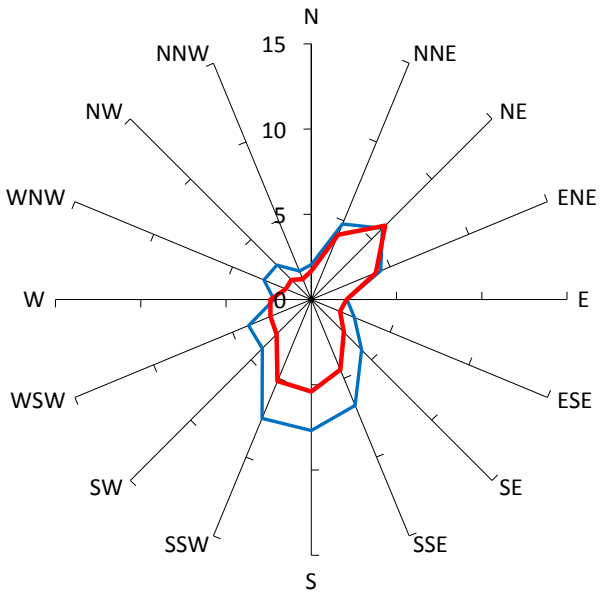
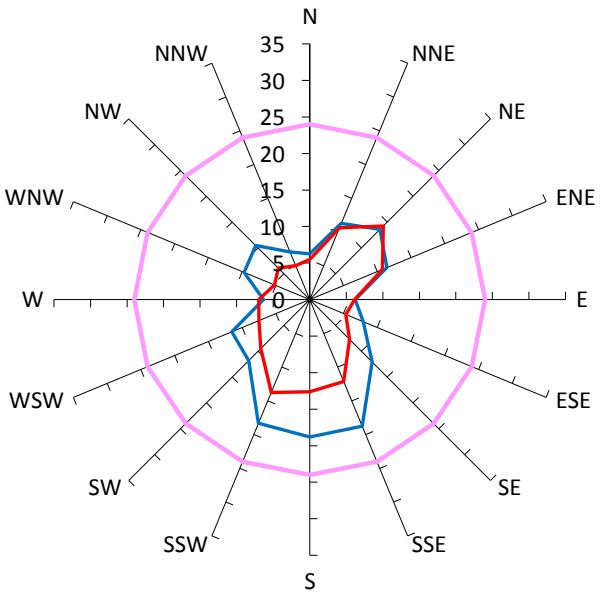
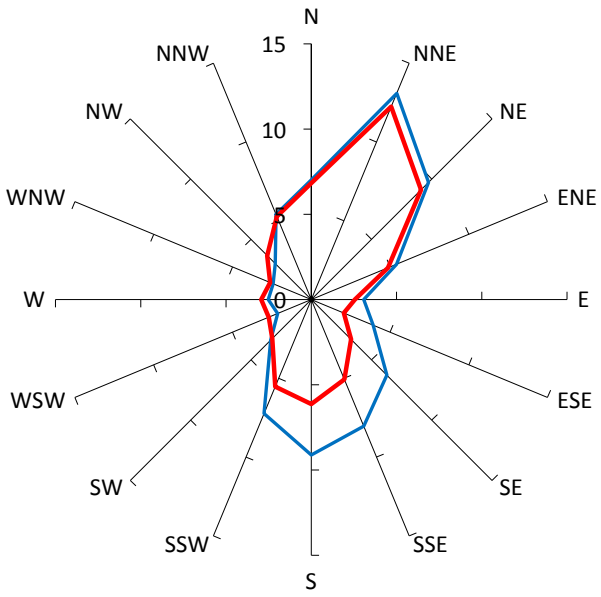
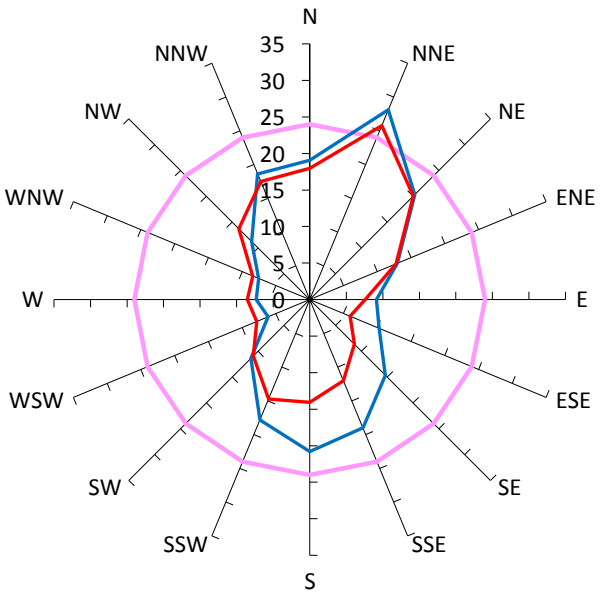
Results for Point 48

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

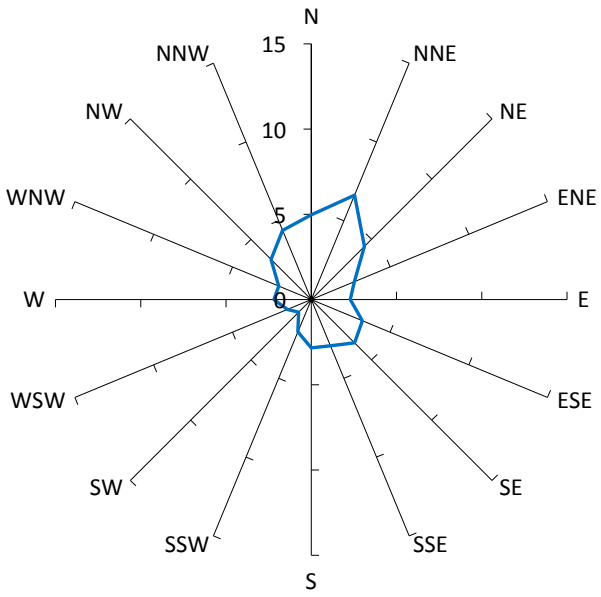
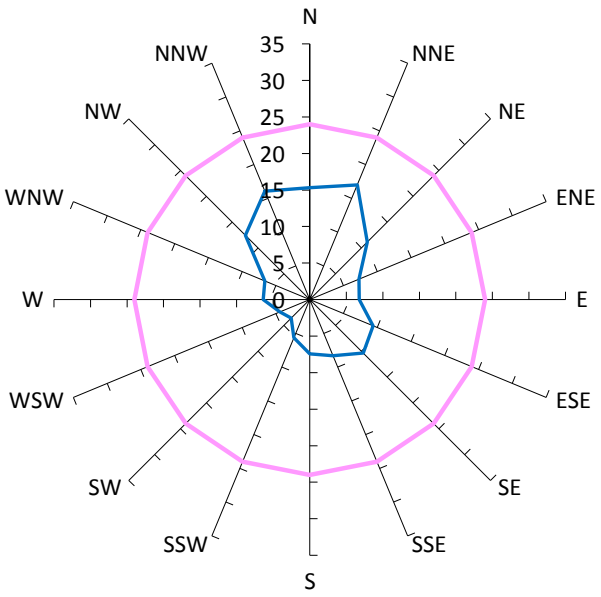
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	39%	19
With development "as proposed", existing trees along Bridge Road included.	24%	14

Results for Point 49

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	56%	28
With development "as proposed", existing trees along Bridge Road included.	48%	26

Results for Point 50

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	17

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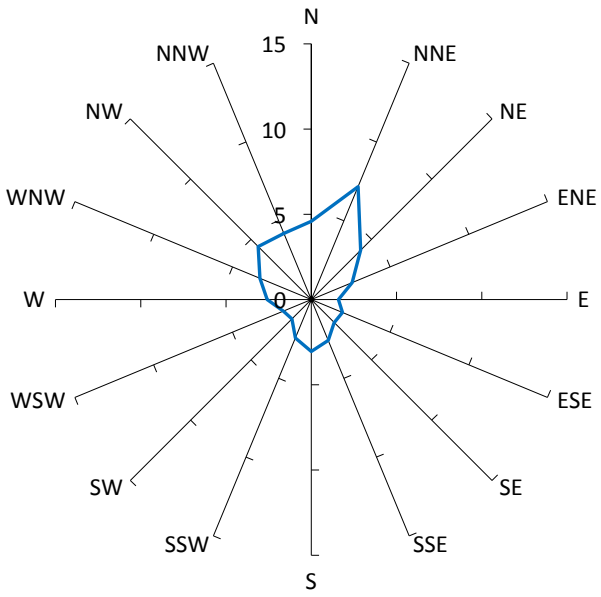
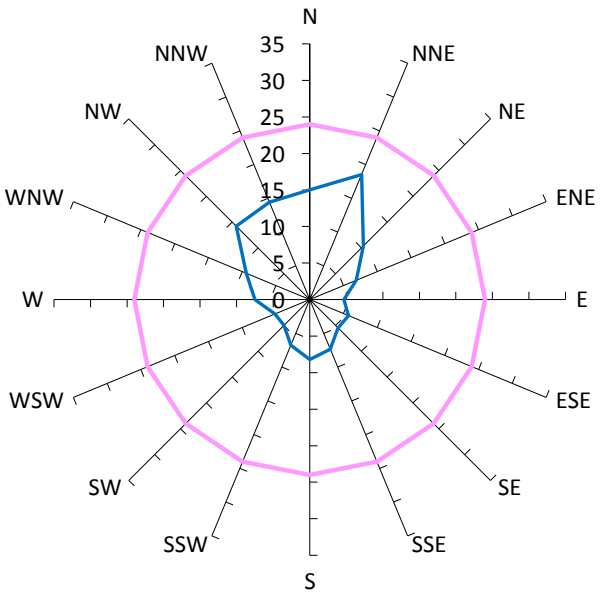
Results for Point 51

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	14%	19

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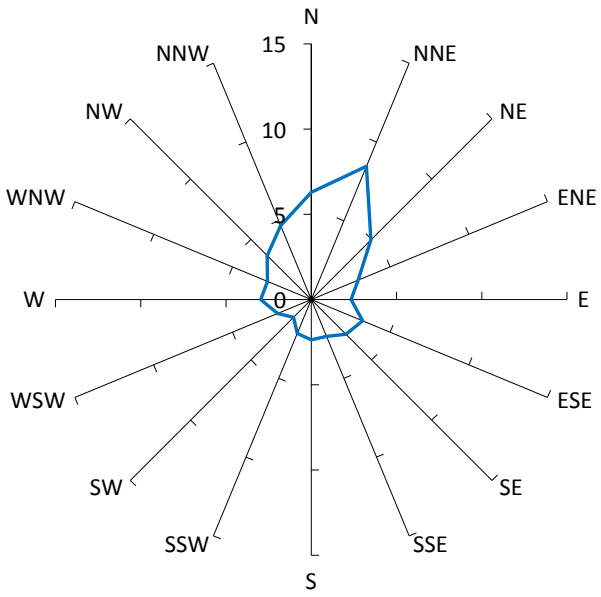
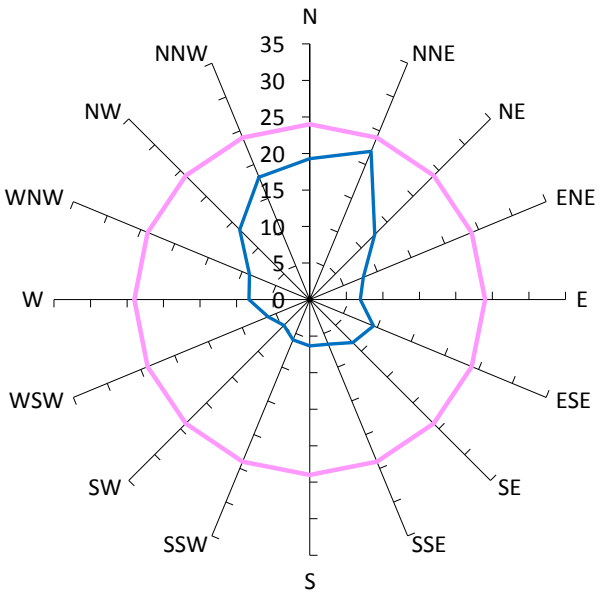
Results for Point 52

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	8%	22

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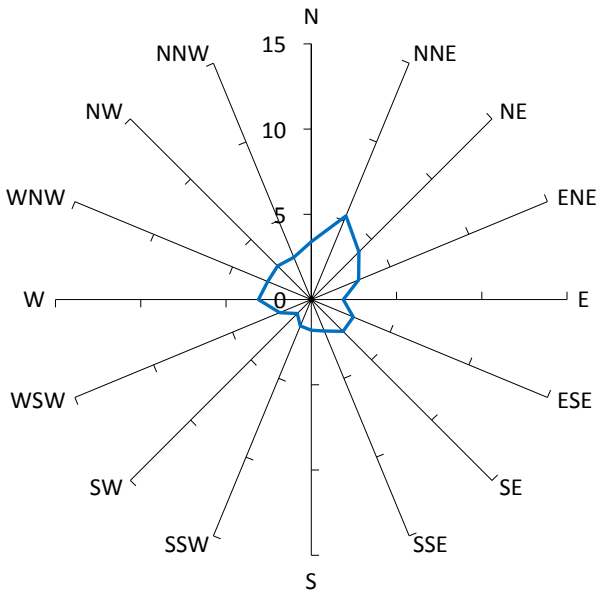
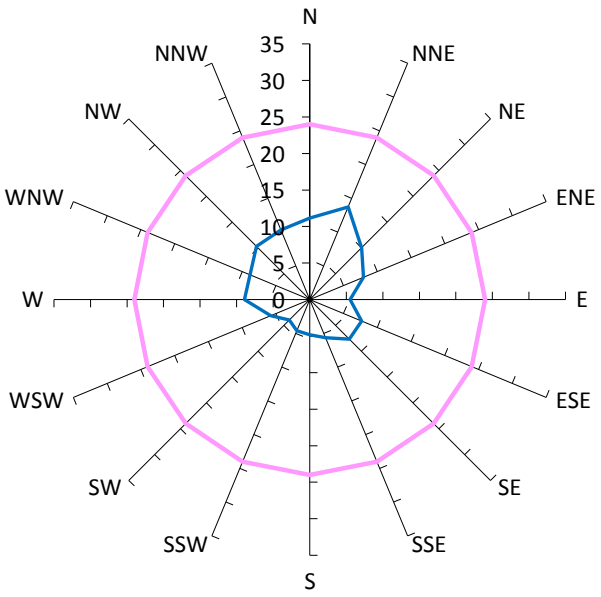
Results for Point 53

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	8%	14

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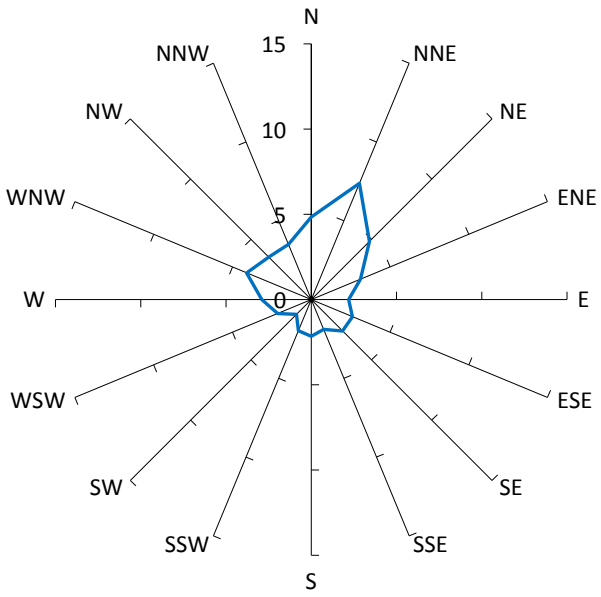
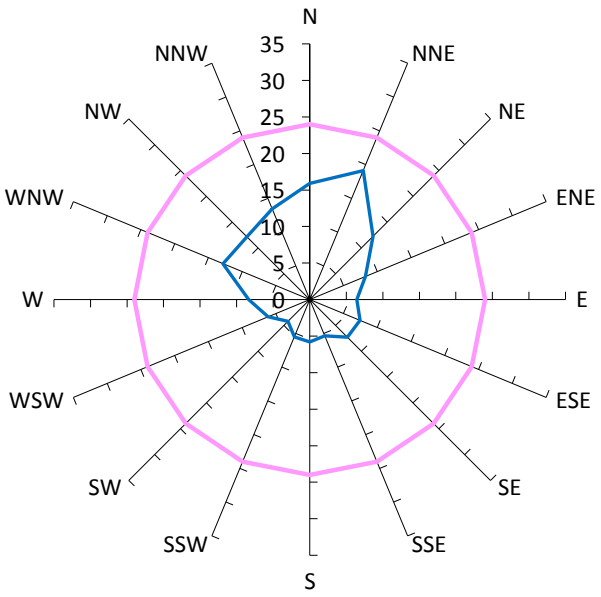
Results for Point 54

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	5%	19

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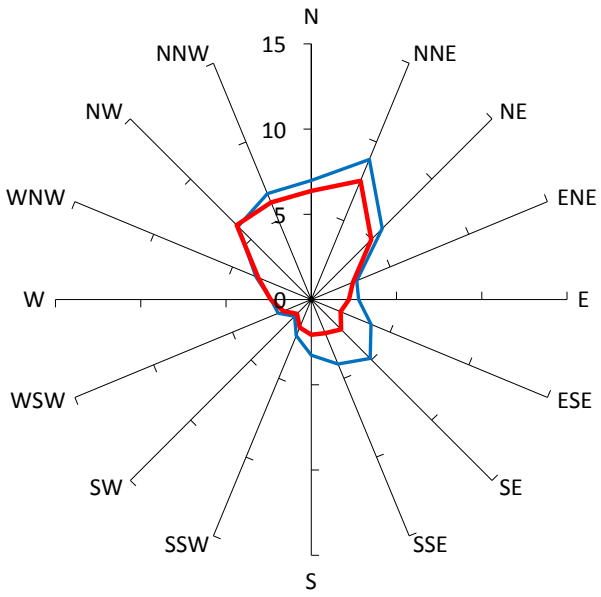
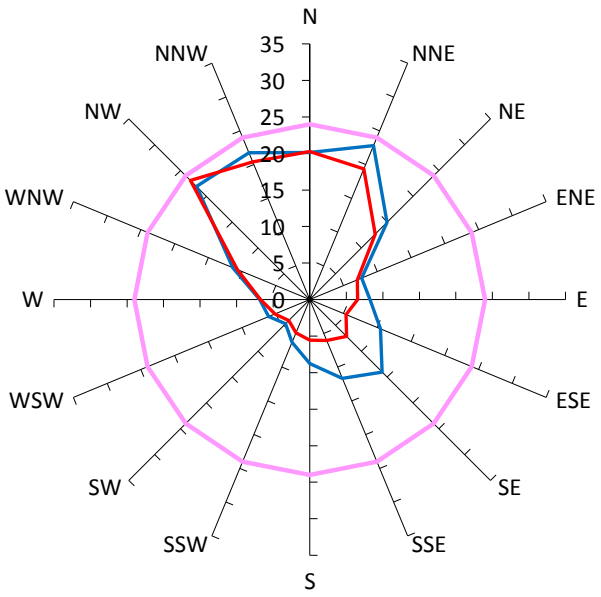
Results for Point 55

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	13%	23
With development "as proposed", existing trees along Bridge Road included.	10%	23

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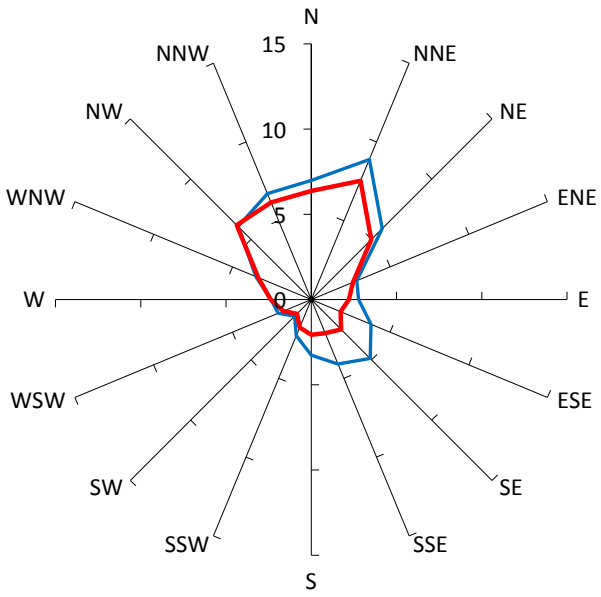
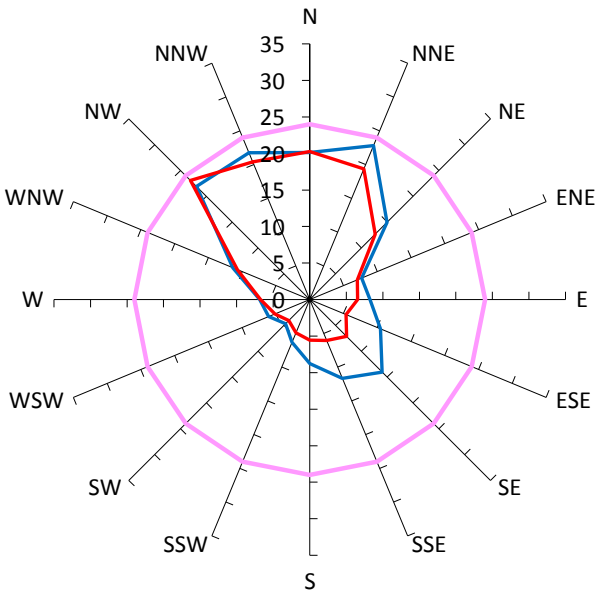
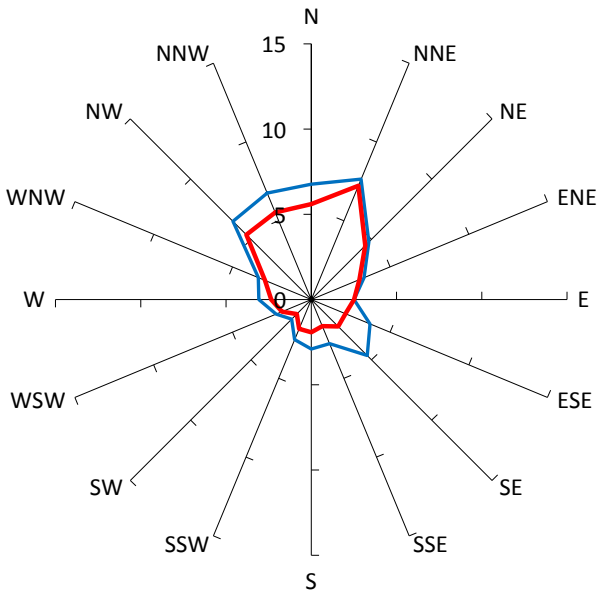
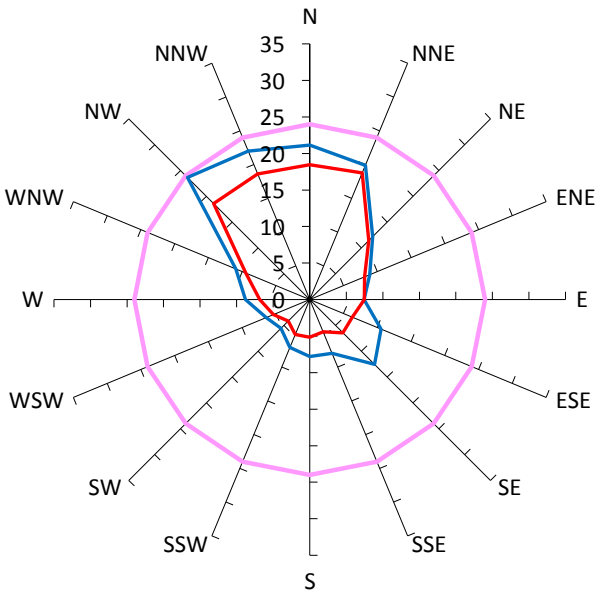
Results for Point 55a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

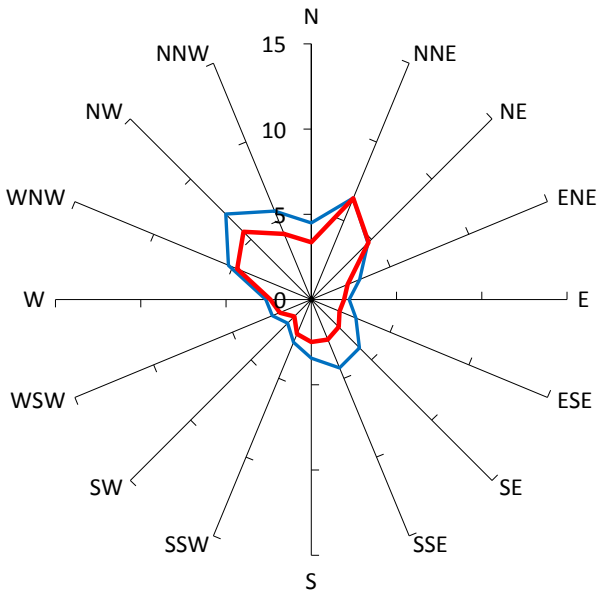
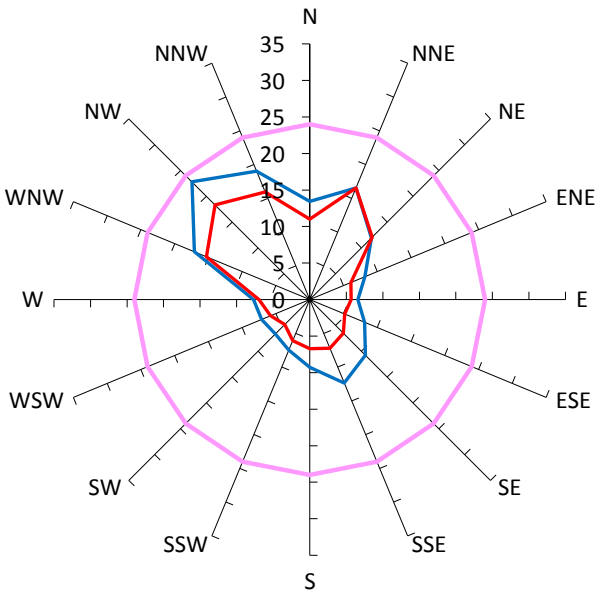
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	32%	23
With development "as proposed", existing trees along Bridge Road included.	24%	23

Results for Point 56

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

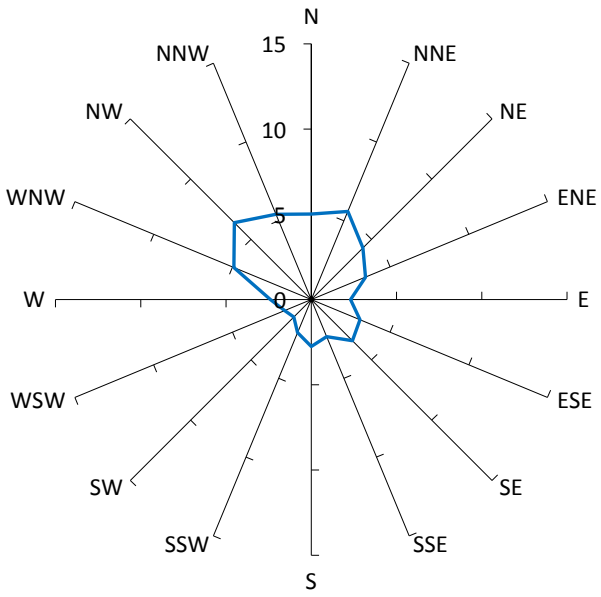
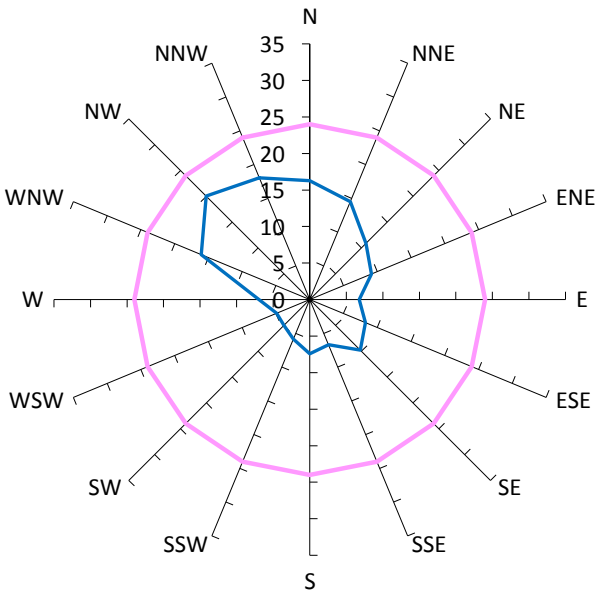
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	12%	24
With development "as proposed", existing trees along Bridge Road included.	7%	19

Results for Point 57

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	7%	23
With development "as proposed", existing trees along Bridge Road included.	4%	18

Results for Point 58

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	5%	20

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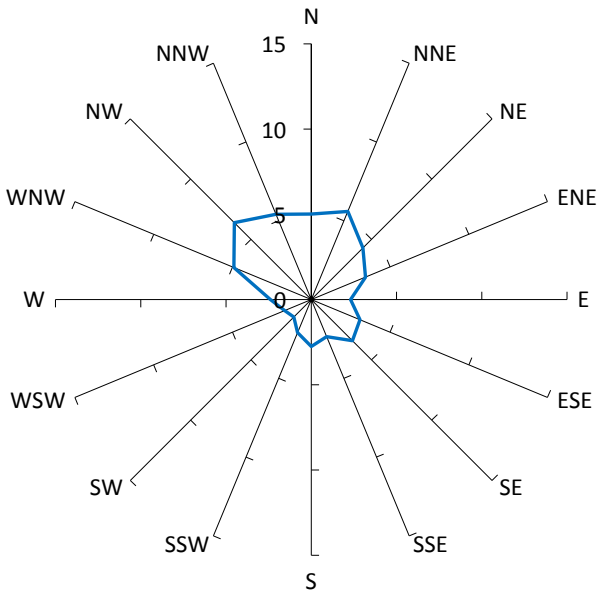
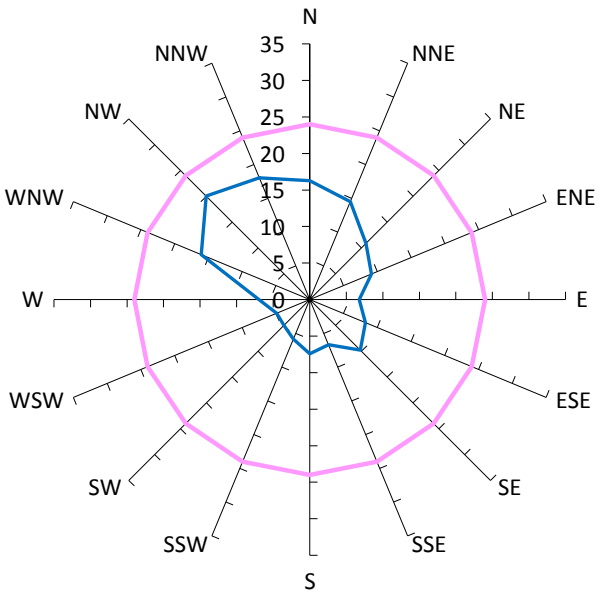
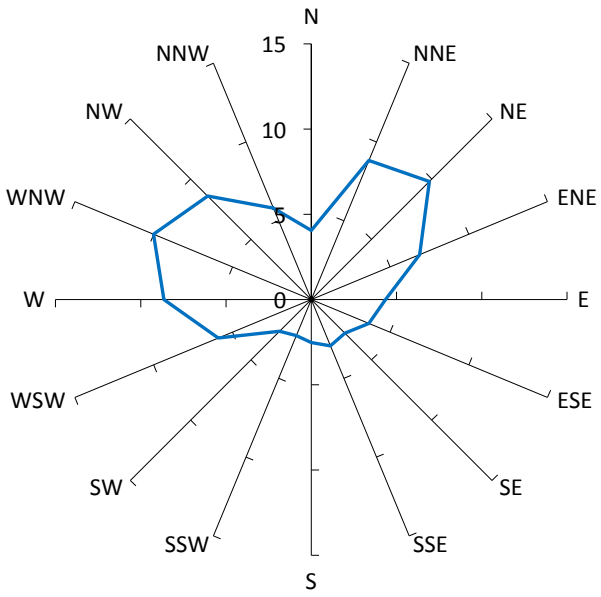
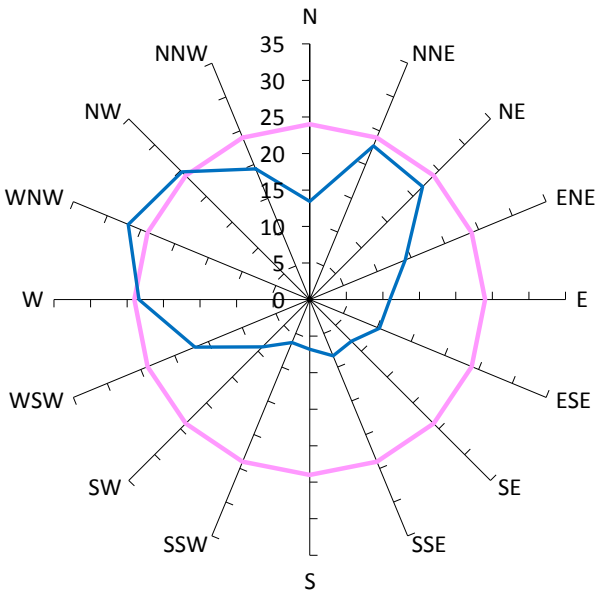
Results for Point 58a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	21%	20

Results for Point 59

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	50%	27

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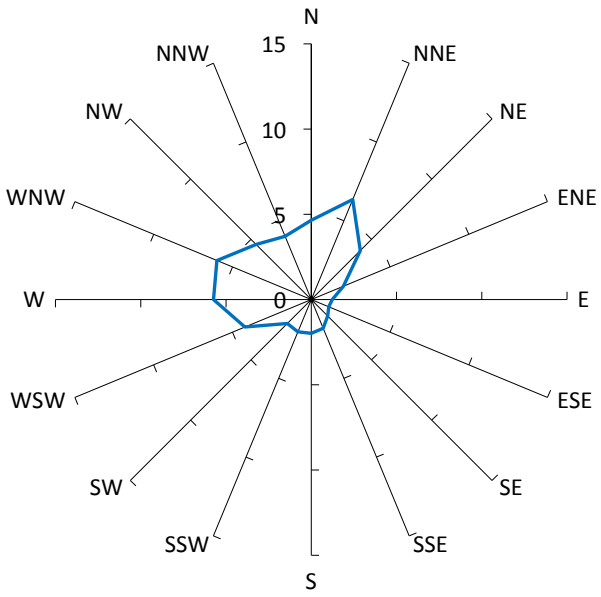
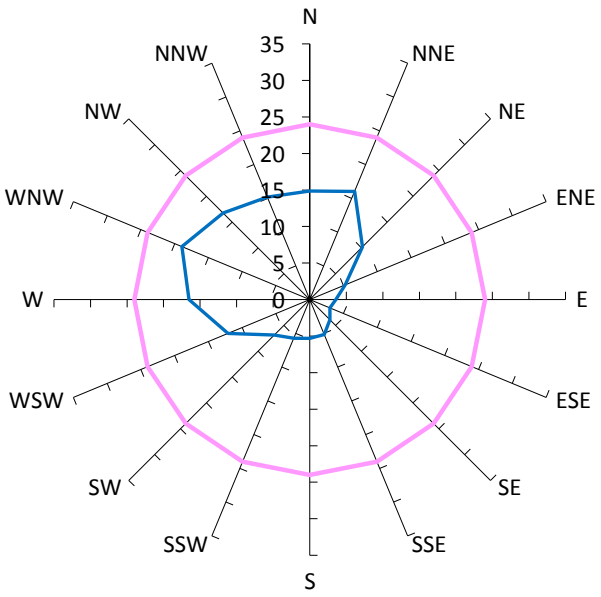
Results for Point 60

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	23%	19

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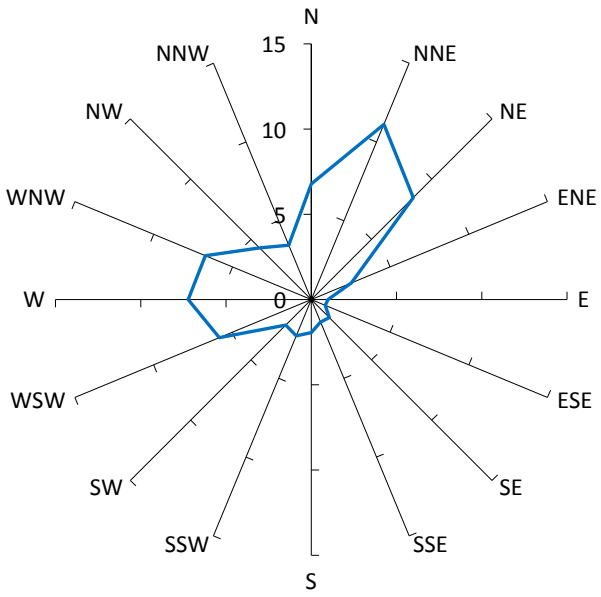
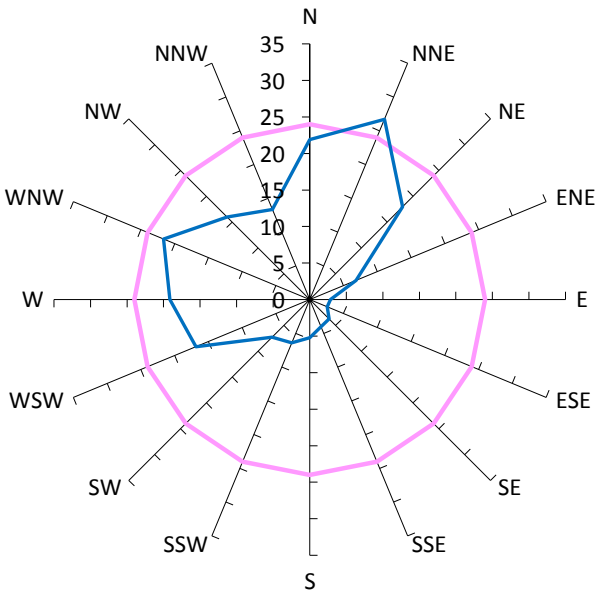
Results for Point 61

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	35%	27

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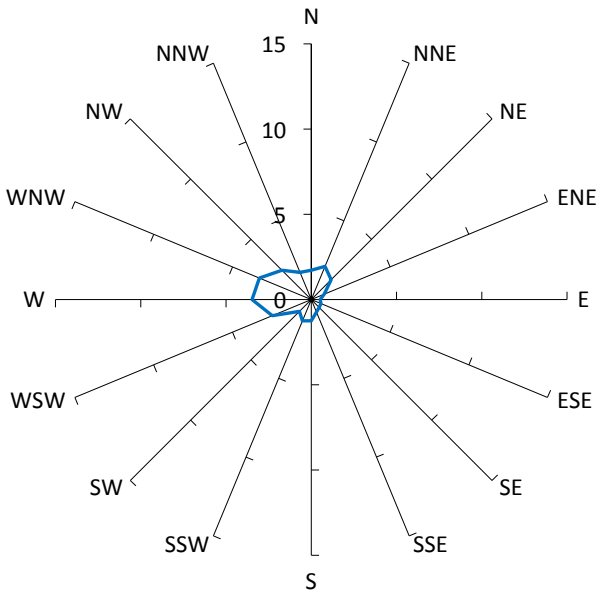
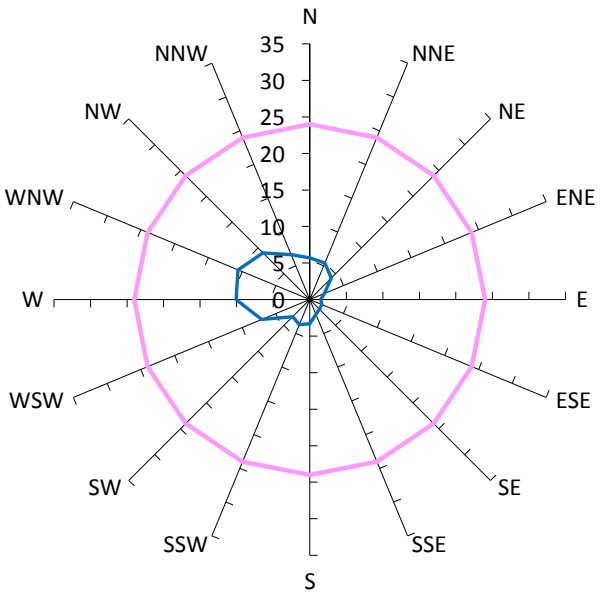
Results for Point 62

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	0%	11

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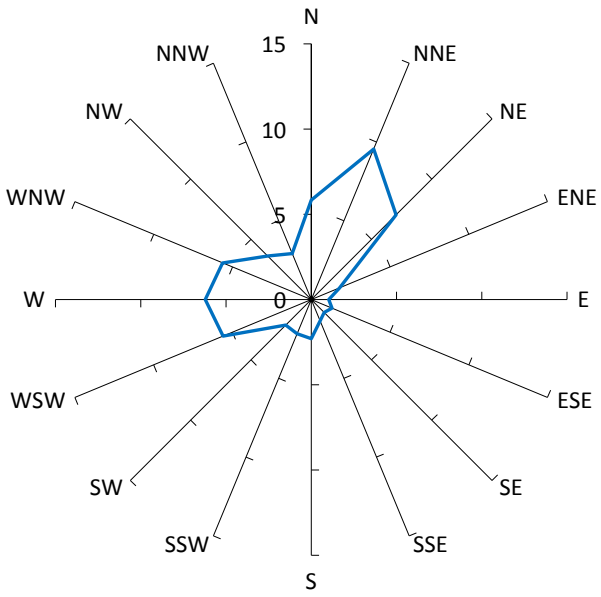
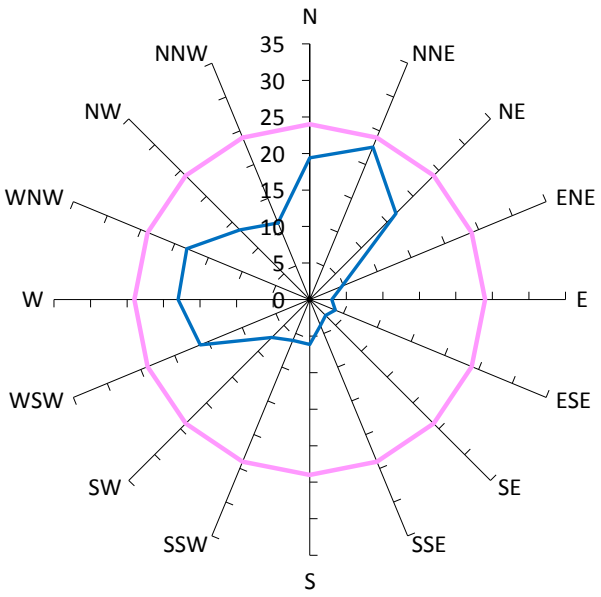
Results for Point 63

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	13%	23

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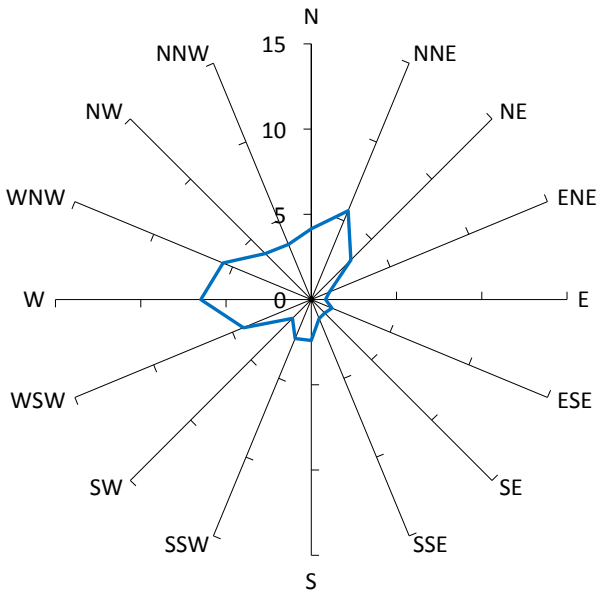
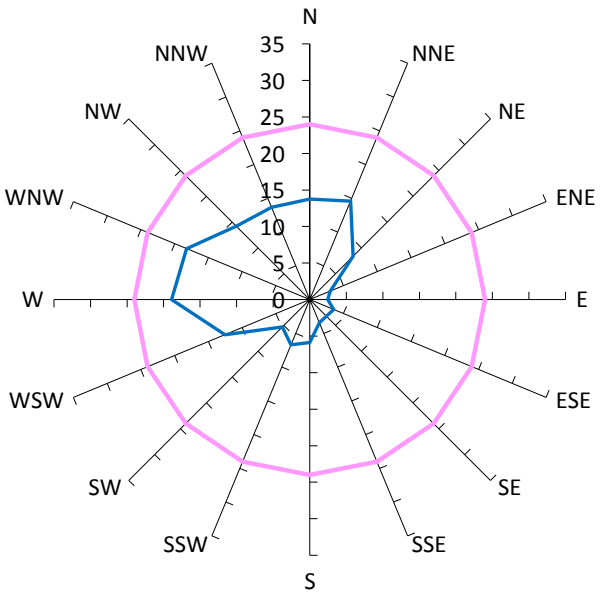
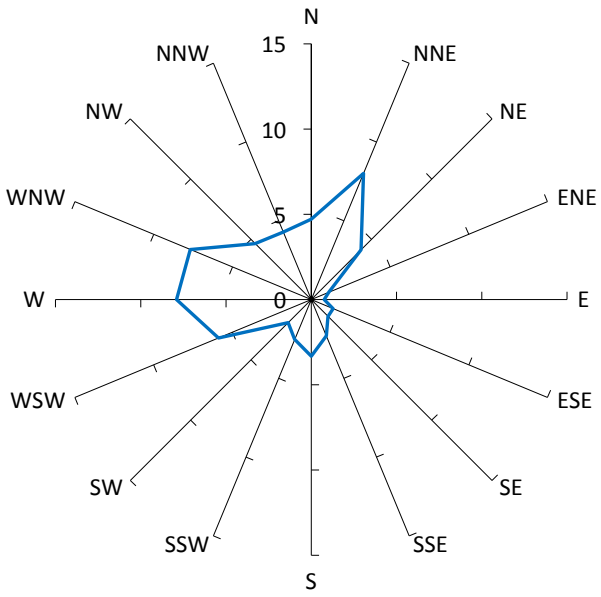
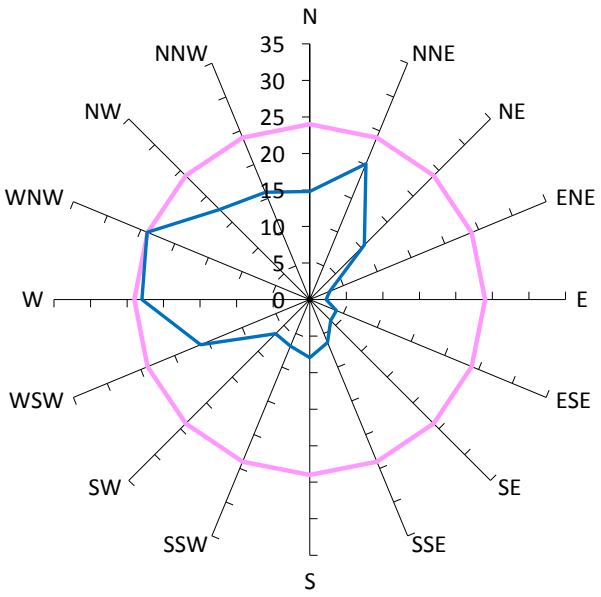
Results for Point 64

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	19%	19

Results for Point 65

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	30%	24

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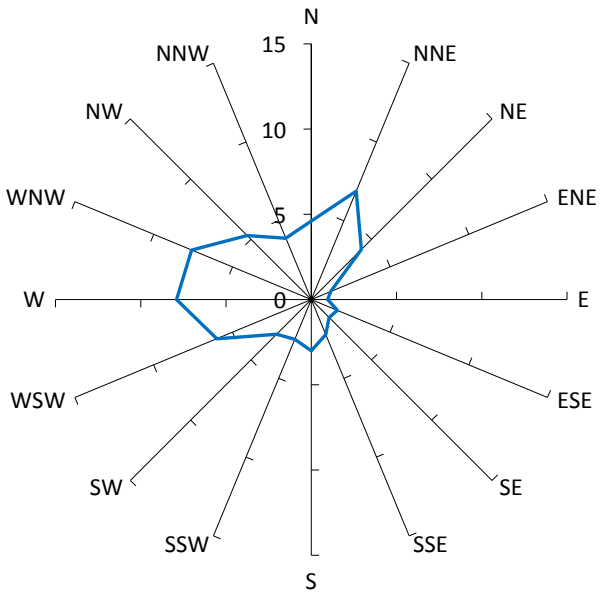
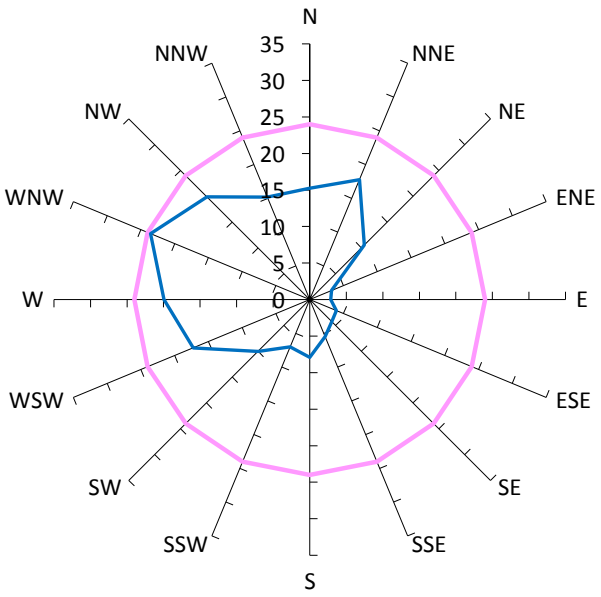
Results for Point 66

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	30%	24

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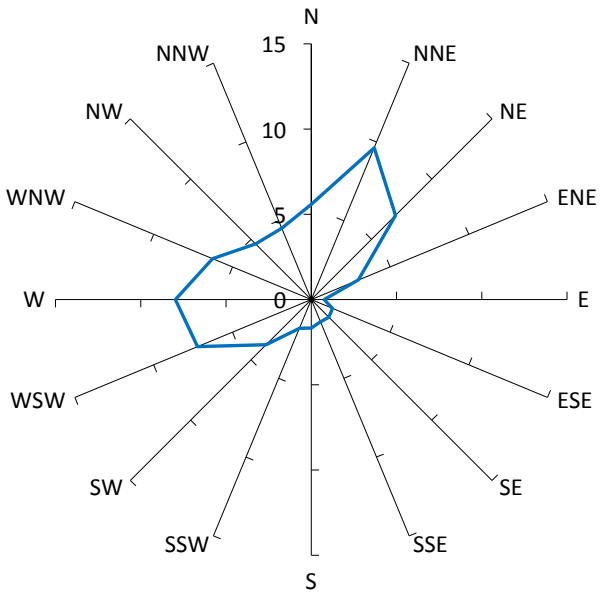
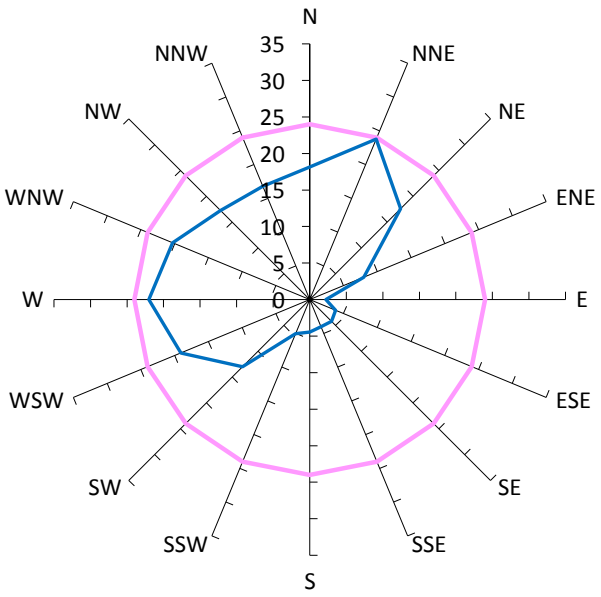
Results for Point 67

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	38%	24

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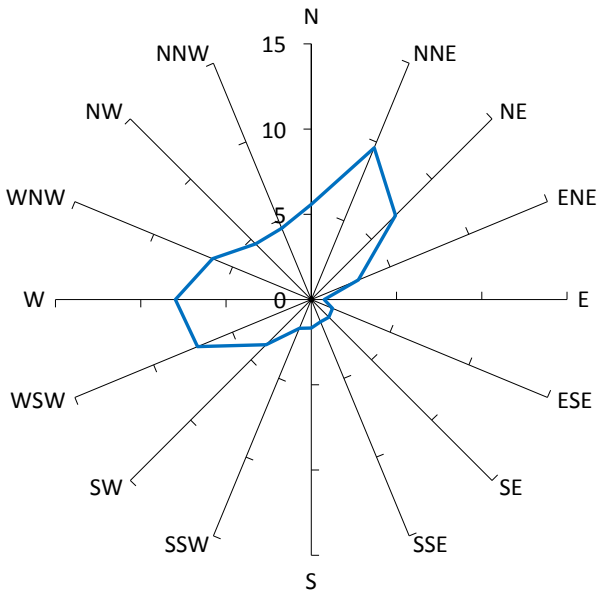
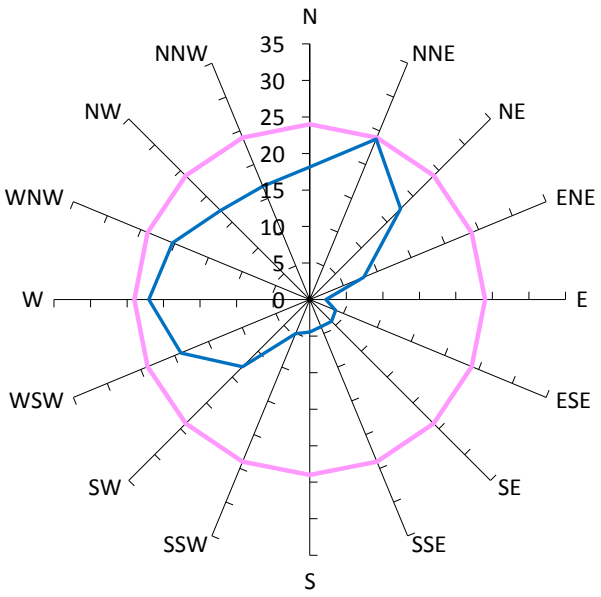
Results for Point 67a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	20%	24

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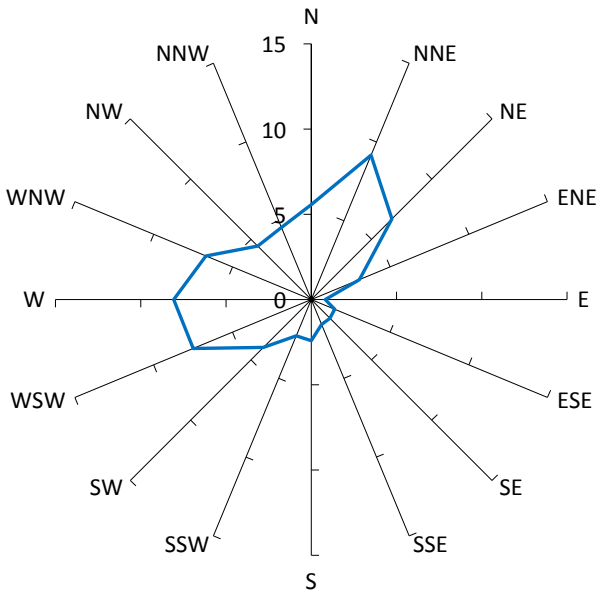
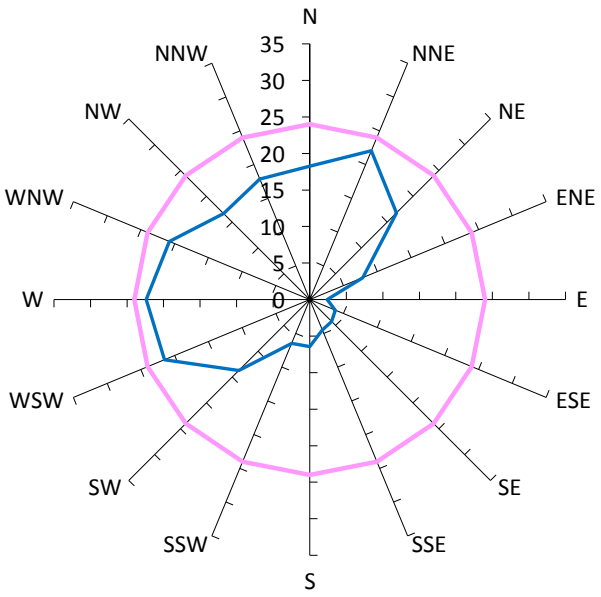
Results for Point 68

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	39%	22

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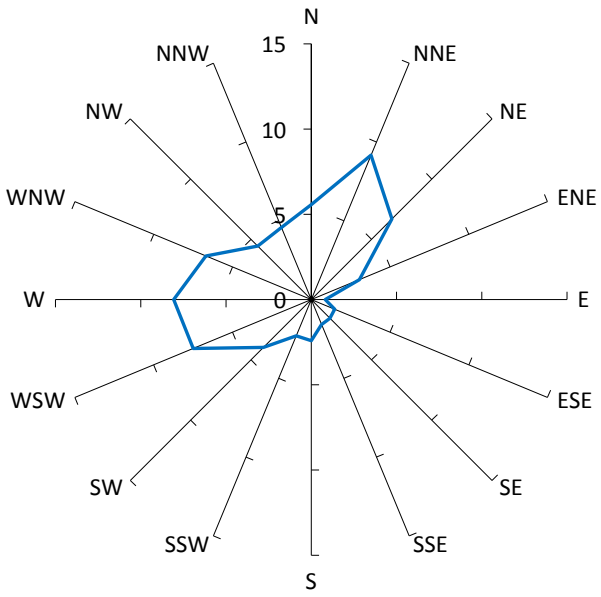
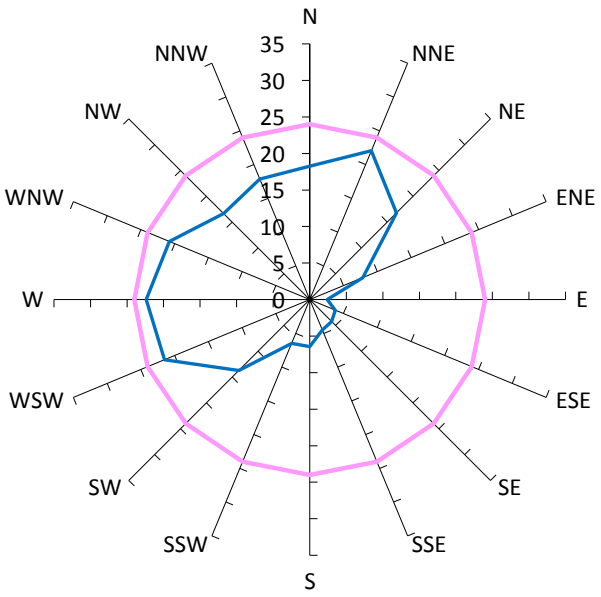
Results for Point 68a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	20%	22

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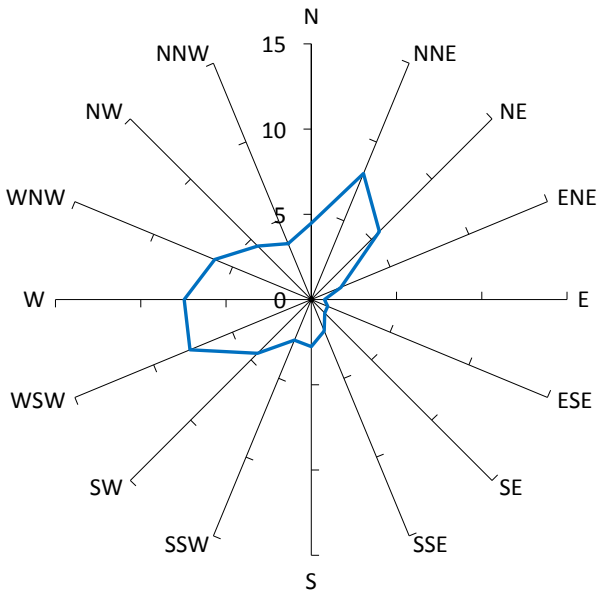
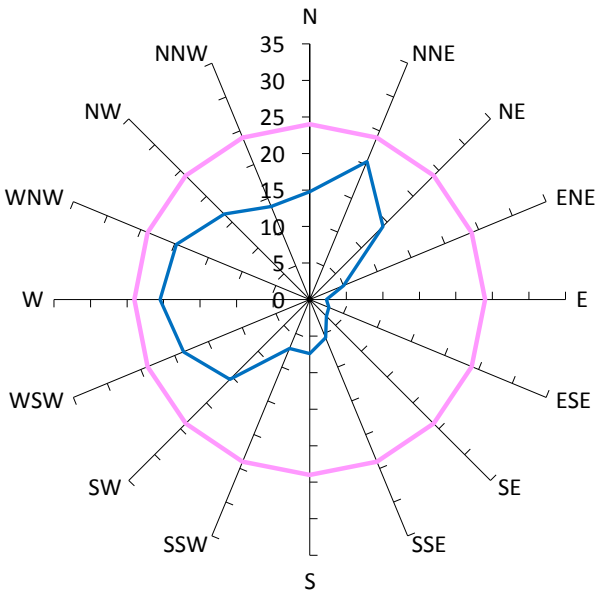
Results for Point 69

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	15%	20

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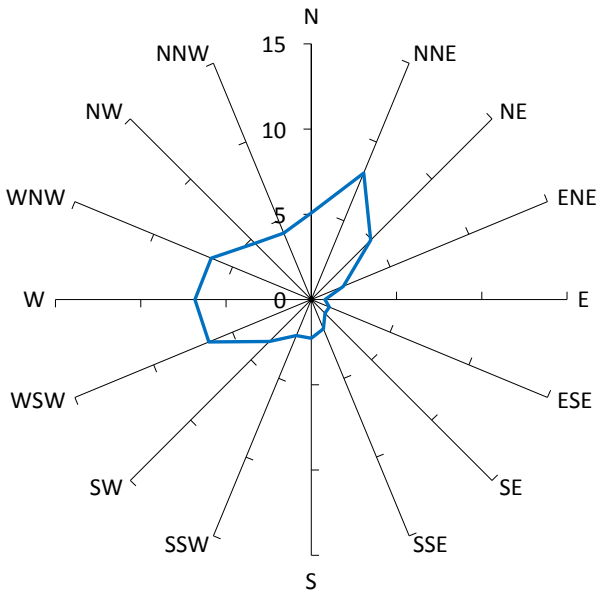
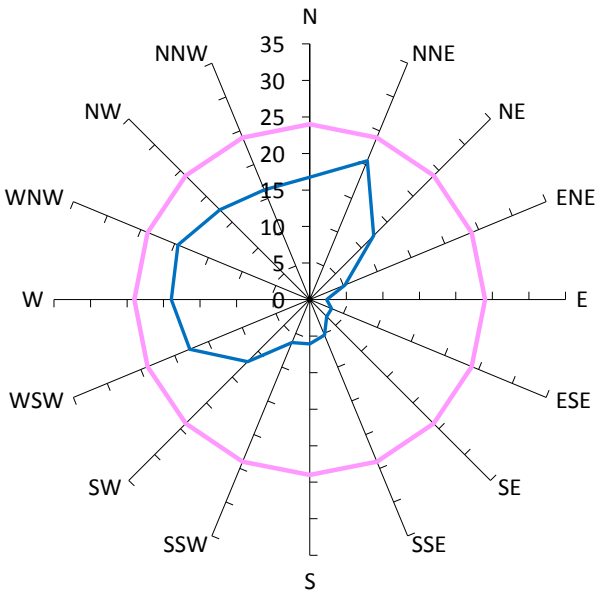
Results for Point 70

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	33%	21

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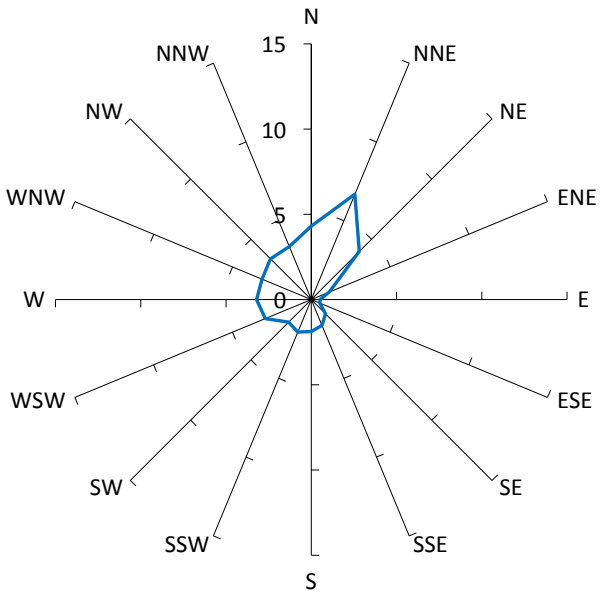
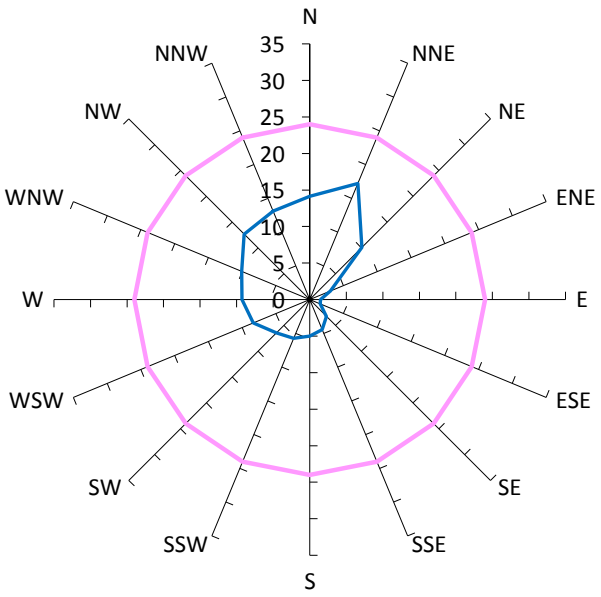
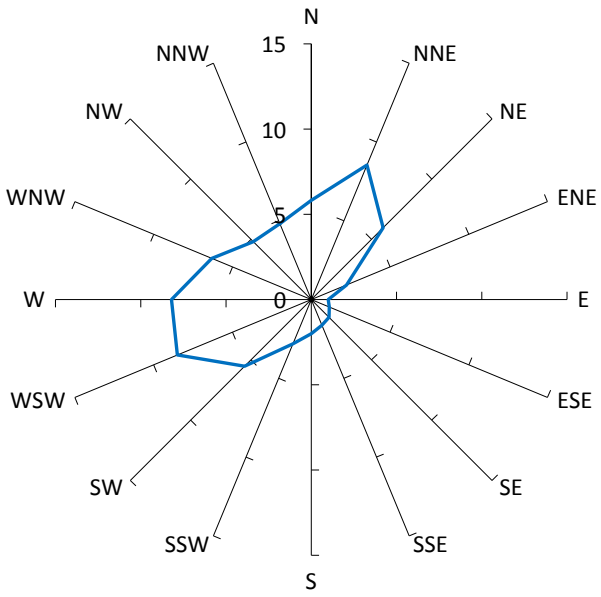
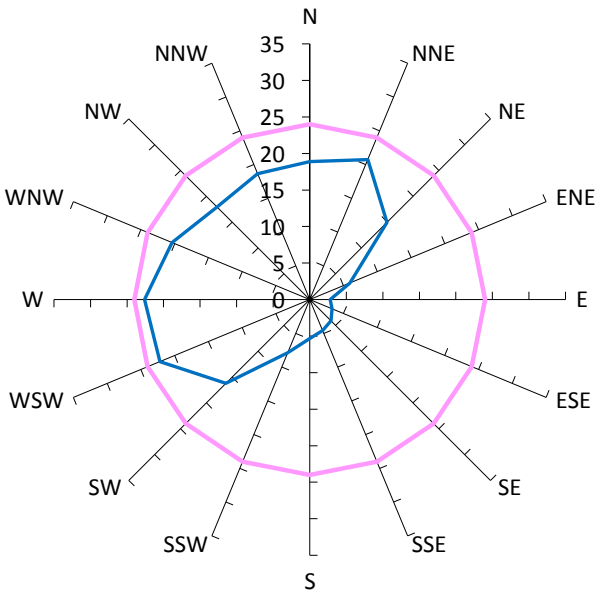
Results for Point 71

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	17

Results for Point 72

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	39%	23

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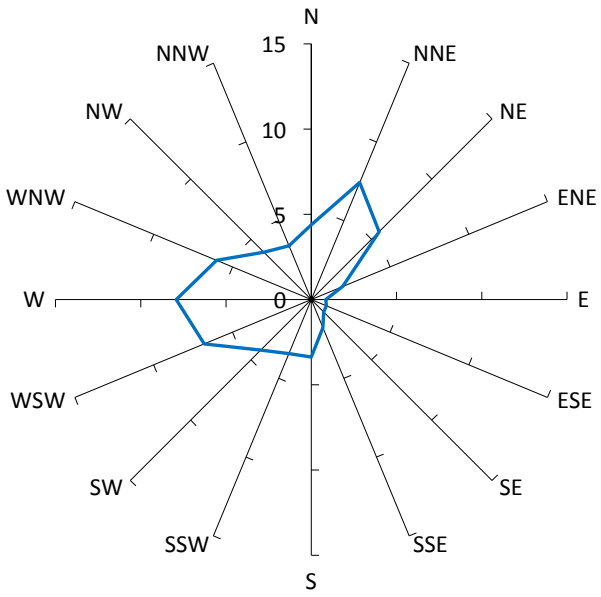
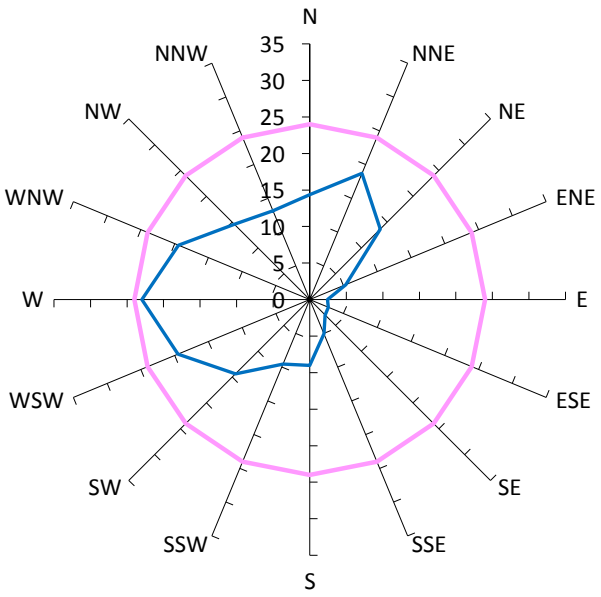
Results for Point 73

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	33%	23

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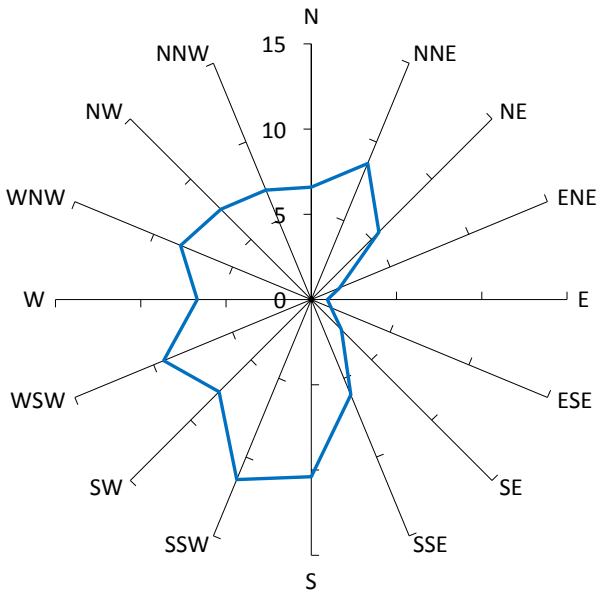
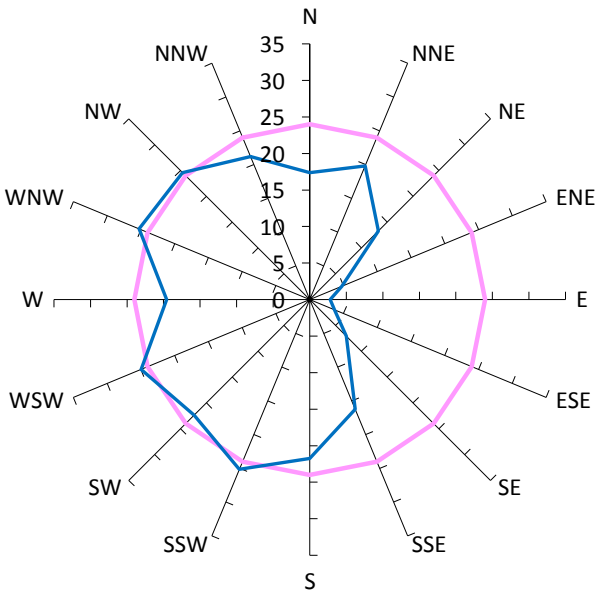
Results for Point 74

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	67%	25

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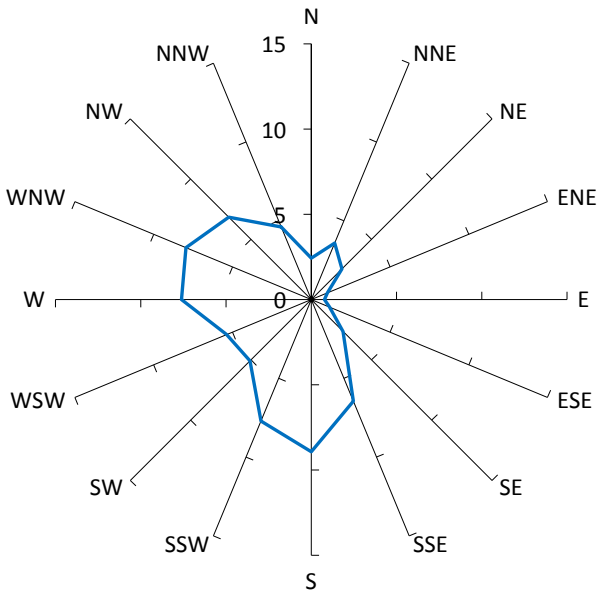
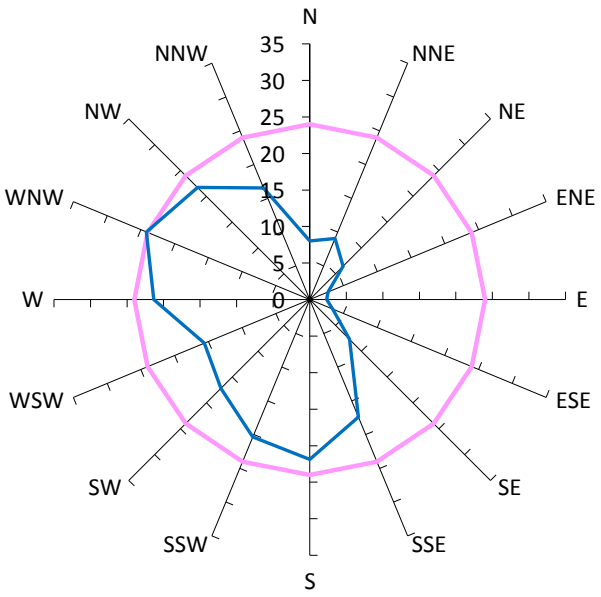
Results for Point 75

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	48%	24

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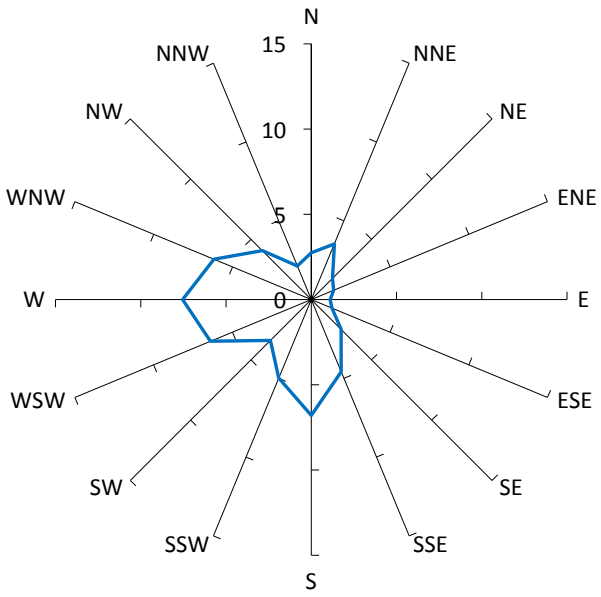
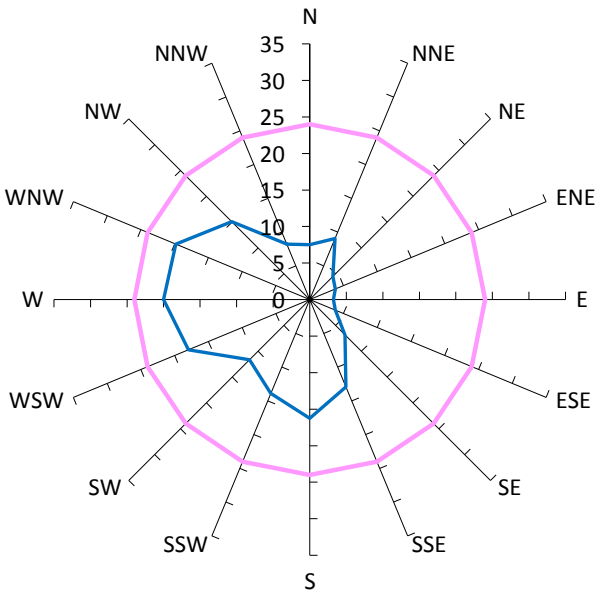
Results for Point 76

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	33%	20

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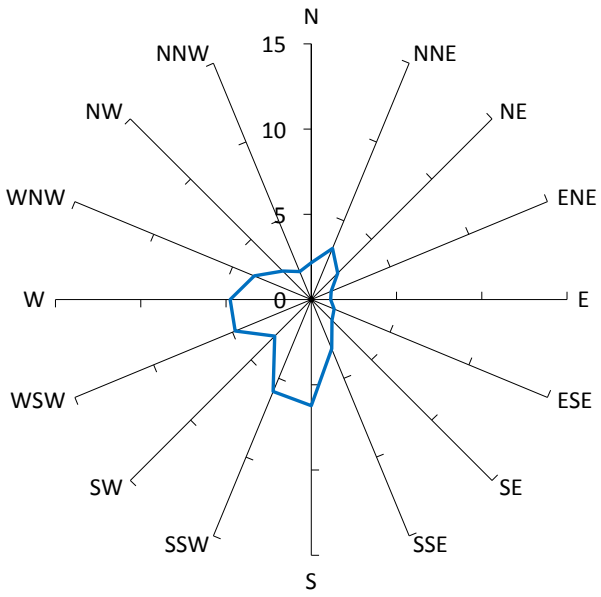
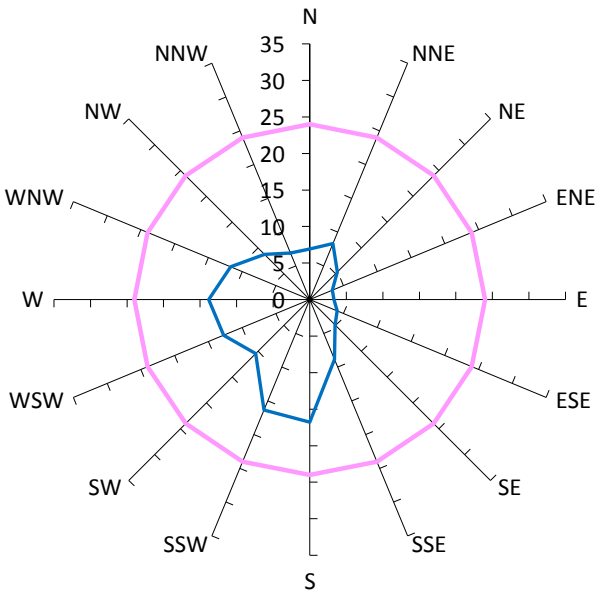
Results for Point 77

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	21%	17

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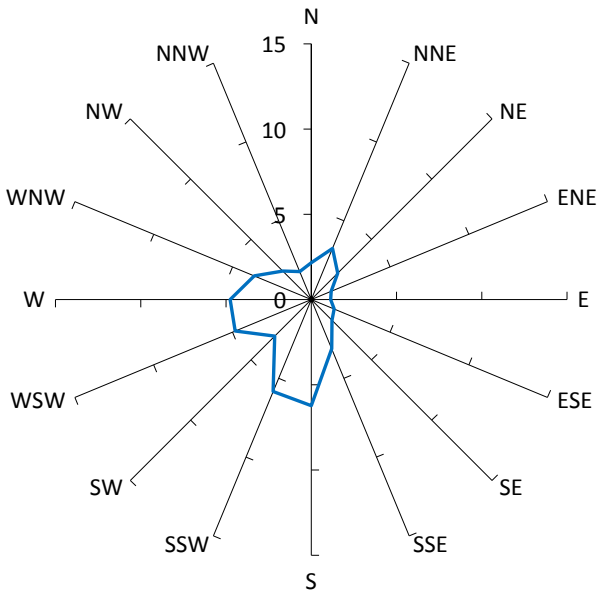
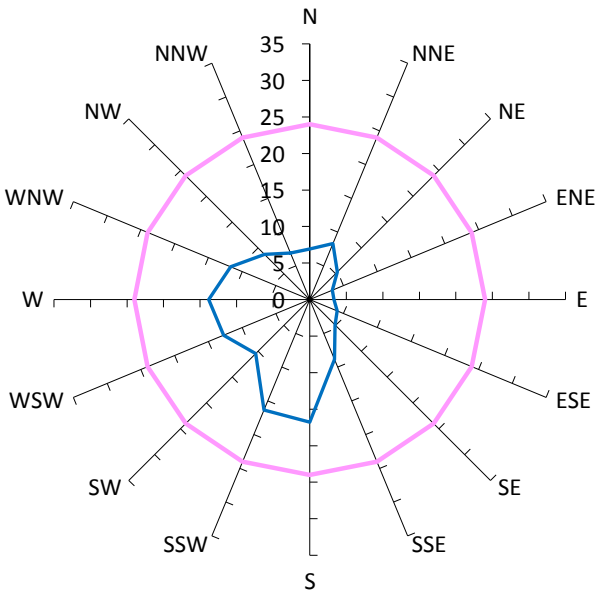
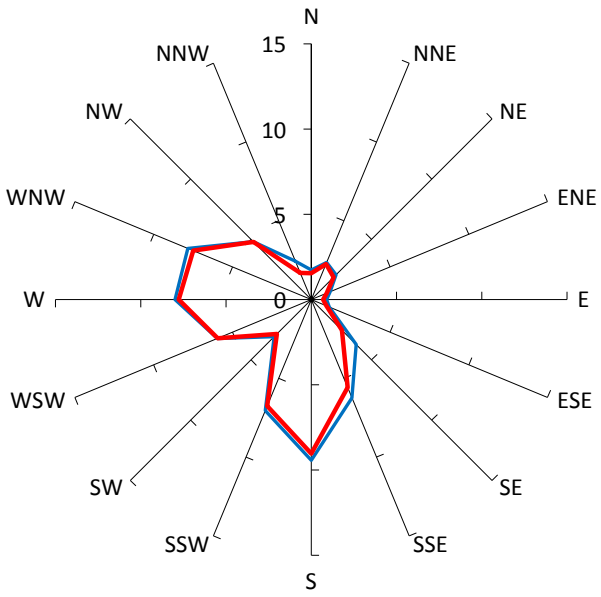
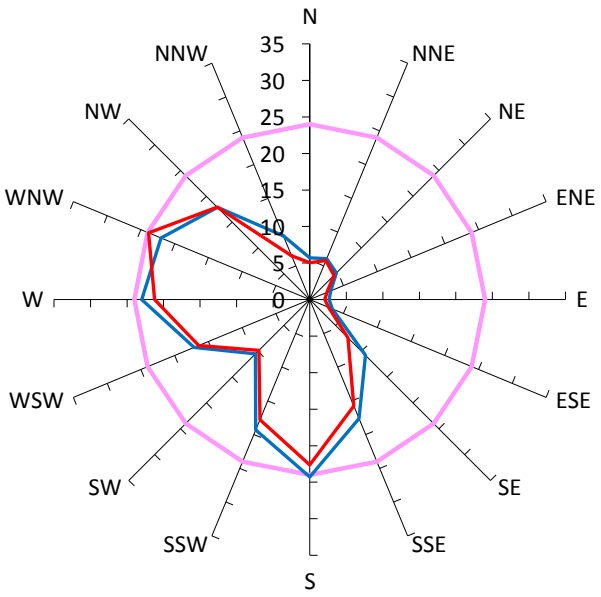
Results for Point 77a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

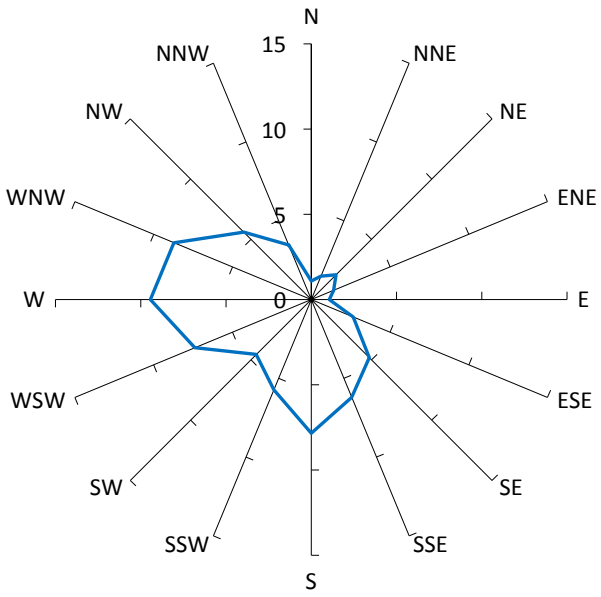
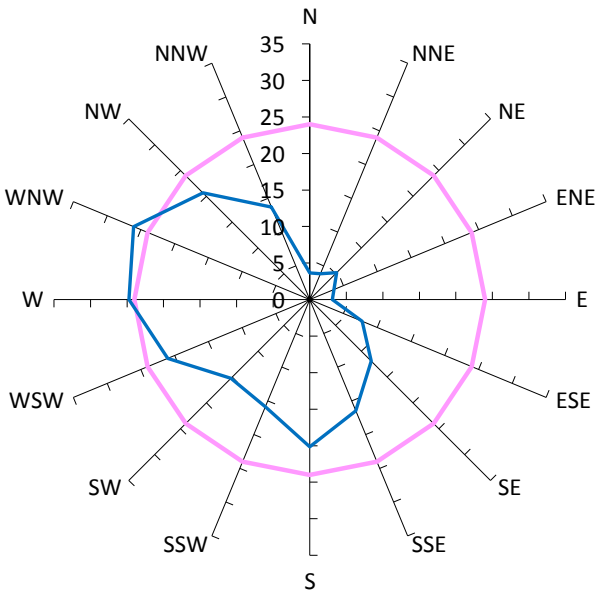
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	17

Results for Point 78

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	22%	24
With development "as proposed", existing trees along Bridge Road included.	20%	24

Results for Point 79

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	46%	26

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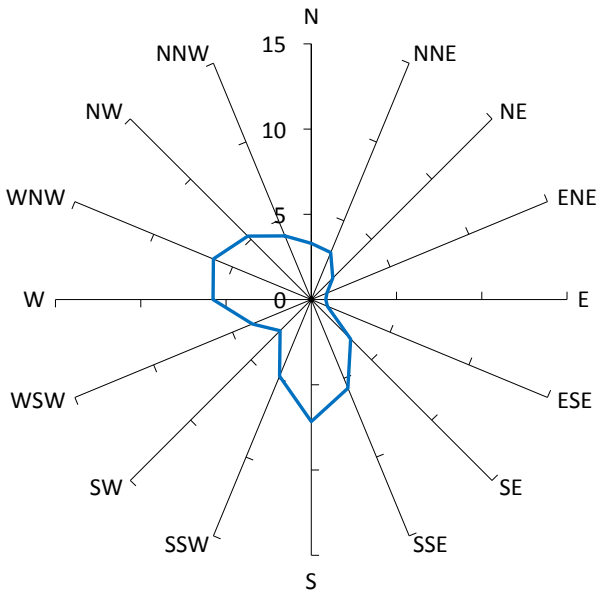
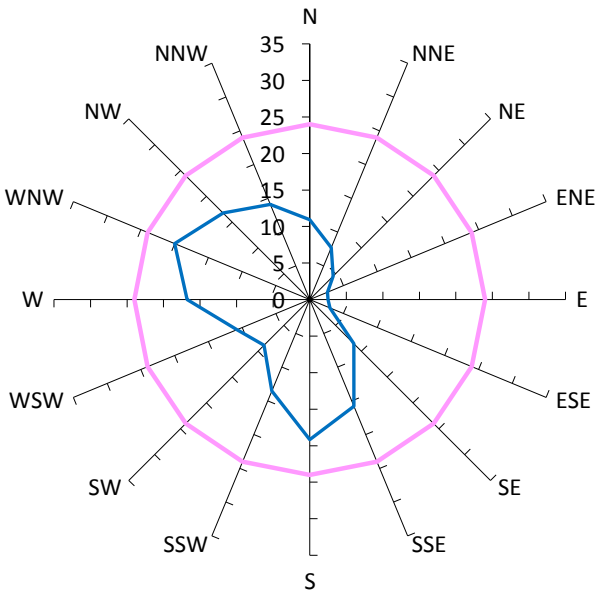
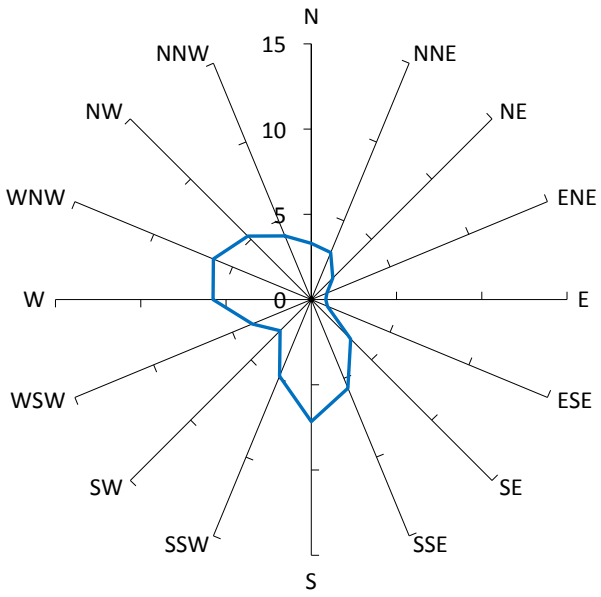
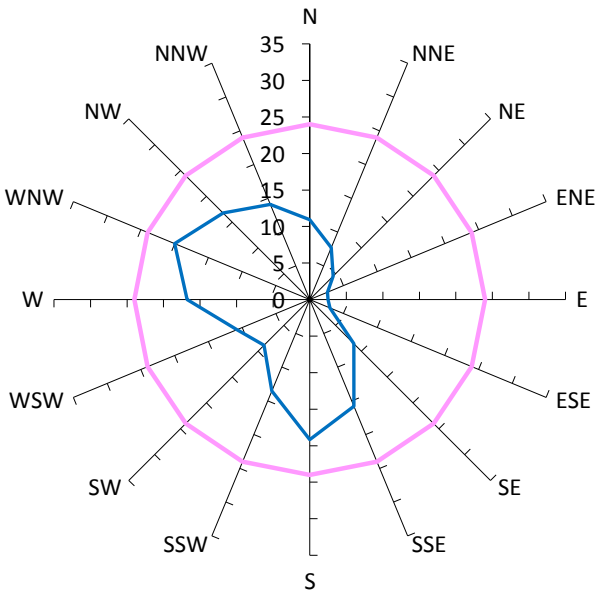
Results for Point 80

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	8%	20

Results for Point 80a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	34%	20

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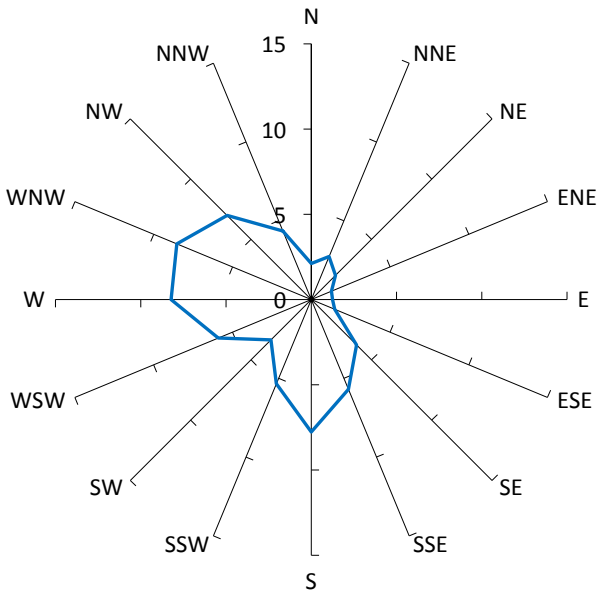
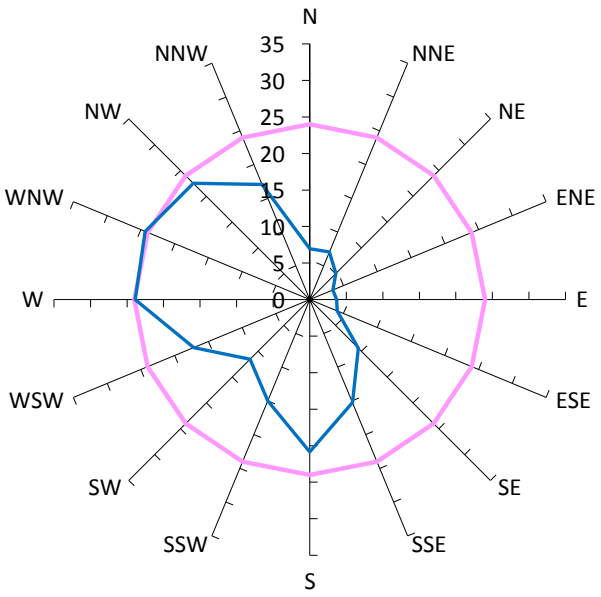
Results for Point 81

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	19%	24

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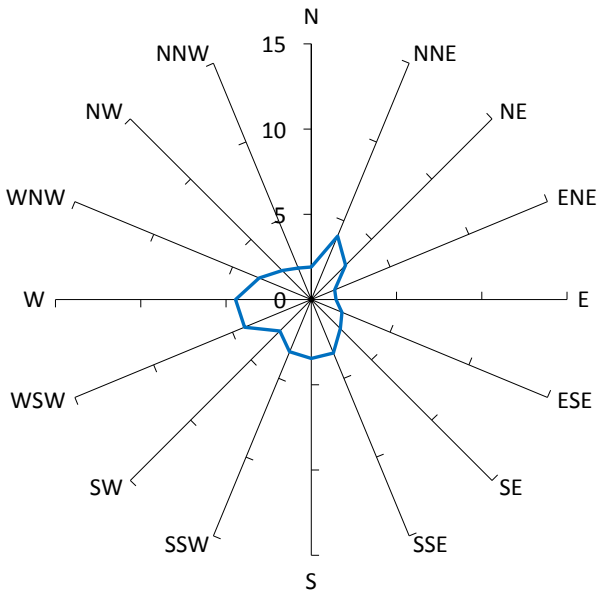
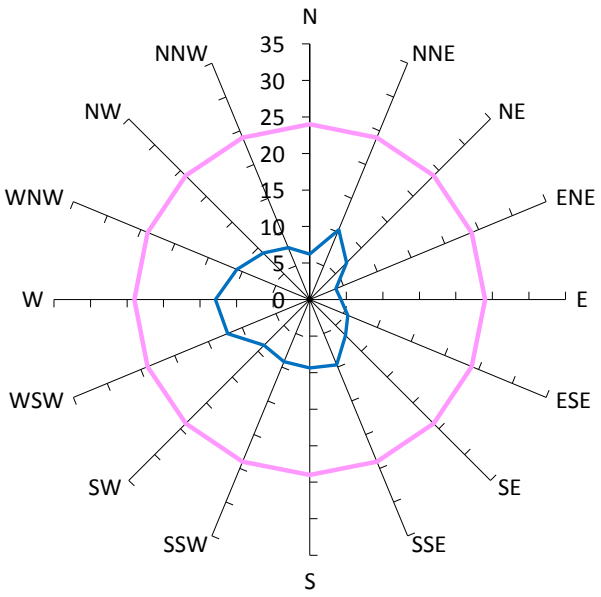
Results for Point 82

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	0%	13

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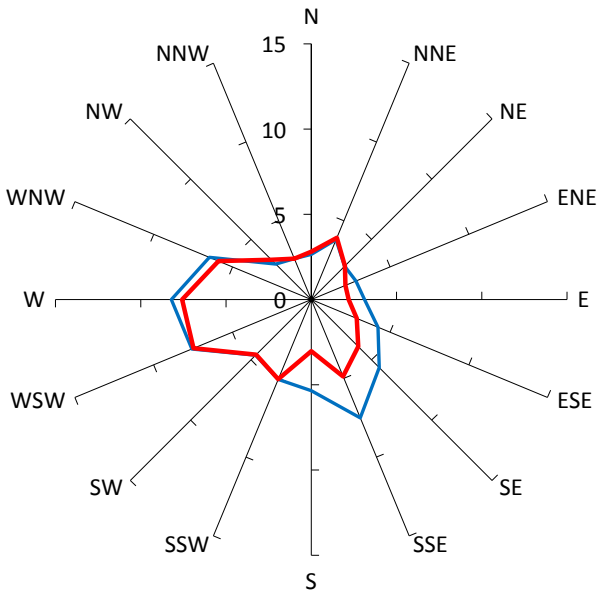
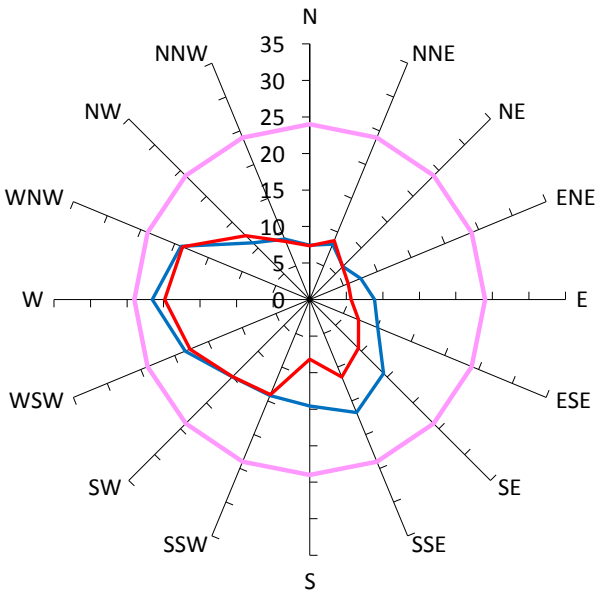
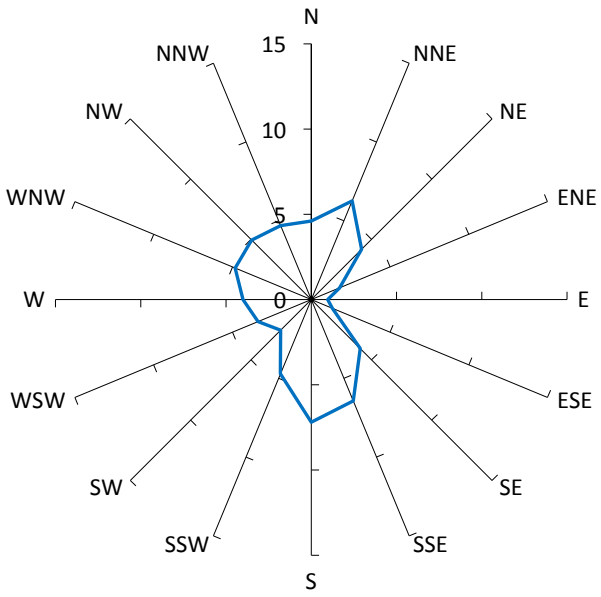
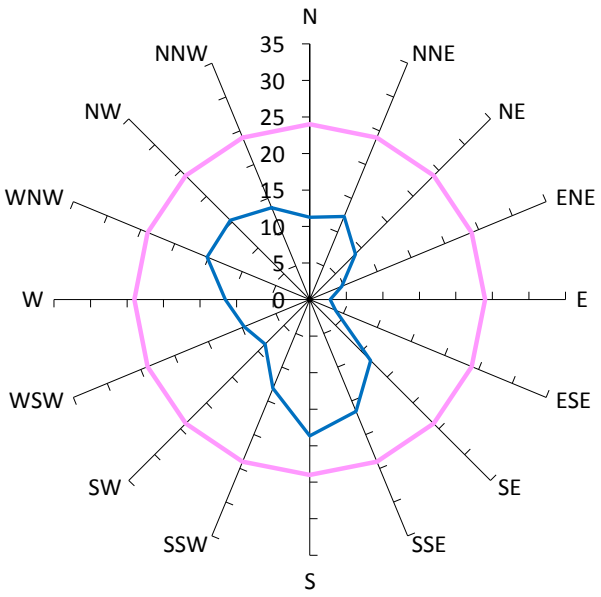
Results for Point 83

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	42%	22
With development "as proposed", existing trees along Bridge Road included.	29%	20

Results for Point 84

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	38%	19

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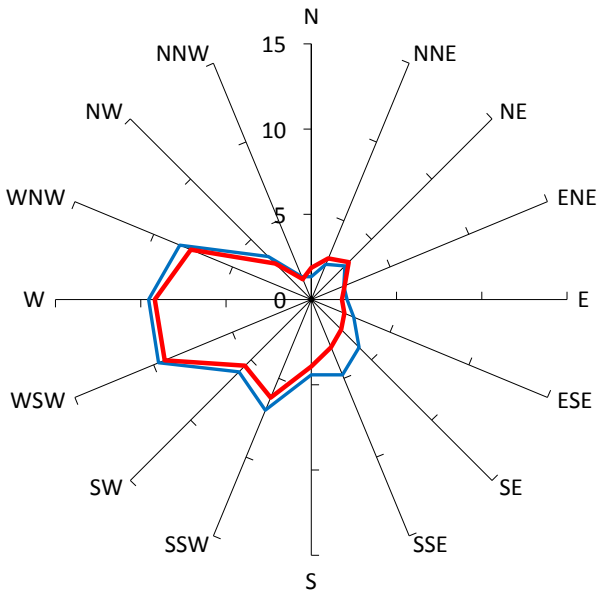
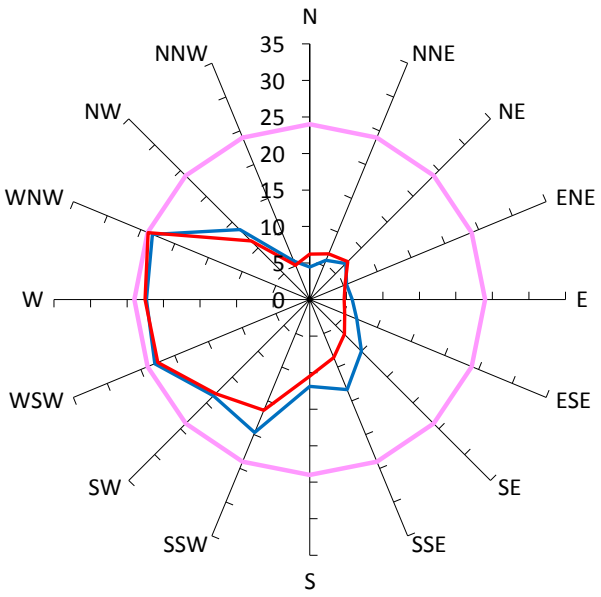
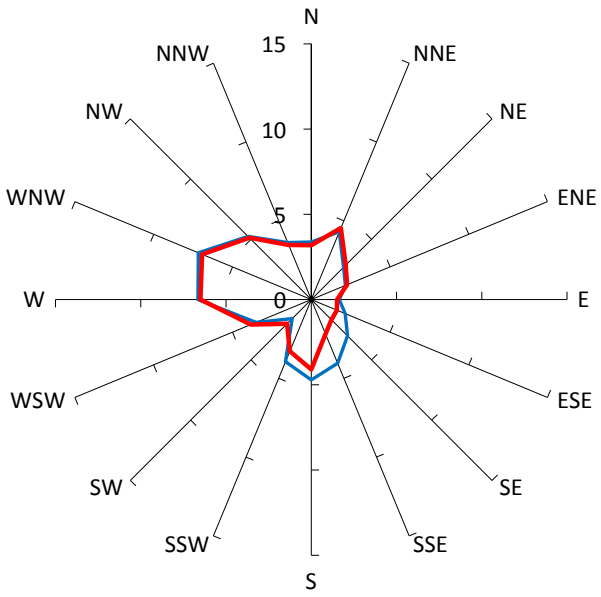
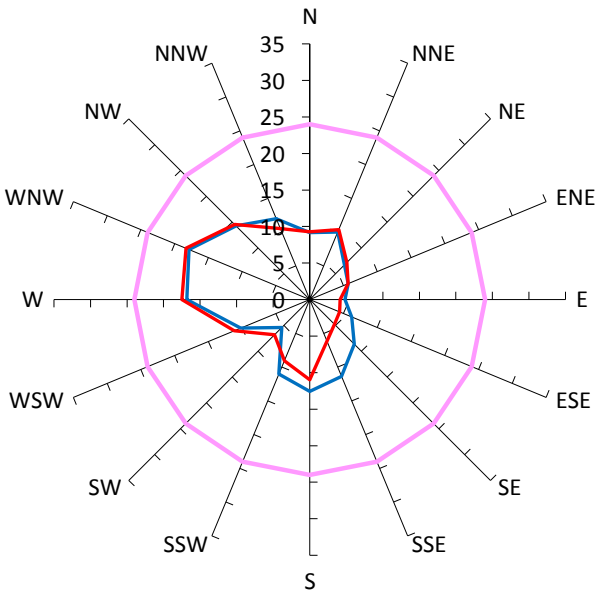
Results for Point 85

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

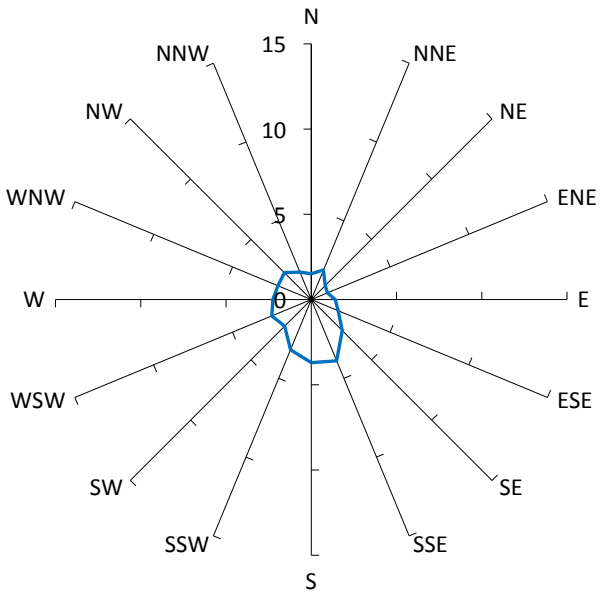
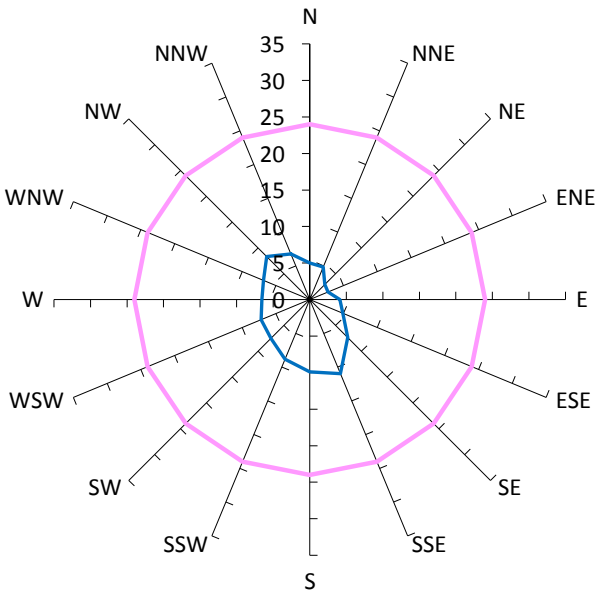
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	34%	23
With development "as proposed", existing trees along Bridge Road included.	26%	24

Results for Point 86

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	24%	18
With development "as proposed", existing trees along Bridge Road included.	20%	18

Results for Point 87

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	0%	11

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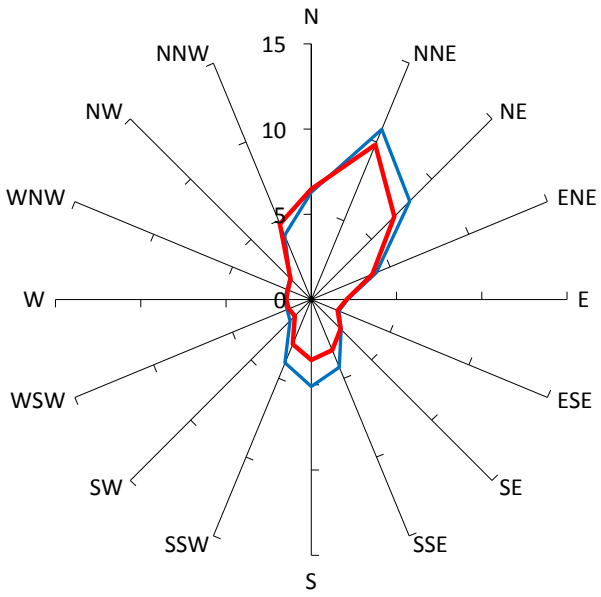
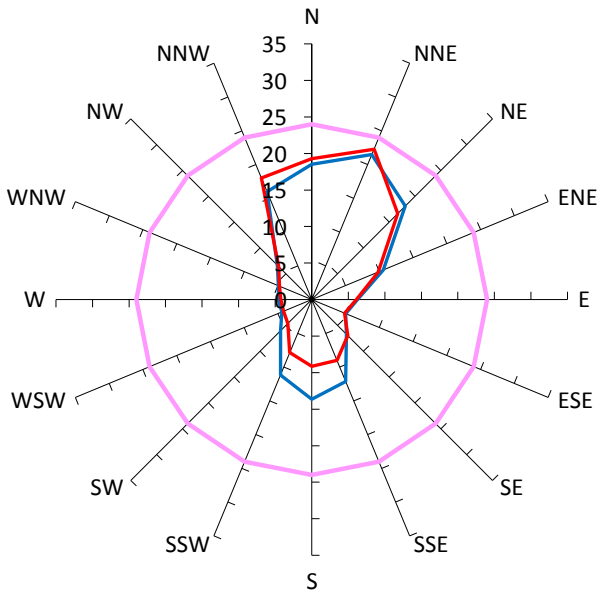
Results for Point 88

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	30%	21
With development "as proposed", existing trees along Bridge Road included.	23%	22

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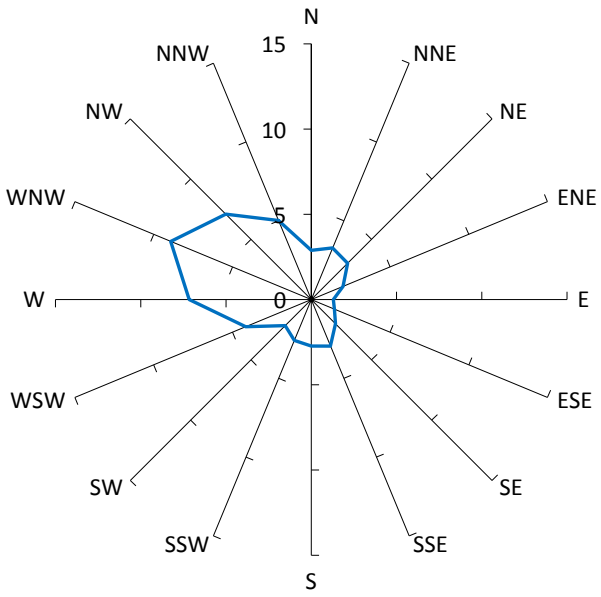
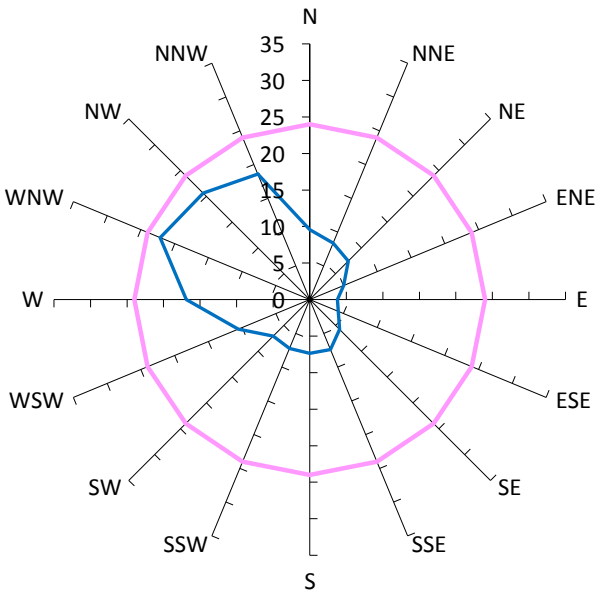
Results for Point 89

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	10%	22

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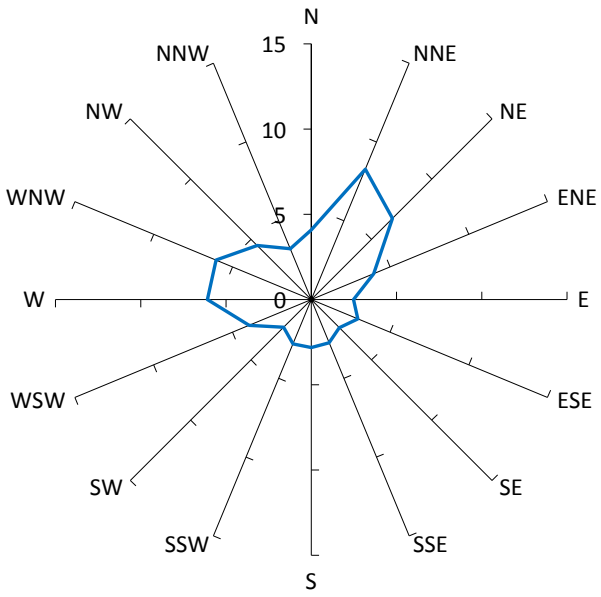
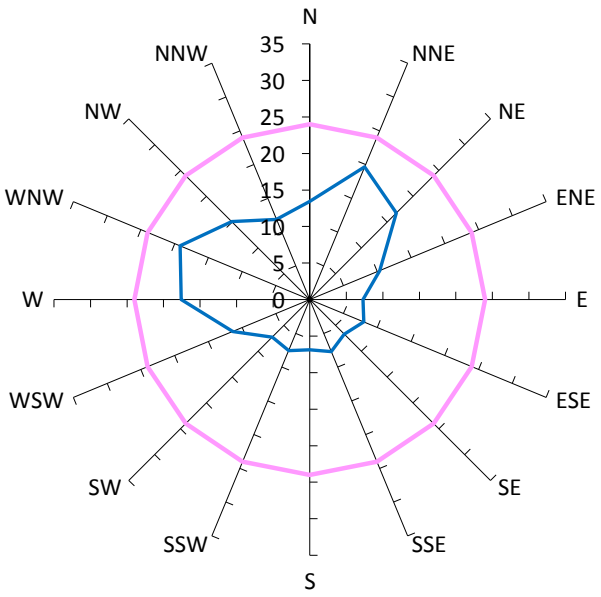
Results for Point 90

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	29%	20

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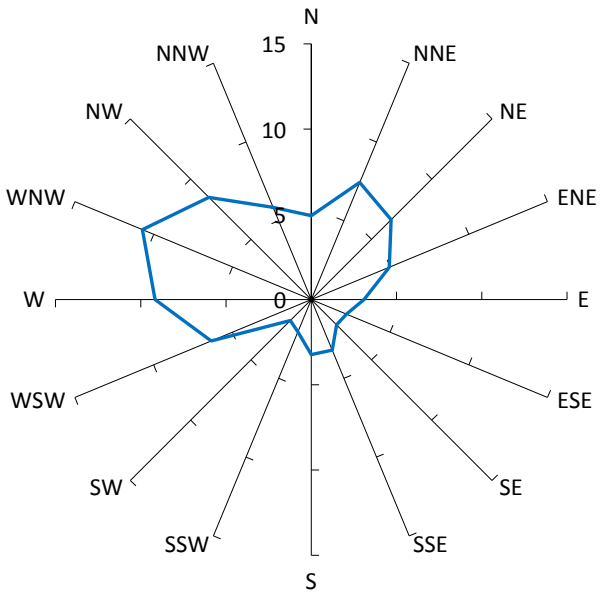
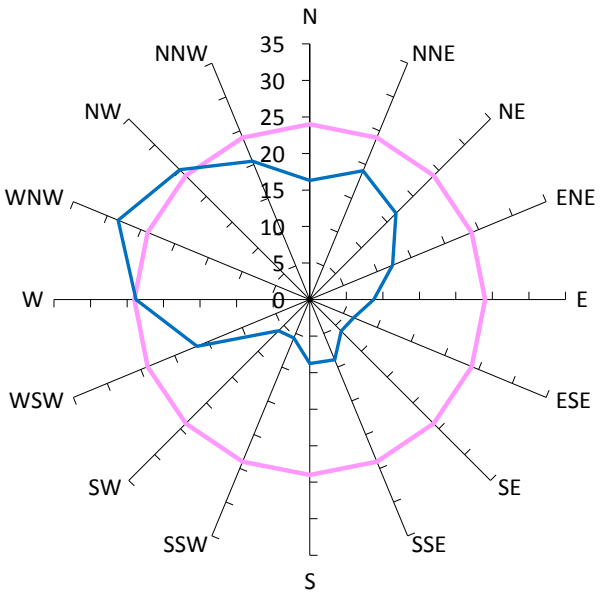
Results for Point 91

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	47%	28

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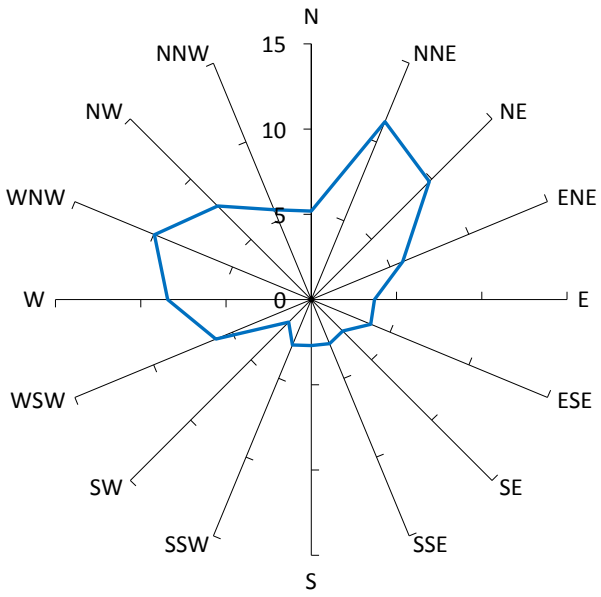
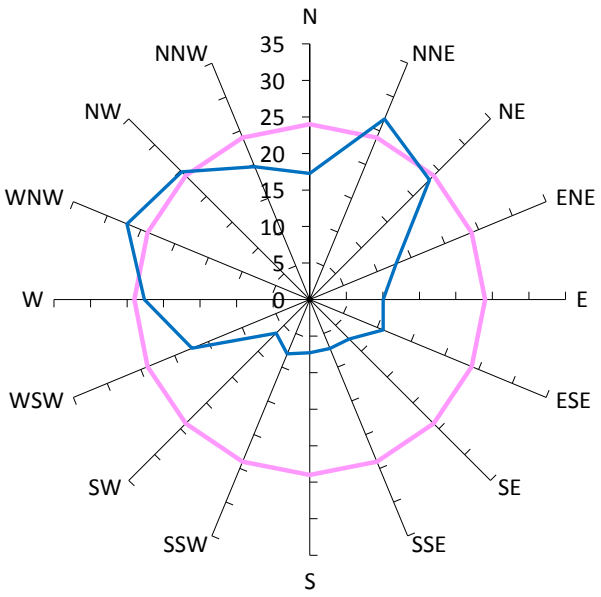
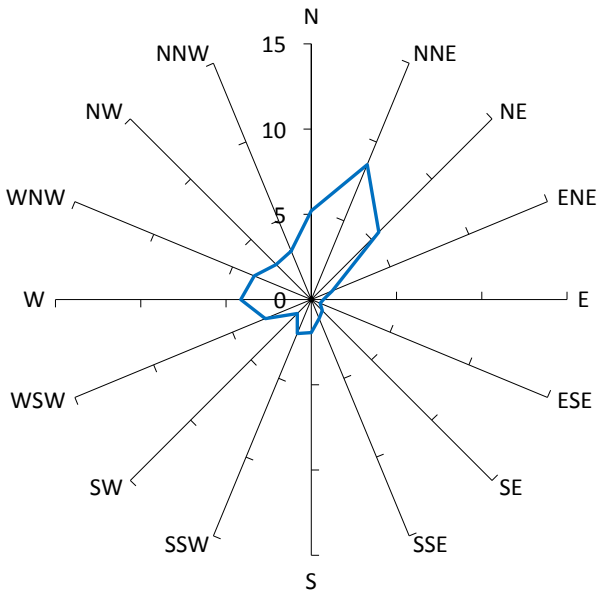
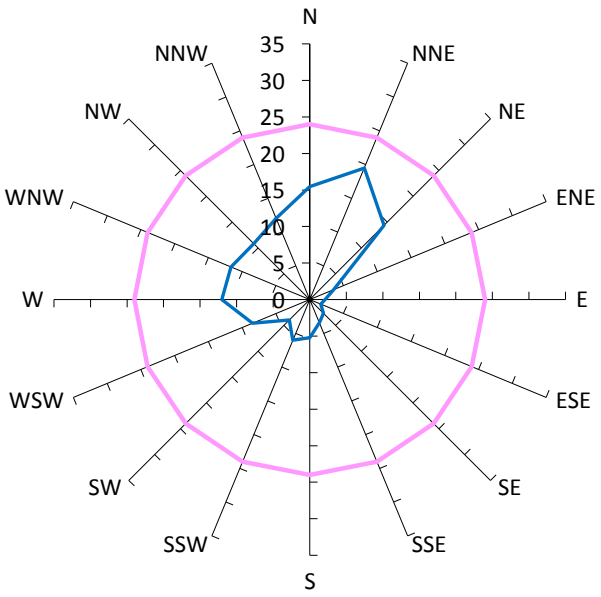
Results for Point 92

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

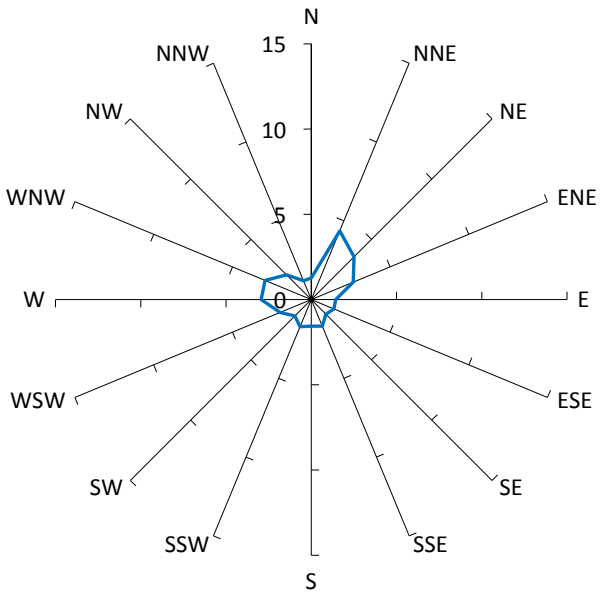
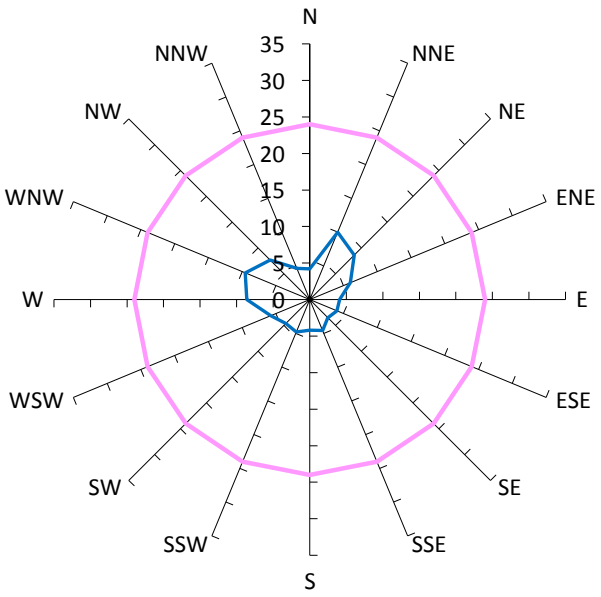
Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	49%	27

Results for Point 93

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	19%	19

Results for Point 94

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	10

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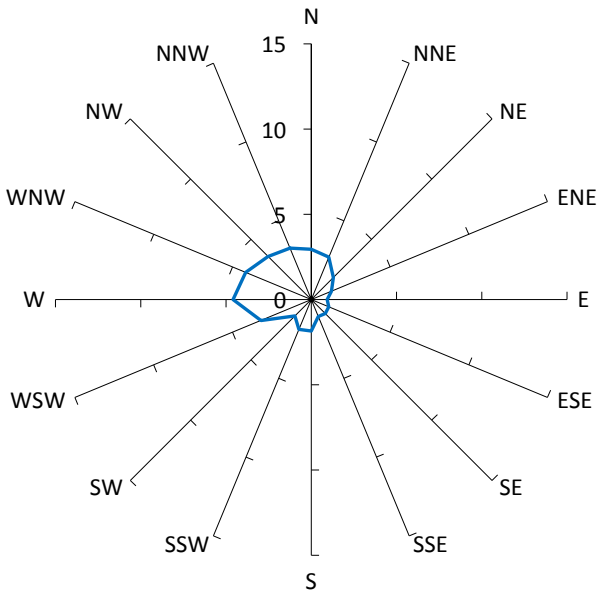
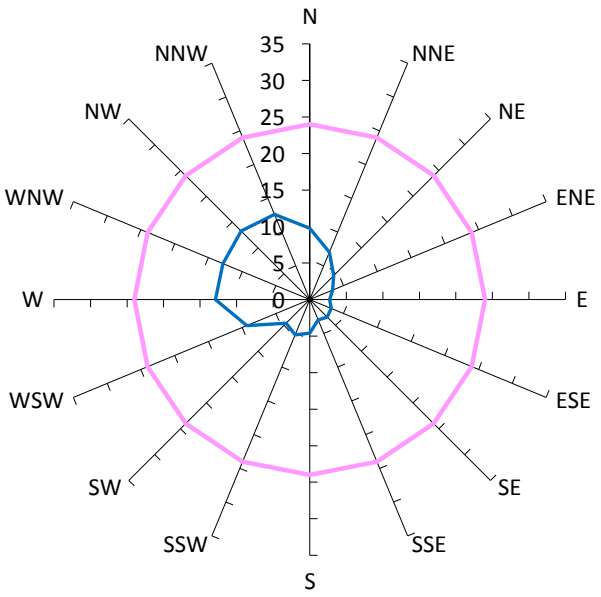
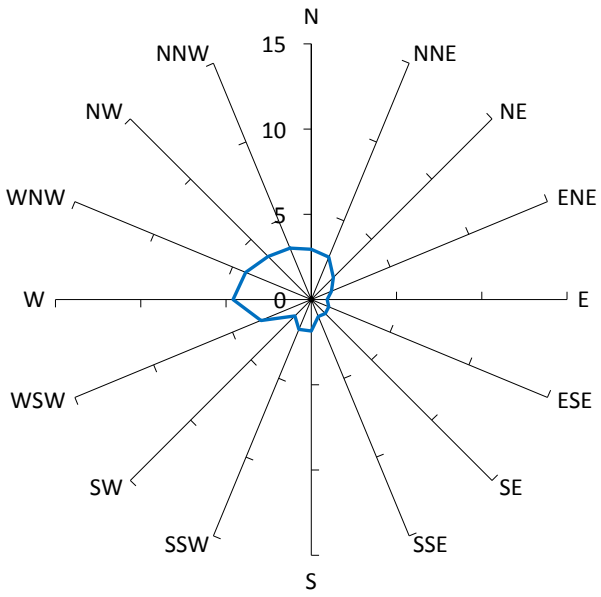
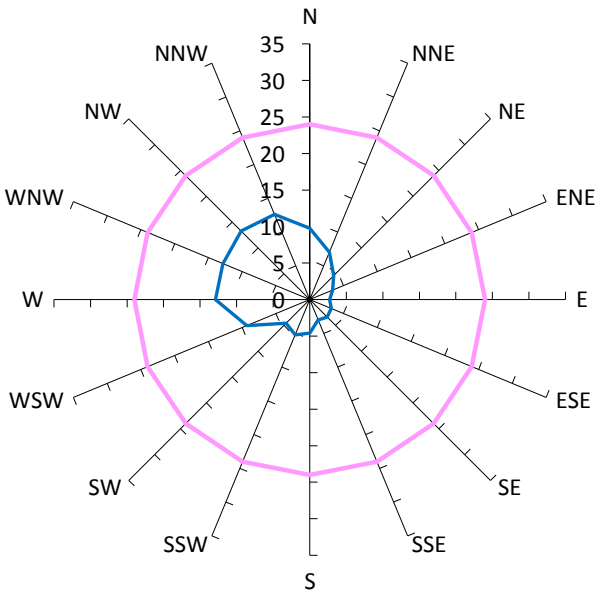
Results for Point 95

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	6%	13

Results for Point 95a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	1%	13

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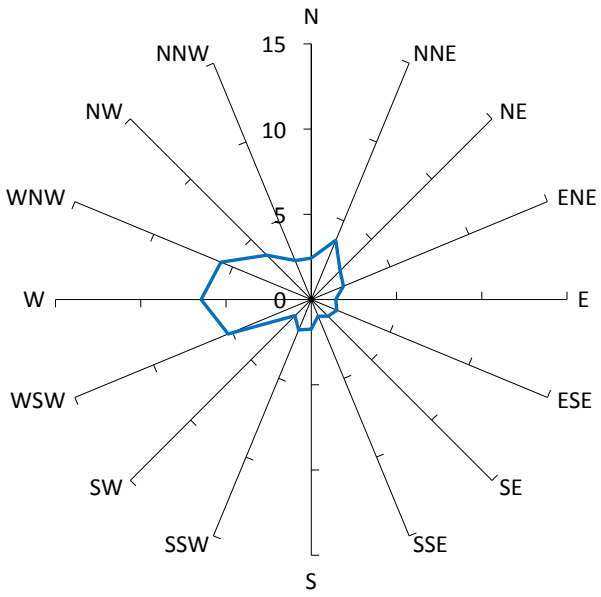
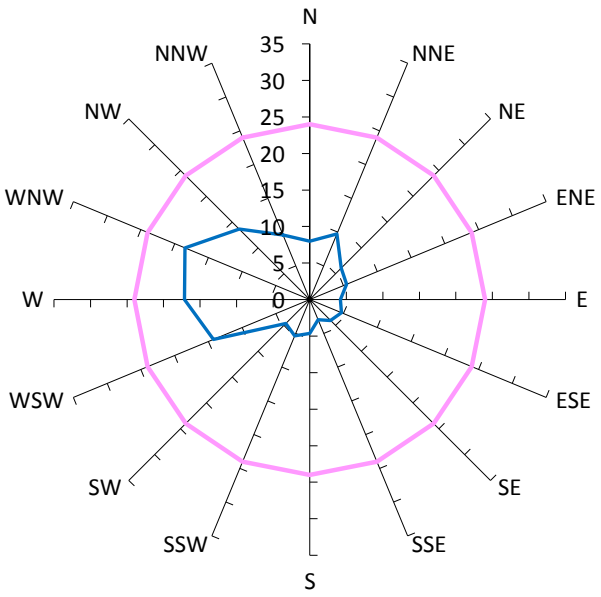
Results for Point 96

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	14%	18

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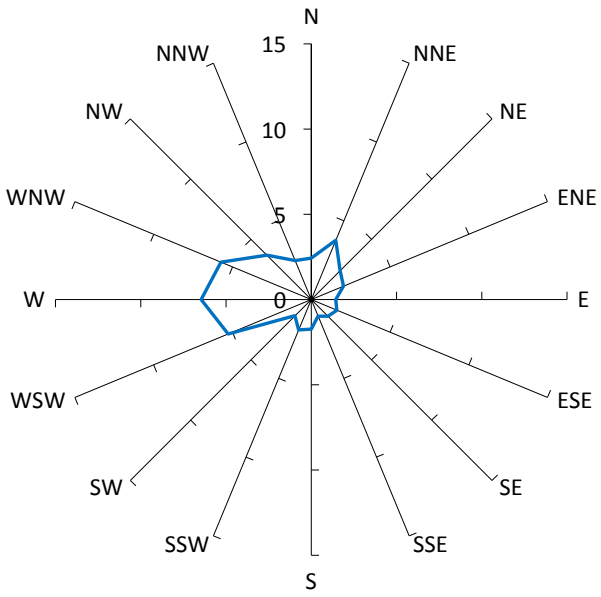
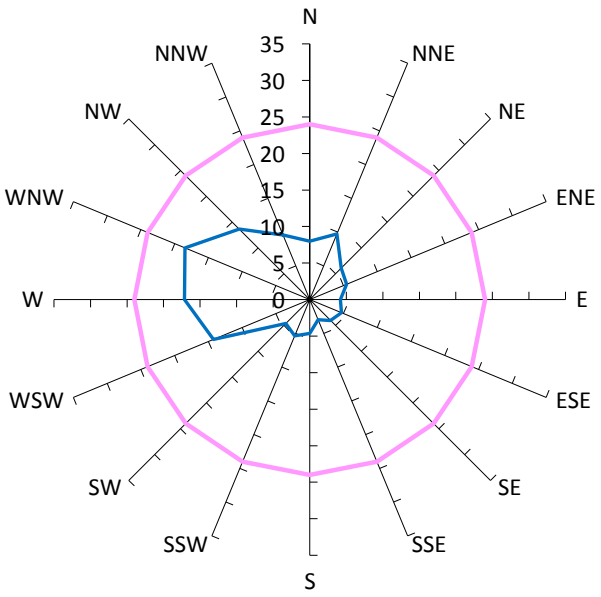
Results for Point 96a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	18

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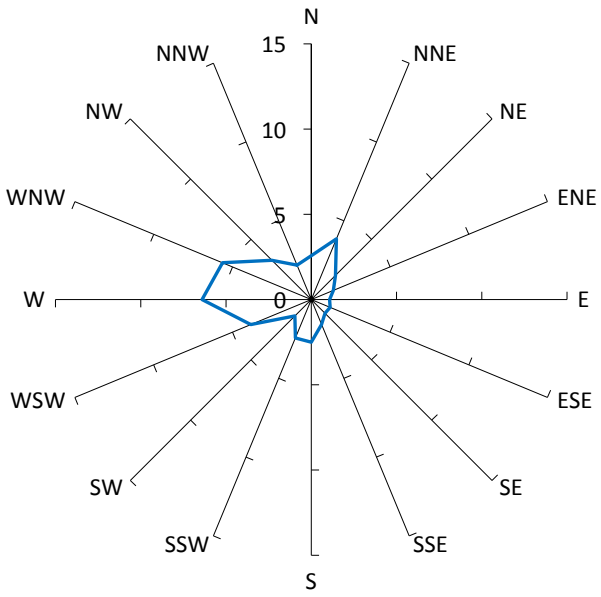
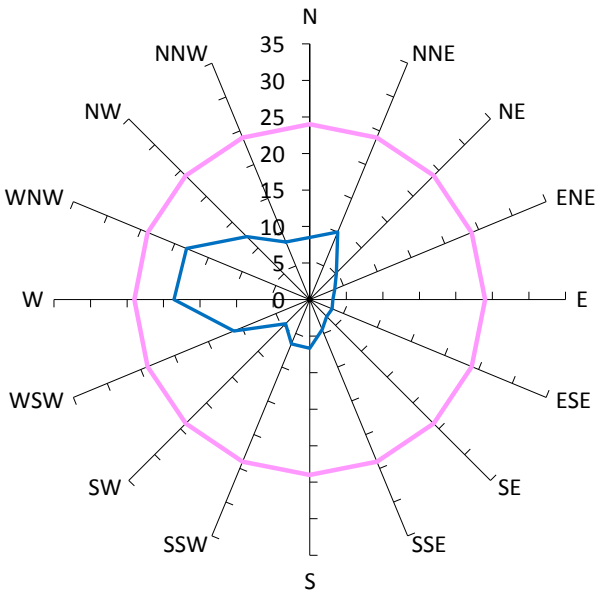
Results for Point 97

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	11%	19

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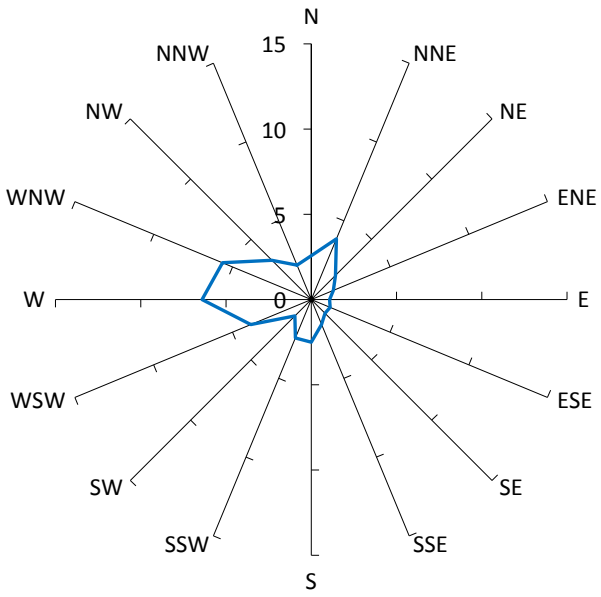
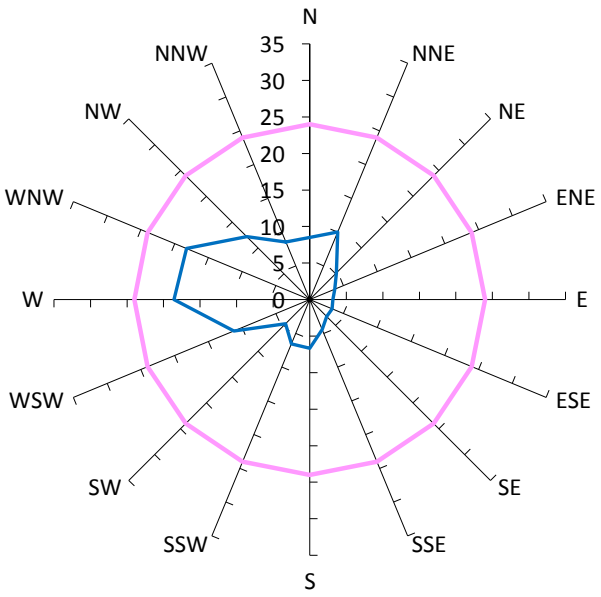
Results for Point 97a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	3%	19

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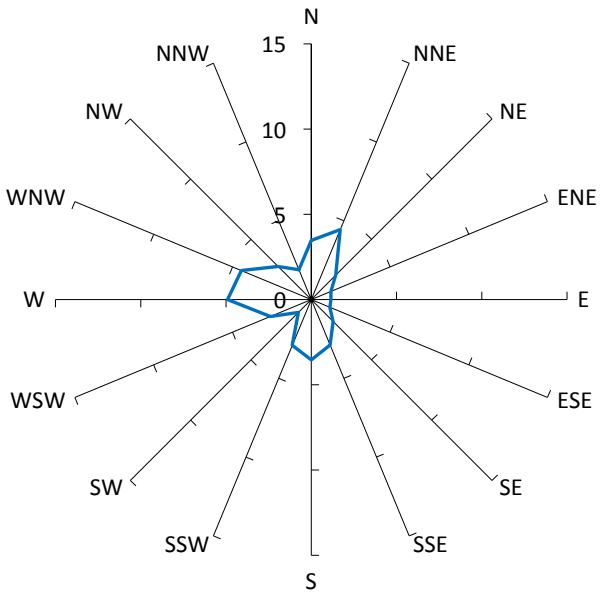
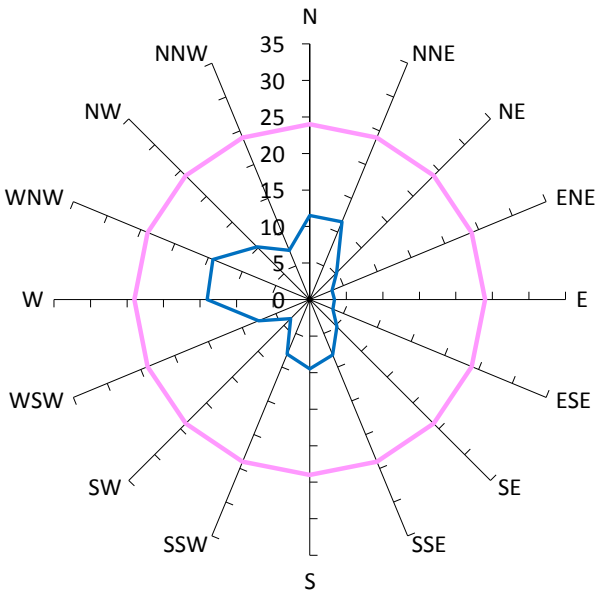
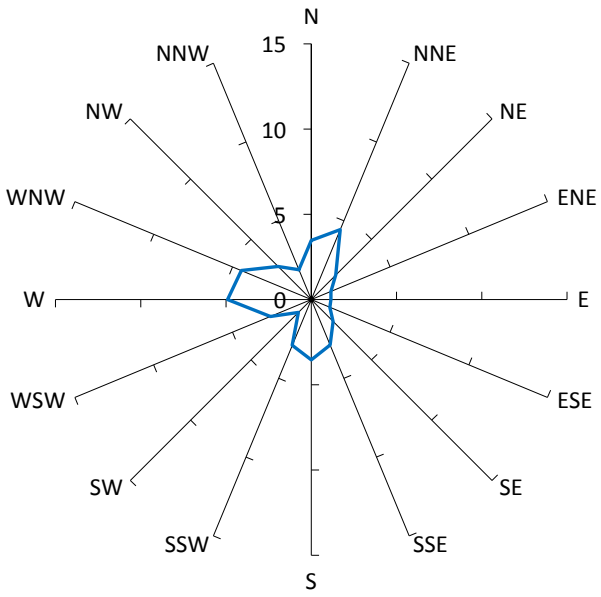
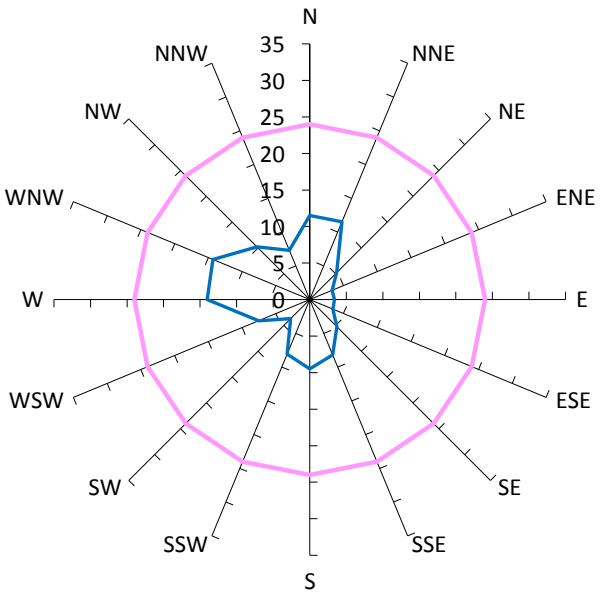
Results for Point 98

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	9%	14

Results for Point 98a

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 6m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Standing (6m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	1%	14

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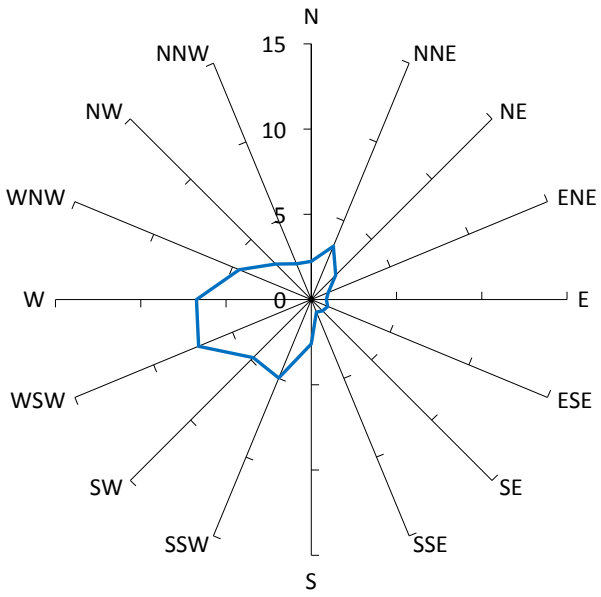
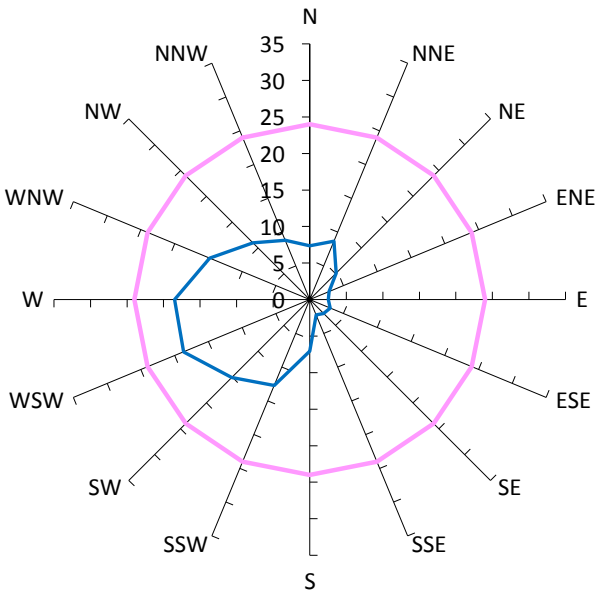
Results for Point 99

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	18%	19

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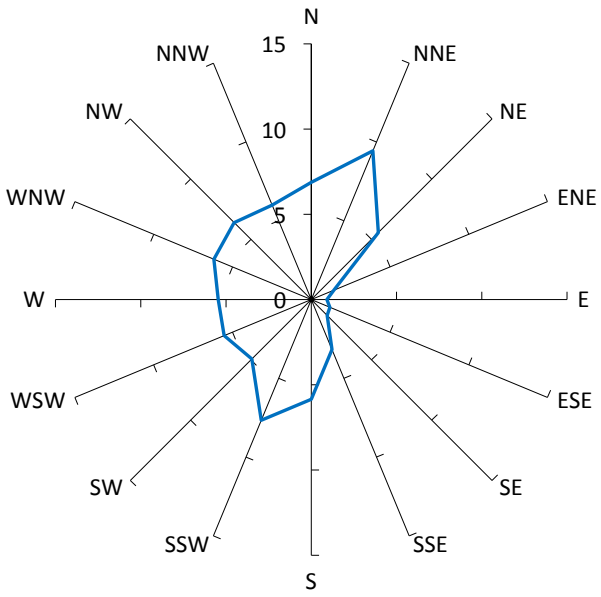
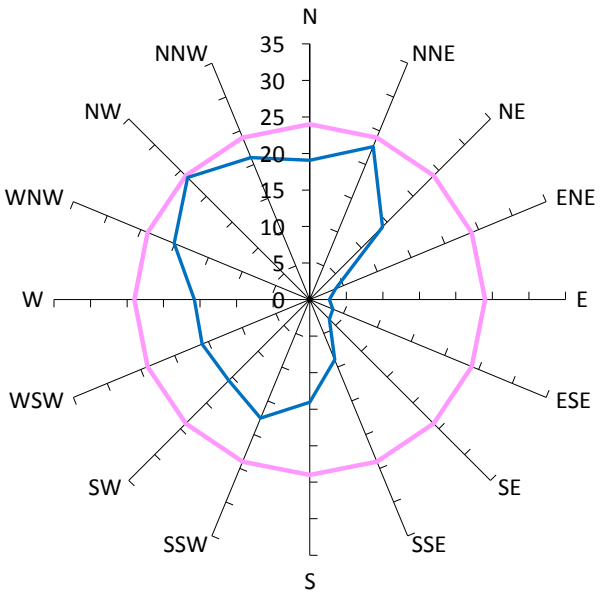
Results for Point 100

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	56%	24

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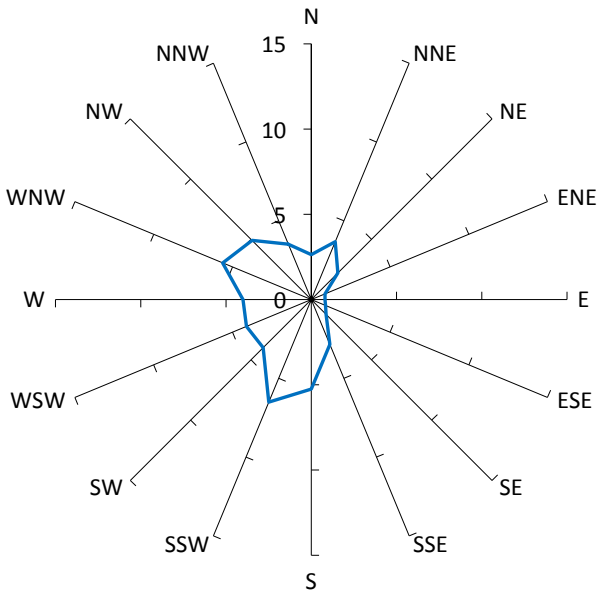
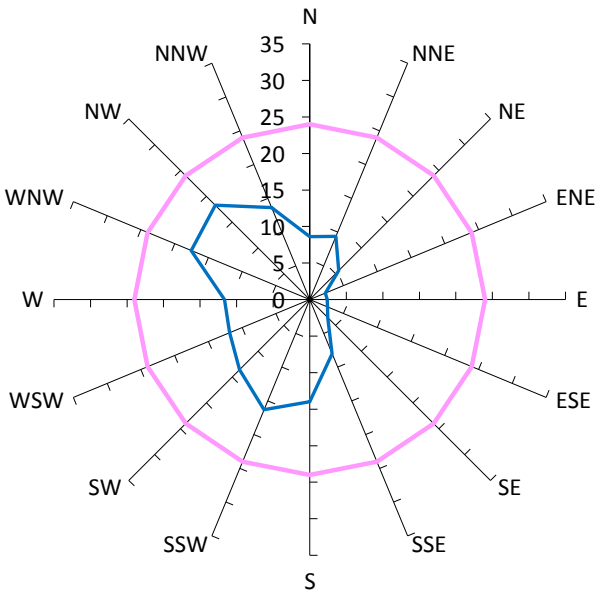
Results for Point 101

Gust Equivalent Mean (m/s)	Maximum Gust (m/s)
	
Comfort Criteria: 4m/s with 5% probability of exceedence	Safety Limit: 24m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Wind Comfort Standards for Sitting (4m/s). Safety Limit (24m/s).	5%	24
With development "as proposed", no vegetation or other treatments.	24%	18

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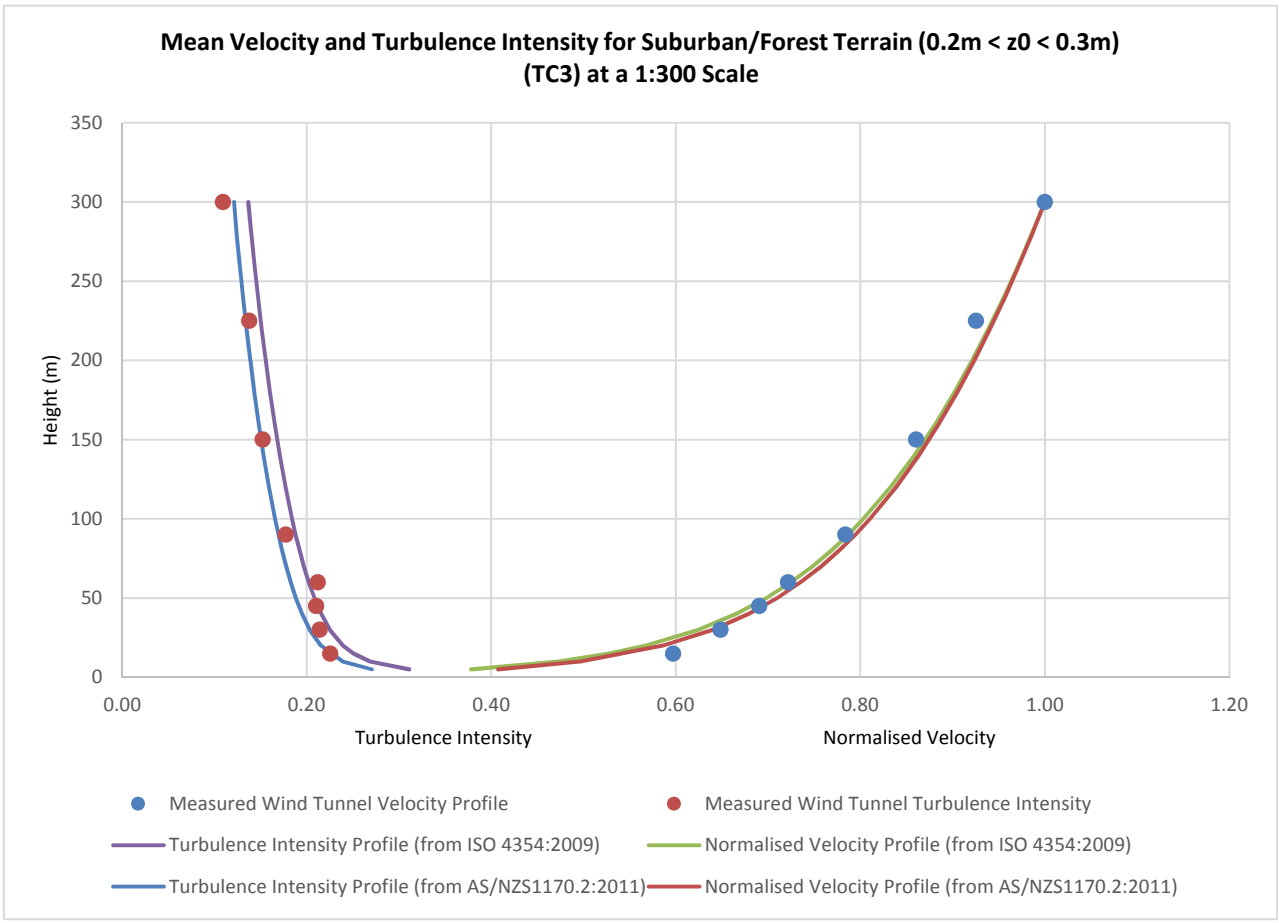
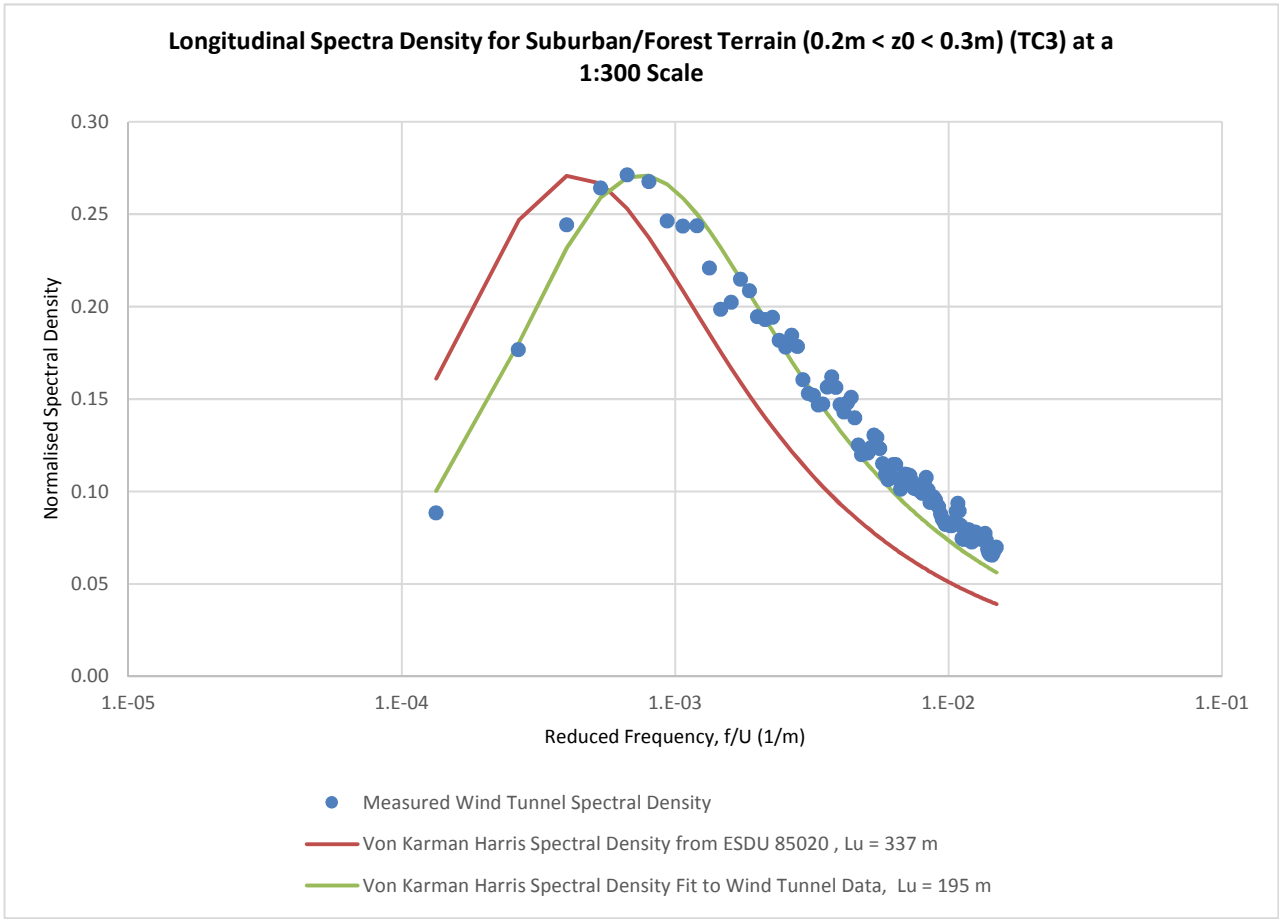
APPENDIX D VELOCITY AND TURBULENCE INTENSITY PROFILES


Mean Velocity and Turbulence Intensity for Suburban/Forest Terrain (0.2m < z0 < 0.3m) (TC3) at a 1:300 Scale
Height (m)
350
300
250
200
150
100
50
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
Turbulence Intensity
Normalised Velocity
Measured Wind Tunnel Velocity Profile
Measured Wind Tunnel Turbulence Intensity
Turbulence Intensity Profile (from ISO 4354:2009)
Normalised Velocity Profile (from ISO 4354:2009)
Turbulence Intensity Profile (from AS/NZS1170.2:2011)
Normalised Velocity Profile (from AS/NZS1170.2:2011)


Longitudinal Spectra Density for Suburban/Forest Terrain (0.2m < z0 < 0.3m) (TC3) at a 1:300 Scale
Normalised Spectral Density
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1.E-05
1.E-04
1.E-03
1.E-02
1.E-01
Reduced Frequency, f/U (1/m)
Measured Wind Tunnel Spectral Density
Von Karman Harris Spectral Density from ESDU 85020 , Lu = 337 m
Von Karman Harris Spectral Density Fit to Wind Tunnel Data, Lu = 195 m