REPORT

PEDESTRIAN LEVEL WIND STUDY

1580 – 1590 & 1650 Dundas Street East

Mississauga, Ontario

Hazelview Investments

REPORT NO. 23021wind **October 11, 2023**

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1. EXECUTIVE SUMMARY

The mixed-use Development proposed by Hazelview Investments for the property municipally known as 1580-1590 & 1650 Dundas Street East, in the City of Mississauga, has been assessed for environmental standards with regard to pedestrian level wind relative to comfort and safety. The pedestrian level wind and gust velocities predicted for the one hundred and sixty-nine (169) locations tested are within the safety criteria and most are within the comfort criteria described within the following report.

The proposed Development involves Blocks A through H including 5 high-rise towers, 5 mid-rise buildings, 3 townhouse blocks, and a Public Park on a parcel of land situated to the south of Dundas Street East along either side of Mattawa Avenue, to the east of Little Etobicoke Creek. The Development is surrounded to prevailing windward directions by mainly low-rise commercial/industrial buildings, with related open parking lots that are interspersed with green fields and the lowlands of Little Etobicoke Creek. Lands to the northeast of the site are occupied by low-rise residential neighbourhoods. The surrounding lands present a relatively coarse terrain that will moderate pedestrian level winds approaching the site from specific directions, whereas more open lands allow winds the opportunity to accelerate as they approach from others.

Urban developments provide surface roughness, which induces turbulence that can be wind friendly, while suburban settings similarly, though to a lesser extent, prevent wind from accelerating as the wind's boundary layer profile thins at the pedestrian level. Conversely, open settings afford wind the opportunity to accelerate. High-rise buildings typically exacerbate wind conditions within their immediate vicinity, to varying degrees, by redirecting wind currents to the ground level and along streets and open areas. Transition zones from open, and/or suburban, to urban settings often prove problematic, as winds exacerbated by relatively more open settings are redirected to flow over, around, down, and between buildings.

The proposed Development penetrates winds that formerly flowed over the site, the increased blockage relative to the existing setting causing wind to redirect to flow over the buildings, without consequence, and/or, depending upon the angle of incidence, around, or down the buildings towards the pedestrian level, as downwash. The Development features significant stepped conditions that intercept downwash associated with prevailing winds, deflecting a portion of said flows around the buildings at elevations well above the pedestrian level. This mitigative design feature as well as other wind friendly design elements: podiums, overhangs, terraces, landscaping, and others, when considered in concert, further moderate wind. This results in moderate changes to the impending wind climate realised at the site and in the surrounds with inclusion of the proposed Development, relative to the existing setting.

Winds are mitigated to varying degrees by the existing surrounds, and as such, upon impact with the proposed Development, tend to split, flowing over, and to a lesser extent around and down the buildings' faces. At the pedestrian level, the winds redirect to travel horizontally along the buildings, around the corners and beyond, creating localised windswept areas. As such, the site is mainly rated for walking, standing, or better, through the winter, and standing or sitting through the summer, with localised windier conditions proximate to building corners

and gaps in between. These areas remain generally comfortable and suitable for the intended uses, with localised uncomfortable conditions through the winter season within the gap between Blocks A and C. The uncomfortable ratings are somewhat near the transition to walking conditions, and with consideration of mitigative features within the area, the space is expected to realise more comfortable conditions than reported that are suitable for the intended use throughout much of the year.

Where mitigation was recommended, it was achieved through the following design features:

- stepped façades
- podiums
- balconies
- overhangs
- wind screens
- landscaping

and others, that were included in the proposed Development's massing and landscape design. Mitigation plans are recommended for various Entrances to the proposed Development, as well as various Outdoor Amenity Spaces throughout the site. Consideration of appropriate mitigation plans for these spaces will result in more comfortable conditions than reported that will be seasonally suitable for the intended use. The proposed Development will realize wind conditions acceptable to a typical suburban context.

Respectfully submitted,

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2. INTRODUCTION

Theakston Environmental Consulting Engineers, Fergus, Ontario, were retained by Hazelview Investments to study the pedestrian level wind environment for their proposed mixed-use Development occupying a portion of a block of lands situated along Mattawa Avenue, municipally known as 1580-1590 & 1650 Dundas Street East in the City of Mississauga, as depicted on the Aerial Photo in Figure 2a. The proposed Development involves Blocks A through H including 5 high-rise towers, 5 mid-rise buildings, 3 townhouse blocks, and a Public Park, as shown in Figure 2b. SvN Architects + Planners provided architectural drawings. The co-operation and interest of the Client and their sponsors in all aspects of this study is gratefully acknowledged.

The specific objective of the study is to determine areas of higher than normal wind velocities induced by the shape and orientation of the proposed buildings and surroundings. The wind velocities are rated in accordance with the safety and comfort of pedestrians, notably at entrances to the buildings, sidewalks, courtyards on the property, as well as other buildings in the immediate vicinity.

In order to obtain an objective analysis of the wind conditions for the property, the wind environment was tested in two configurations. The existing configuration included existing and proposed buildings in the surrounding area. The proposed configuration included the Development's subject buildings. Mitigation procedures were assessed during these tests to determine their impact on the various wind conditions.

The laboratory techniques used in this study are established procedures that have been developed specifically for analyses of this kind. The methodology, summarized herein, describes criteria used in the determination of pedestrian level wind conditions. The facilities used by Theakston are ideal for observance of the Development at various stages of testing, and the development of wind mitigation measures, if necessary.

3. OBJECTIVES OF THE STUDY

1. To quantitatively assess, by model analyses, the pedestrian level wind environment under existing conditions and future conditions with the Development in accordance with the City of Mississauga's Terms of Reference.

2. To assess mitigative solutions.

3. To publish a Consultant's report documenting the findings and recommendations.

4. METHOD OF STUDY

4.1 General

The Theakston Environmental wind engineering facility was developed for the study of, among other sciences, the pedestrian level wind environment occurring around buildings, with focus on the safety and comfort of pedestrians. To this end, physical scale models of proposed Development sites, and immediate surroundings, are built, instrumented and tested at the facility with resulting wind speeds measured for different wind directions at various locations likely to be frequented by pedestrians. This quantitative analysis provides predictions of wind speeds for various probabilities of occurrence and for various percentages of time that are ultimately weighted relative to a historical range of wind conditions, and provided to the client.

The techniques applied to wind and other studies carried out at the facility, utilize a boundary layer wind tunnel and/or water flume (Figure 1). The testing facility has been developed for these kinds of environmental studies, and has been adapted with equipment, testing procedures and protocols, in order to provide results comparable to full scale. Theakston's Boundary Layer Wind Tunnel, which lends itself well to the simultaneous acquisition of large data streams, was used to measure the wind environment at the site while the water flume, which is excellent for flow visualization, can be used to help understand problematic wind flow conditions.

The purpose of this Pedestrian Level Wind Study is to evaluate the pedestrian level wind speeds for a full range of wind directions. To accomplish this, the wind's mean speed boundary layer profiles are simulated and applied to a site-specific model under test, instrumented with differential pressure probes at locations of interest. During testing, pressure readings are taken over a one-hour model scale period of time, at a full-scale height of approximately 1.8m and correlated to mean and gust wind speeds, expressed as ratios of the gradient wind speed.

The mean and gust wind speeds at the one hundred and sixty-nine (169) points tested were subsequently combined with the design probability distribution of gradient wind speed and direction, (wind statistics) recorded at Airports in the vicinity, to provide predictions of the full-scale pedestrian level wind environment. Predictions of the full-scale pedestrian level wind environment are presented as the wind speed exceeded 20% of the time, based on winter and summer winds in Figures 6a and 6b. Criterion employed by Theakston Environmental was developed by others and us and published in the attached references. The methodology has been applied to over 800 projects on this continent and abroad.

4.2 Meteorological Data

The wind climate for the Mississauga region that was used in the analysis was based on historical records of wind speed and direction measured at Pearson International Airport for the period between 1980 and 2022. The meteorological data includes hourly wind records and annual extremes. The analysis of the hourly wind records provides information to develop the statistical climate model of wind speed and direction. From this model, predicted wind speeds regardless of

wind direction for various return periods can be derived. The record of annual extremes was also used to predict wind speeds at various return periods. Based on the analysis of the hourly records, the predicted hourly-mean wind speed measured at 10*m* above grade, corrected for a standard open exposure definition, is 25*m/s* for a return period of 50 years.

4.3 Statistical Wind Climate Model

For the analysis of the data, the wind climate model is converted to a reference height of 500*m* using a standard open exposure wind profile. The mean-hourly wind speed at a 500*m* reference height used for this study is 45.6*m/s* for a return period of 50 years. The corresponding 1-year return period wind speed at the 500*m* height is 36*m/s*.

The design probability distribution of mean-hourly wind speed and wind direction at reference height is shown for Pearson International Airport in Figure 5. Distributions for Winter and Summer are shown. From this it is apparent that winds can occur from any direction, however, historical data indicates the directional characteristics of strong winds during the winter months are north through west to southwest. Through the summer months, the winds are not as strong and are mainly from the same directions as winter winds, with the addition of winds from the southeast more often.

4.4 Wind Simulation

To simulate the correct macroclimate, the upstream flow passes over conditioning features placed upstream of the model, essentially strakes and an appropriately roughened surface, as required to simulate the full-scale mean speed boundary layer approach flow profiles occurring at the site.

4.5 Pedestrian Level Wind Velocity Study

A physical model of the proposed Development and pertinent surroundings, including existing buildings, roadways, pathways, terrain and other features, was constructed to a scale of 1:500. The model is based upon information gathered during a virtual site visit to the proposed Development site, and surrounding area. SnV Architects + Planners provided architectural drawings. City of Mississauga aerial photographs were also used in development of the model to ensure the model reasonably represents conditions at the proposed Development. The model is constructed on a circular base so that, by rotation, any range of wind directions can be assessed. Structures and features that are deemed to have an impact on the wind flows are included upwind of the scale model.

In these studies, the effects of wind were analysed using omni-directional wind velocity probes that are placed on the model and located at the usual positions of pedestrian activity. The probes measure both mean and fluctuating wind speeds at a height of approximately 1.8m. During testing, the model sample period is selected to represent 1hr of sampling time at full scale. The

velocities measured by the probes are recorded by a computerized data acquisition system and combined with historical meteorological data via a post-processing program.

4.6 Pedestrian Comfort Criteria

The assignment of pedestrian comfort takes into consideration pedestrian safety and comfort attributable to mean and gust wind speeds. Gusts have a significant bearing on safety, as they can affect a person's balance, while winds flowing at or near mean velocities have a greater influence upon comfort.

Figure 6 presents results for the mean wind speed that is exceeded 20% of the time. These speeds are directly related to the pedestrian comfort at a particular point. The overall comfort rating, for existing and proposed, are depicted in Figure 7. A comparison of pedestrian level comfort conditions for each probe is shown in a table in Figure 10. Table 1, below, summarizes the comfort criteria used in the presentation of the results depicted in Figures 6 and 7.

Table 1: Comfort Criteria

ACTIVITY	Gust Equivalent Mean Speed Exceeded 20% of the Time	Description
COMFORT	***km/h***	
Sitting	0-10	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away.
Standing	0-15	Gentle breezes suitable for main building entrances and bus stops.
Walking	0-20	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	>20	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

The activities are described as suitable for Sitting, Standing, Walking, or Uncomfortable, depending on average wind speed exceeded 20% of the time. For a point to be rated as suitable for Sitting, for example, the wind conditions must not exceed 10*km/h*, more than 20% of the time. Thus, in the plots (Figure 6), the upper limit of each bar ends within the range described by the comfort category. For sitting, the rating would include conditions ranging from calm up to wind speeds that would rustle tree leaves or wave flags slightly, as presented in the Beaufort Scale included in the Appendices. As the name infers, the category is recommended for outdoor space where people might sit for extended periods.

The Standing category is slightly more tolerant of wind, including wind speeds from calm up to 15*km/h*. In this situation, the wind would rustle tree leaves and, on occasion, move smaller branches while flags flap. This category would be suitable for locations where people might sit for short periods or stand in relative comfort. The Walking category includes wind speeds from calm up to 20*km/h*. These winds would set tree limbs in motion, lift leaves, litter and dust, and the locations are suitable for activity areas. The Uncomfortable category covers a broad range of wind conditions that are generally a nuisance for most activities, including wind speeds above 20*km/h*.

In Figure 6, the probe locations are listed along the bottom of the chart; beneath the graphical representation of the Mean Wind Speed exceeded 20% of the time. Along the right edge of the plot the comfort categories are shown. The background of the plot is lightly shaded in colours corresponding to the categories shown in Table 1. Each category represents a 5*km/h* (or more) interval. The location is rated as suitable for Sitting, Standing, Walking, or Uncomfortable, if the bar extends into the corresponding interval.

The charts represent the average person's response to wind force. Effects such as wind chill and humidex (based on perception) are not considered. Also clothing is not considered, since clothing and perceived comfort varies greatly among the population. There are many variables that contribute to a person's perception of the wind environment beyond the seasonal variations presented. While people are generally more tolerant of wind during the summer months, than during the winter, due to the wind cooling effect, people become acclimatized to a particular wind environment. Persons dwelling near the shore of an ocean, large lake or open field are more tolerant of wind than someone residing in a sheltered wind environment.

4.7 Pedestrian Safety Criteria

Safety criteria are also included in the analysis to ensure that strong winds do not cause a loss of balance to individuals occupying the area. The safety criteria are based on wind speeds exceeded nine times per year as shown in Table 2.

Both the Comfort and Safety Criteria are based on those described in the City's Terms of Reference for Wind.

Table 2: Safety Criteria

ACTIVITY	Mean Wind Speed Exceeded 9 Times per year	Description
SAFETY	***km/h***	
All-Weather Areas	0 - 90	Acceptable gust speeds that will not adversely affect a pedestrian's balance and footing.
Exceeding All-Weather Areas	>90	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

4.8 Pedestrian Comfort Criteria – Seasonal Variation

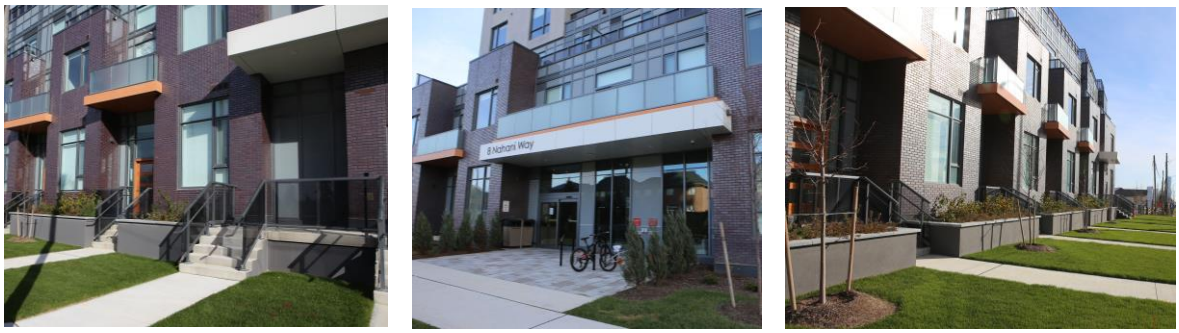
The level of comfort perceived by an individual is highly dependent on seasonal variations of climate. Perceived comfort is also specific to each individual, and depends on the clothing choices. The comfort criterion that is being used averages the results across the general population to remove effects of individuals and clothing choices, however, seasonal effects are important. For instance, a terrace or outdoor amenity space may have limited use during the winter season, but require acceptable comfort during the summer.

The comfort of a site is based on the "winter" or "summer" results of the study, Figures 6a and 6b and 7a through 7d. When compared to the annual average wind speed, winter winds are about 9% higher and summer winds are about 9% lower.

4.9 Wind Mitigation Strategies

Wind mitigative features such as podiums, setbacks, stepped façades, balconies, notches, overhangs, canopies, and others, assist in discouraging downwash associated with prevailing winds. These features deflect portions of said winds around buildings at elevations well above the pedestrian level, and moderate upsets to wind conditions with inclusion of new developments. Additional mitigative features may also be applied for localised areas that experience conditions that are inappropriate for the intended use. These features, discussed below, add roughness into wind streamlines and protect exposed areas from high pedestrian level winds.

Entrances to buildings may be mitigated by locating them away from building corners and through recessing the entrances into the façades of the building. Additional mitigative features such as railings, canopies, coarse plantings, porous wind screens, and others, would further assist in mitigating said areas. Examples of these wind mitigation measures are shown below.



Examples of Wind Mitigative Measures at Entrances (recessed entrances, railings, canopies, raised planters, coniferous trees).

Activity areas such as Outdoor Amenity Spaces may similarly be mitigated through implementation of 1.8m – 2.4m high perimeter wind screens, trellises, raised planters, coarse

plantings, and others, situated about the spaces as practical. Examples of these wind mitigative measures are shown below.

Examples of Wind Mitigative Measures at Activity Spaces (wind screens, raised planters, trellises)

The model was assessed with selected mitigation strategies during these tests to determine their impact on the various wind conditions. Further testing may be required in order to determine the effectiveness of any additionally proposed wind mitigative features, if desired.

5. RESULTS

5.1 Study Site and Test Conditions

Proposed Development

The Development municipally known as 1580-1590 & 1650 Dundas Street East occupies lands situated along Mattawa Avenue, to the southeast of Dundas Street East in the City of Mississauga. The lands are currently occupied by two large 2 storey commercial buildings and a small single storey restaurant, all fronting Dundas Street East, with large parking lots flanking Mattawa Avenue to the southeast beyond. The proposed Development is partitioned into Blocks A through H that are assigned to the proposed buildings, a Public Park and buffer along Little Etobicoke Creek.

Block A is comprised of 15, 29, and 41 storey towers denoted Buildings A1, A2, and A3. Buildings A1 and A2 are connected by a 2 and 11 storey podium with Outdoor Amenity Space proposed on the 3rd and 12th levels. Buildings A2 and A3 are similarly connected by a 2 and 8 storey podium with Outdoor Amenity Space on the 9th level. Retail and Main Residential Entrances to Block A are proposed fronting Dundas Avenue East and Mattawa Avenue. A Multi-Use Pathway is proposed along the southwestern façade at-grade.

Block C is comprised of a 35 storey tower denoted Building C1, with a stepped 12 storey podium accommodating Outdoor Amenity Spaces at the 2nd, 3rd, and 13th levels. The Retail Entrances and Main Residential Entrance to Block C are proposed fronting Mattawa Avenue. A Daycare Entrance and a related at-grade Outdoor Play Space are located along the southwestern façade. A Multi-Use Pathway is also proposed along the southwestern façade at-grade.

Block E consists of 15, 8, and 18 storey buildings denoted Buildings E1, E2, and E3. The buildings feature stepped wings and are connected by a 1 storey podium accommodating an Outdoor Amenity Space on the 2nd level. Outdoor Amenity Space is also proposed atop Building E2 on the 9th level. Retail and Main Residential Entrances to Block E are proposed fronting Dundas Avenue East and Mattawa Avenue. A Pedestrian Mews is proposed along the northeastern façade at-grade.

Block F consists of two 12 storey buildings denoted Buildings F1 and F3. The buildings are connected by a stepped 1 and 3 storey podium accommodating Outdoor Amenity Space at the 2nd level. Outdoor Amenity Spaces are also proposed atop a step to the northeast of Building F1 on the 10th level, and atop a step to the north of Building F3 at the 7th level. Retail and Main Residential Entrances to Block F are proposed fronting Mattawa Avenue. Two 3 storey townhouse blocks, denoted FTH1 and FTH2, are also proposed along the northeastern portion of the block, with at-grade Outdoor Amenity Spaces adjacent to the townhouse blocks and a Pedestrian Mews along the northeastern façades.

Block G consists of 12 and 18 storey buildings denoted Buildings G1 and G2. The buildings feature stepped wings and are connected by a 1 storey podium accommodating Outdoor Amenity Space at the 2nd level. Outdoor Amenity Spaces are also proposed atop a step to the northeast of Building G1 on the 10th level, and atop a step to the northeast of Building G2 at the 9th level. Retail and Main Residential Entrances to Block G are proposed fronting Mattawa Avenue. A 3 storey townhouse block, denoted GTH1, is also proposed along the northeastern portion of the block, with a Pedestrian Mews also along the northeastern boundary of the block.

Block B consists of a Public Park, and Blocks D and H respectively consist of a Hazard Zone and a Buffer Zone located along the southwestern extents of the site.

The configuration of the proposed Development is shown in Figure 2b. The Development, located in the City of Mississauga, is depicted in the Aerial Photo in Figure 2a. Note: Mississauga's street orientation is relative to the Lake Ontario Shoreline resulting in east/west orientated streets in the subject area being offset by approximately 50 degrees north.

View of the 1580- 1590 & 1650 Dundas Street East Development Site Looking Southeast (Google).

Surrounding Area

The Development is, for all intents and purposes, surrounded to prevailing windward directions by a suburban mix of commercial and residential buildings, related open areas, and mature vegetation. These buildings and related open areas have a sympathetic relationship with the pending wind climate.

As mentioned, buildings in the immediate surrounds to the northeast are comprised of a low-rise residential neighbourhood, with lands to remaining directions mainly occupied by low-rise commercial/industrial buildings, with related open parking areas that are interspersed with green fields and the lowlands of Little Etobicoke Creek to the southwest of the site.

Figures 2a and 2b depict the site and its immediate context. The site model, shown in Figure 3, is built to a scale of 1:500. For all intents and purposes, a mix of suburban development comprised of low-rise buildings and related open lands surround the site. The surrounding lands present a relatively coarse terrain that will moderate pedestrian level winds approaching the site from specific directions, whereas more open lands allow winds the opportunity to accelerate as they approach from others.

Macroclimate

For the proposed Development, the upstream wind flow during testing was conditioned to simulate an atmospheric boundary layer passing over suburban terrain. The terrain within the site's immediate vicinity was incorporated into the proximity model. Historical meteorological data recorded from the Toronto Pearson International Airport was used in this analysis. For studies in the City of Mississauga, the data is presented for two seasons and the resulting wind roses are presented as mean velocity and percent frequency in Figure 5. The mean velocities presented in the wind roses are measured at an elevation of 10*m*. Thus, representative ground level velocities at a height of 2*m*, for an urban macroclimate, are 52% of the mean values indicated on the wind rose, (for suburban and rural macroclimates the values are 63% and 78% respectively).

Winter (November through April) has the higher mean velocities with prevailing winds from the from north through west to southwest as indicated in Figure 5a. Summer (May through October) has lower mean wind velocities with similar prevailing winds from the north through west, with a southeasterly component, as indicated in Figure 5b. Reported pedestrian comfort ratings generally pertain to winter conditions, unless stated otherwise.

5.2 Pedestrian Level Wind Velocity Study

On the site model, one hundred and sixty-nine (169) wind velocity measurement probes were located around the proposed Development, activity areas, and surrounds, to determine conditions related to comfort and safety. Figure 4 depicts probe locations at which pedestrian level wind velocity measurements were taken in the existing and proposed scenarios. For the existing setting, the subject buildings were removed and the "existing" site model retested with the current buildings on site.

Measurements of pedestrian level mean and gust wind speeds at the various locations shown were taken over a period of time equivalent to one hour of measurements at full-scale. The mean ground level wind velocity measured is presented as a ratio of gradient wind speed, in the plots of Figure B of the Appendices, for each point in the existing and proposed scenarios. These relative wind speeds are presented as polar plots in which the radial distance for a particular wind direction represents the wind speed at the location for that wind direction, expressed as a ratio of the corresponding wind speed at gradient height. They do not assist in assessing wind comfort conditions until the probability distribution gradient wind speed and direction is applied.

The design probability distribution gradient wind speed and direction, taken from historical meteorological data for the area (see Figure 5) was combined with pedestrian level mean and gust wind speeds measured at each point to provide predictions of the percentage of time a point will be comfortable for a given activity. These predictions of mean and maximum or "gust" wind speeds are provided for winter and summer in Figures 6a and 6b, respectively. A table comparing comfort and safety ratings for each probe is provided in Figure 10.

The ratings for a given location are conservative by design. When the existing surroundings and proposed buildings' fine massing details and actual landscaping are taken into consideration, the results tend toward a more comfortable site than quantitative testing alone would indicate.

Venturi action, scour action, downwash and other factors, as discussed in the Appendix on wind flow phenomena, can be associated with large buildings, depending on their orientation and configuration. These serve to increase wind velocities. Open areas within a heavily developed area may also encounter high wind velocities. Consequently, wind force effects are common in heavily built-up areas. The Development site is open to a predominantly suburban setting to prevailing and remaining compass points with winds flowing over and between buildings. As such, the surroundings can be expected to influence wind at the site to varying degrees. It should be noted that the probes are positioned at points typically subject to windy conditions in order to determine the worst-case scenario.

5.3 Review of Probe Results

The probe results, as follows, were clustered into groups comprised of Neighbouring Areas as well as Blocks A, B, C, E, F, G, and H within the site (no probes were situated within Block D as it is a hazard zone and will not be accessed by pedestrians). The measurement locations are depicted in Figure 4 and are listed in Figures 6a and 6b in winter and summer and for the existing and proposed configurations. The results are also graphically depicted for the existing and proposed configurations in Figures 7a – 7d, and compared in a table in Figure 10. The following discusses anticipated wind conditions and suitability for the points' intended use.

5.3.1 Neighbouring Areas

Dundas Street East

Probes 2 through 5 and 37 through 41 were located along Dundas Street East within the zone of influence of the proposed Development site. These probe locations indicate wind conditions that are rated suitable for mainly standing throughout the year in the existing setting, with exceptions. In the winter months, probe 5 realises windier conditions, suitable for walking, and in the summer months more comfortable conditions, suitable for sitting, are realised at probes 3, and 37 through 40. The fairly comfortable conditions can be attributed to the flanking low-rise buildings along the street directing large portions of the wind climate to flow over the buildings, above the pedestrian level.

With inclusion of the proposed Development, probes situated along Dundas Street East realised changes in wind patterns that were insufficient to change the majority of the seasonal comfort ratings. In the winter months, probes 37 and 41 realised sufficient increases in easterly and westerly winds to change the ratings from standing to walking. In the summer months, probes 37, 38, and 39 similarly realised increases in westerly through southwesterly and easterly through northeasterly winds that changed the ratings from sitting to standing.

As such, Dundas Street East will realise fairly similar conditions to the existing setting with inclusion of the proposed Development, and will remain comfortable and suitable for the intended use throughout the year. Consideration of design and landscape elements that were too fine to include in the massing model will result in more comfortable conditions than reported.

Dundas Street East falls within the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

Mattawa Avenue

Probes 6 through 10, 19 through 27, 42 through 46, and 80 through 94 were situated along Mattawa Avenue, running through the centre of the site. In the existing setting, said points are rated mainly suitable for standing throughout the year, with the exception of summer sitting conditions at probes 8, 9, and 23 through 27. The generally comfortable conditions can again be attributed to the existing low-rise buildings providing blockage from portions of the wind climate for areas along the street.

With inclusion of the proposed Development, a realignment of winds was noted along Mattawa Avenue. The changes can be attributed to the proposed Development causing a realignment of winds that reduces apparent wind effects at the pedestrian level for several wind directions, but causes an increase to winds for others, as indicated in the Appendices Figure B, Ground Level Wind Velocity Plots presented as a ratio of gradient wind velocity. Increases in wind conditions can be attributed to the proposed Development redirecting winds through downwash and other phenomena, to flow down and around the proposed buildings and along portions of Mattawa Avenue. Conversely, improvements in wind conditions can be attributed to the proposed Development effectively reducing the propensity for specific winds being deflected to flow along the street and over the areas, resulting in the observed leeward effect.

The majority of probes situated adjacent to the proposed buildings realised increases in winds that are directed to flow down and around the towers and through gaps between. This results in generally windier conditions along Mattawa Avenue, changing the majority of the winter ratings from standing to walking in these areas. Portions of Mattawa Avenue proximate to the open lands of Block B realised more subtle changes in winds, remaining mainly suitable for standing through the winter, with a few localised sitting conditions. In the summer season, Mattawa Avenue remains suitable for sitting or standing, with the exception of walking conditions at probe 10.

As such, Mattawa Avenue will realise generally windier conditions than the existing setting with inclusion of the proposed Development, however the street will remain comfortable and suitable for the intended use throughout the year. Mattawa Avenue will also realise more comfortable conditions than reported with consideration of fine design and landscape elements that were too fine to include in the massing model.

Mattawa Avenue passes the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

Coram Crescent & Private Backyards

Probes 128 through 131 were located along Coram Crescent, situated to the northeast of the proposed Development site, and probes 123 through 127 were similarly located within private backyards of properties along the street. In the existing setting, the area is rated suitable for standing throughout the winter and sitting throughout the summer, with exceptions. Probe 131 realises more comfortable conditions, rated for sitting in the winter, and probes 126, 127, and 128 realise windier conditions, rated for standing in the summer.

With inclusion of the proposed Development, Coram Crescent and the related private backyards realise fairly subtle changes in winds. Additional blockage from westerly through southwesterly winds by the proposed buildings was sufficient to improve the summer ratings at probes 126, 127, and 128 from standing to sitting. The remaining seasonal comfort ratings were unchanged. As such, Coram Crescent and the related private backyards will realise improvements in winds in the proposed setting and will remain comfortable and suitable for the intended uses. Consideration of existing and proposed fine design and landscape features will result in more comfortable conditions than reported.

Coram Crescent and the related private backyards fall within the pedestrian level wind velocity safety criteria.

Pallett Green Park

Probes 119 through 122 were located within Pallett Green Park, situated to the southwest of the proposed Development site. In the existing setting, the park is rated for standing through the winter and sitting through the summer.

In the proposed setting, portions of the park realise increases in northerly winds, sufficient to change the summer ratings at probes 119 and 121 from sitting to standing. The park area remains generally suitable for the intended use throughout the year and will realise more comfortable

conditions than reported with consideration of existing and proposed fine design and landscape elements, such as the existing vegetation to the north of the park.

Pallett Green Park falls within the pedestrian level wind velocity safety criteria.

5.3.2 Block A

Probes 1 through 12 and 103 through 106 were located around Block A at-grade. Probes 132 through 142 were similarly located atop Rooftop Outdoor Amenity Spaces on Block A. All probes situated within Block A pass the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

Block A Entrances

Probes 1 and 2 were located adjacent to the Main Residential Entrances to Building A1. The area is exposed to portions of the northerly and southerly wind climate that are directed to flow around the westmost corner of Building A1, however they are well protected from the remainder of the wind climate and as such realise conditions suitable for standing year-round. The Main Residential Entrances to Building A1 will be comfortable and suitable for the intended uses.

Probes 8 and 10 were respectively located adjacent to the Main Residential Entrances to Buildings A2 and A3, fronting Mattawa Avenue. The area is exposed to large portions of the wind climate that are directed to flow down and around the proposed buildings and through the gap between along Mattawa Avenue. As such, the Main Residential Entrances to Buildings A2 and A3 are rated for walking year-round, with the exception of standing conditions at the Building A2 entrance in the summer. Mitigation plans are recommended for these entrances that may include recessing the entrances into the façades, and/or the addition of porous wind screens adjacent to the entrances that will protect door leafs from winds flowing along the building façades. Consideration of appropriate mitigation plans for the entrances will result in more comfortable conditions that are suitable for the intended uses throughout the year.

Probes 3 through 6 and 9 were located adjacent to Retail Entrances to the Block A buildings. The entrances are mainly rated for standing throughout the year, with exceptions. In the summer months, probe 3 realises more comfortable conditions, suitable for sitting. Conversely, probes 5 and 9 realise windier conditions in the winter, rated for walking. Mitigation plans are recommended for the Retail Entrances located adjacent to probes 5 and 9 that may include recessing the entrances into the façades, and/or the addition of porous wind screens adjacent to the entrances that will protect door leafs from winds flowing along the building façades. Consideration of appropriate mitigation plans for the entrances will result in more comfortable conditions that are suitable for the intended uses throughout the year.

Probes 11 and 12 were located adjacent to Townhouse Entrances along the southeastern façade of Block A. The area is exposed to large portions of the northerly and southerly wind climate that are directed to flow down and around the proposed buildings and through the gap between Blocks A and C. As such, the area is rated suitable for standing in the summer and walking through the winter months. The Townhouse Entrances are recessed into the building façades

and will realise more comfortable conditions than the probes beyond, resulting in conditions that are expected to be suitable for the intended uses throughout the year.

Wind conditions comfortable for standing are preferable at building entrances while conditions suitable for walking are suitable for sidewalks. The various Entrances to Block A will realise conditions suitable for the intended uses with incorporation of appropriate mitigation plans where necessary, as described above.

Block A Walkways

Probe 7 was located adjacent to an outdoor stairwell fronting Mattawa Avenue and leading to an upper level amenity area. The area is rated for walking in the winter and standing in the summer and will be suitable for the intended use as a walkway.

Probes 103 through 106 were located on the proposed multi-use pathway along the southwestern edge of Block A. The area is protected from large portions of the dominant wind climate by the proposed Block A buildings and as such realises conditions suitable for standing throughout the year, with the exception of walking conditions at probe 106 in the winter months. The area will be comfortable and suitable for the intended use as a walkway.

Block A Outdoor Amenity Spaces

Probes 132 through 135 were located within the 3rd level Outdoor Amenity Space between Buildings A1 and A2, with probe 134 being located within the breezeway beneath the overhang of the building above. The space was tested with 2.0m high perimeter wind screens. Probes 132 and 133, located at the south end of the space are protected from much of the dominant wind climate by the surrounding buildings and as such are rated for sitting in the summer months. Probe 135, at the north end of the space, is exposed to winds emanating from northerly and southerly directions, resulting in conditions suitable for standing in the summer months. Probe 134, located within the breezeway, is susceptible to large portions of the wind climate that are directed to flow around the buildings and are funneled through the breezeway area. As such, probe 134 realises conditions suitable for walking throughout the summer. A mitigation plan is required for the area that may include closing-off one end of the breezeway in order to stop the flow of wind through the area.

Probes 136 and 137 were located within the 3rd level Outdoor Amenity Space between Buildings A2 and A3. The space was tested with 2.0m high perimeter wind screens. The area is protected from large portions of the wind climate by the proposed buildings, however it is exposed to portions of the easterly wind climate and as such is rated for sitting at probe 136 and standing at probe 137 in the summer. A mitigation plan is recommended for the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

Probes 138 and 139 were located within the 9th level Outdoor Amenity Space between Buildings A2 and A3. The space was tested with 2.0m high perimeter wind screens. The area

is protected from portions of the wind climate by the proposed buildings, however it is exposed to winds that are directed to flow down and around the adjacent towers and as such is rated for standing in the summer. A mitigation plan is recommended for the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

Probes 140 through 142 were located within the 12th level Outdoor Amenity Space between Buildings A1 and A2. The space was tested with 2.0m high perimeter wind screens. The area is protected from portions of the wind climate by the proposed buildings, however it is exposed to northwesterly and southeasterly winds that are directed to flow down and around the adjacent towers and as such is rated for sitting at probe 140 and standing at probes 141 and 142 in the summer. A mitigation plan is recommended for the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

5.3.3 Block B

Probes 95 through 102 were located within the proposed Public Park of Block B. The probes within the park indicate conditions suitable for standing throughout the majority of the year, with sitting conditions noted at probes 97, 98, 99, and 101 in the summer season. The area is expected to be generally comfortable and seasonally suitable for the intended use throughout year, however a mitigation plan may be prepared for the Public Park, if sitting conditions are desired throughout larger portions of the space. The mitigation plan could include berms, fencing, porous wind screens, coniferous trees, raised planters, recessed seating areas, and/or others situated throughout the space where practical.

All probes situated within Block B pass the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

5.3.4 Block C

Probes 13 through 21 and 107 through 109 were located around Block C at-grade. Probes 143 through 145 were similarly located atop Rooftop Outdoor Amenity Spaces on Block C. All probes situated within Block C pass the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

Block C Entrances

Probe 20 was located adjacent to the Main Residential Entrance to Building C1, accessed via Mattawa Avenue. The area is exposed to large portions of the wind climate that are directed to flow down and around the proposed buildings and through the gap between along Mattawa

Avenue, resulting in conditions suitable for standing in the summer and walking in the winter. A mitigation plan is recommended for the entrance that may include recessing the entrance into the façade, and/or the addition of porous wind screens adjacent to the entrance that will protect door leafs from winds flowing along the building façade. Consideration of an appropriate mitigation plan for the entrance will result in more comfortable conditions that are suitable for the intended use throughout the year.

Probes 18, 19, and 21 were similarly located adjacent to Retail Entrances to Building C1. The areas are similarly exposed to winds flowing down and around the building, resulting in conditions suitable for mainly standing throughout the year with the exception of walking conditions at probes 19 and 21 in the winter season. Mitigation plans are recommended for the Retail Entrances located adjacent to probes 19 and 21 that may include recessing the entrances into the façades, and/or the addition of porous wind screens adjacent to the entrances that will protect door leafs from winds flowing along the building façades. Consideration of appropriate mitigation plans for the entrances will result in more comfortable conditions that are suitable for the intended uses throughout the year.

Probe 17 was located adjacent to the Daycare Entrance to Building C1, accessed along the southwestern façade. The entrance is exposed to westerly winds, however it is well protected from large portions of the remaining wind climate and as such is rated suitable for standing year-round will be suitable for the intended use.

Probes 13 and 14 were located adjacent to Townhouse Entrances along the northwestern façade of Block C. The area is exposed to large portions of the wind climate that are directed to flow down and around the proposed buildings and through the gap between Blocks A and C. As such, the area is rated suitable for walking in the summer and uncomfortable through the winter months. The Townhouse Entrances are recessed into the building façades and will realise considerably more comfortable conditions than the probes beyond, resulting in conditions at said entrances that are expected to be suitable for the intended uses throughout much of the year. The walkway beyond is expected to remain windy throughout portions of the year, however consideration of additional fine design and landscape elements within the area that were too fine to include in the massing model will result in more comfortable conditions than reported.

Wind conditions comfortable for standing are preferable at building entrances while conditions suitable for walking are suitable for sidewalks. The various Entrances to Block C will realise conditions suitable for the intended uses with incorporation of appropriate mitigation plans where necessary, as described above.

Block C Walkways

Probe 15 was located along a walkway area to the west of Building C1. The area is rated for walking in the winter and standing in the summer and will be suitable for the intended use as a walkway.

Probes 107 through 109 were located on the proposed multi-use pathway along the southwestern edge of Block C. The area is protected from large portions of the dominant wind climate by the proposed Block A and Block C buildings and as such realises conditions suitable for standing throughout the year, with the exception of walking conditions at probe 109 in the winter months. The area will be comfortable and suitable for the intended use as a walkway.

Block C Outdoor Amenity Spaces

Probe 16 was located within the at-grade Outdoor Daycare Play Space to the west of Building C1. The area is protected from much of the dominant wind climate by the surrounding buildings and as such is rated for sitting in the summer and standing in the winter. The winter rating is near the transition to sitting conditions and with consideration of fine design and landscape elements that were too fine to include in the massing model is expected to be suitable for sitting through the majority of the year. The Outdoor Daycare Play Space will be comfortable and suitable for the intended use year-round.

Probe 143 was located within the 2nd level Outdoor Amenity Space on the northwestern façade of Building C1. The space was tested with 2.0m high perimeter wind screens. The area is protected from large portions of the wind climate by the surrounding buildings and as such is rated suitable for sitting in the summer and will be seasonally suitable for the intended use.

Probe 144 was located within the 3rd level Outdoor Amenity Space on the northwestern façade of Building C1. The space was tested with 2.0m high perimeter wind screens. The area is protected from portions of the wind climate by the surrounding buildings, however it is exposed to westerly winds that are directed to flow down and around the adjacent towers and as such is rated for standing in the summer. A mitigation plan is recommended for the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

Probe 145 was located within the 13th level Outdoor Amenity Space on the northwestern façade of Building C1. The space was tested with 2.0m high perimeter wind screens. The area is similarly protected from portions of the wind climate by the surrounds, however it is exposed to northerly through northeasterly and westerly through southwesterly winds that are directed to flow down and around the adjacent towers and as such is rated for standing in the summer. A mitigation plan is recommended for the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

5.3.5 Block E

Probes 22 through 41 were located around Block E at-grade, and probes 146 through 155 were similarly located atop Rooftop Outdoor Amenity Spaces on Block E. All probes situated

within Block E pass the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

Block E Entrances

Probe 40 was located adjacent to the Main Residential Entrance to Building E1, accessed via Dundas Street East. The entrance is recessed into the façade of the building and protected from large portions of the wind climate, resulting in conditions rated suitable for standing in the winter and sitting in the summer. The Main Residential Entrance to Building E1 will be comfortable and suitable for the intended use year-round.

Probe 26 was located adjacent to the Main Residential Entrance to Building E3, accessed via Mattawa Avenue. The area is exposed to large portions of the wind climate that are directed to flow down and around the proposed buildings and through the gap between along Mattawa Avenue, resulting in conditions suitable for standing in the summer and walking in the winter. A mitigation plan is recommended for the entrance that may include recessing the entrance into the façade, and/or the addition of porous wind screens adjacent to the entrance that will protect door leafs from winds flowing along the building façade. Consideration of an appropriate mitigation plan for the entrance will result in more comfortable conditions that are suitable for the intended use throughout the year.

Probes 22, 24, 25, and 27 were located adjacent to Retail Entrances to Block E, located along Mattawa Avenue. The areas are similarly exposed to winds flowing down and around the proposed buildings and along Mattawa Avenue, resulting in conditions suitable for walking in the winter and standing in the summer. Mitigation plans are recommended for the Retail Entrances that may include recessing the entrances into the façades, and/or the addition of porous wind screens adjacent to the entrances that will protect door leafs from winds flowing along the building façades. Consideration of appropriate mitigation plans for the entrances will result in more comfortable conditions that are suitable for the intended uses throughout the year.

Probes 37 through 39 and 41 were also located adjacent to Retail Entrances to Building E1, located along Dundas Street East. The areas are similarly exposed to winds flowing down and around the building, resulting in conditions suitable for mainly standing throughout the year with the exception of walking conditions at probes 37 and 41 in the winter season. Mitigation plans are recommended for the Retail Entrances located adjacent to probes 37 and 41 that may include recessing the entrances into the façades, and/or the addition of porous wind screens adjacent to the entrances that will protect door leafs from winds flowing along the building façades. Consideration of appropriate mitigation plans for the entrances will result in more comfortable conditions that are suitable for the intended uses throughout the year.

Probes 30, 31, 33, 34, and 35 were located adjacent to Townhouse Entrances along the northeastern and southeastern façades of Block E. The areas are protected from large portions of the dominant westerly wind climate by the proposed buildings and as such realise fairly comfortable conditions, suitable for standing year-round at probes 30 and 31, and sitting year-round at probes 33 through 35. The Townhouse Entrances to Block E will be comfortable and suitable for the intended uses year-round.

Wind conditions comfortable for standing are preferable at building entrances while conditions suitable for walking are suitable for sidewalks. The various Entrances to Block E will realise conditions suitable for the intended uses with incorporation of appropriate mitigation plans where necessary, as described above.

Block E Walkways

Probe 23 was located adjacent to an outdoor stairwell fronting Mattawa Avenue and leading to an upper level amenity area. The area is rated for standing year-round and will be suitable for the intended use as a walkway.

Probes 28, 29, and 32 were located along walkways on the southeastern façade of Block E. The areas are protected from large portions of the dominant wind climate by the surrounding buildings and as such realise conditions suitable for standing throughout the year, with the exception of sitting conditions at probe 28 in the summer. Probe 36 was similarly located along a walkway proximate to the northern corner of Block E and was rated suitable for sitting in the summer and standing through the winter. The areas will be comfortable and suitable for the intended use as a walkway, year-round.

Block E Outdoor Amenity Spaces

Probes 146 through 152 were located within the 2nd level Outdoor Amenity Space between Buildings E1, E2, and E3. The space was tested with 2.0m high perimeter wind screens. The area is protected from large portions of the wind climate by the surrounding buildings, however portions of the space are exposed to winds that are directed to flow down and around the adjacent towers. As such, the summer ratings indicate conditions suitable for sitting at probes 146 and 149, and standing conditions at probes 147, 148, and 150 through 152. A mitigation plan is recommended for the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

Probes 153 through 155 were located within the 9th level Outdoor Amenity Space atop Building E2. The space was tested with 2.0m high perimeter wind screens. The area is similarly protected from portions of the wind climate by the surrounds, however it is exposed to northerly winds that approach from over open lands. As such, probes 153 and 155 are rated for sitting in the summer, while probe 154 is rated for standing. A mitigation plan is recommended for the central portion of the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

5.3.6 Block F

Probes 42 through 67 were located around Block F at-grade, and probes 156 through 161 were located atop Rooftop Outdoor Amenity Spaces on Block F. All probes situated within Block

F pass the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

Block F Entrances

Probes 42 and 46 were respectively located adjacent to the Main Residential Entrances to Buildings F1 and F3, accessed via Mattawa Avenue. The areas are exposed to large portions of the wind climate that are directed to flow down and around the proposed buildings and through the gap between along Mattawa Avenue, resulting in conditions suitable for standing in the summer and walking in the winter. Mitigation plans are recommended for the entrances that may include recessing the entrances into the façades, and/or the addition of porous wind screens adjacent to the entrances that will protect door leafs from winds flowing along the building façades. Consideration of appropriate mitigation plans for the entrances will result in more comfortable conditions that are suitable for the intended uses throughout the year.

Probes 43 and 44 were similarly located adjacent to Retail Entrances to Building F1 fronting Mattawa Avenue. The areas are similarly exposed to winds flowing down and around the building, resulting in conditions suitable for mainly standing throughout the year with the exception of walking conditions at probe 43 in the winter season. A mitigation plan is recommended for the Retail Entrance located adjacent to probe 43 that may include recessing the entrance into the façade, and/or the addition of porous wind screens adjacent to the entrance that will protect door leafs from winds flowing along the building façade. Consideration of an appropriate mitigation plan for the entrance will result in more comfortable conditions that are suitable for the intended use throughout the year.

Probes 48 through 59 and 60 through 65 were located adjacent to Townhouse Entrances to Buildings F1, F3, FTH1, and FTH2, accessed along the private laneway and pedestrian mews. The areas are well protected from large portions of the wind climate and as such are rated for sitting throughout the majority of the year, with the exception of localised standing conditions at probes 57 and 58 in the winter, and probe 59 year-round. The Townhouse Entrances to Block F will be comfortable and suitable for the intended uses throughout the year.

Wind conditions comfortable for standing are preferable at building entrances while conditions suitable for walking are suitable for sidewalks. The various Entrances to Block F will realise conditions suitable for the intended uses with incorporation of appropriate mitigation plans where necessary, as described above.

Block F Walkways

Probe 45 was located adjacent to an outdoor stairwell fronting Mattawa Avenue and leading to an upper level amenity area. The area is rated for standing in the summer and walking through the winter season, and will be suitable for the intended use as a walkway.

Probe 47 was located along a walkway on the southeastern façade of Building F3. The area is protected from portions of the wind climate by the surrounding buildings, however it is exposed to winds emanating from westerly through southerly directions. The area is rated for standing in the summer and walking in the winter and will be suitable for the intended use as a walkway.

Block F Outdoor Amenity Spaces

Probes 66 and 67 were located within the at-grade Outdoor Amenity Spaces adjacent to the townhouse blocks FTH1 and FTH2. The space between the townhouse blocks (probe 66) is protected from the majority of the wind climate by the surrounding buildings and as such is rated for sitting year-round and will be suitable for the intended use. The space to the southeast of FTH2 (probe 67) is similarly protected from much of the dominant wind climate by the surrounding buildings, however it is exposed to southerly through southwesterly winds and as such is rated for standing throughout the year. A mitigation plan is recommended for the space that may include fencing/porous wind screens, coniferous trees, raised planters, etc. situated throughout the space as practical. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

Probes 156 through 159 were located within the 2nd level Outdoor Amenity Space between Buildings F1 and F3. The space was tested with 2.0m high perimeter wind screens. The area is protected from portions of the wind climate by the surrounding buildings, however it is exposed to portions of the easterly and southerly wind climate that are directed to flow down and around the adjacent towers. As such, probes 156, 157, and 158 are rated for sitting through the summer, and probe 159 is rated for standing. A mitigation plan is recommended for the southmost portion of the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

Probe 160 was located within the 6th level Outdoor Amenity Space on the northmost corner of Building F3. The space was tested with 2.0m high perimeter wind screens. The area is protected from large portions of the wind climate and as such is rated suitable for sitting in the summer and will be seasonally suitable for the intended use.

Probe 161 was located within the 9th level Outdoor Amenity Space on the northeastern façade of Building F1. The space was tested with 2.0m high perimeter wind screens. The area is similarly protected from large portions of the wind climate and is rated suitable for sitting in the summer and will be seasonally suitable for the intended use.

5.3.7 Block G

Probes 68 through 88 were located around Block G at-grade, and probes 162 through 169 were located atop Rooftop Outdoor Amenity Spaces on Block G. All probes situated within Block G pass the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

Block G Entrances

Probes 80 and 84 were respectively located adjacent to the Main Residential Entrances to Buildings G1 and G2, accessed via Mattawa Avenue. The areas are exposed to large portions of the wind climate that are directed to flow down and around the proposed buildings and along

Mattawa Avenue, resulting in conditions suitable for mainly standing year-round, with the exception of winter walking conditions at probe 84. A mitigation plan is recommended for the Main Residential Entrance to Building G2 that may include recessing the entrance into the façade, and/or the addition of porous wind screens adjacent to the entrance that will protect door leafs from winds flowing along the building façade. Consideration of an appropriate mitigation plan for the entrance will result in more comfortable conditions that are suitable for the intended use throughout the year.

Probes 81 through 83 were similarly located adjacent to Retail Entrances to Block G fronting Mattawa Avenue. The areas are similarly exposed to winds flowing down and around the buildings, resulting in conditions suitable for sitting or standing throughout the year with the exception of walking conditions at probe 83 in the winter season. A mitigation plan is recommended for the Retail Entrance located adjacent to probe 83 that may include recessing the entrance into the façade, and/or the addition of porous wind screens adjacent to the entrance that will protect door leafs from winds flowing along the building façade. Consideration of an appropriate mitigation plan for the entrance will result in more comfortable conditions that are suitable for the intended use throughout the year.

Probes 68 through 75 were located adjacent to Townhouse Entrances to Building GTH1, accessed along the private laneway and pedestrian mews. Probes 76 through 78 and 85 through 88 were similarly located adjacent to Townhouse Entrances to Buildings G1 and G2, accessed via the private laneway and Mattawa Avenue. The areas are well protected from large portions of the wind climate and as such are rated for sitting throughout the majority of the year, with the exception of localised standing conditions at probes 72, 73, 86, and 87 in the winter, and probe 85 year-round. The Townhouse Entrances to Block G will be comfortable and suitable for the intended uses throughout the year.

Wind conditions comfortable for standing are preferable at building entrances while conditions suitable for walking are suitable for sidewalks. The various Entrances to Block G will realise conditions suitable for the intended uses with incorporation of appropriate mitigation plans where necessary, as described above.

Block G Walkways

Probe 79 was located along a walkway on the northwestern façade of Building G1. The area is protected from portions of the wind climate by the surrounding buildings, however it is exposed to winds emanating from northerly and southwesterly directions that flow through the gap between Blocks F and G. The area is rated for walking year-round and will be suitable for the intended use as a walkway.

Block G Outdoor Amenity Spaces

Probes 162 through 167 were located within the 2nd level Outdoor Amenity Space between Buildings G1 and G2. The space was tested with 2.0m high perimeter wind screens. The area is protected from portions of the wind climate by the surrounding buildings, however it is exposed to winds that are directed to flow down and around the adjacent towers. As such, in the summer months, probes 162, 163, and 166 are rated for sitting and probes 164, 165, and

167 are rated for standing. A mitigation plan is recommended for the space that may include the addition of trellises over seating areas, coniferous trees, raised planters populated with coarse plantings, and/or others situated throughout the space. Consideration of an appropriate mitigation plan for the space will result in more comfortable conditions that are seasonally suitable for the intended use.

Probe 168 was located within the 9th level Outdoor Amenity Space on the northeastern façade of Building G2. The space was tested with 2.0m high perimeter wind screens. The area is protected from large portions of the wind climate and as such is rated suitable for sitting in the summer and will be seasonally suitable for the intended use.

Probe 169 was located within the 10th level Outdoor Amenity Space on the northeastern façade of Building G1. The space was tested with 2.0m high perimeter wind screens. The area is similarly protected from large portions of the wind climate and is rated suitable for sitting in the summer and will be seasonally suitable for the intended use.

5.3.8 Block H

Probes 110 through 114 were located within Block H1, and probes 115 through 118 were located within Block H2, within the buffer zone on the southwestern edge of the proposed Development site. The area is mainly rated suitable for standing throughout the year in the proposed setting, with exceptions. Probes 110, 112, and 113 realise windier conditions in the winter months, rated for walking. Conversely, more comfortable conditions rated for sitting are noted at probes 117 and 118 in the summer and probe 116 year-round. The buffer zone is not expected to be frequented by pedestrians, however it will be suitable as a walking-area, if desired.

All probes situated within Block H pass the pedestrian level wind velocity safety criteria, as described in Section 4.7 and depicted in Figure 9.

5.4 Summary

The observed wind velocity and flow patterns at the proposed Development site are largely influenced by approach wind characteristics that are dictated by the predominantly suburban mix of residential and commercial development, and related open areas, mitigating the wind to different degrees on approach. Historical weather data indicates that strong winds of a mean wind speed greater than 30 km/h occur approximately 15 percent of the time during the winter months and 7 percent of the time during the summer. Once the subject site is developed, ground level winds at some locations will improve, or remain similar to the existing setting, with generalized increases in pedestrian level winds within the site. The consideration of proposed surface roughness will result in conditions more comfortable than those reported herein. The relationship between surface roughness and wind is discussed in the Appendix and shown graphically in Figure A of the same section.

With inclusion of the proposed Development, the site and surrounds are predicted generally comfortable and suitable for walking, standing, or better, throughout the winter, and standing or sitting throughout the summer, with localized windier conditions proximate to building corners and gaps in between. These areas remain generally comfortable and suitable for the intended uses, with localised uncomfortable conditions through the winter season within the gap between Blocks A and C. The uncomfortable ratings are somewhat near the transition to walking conditions, and with consideration of mitigative features within the area, the space is expected to realise more comfortable conditions than reported that are suitable for the intended use throughout much of the year.

Mitigation plans are recommended for various Entrances to the proposed Development, as well as various Outdoor Amenity Spaces throughout the site. Consideration of appropriate mitigation plans for these spaces will result in more comfortable conditions than reported that will be seasonally suitable for the intended use.

The proposed Development is predicted to realise wind conditions suitable to the context.

6. FIGURES:

Figure 1: Laboratory Testing Facility

Figure 2a: Site Aerial Photo

Figure 2b: Site Plan

1 SITE PLAN - ROOF
A011 1 : 750

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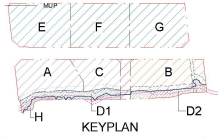
NO.	DATE	REVISION/ COMMENT
1	2022-07-29	Issued for ZBA/OPA

NOTES

ROOF LEGEND

- XX.XX m — SEPERATION DISTANCE
- EXISTING ELEVATION
- 199.0 — PROPOSED ELEVATION
- TOWER FLOOR PLATE (10-42 STORIES)
- TALL MID-RISE FLOOR PLATE (9-15 STORIES)
- LOW TO MID-RISE FLOOR PLATE (1-8 STORIES)
- GREEN ROOF/ LANDSCAPE
- OUTDOOR AMENITY AREA
- EXISTING PROPERTY LINE
- PROPERTY LINE
- PARCEL LINE
- PRIVATE ROAD EASMENT
- 10m OFFSET FROM DRIP LINE
- DRIPLINE
- 7m OFFSET FROM LTSTOB
- LONG TERM STABLE TOP OF SLOPE



KEYPLAN

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Mississauga, Ontario
Hazelview Investments

SITE PLAN - ROOF

PROJECT	42075_1	DRAWN	SvN
SCALE	As indicated	CHECKED	SvN
DATE	03/09/21	PLOTTED	10/2/2023 4:21:13 PM

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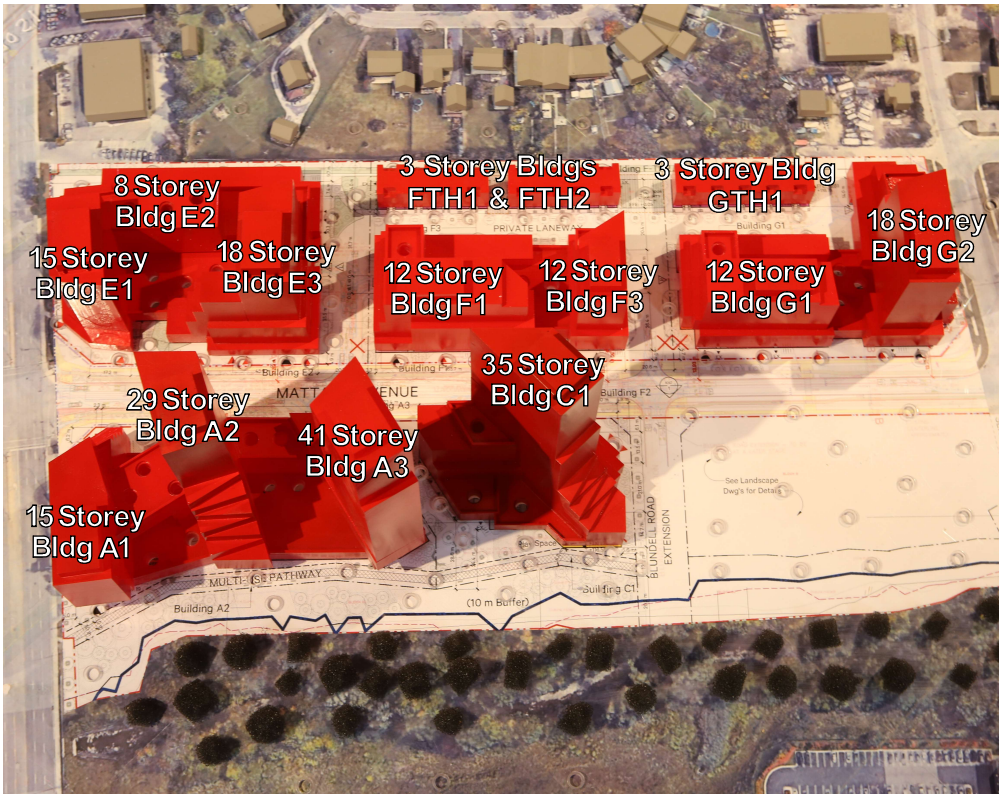
Figure 3: 1:500 Scale model of test site

a) Overall view of model - Proposed Site



b) Close-up view of model - Proposed Site

Figure 4: Location plan for pedestrian level wind velocity measurements.

Figure 5a: Winter Wind Rose - Pearson International Airport

Historical Directional Distribution of Winds (@ 10*m* height)
November through April (1980 - 2022)

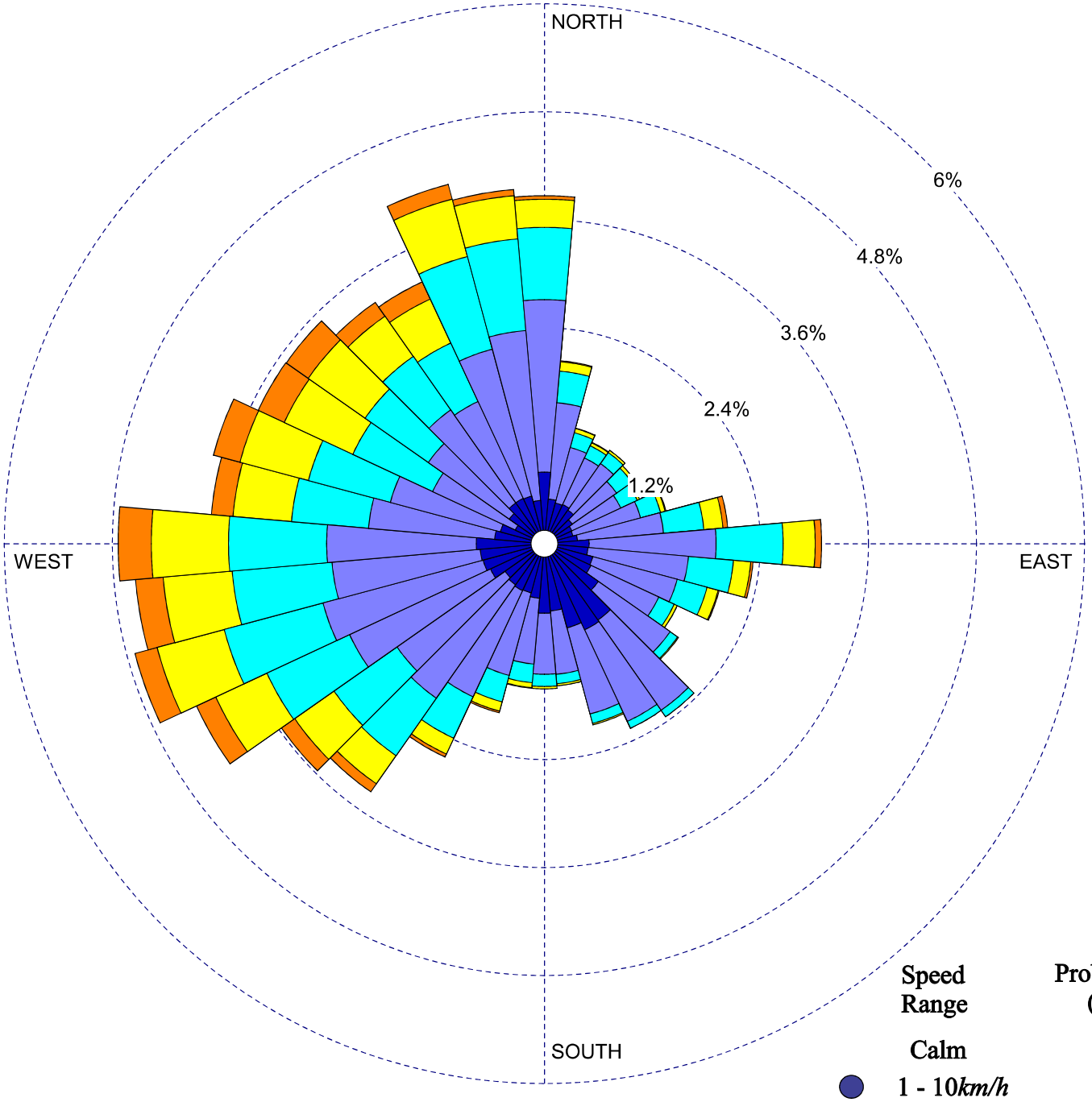
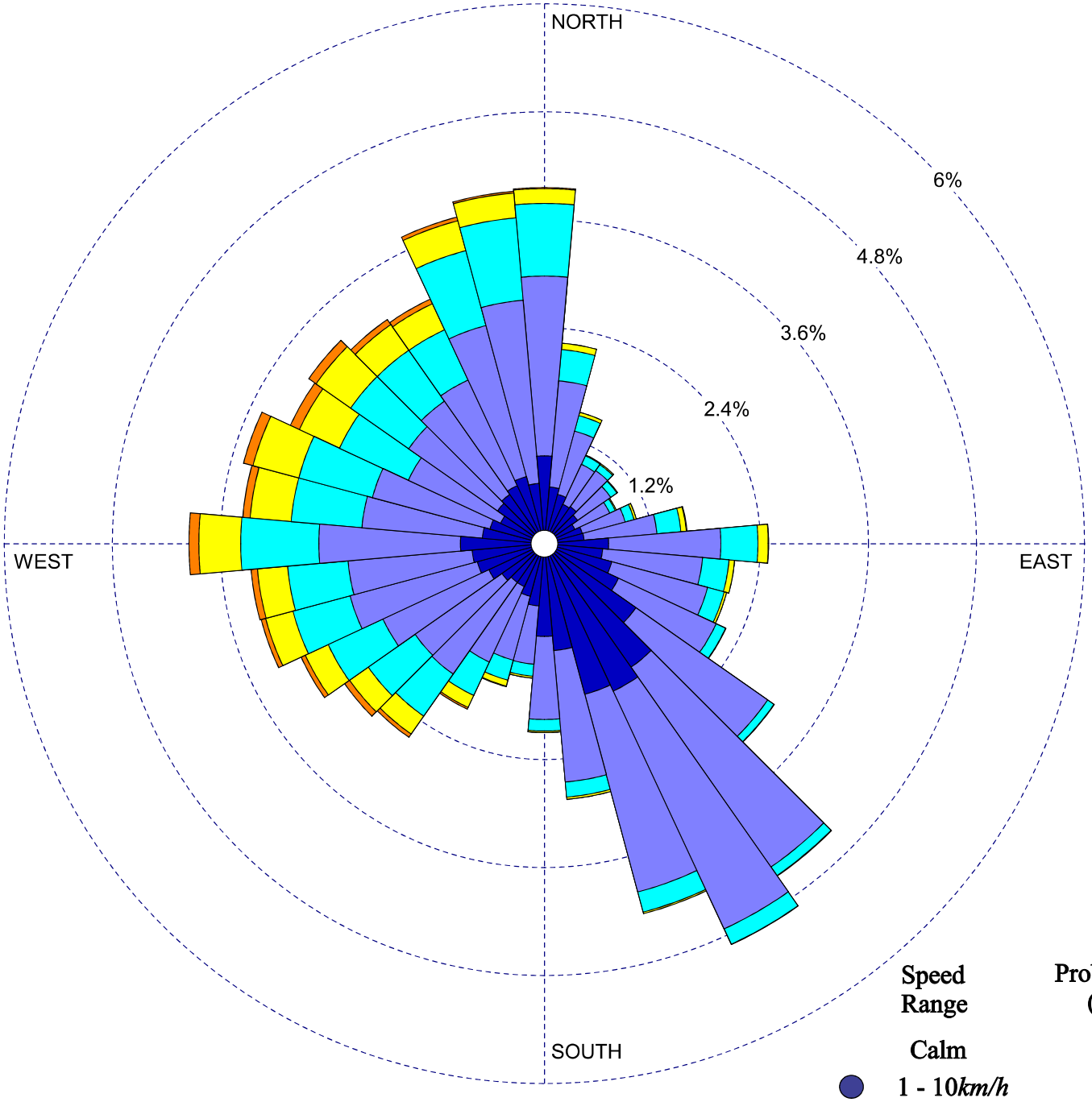


Figure 5b: Summer Wind Rose - Pearson International Airport

Historical Directional Distribution of Winds (@ 10*m* height)
May through October (1980 - 2022)



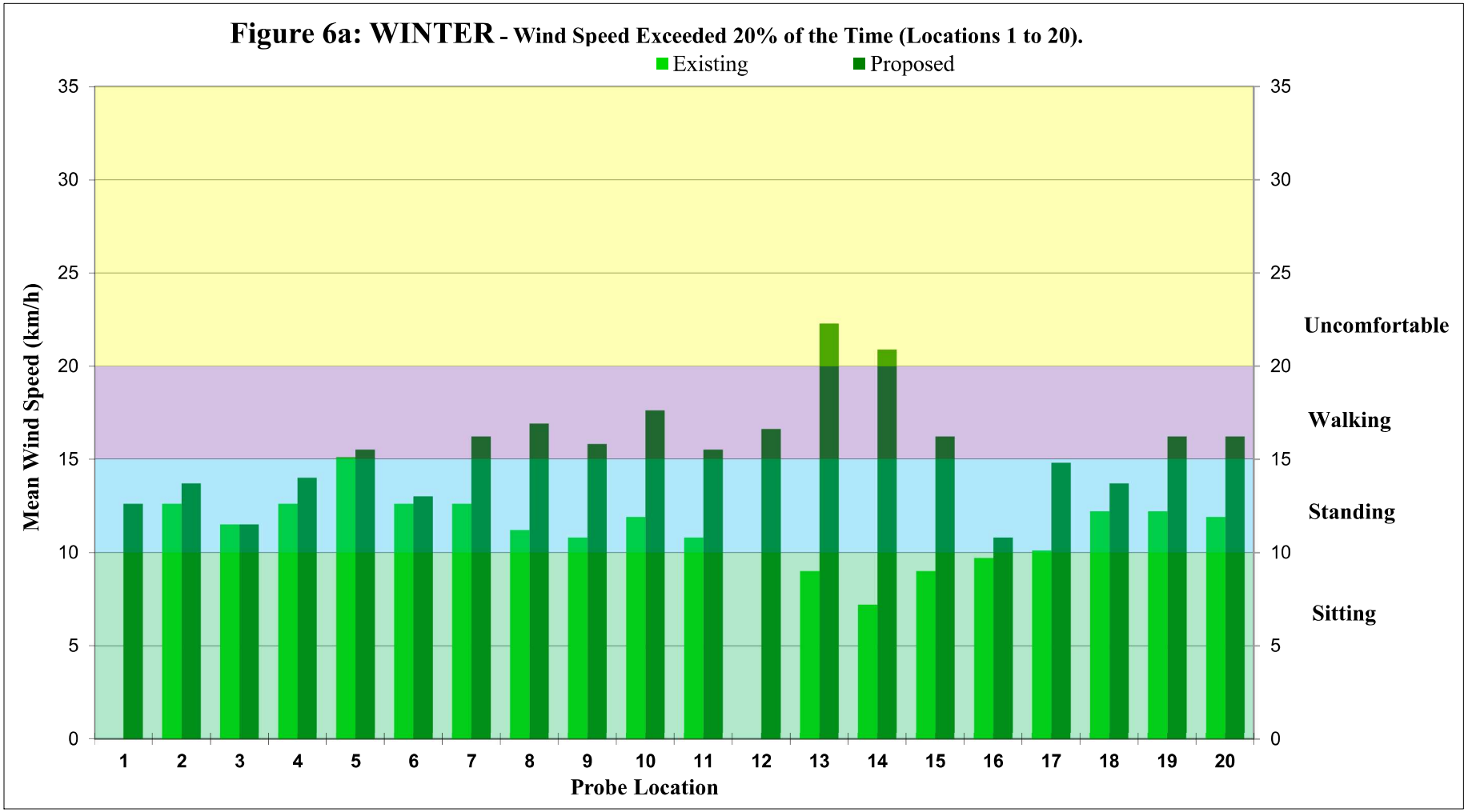
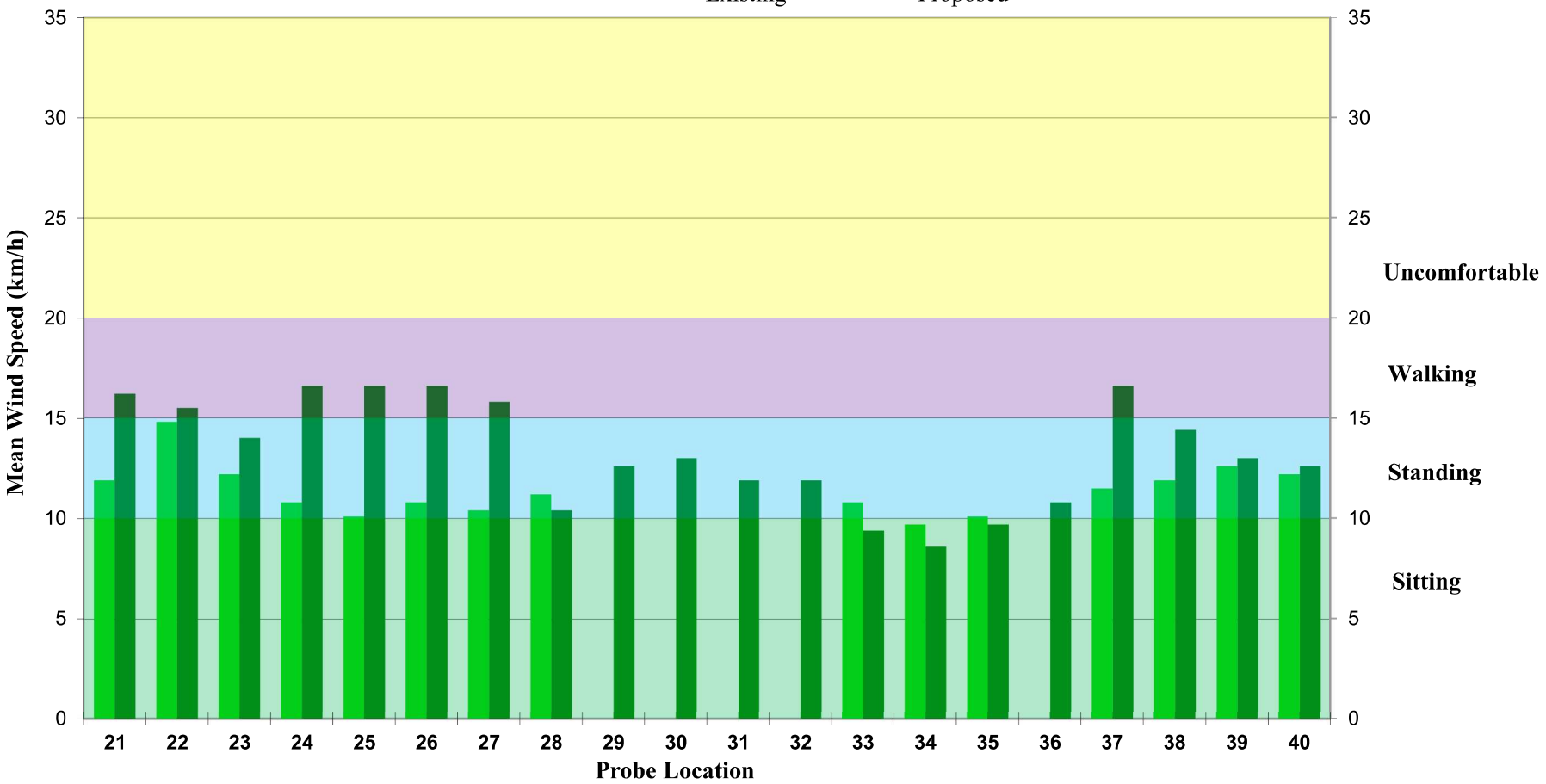


Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 1 to 20).
Existing
Proposed
Mean Wind Speed (km/h)
Probe Location
Uncomfortable
Walking
Standing
Sitting
0
5
10
15
20
25
30
35
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 21 to 40).



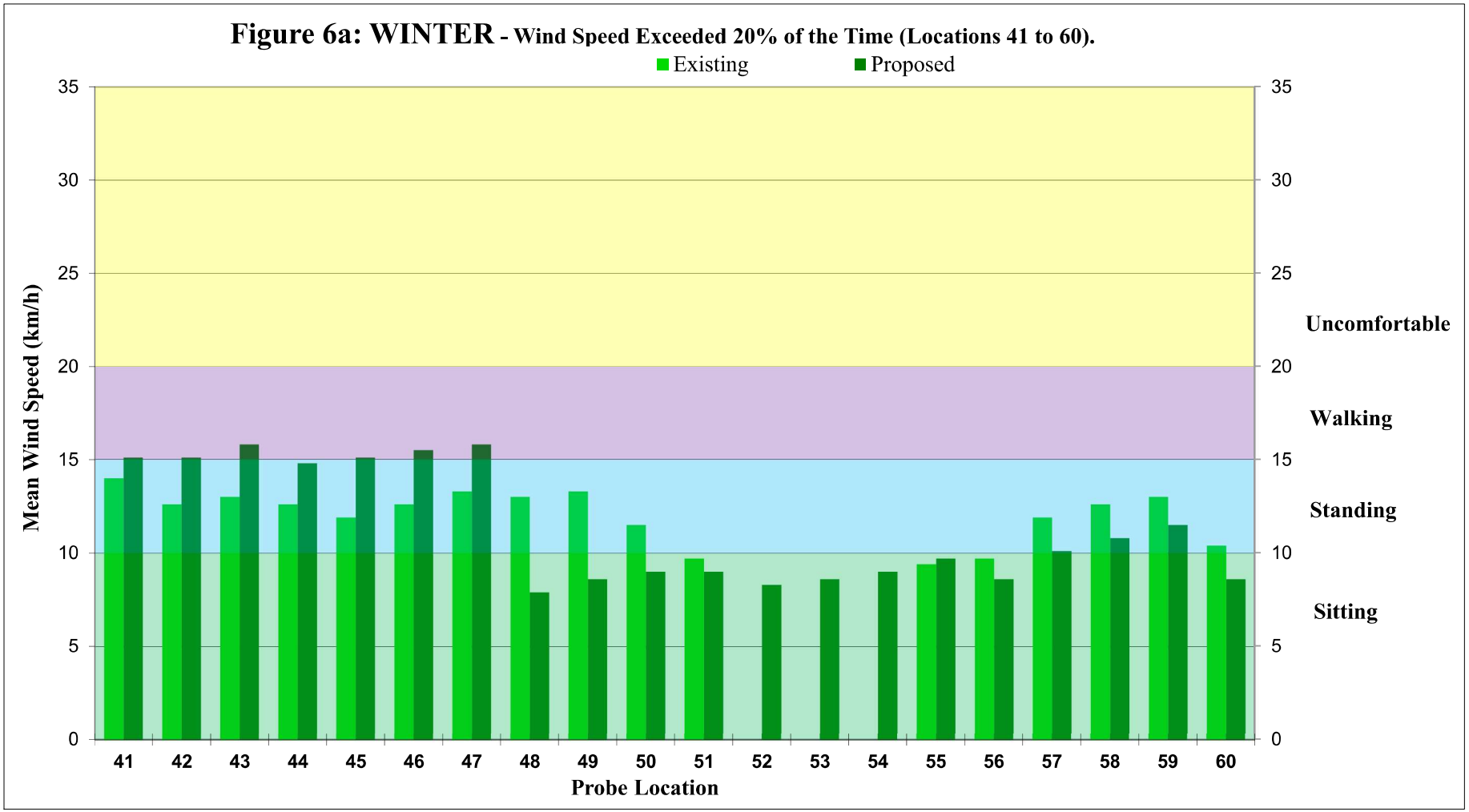


Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 41 to 60).
Existing
Proposed
Mean Wind Speed (km/h)
35
30
25
20
15
10
5
0
Uncomfortable
Walking
Standing
Sitting
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
Probe Location

Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 61 to 80).

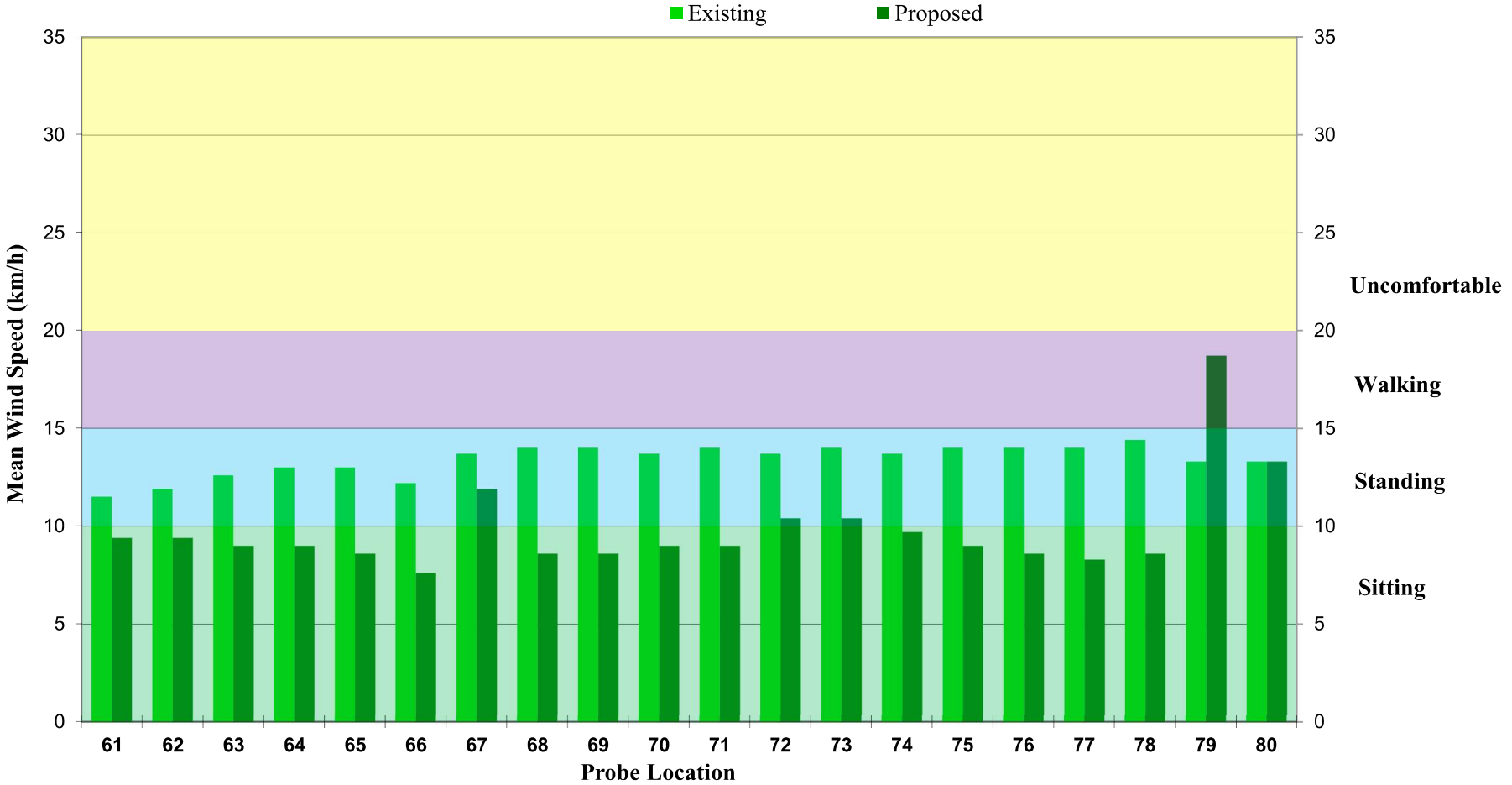


Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 81 to 100).

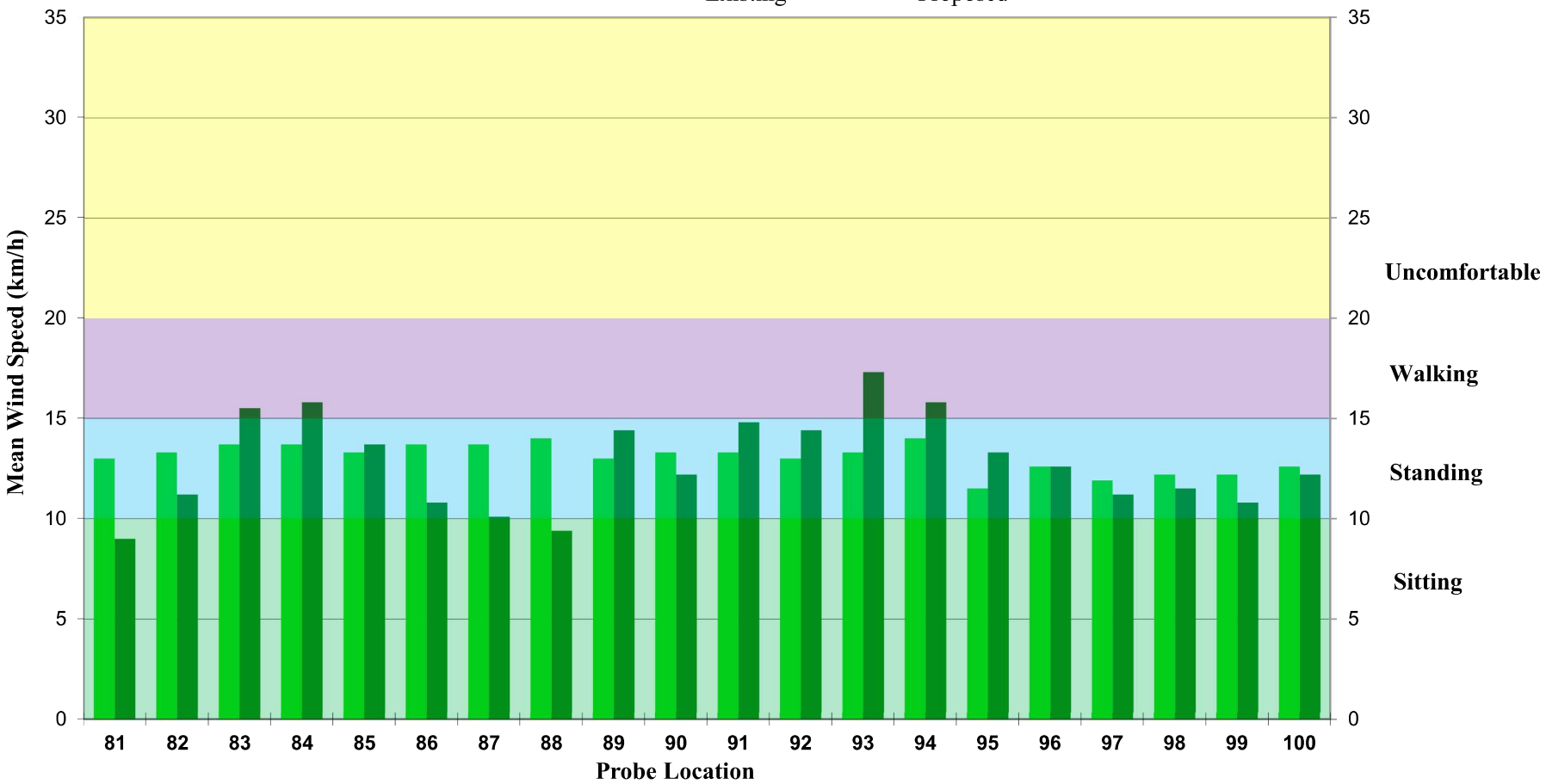


Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 101 to 120).

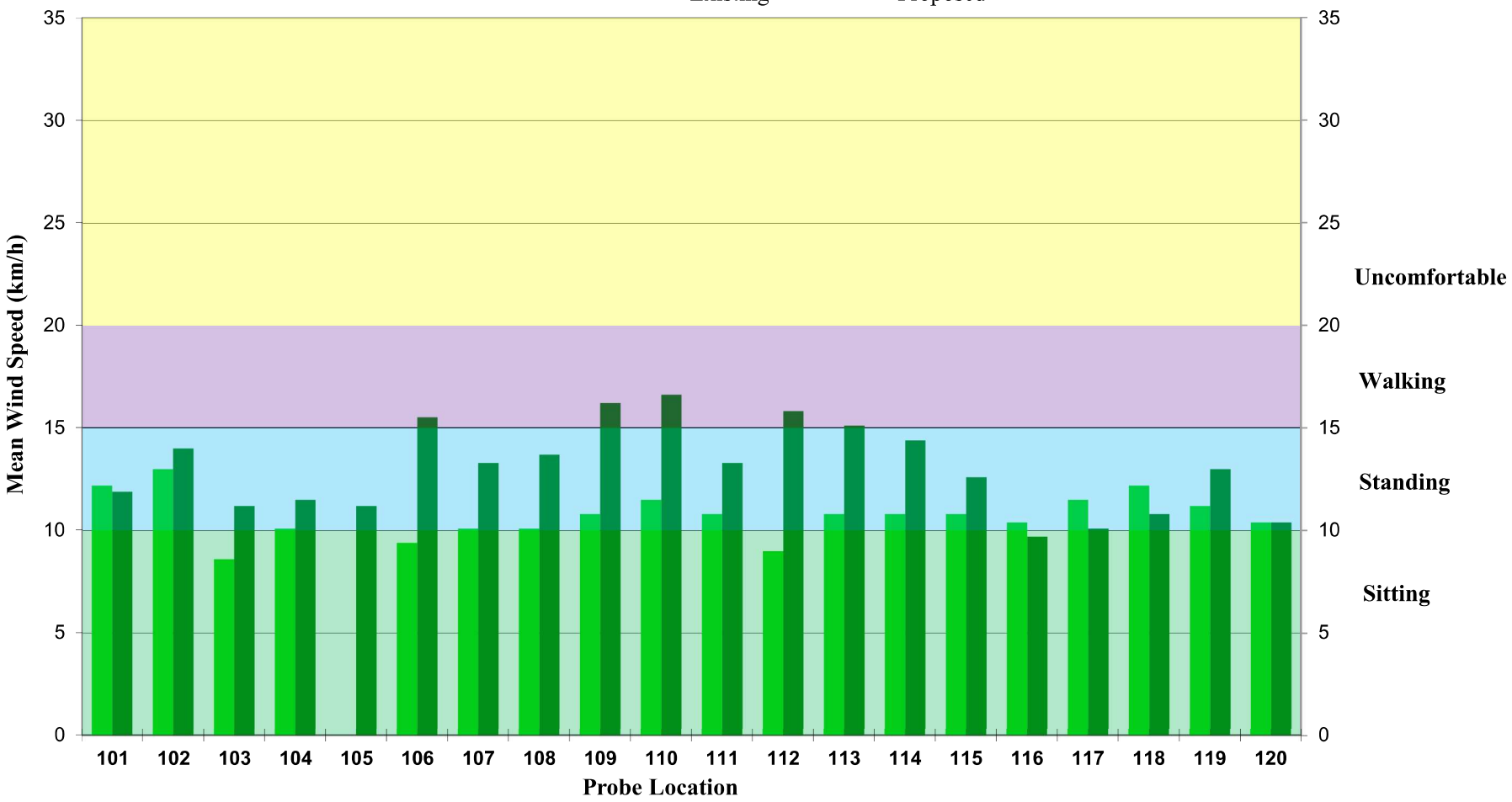


Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 121 to 140).

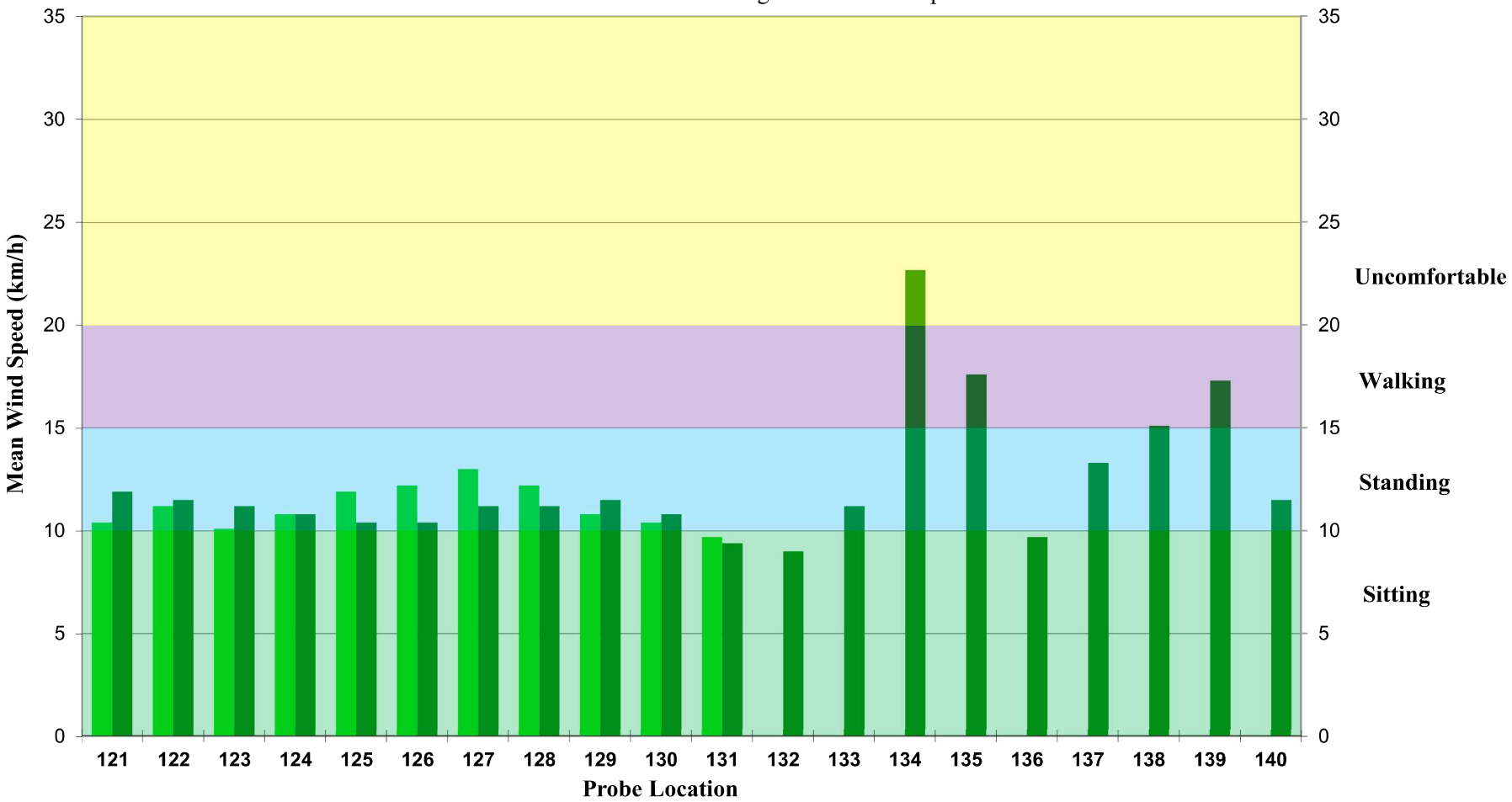


Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 141 to 160).

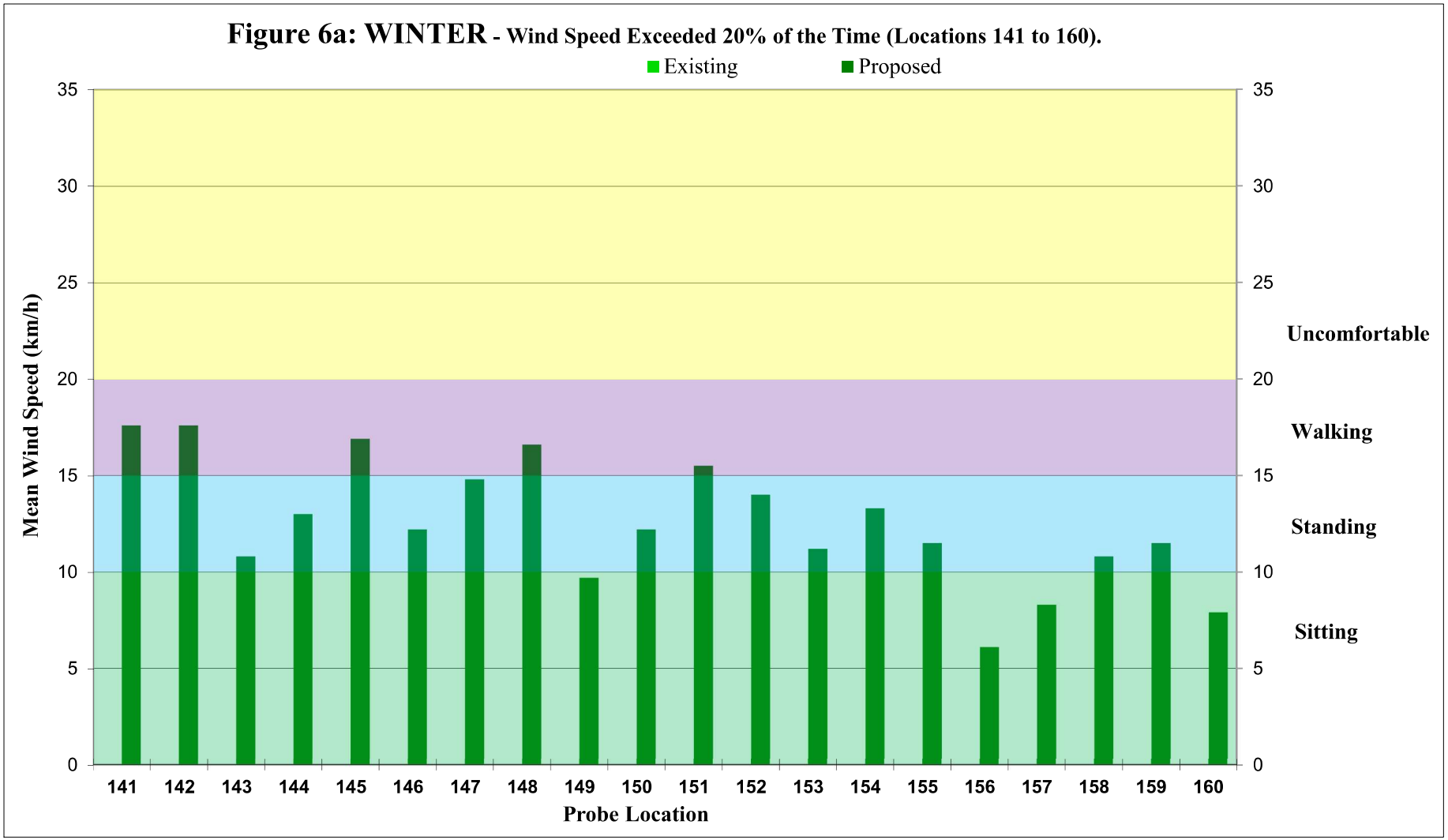


Figure 6a: WINTER - Wind Speed Exceeded 20% of the Time (Locations 161 to 169).

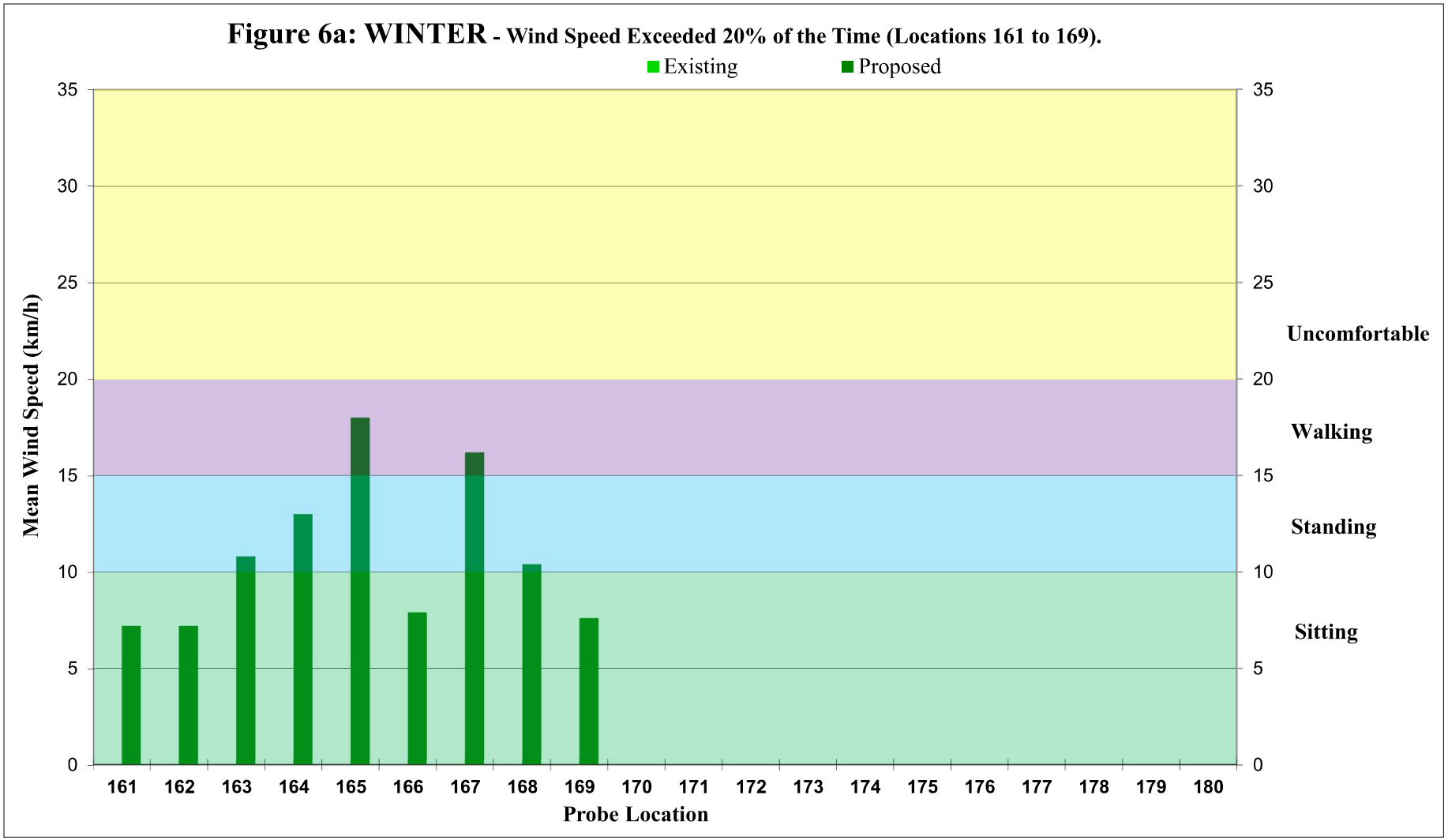
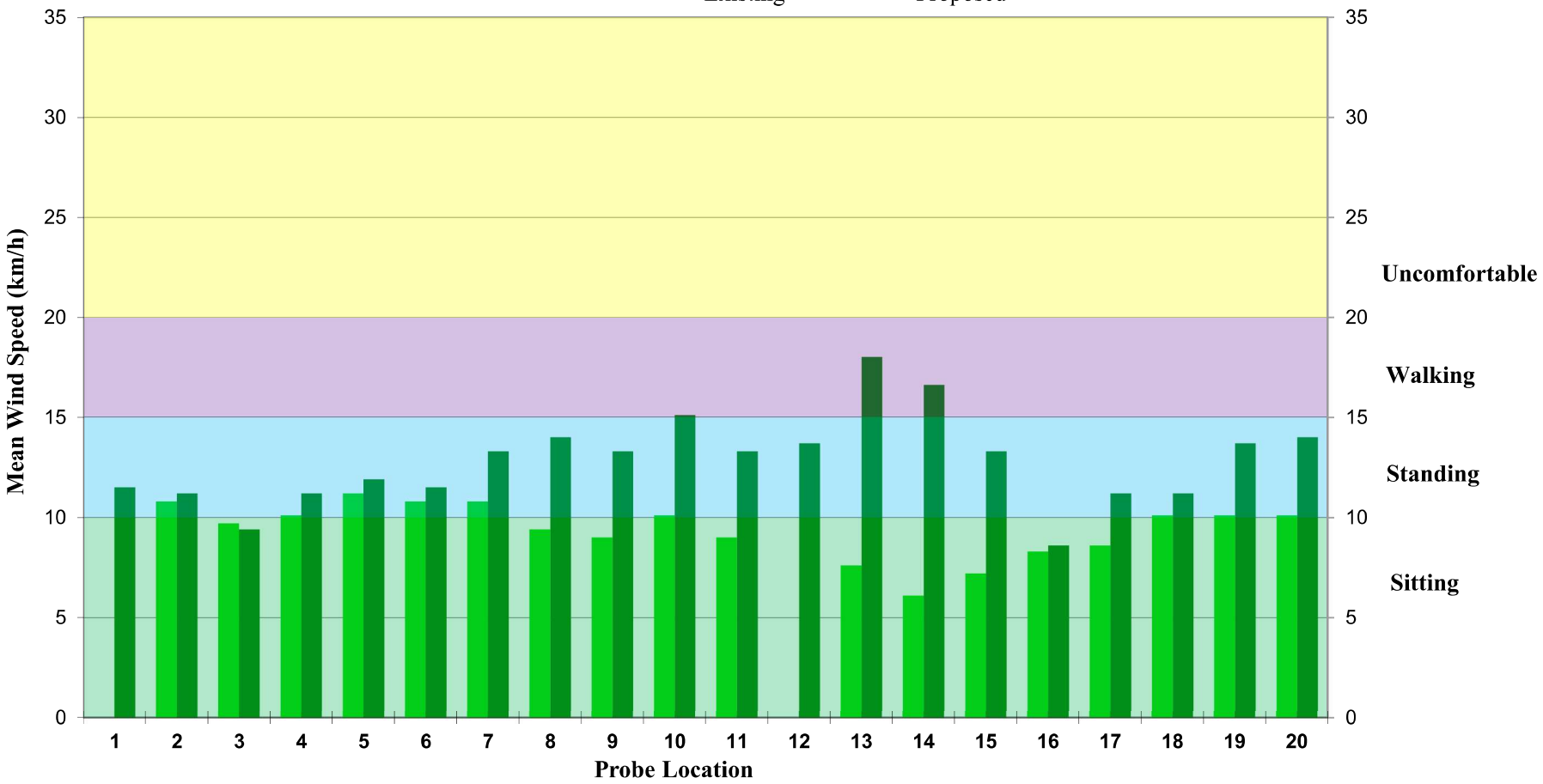


Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 1 to 20).



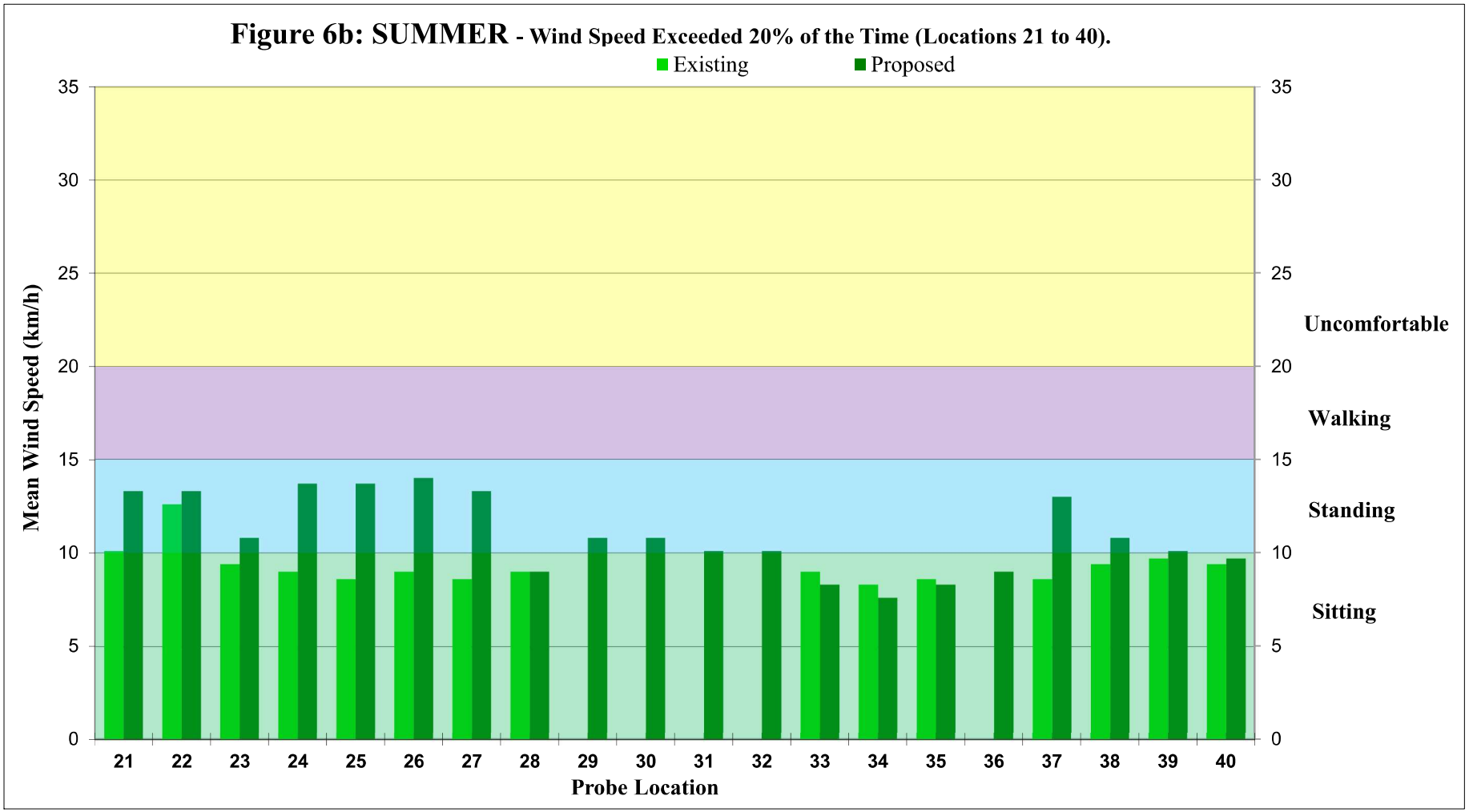


Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 21 to 40).
Existing
Proposed
Mean Wind Speed (km/h)
0
5
10
15
20
25
30
35
Uncomfortable
Walking
Standing
Sitting
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
Probe Location

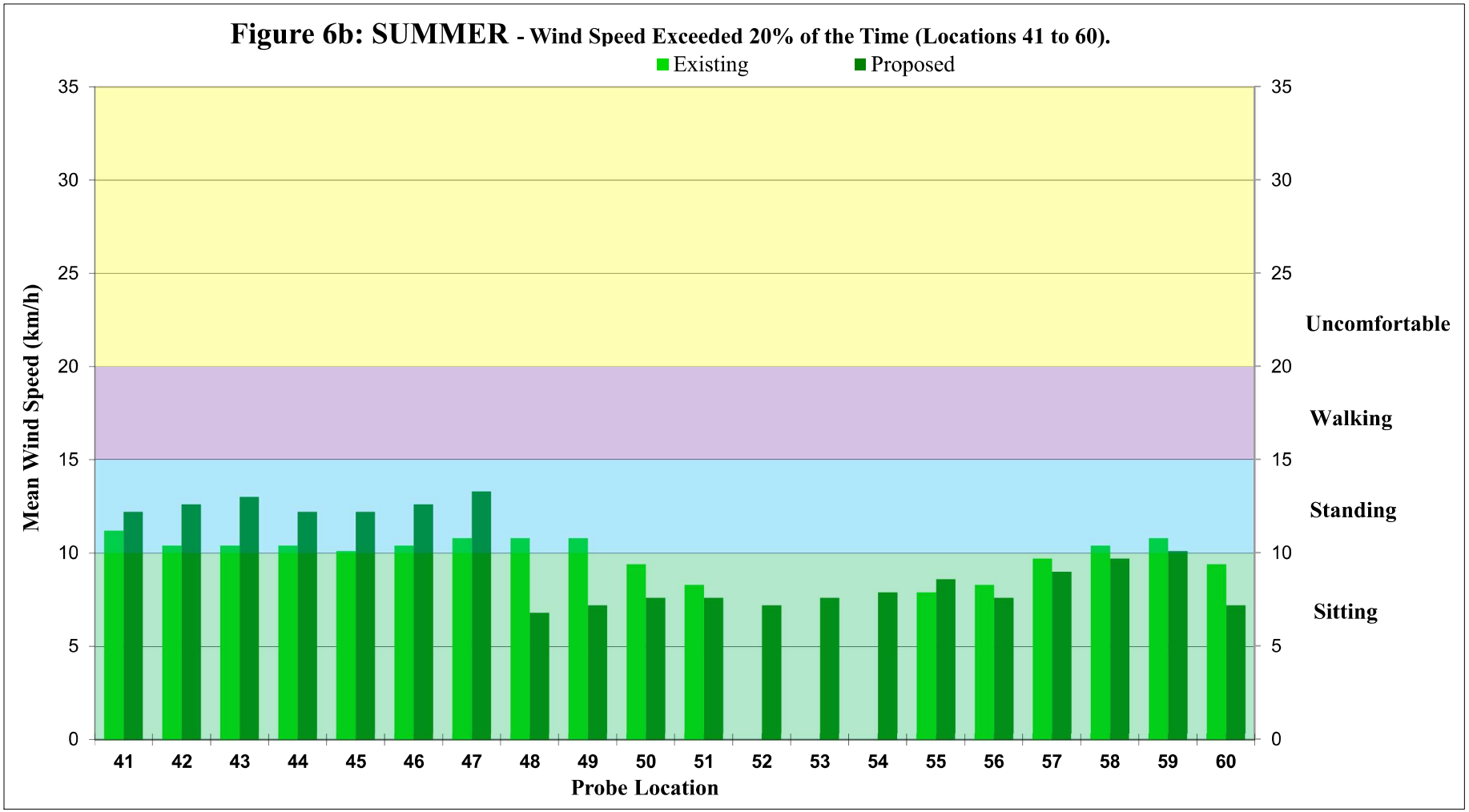


Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 41 to 60).
Existing
Proposed
Mean Wind Speed (km/h)
0
5
10
15
20
25
30
35
Uncomfortable
Walking
Standing
Sitting
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
Probe Location

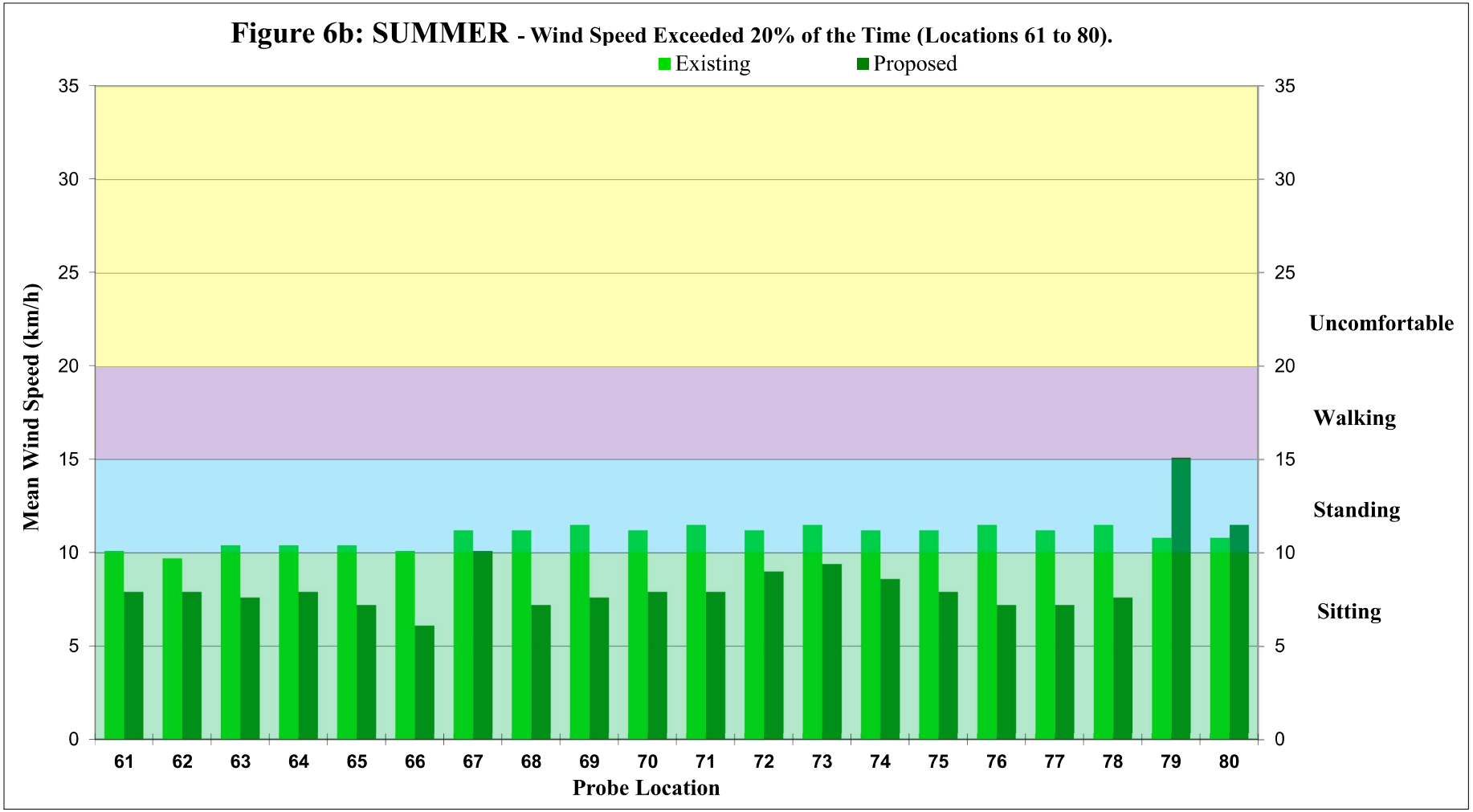


Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 61 to 80).
Existing
Proposed
Mean Wind Speed (km/h)
35
30
25
20
15
10
5
0
Uncomfortable
Walking
Standing
Sitting
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
Probe Location

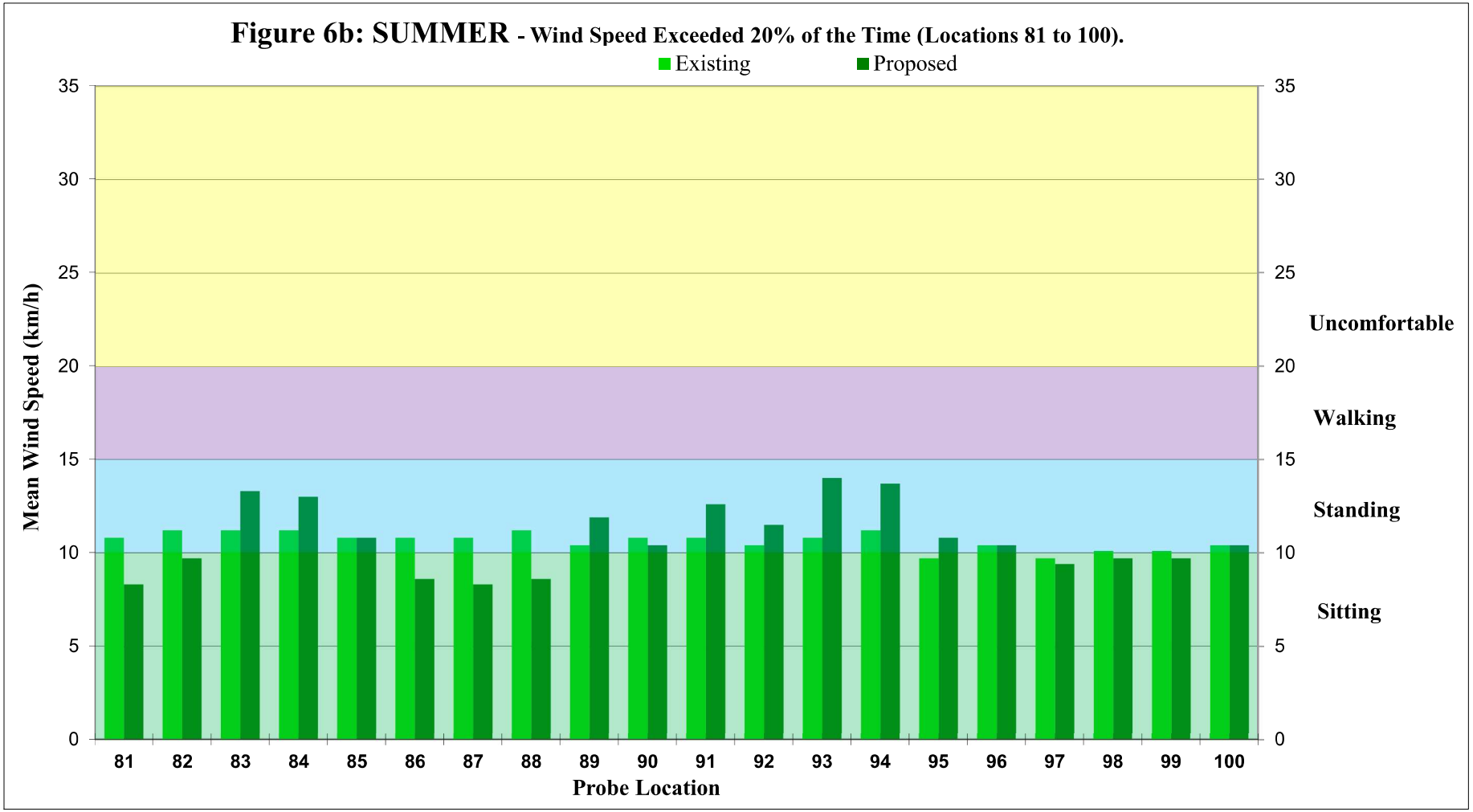


Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 81 to 100).
Existing
Proposed
Mean Wind Speed (km/h)
35
30
25
20
15
10
5
0
Uncomfortable
Walking
Standing
Sitting
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
Probe Location

Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 101 to 120).

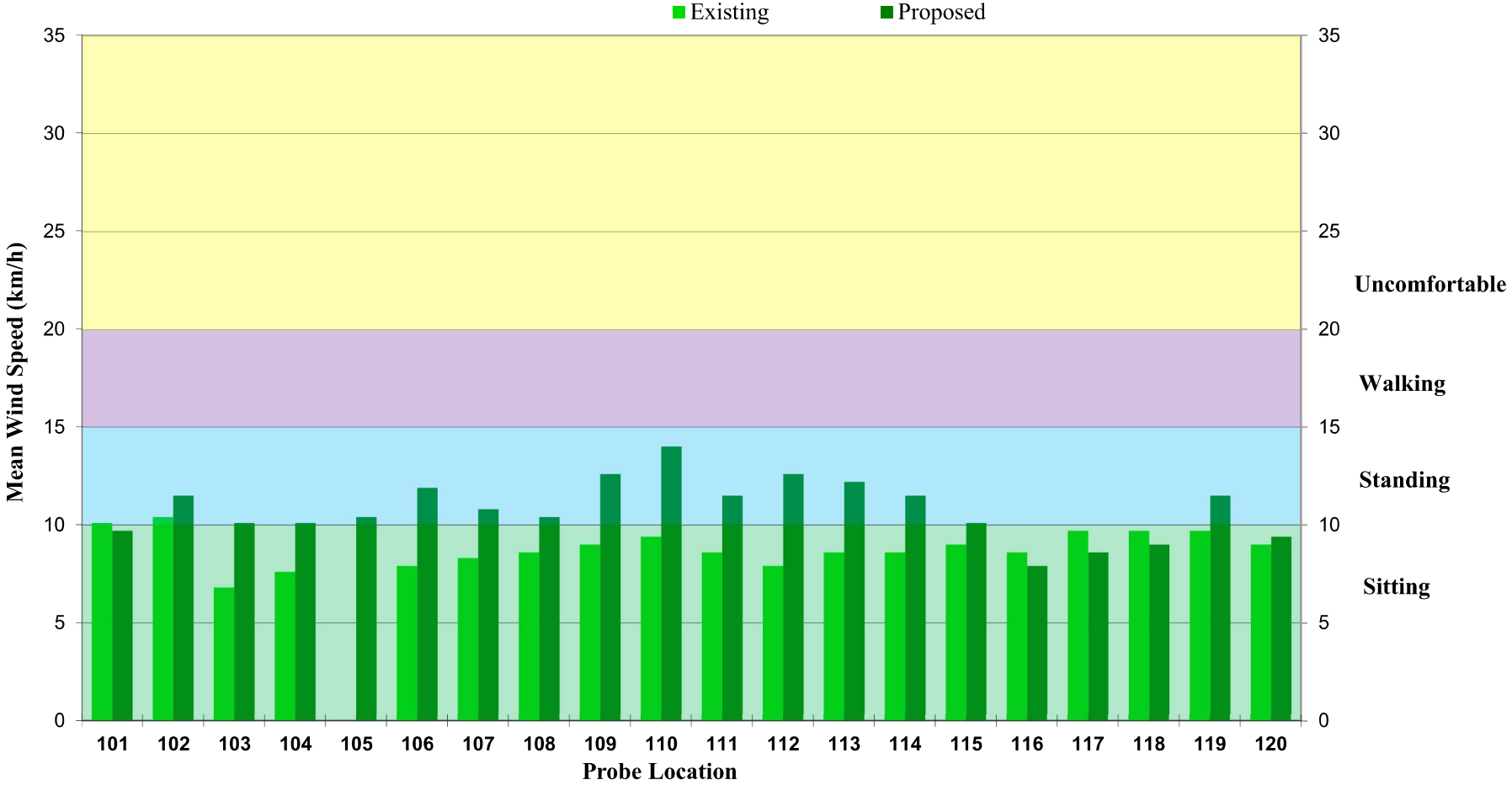


Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 121 to 140).

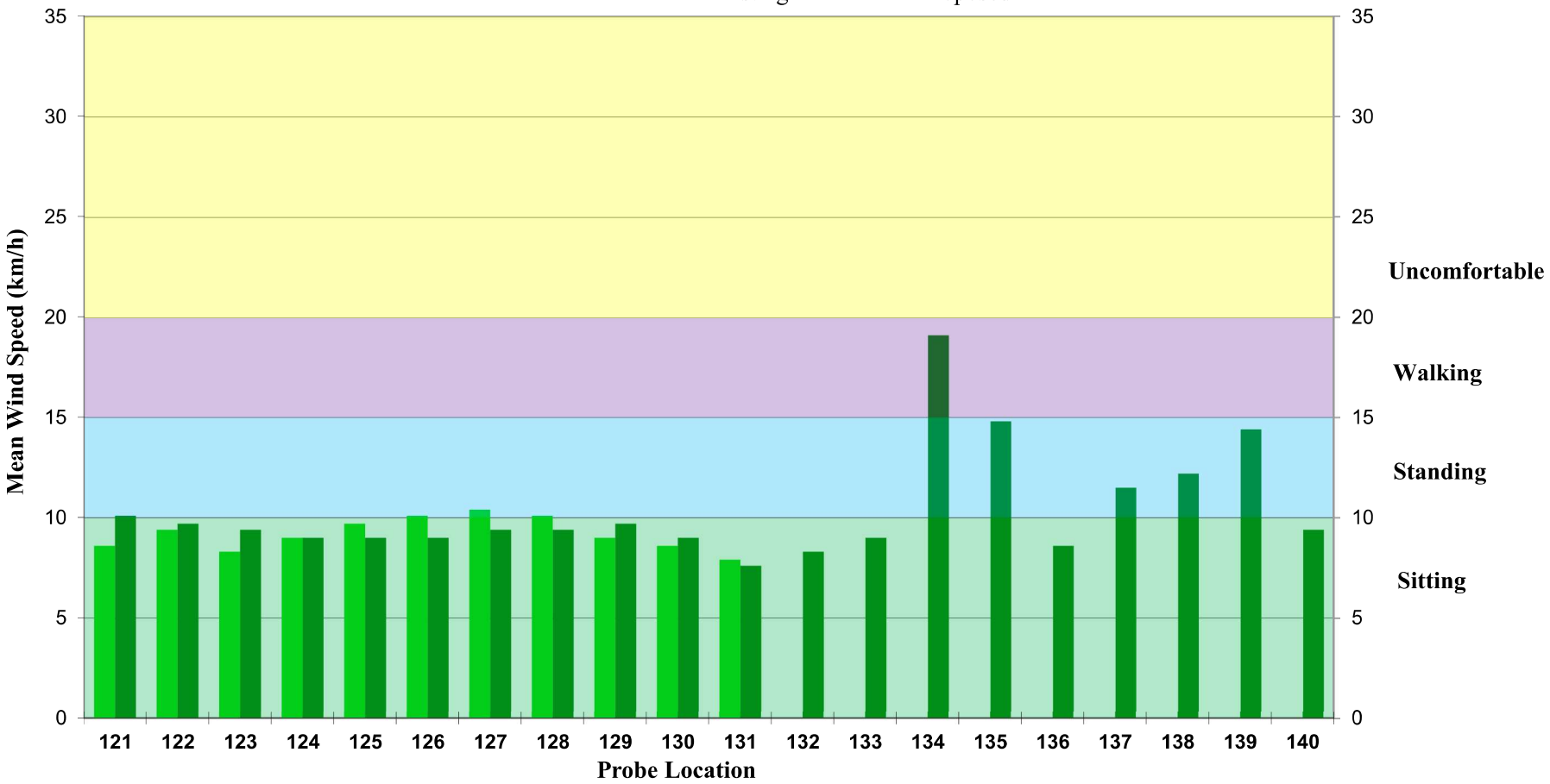


Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 141 to 160).

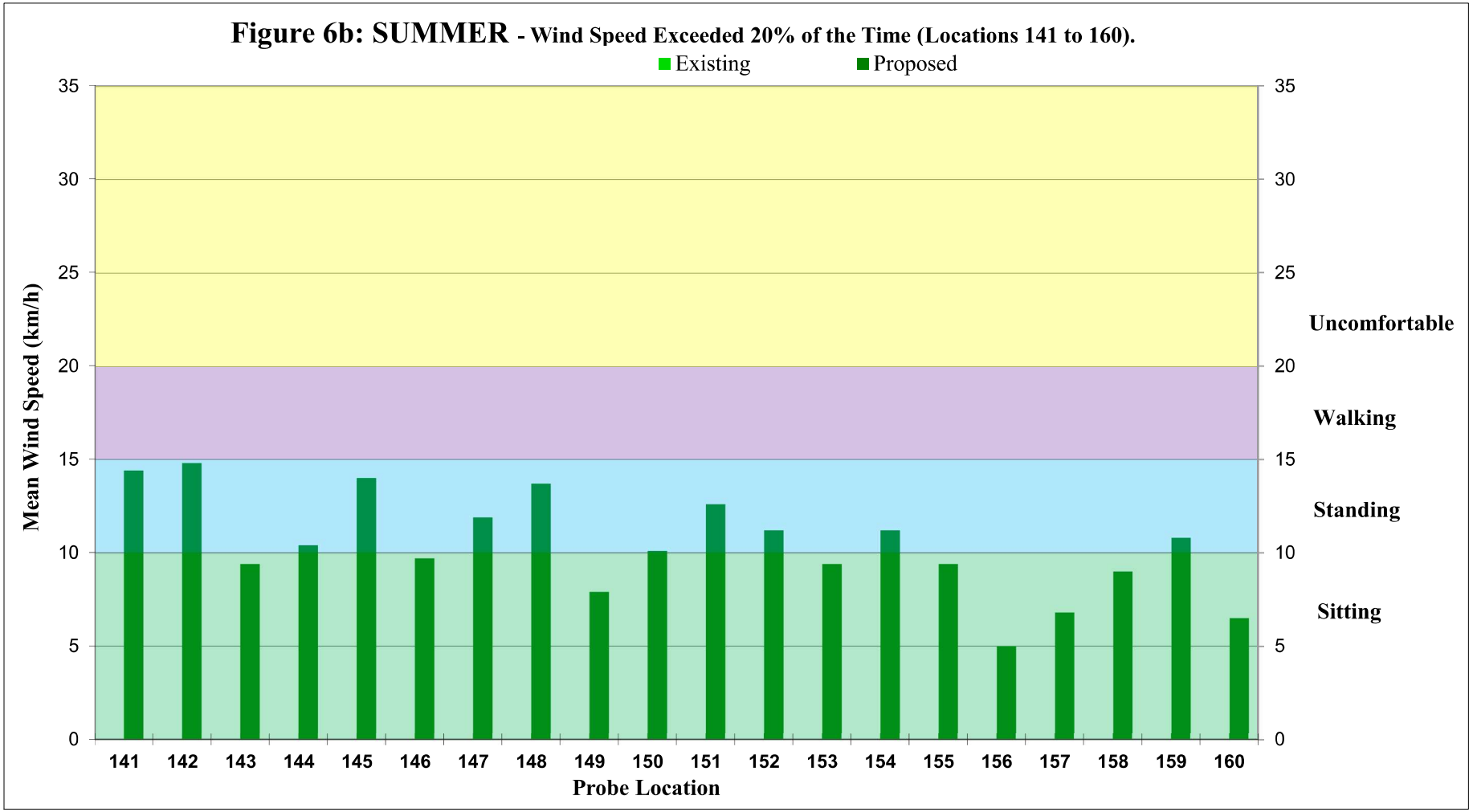


Figure 6b: SUMMER - Wind Speed Exceeded 20% of the Time (Locations 161 to 169).

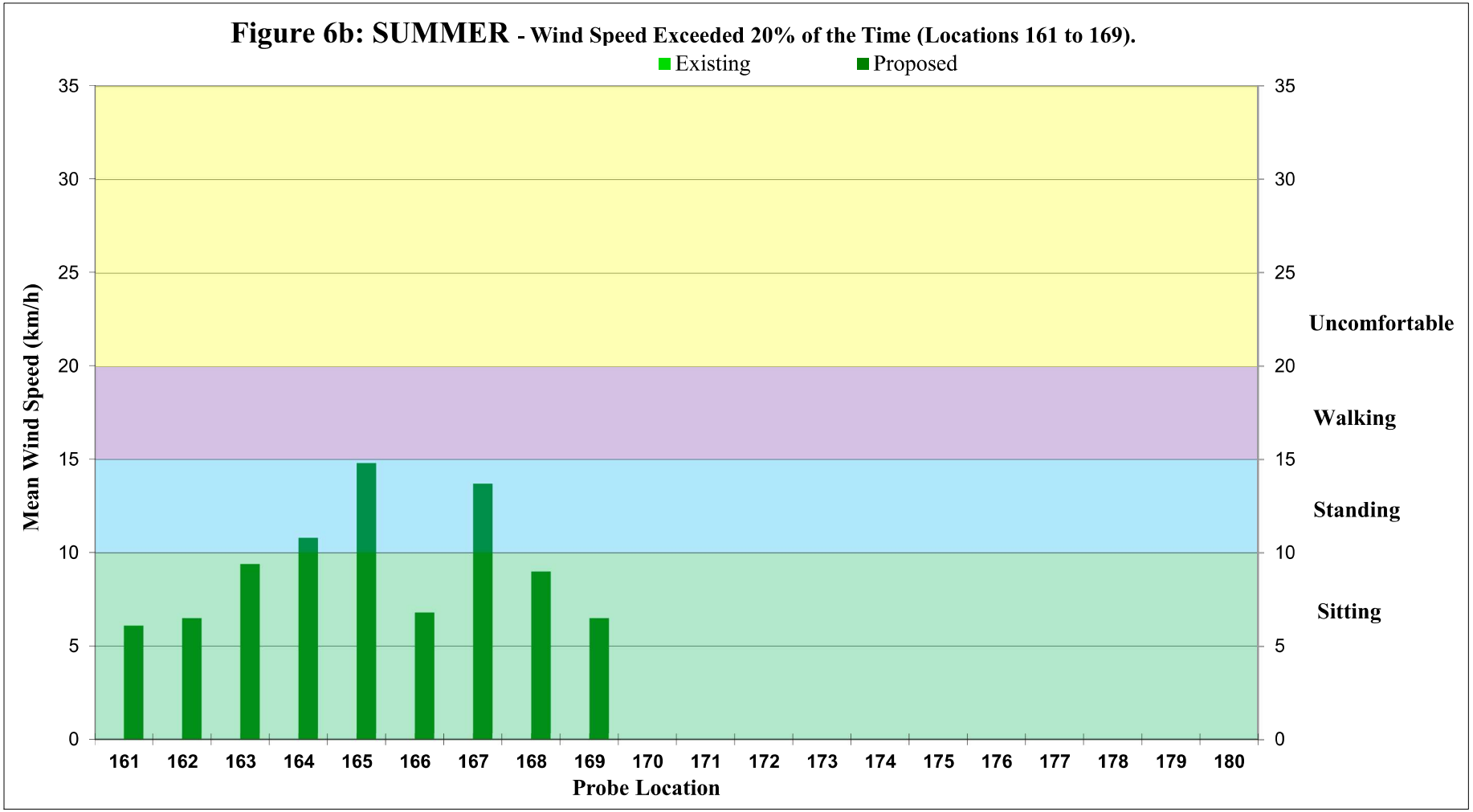


Figure 7a: Pedestrian level wind velocity comfort categories.

Figure 7b: Pedestrian level wind velocity comfort categories.

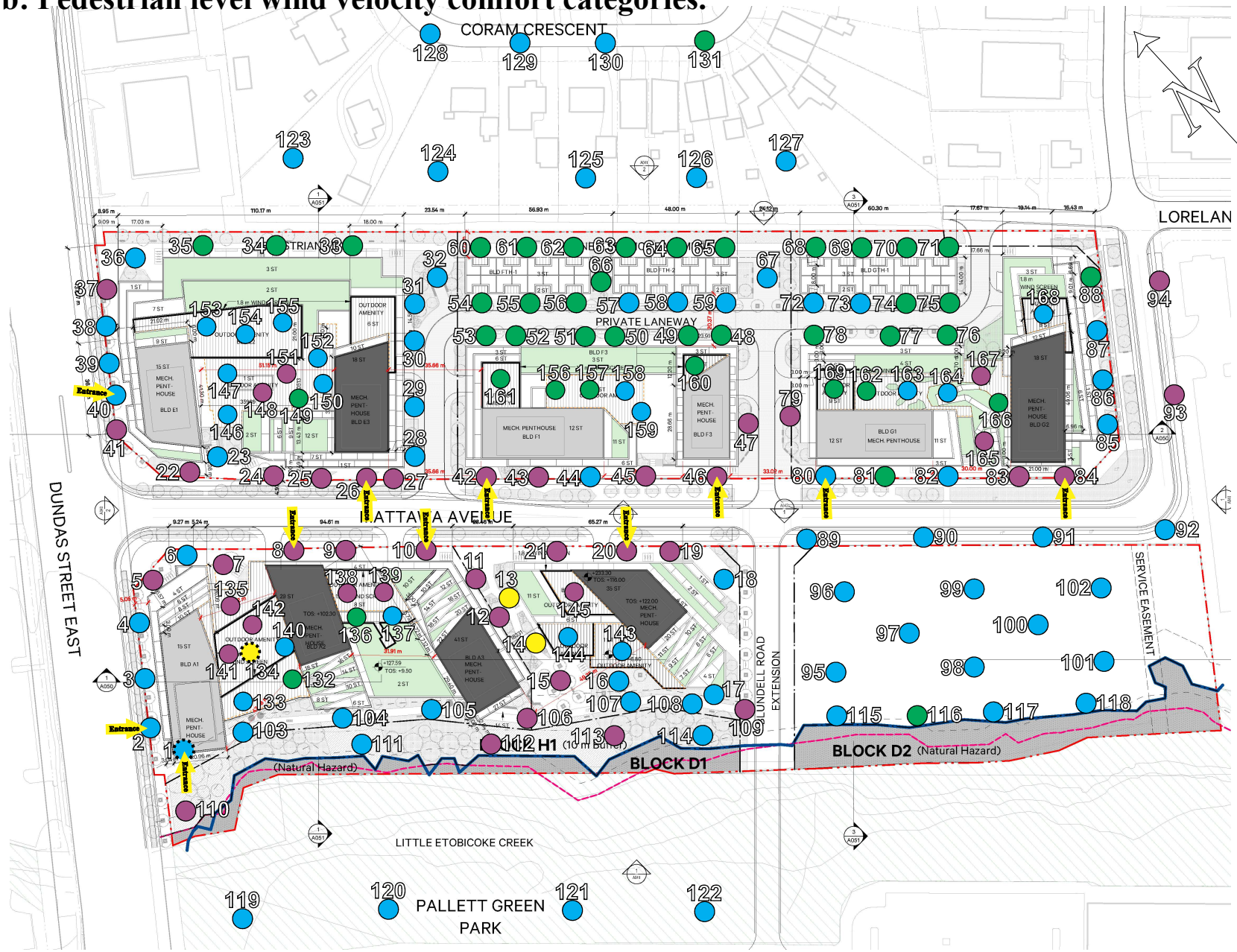


Figure 7c: Pedestrian level wind velocity comfort categories.

Figure 7c: Pedestrian level wind velocity comfort categories.

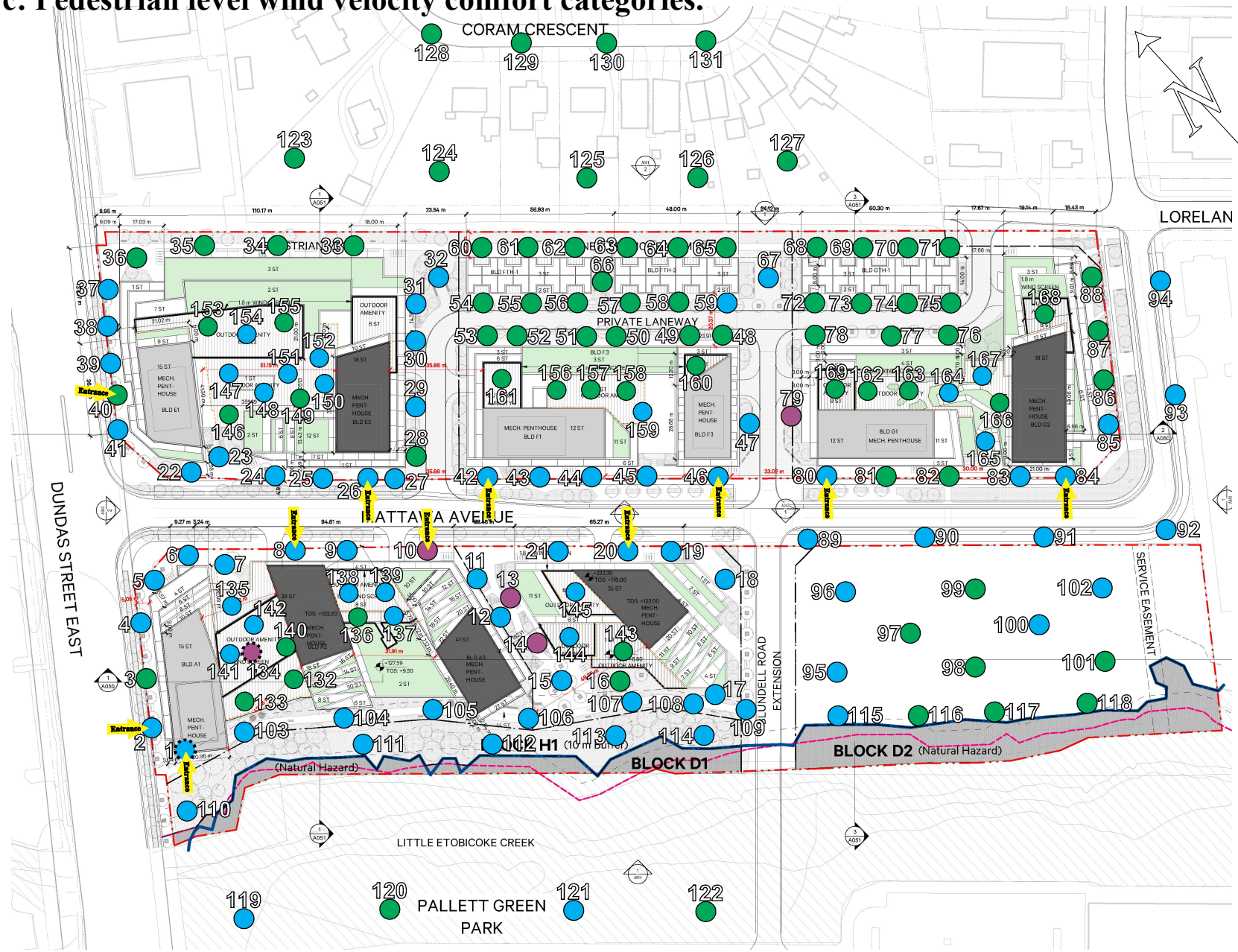


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 1 to 20).

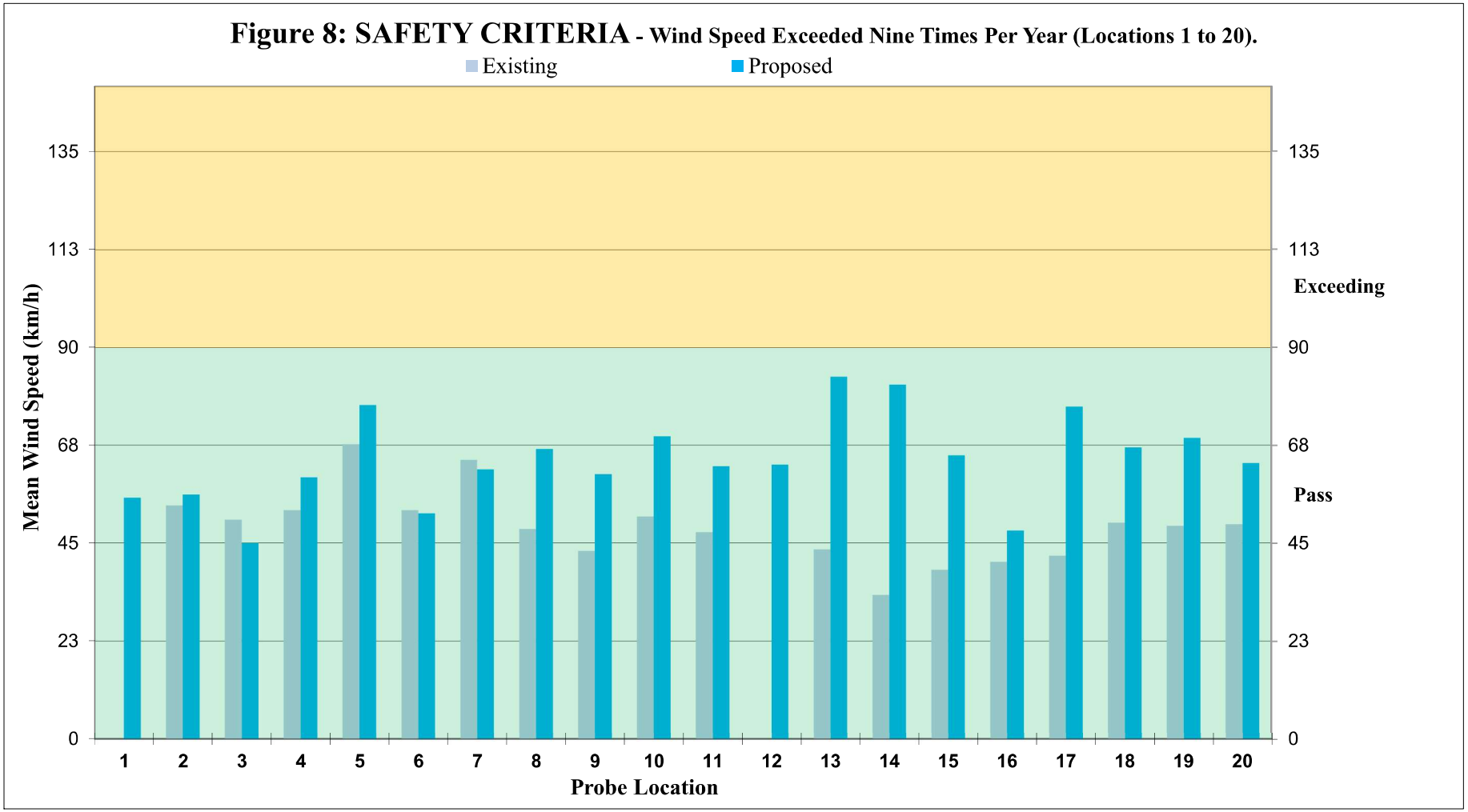


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 21 to 40).

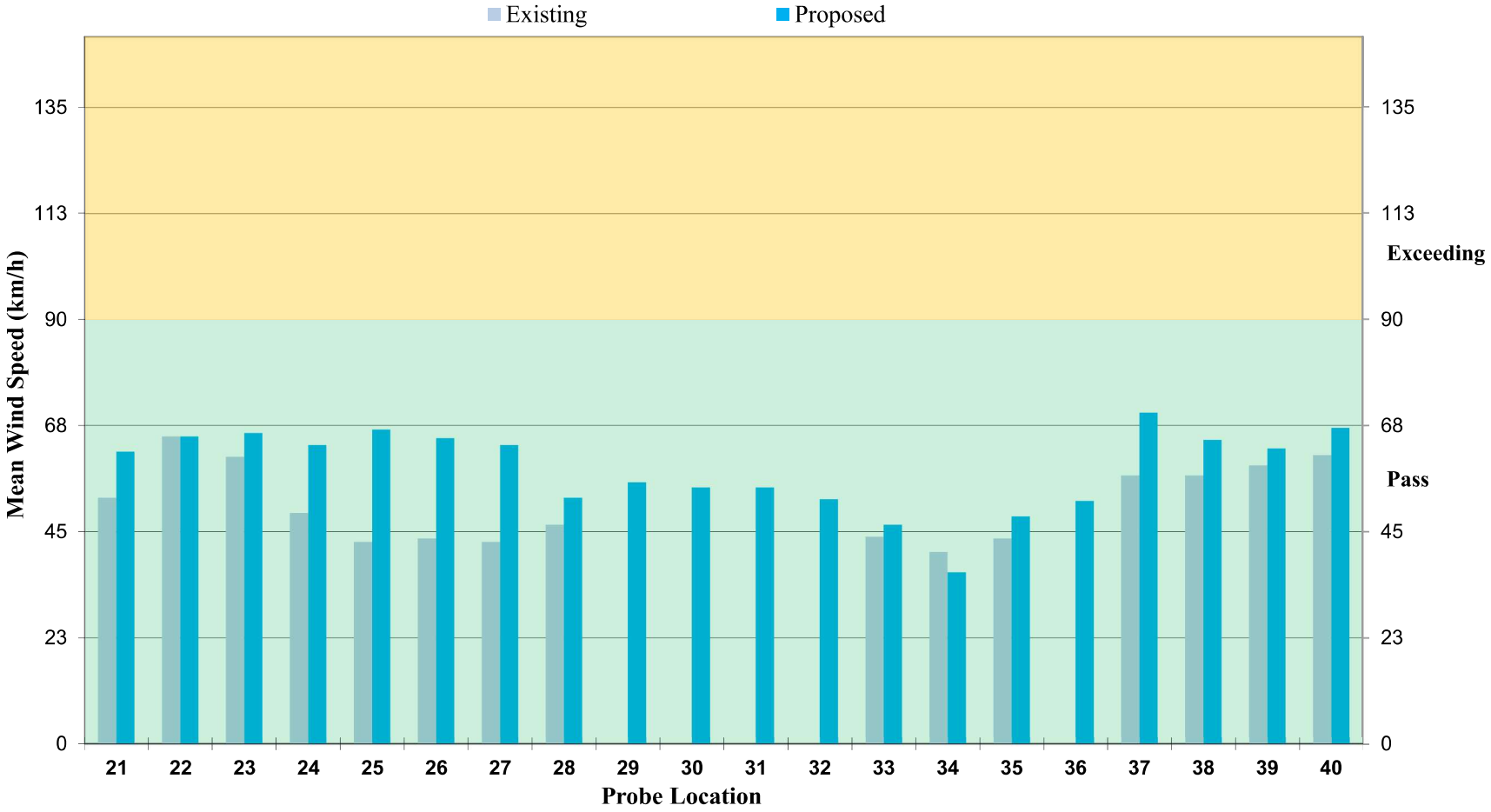


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 41 to 60).

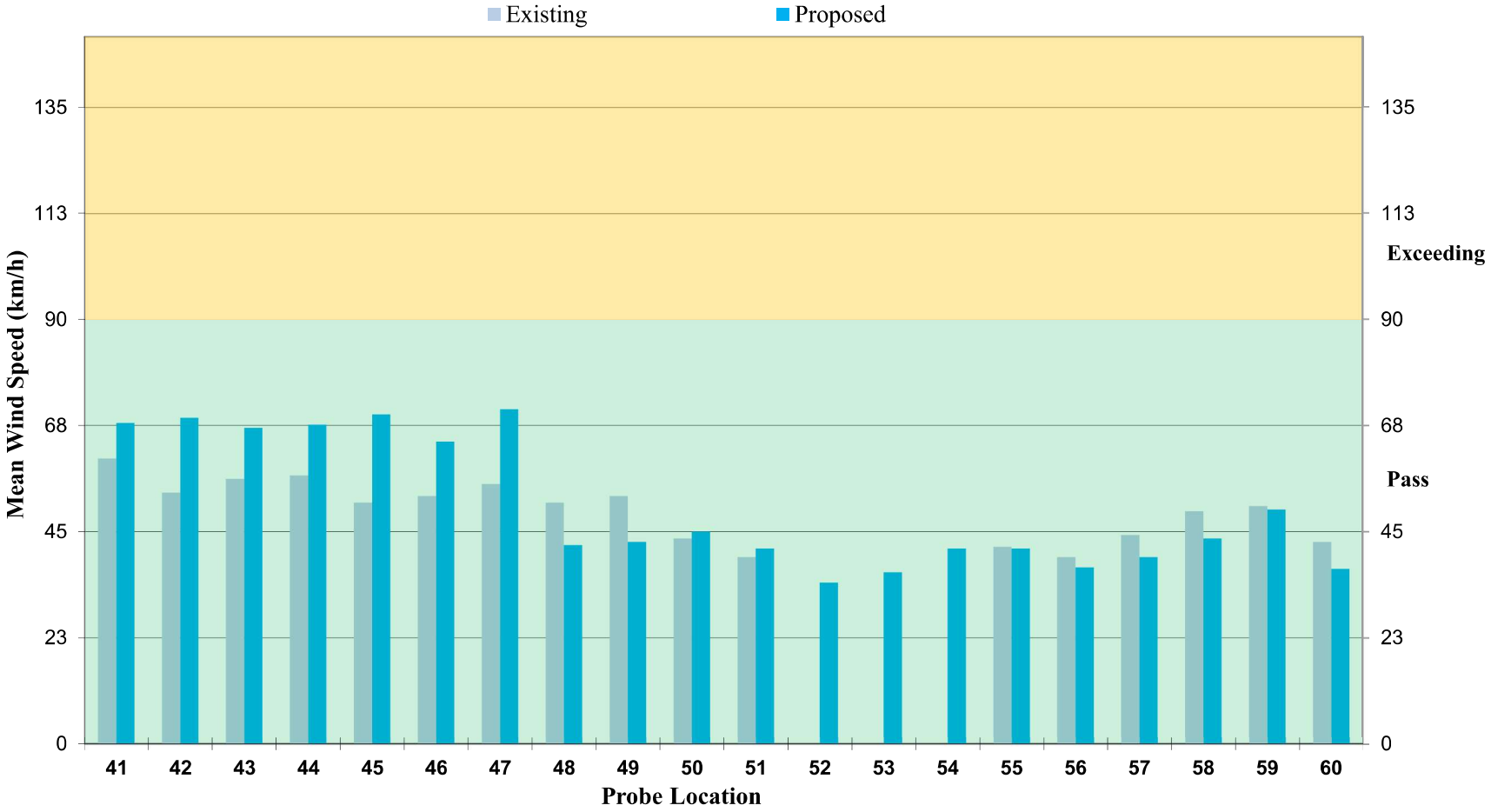


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 61 to 80).

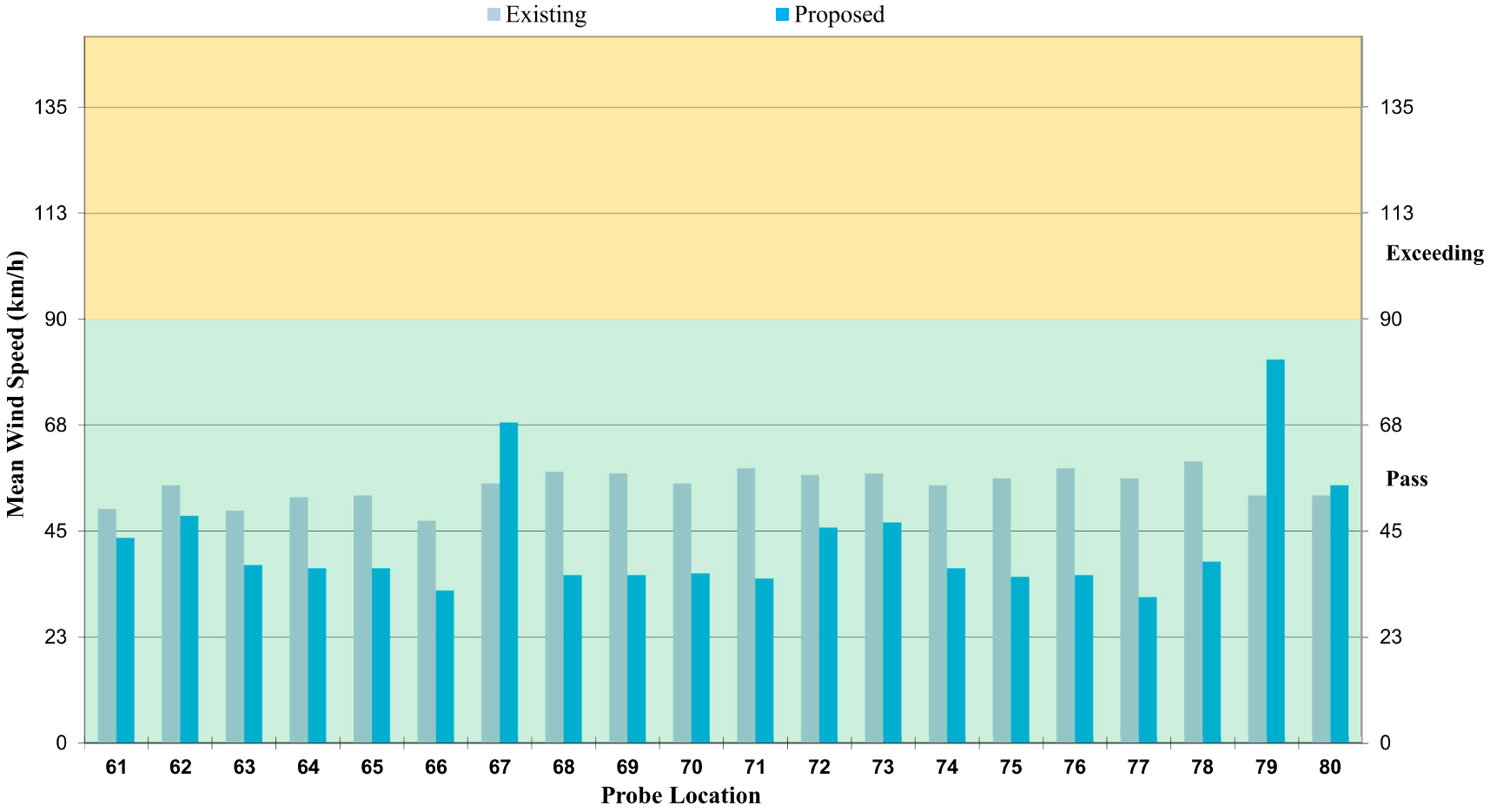


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 81 to 100).

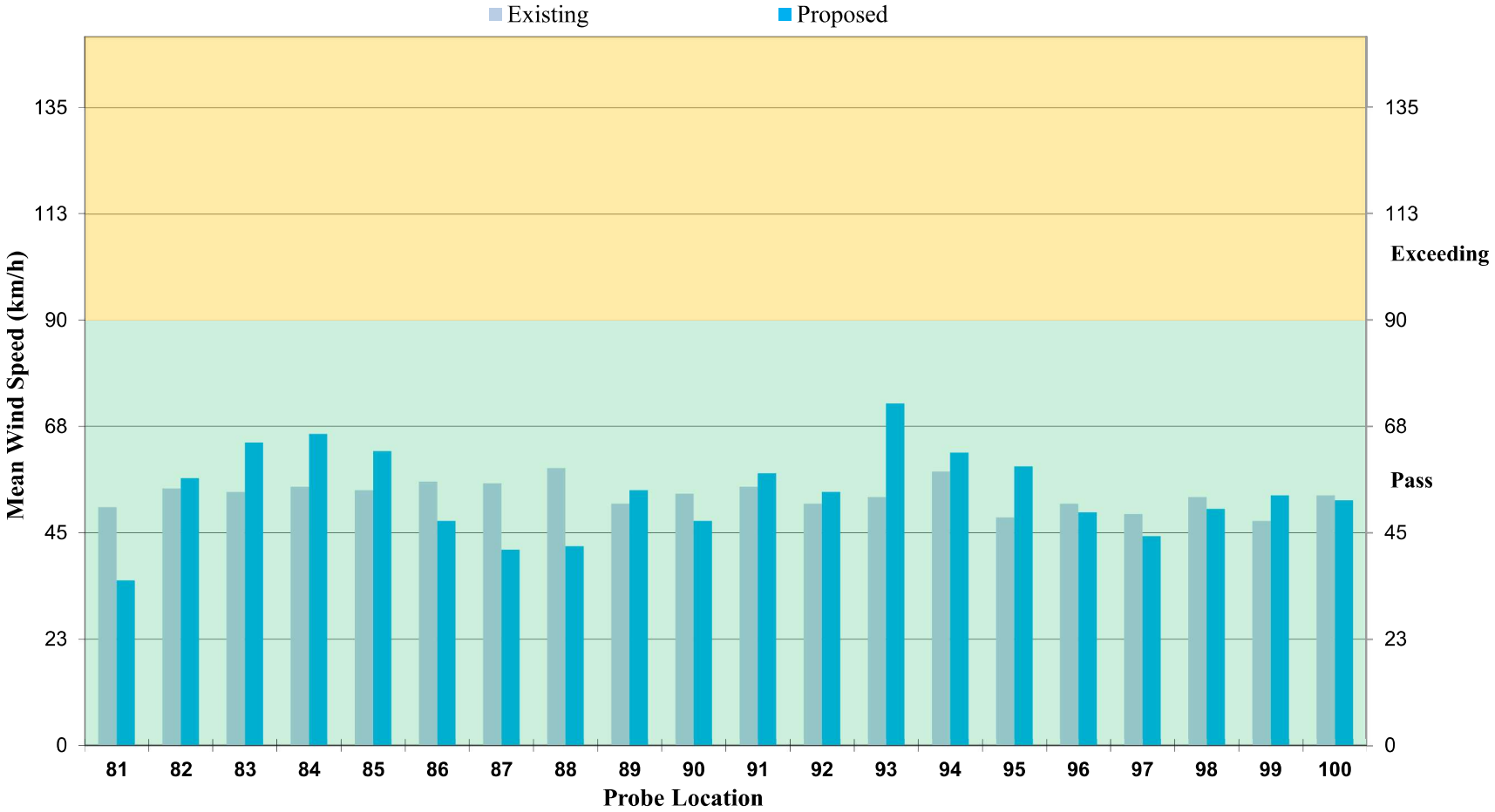


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 101 to 120).

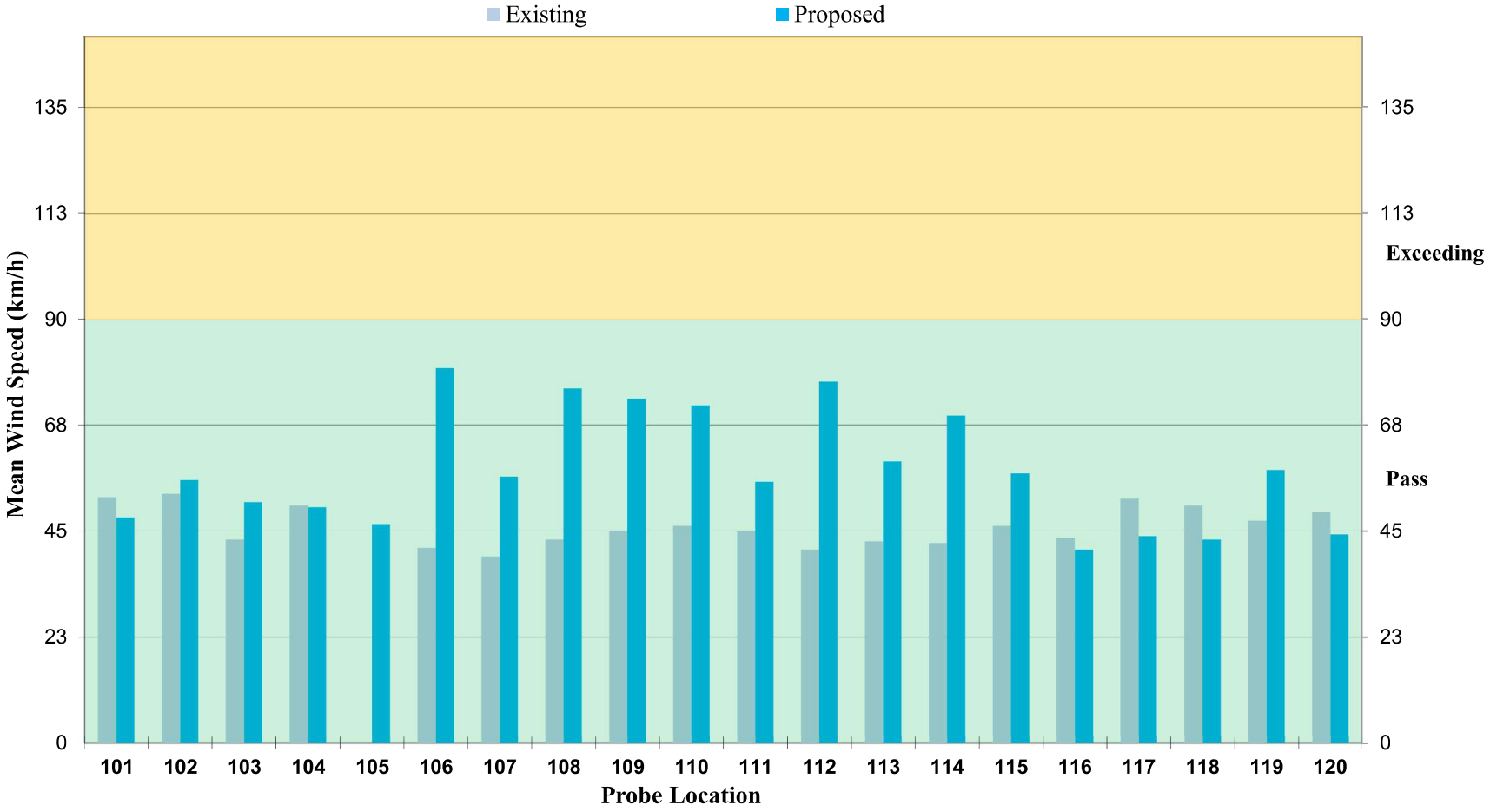


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 121 to 140).

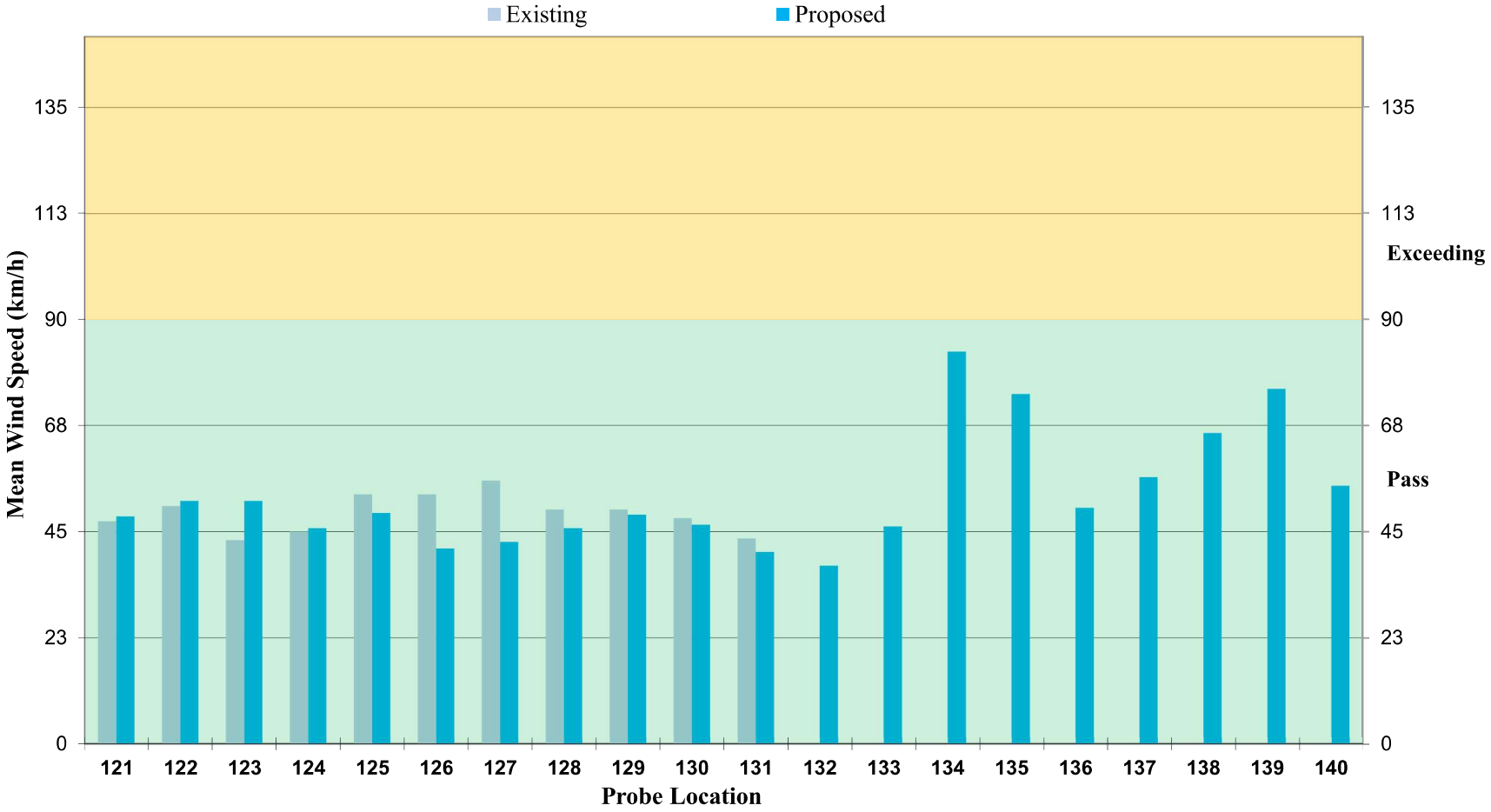


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 141 to 160).

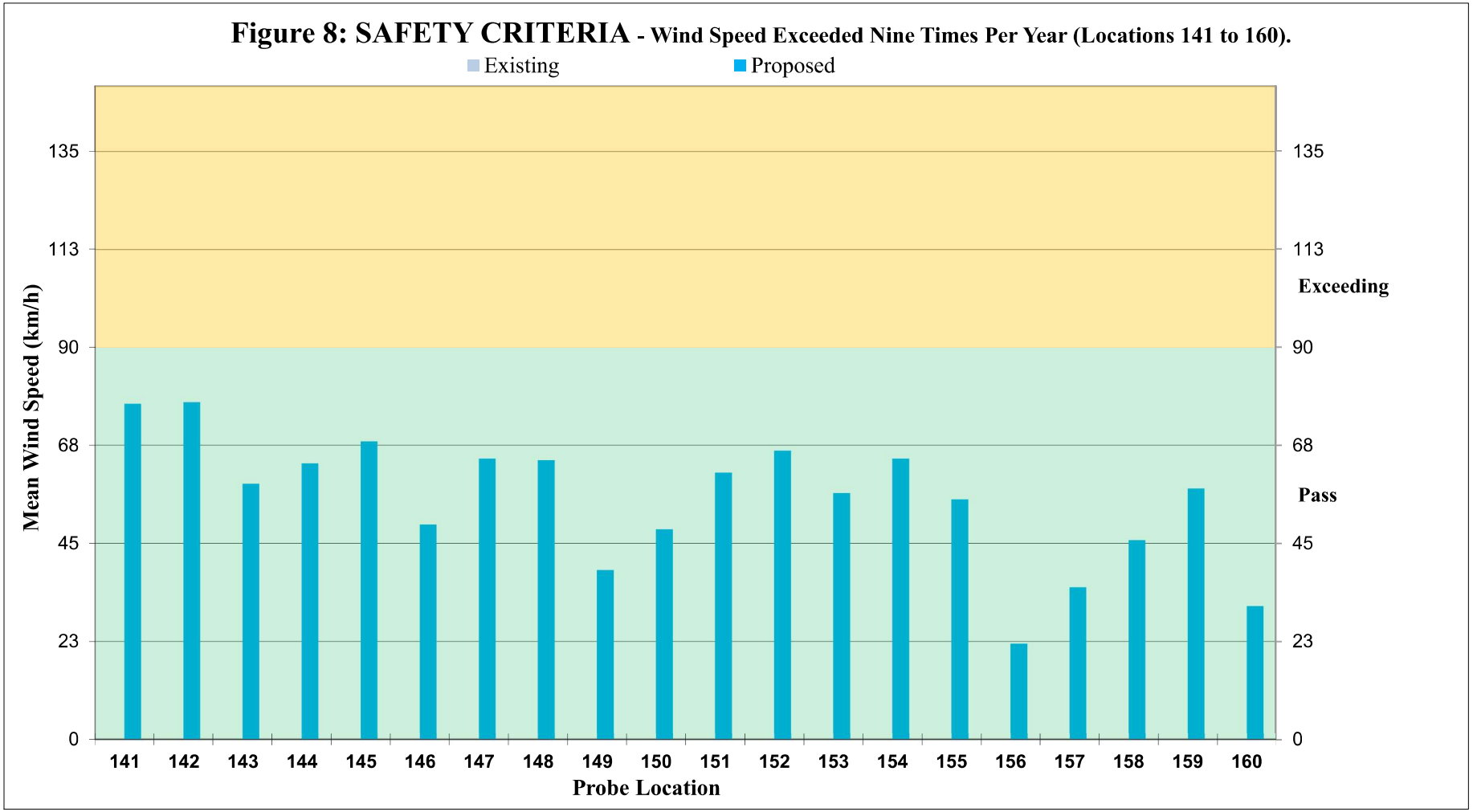


Figure 8: SAFETY CRITERIA - Wind Speed Exceeded Nine Times Per Year (Locations 161 to 169).

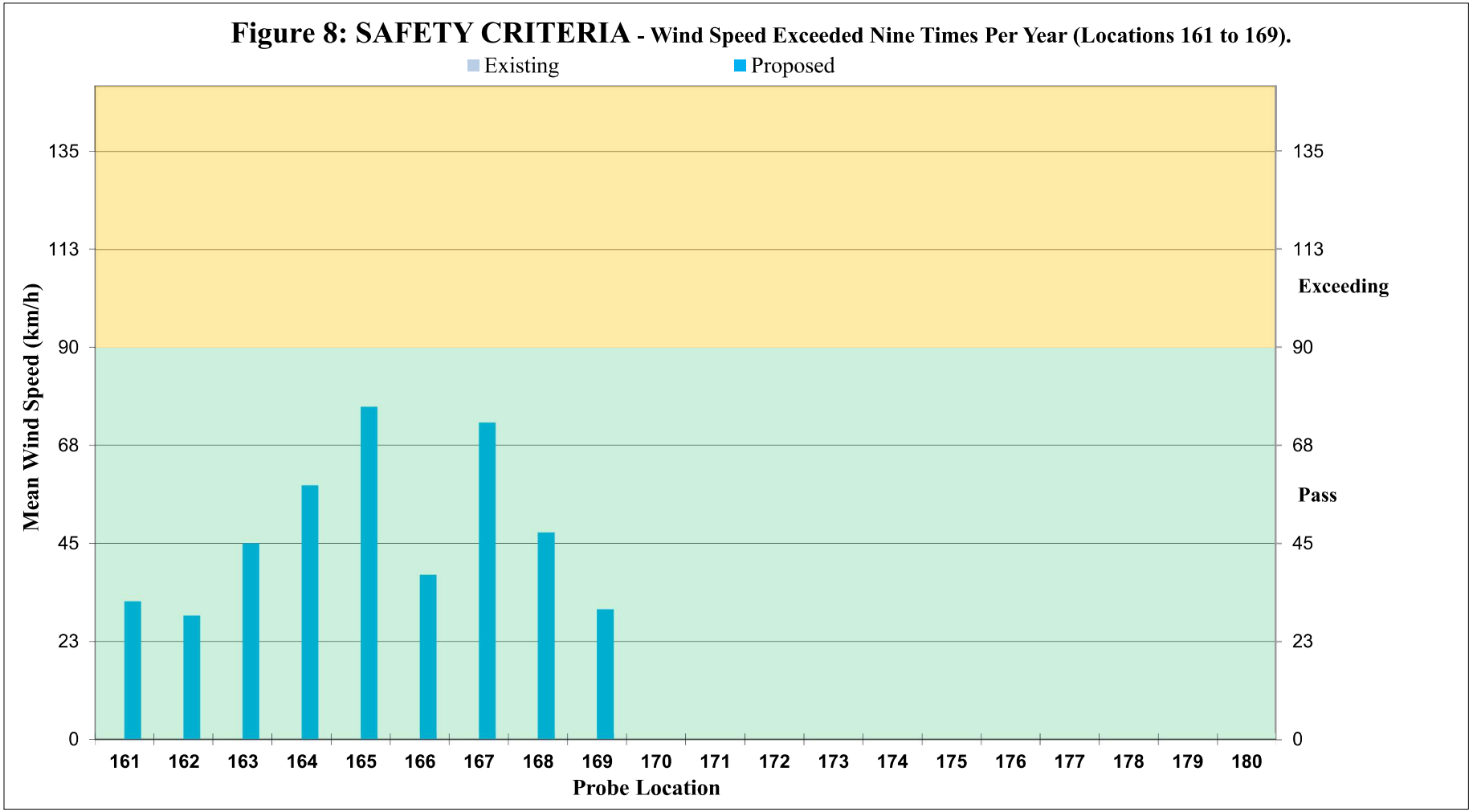
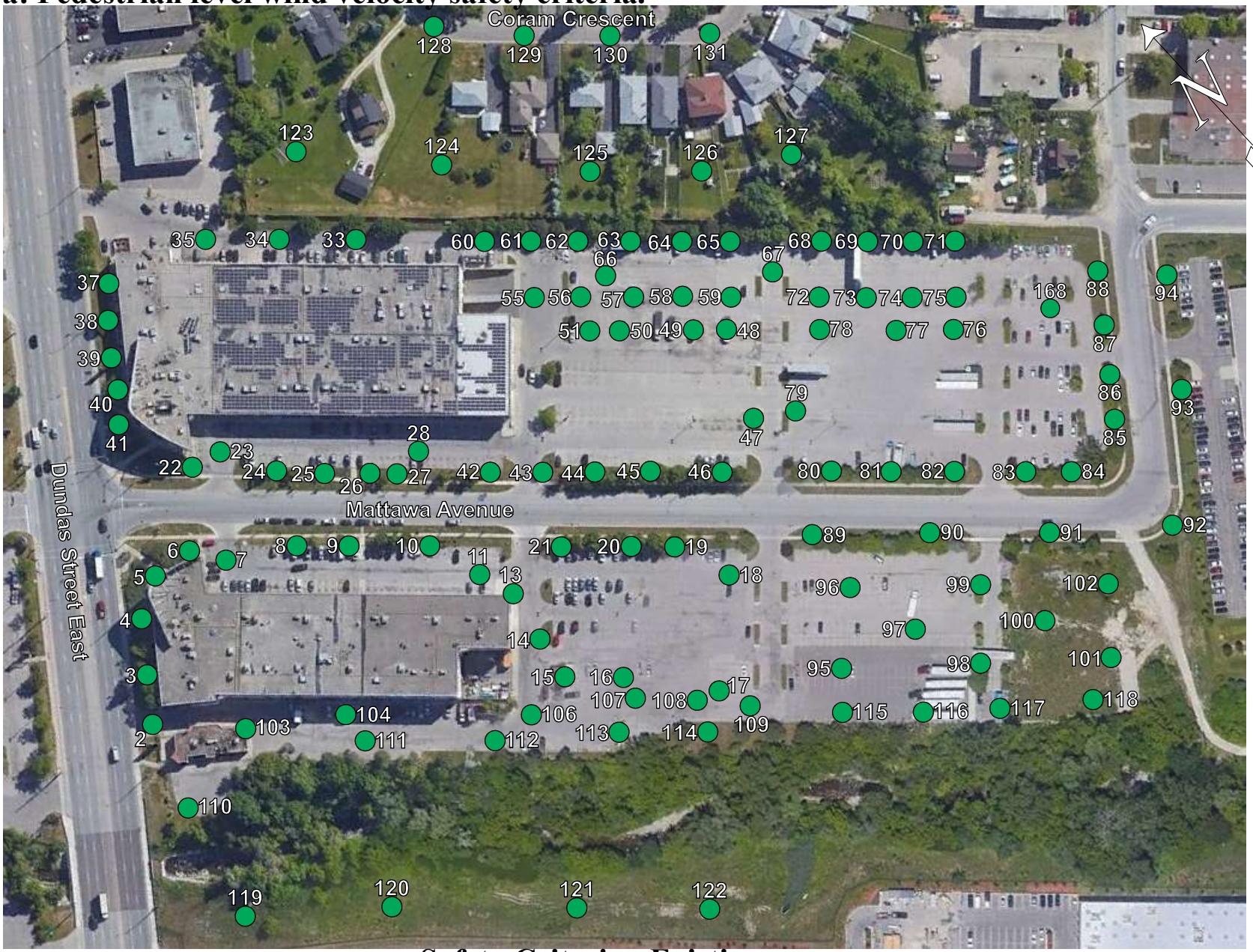


Figure 9a: Pedestrian level wind velocity safety criteria.



Safety Criteria - Existing

Pass Exceeding

Figure 9b: Pedestrian level wind velocity safety criteria.

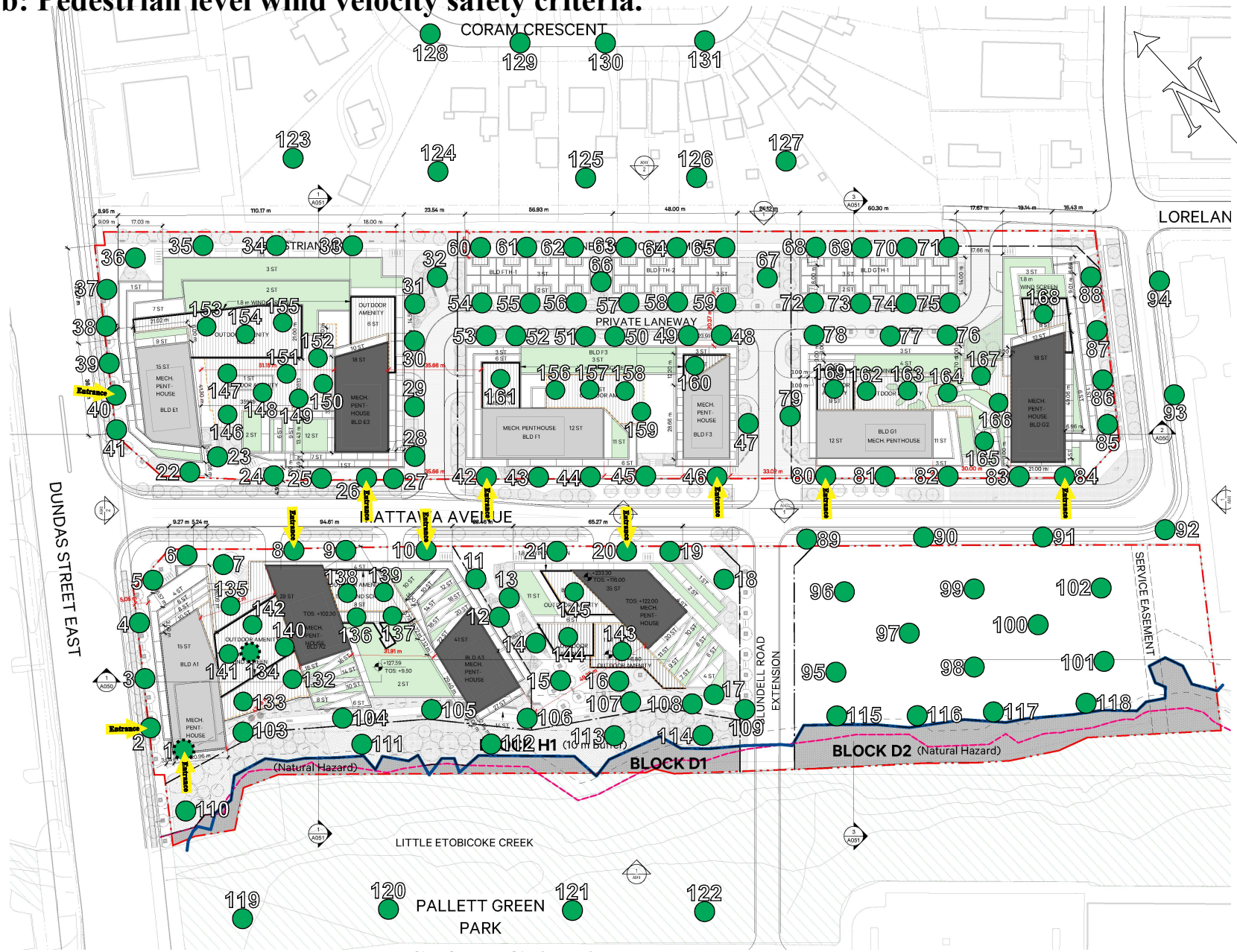


Figure 10: Pedestrian level wind comfort and safety comparison table.

	Mean Wind Speed (km/h)					
	Winter		Summer		Safety	
Probe	Existing	Proposed	Existing	Proposed	Existing	Proposed
1	0.0	12.6	0.0	11.5	0.0	55.4
2	12.6	13.7	10.8	11.2	53.6	56.2
3	11.5	11.5	9.7	9.4	50.4	45.0
4	12.6	14.0	10.1	11.2	52.6	60.1
5	15.1	15.5	11.2	11.9	67.7	76.7
6	12.6	13.0	10.8	11.5	52.6	51.8
7	12.6	16.2	10.8	13.3	64.1	61.9
8	11.2	16.9	9.4	14.0	48.2	66.6
9	10.8	15.8	9.0	13.3	43.2	60.8
10	11.9	17.6	10.1	15.1	51.1	69.5
11	10.8	15.5	9.0	13.3	47.5	62.6
12	0.0	16.6	0.0	13.7	0.0	63.0
13	9.0	22.3	7.6	18.0	43.6	83.2
14	7.2	20.9	6.1	16.6	33.1	81.4
15	9.0	16.2	7.2	13.3	38.9	65.2
16	9.7	10.8	8.3	8.6	40.7	47.9
17	10.1	14.8	8.6	11.2	42.1	76.3
18	12.2	13.7	10.1	11.2	49.7	67.0
19	12.2	16.2	10.1	13.7	49.0	69.1
20	11.9	16.2	10.1	14.0	49.3	63.4
21	11.9	16.2	10.1	13.3	52.2	61.9
22	14.8	15.5	12.6	13.3	65.2	65.2
23	12.2	14.0	9.4	10.8	60.8	65.9
24	10.8	16.6	9.0	13.7	49.0	63.4
25	10.1	16.6	8.6	13.7	42.8	66.6
26	10.8	16.6	9.0	14.0	43.6	64.8
27	10.4	15.8	8.6	13.3	42.8	63.4
28	11.2	10.4	9.0	9.0	46.4	52.2
29	0.0	12.6	0.0	10.8	0.0	55.4
30	0.0	13.0	0.0	10.8	0.0	54.4
31	0.0	11.9	0.0	10.1	0.0	54.4
32	0.0	11.9	0.0	10.1	0.0	51.8
33	10.8	9.4	9.0	8.3	43.9	46.4
34	9.7	8.6	8.3	7.6	40.7	36.4
35	10.1	9.7	8.6	8.3	43.6	48.2
36	0.0	10.8	0.0	9.0	0.0	51.5
37	11.5	16.6	8.6	13.0	56.9	70.2
38	11.9	14.4	9.4	10.8	56.9	64.4
39	12.6	13.0	9.7	10.1	59.0	62.6
40	12.2	12.6	9.4	9.7	61.2	67.0
41	14.0	15.1	11.2	12.2	60.5	68.0
42	12.6	15.1	10.4	12.6	53.3	69.1
43	13.0	15.8	10.4	13.0	56.2	67.0
44	12.6	14.8	10.4	12.2	56.9	67.7
45	11.9	15.1	10.1	12.2	51.1	69.8
46	12.6	15.5	10.4	12.6	52.6	64.1
47	13.3	15.8	10.8	13.3	55.1	70.9
48	13.0	7.9	10.8	6.8	51.1	42.1
49	13.3	8.6	10.8	7.2	52.6	42.8
50	11.5	9.0	9.4	7.6	43.6	45.0
51	9.7	9.0	8.3	7.6	39.6	41.4
52	0.0	8.3	0.0	7.2	0.0	34.2
53	0.0	8.6	0.0	7.6	0.0	36.4
54	0.0	9.0	0.0	7.9	0.0	41.4
55	9.4	9.7	7.9	8.6	41.8	41.4
56	9.7	8.6	8.3	7.6	39.6	37.4
57	11.9	10.1	9.7	9.0	44.3	39.6
58	12.6	10.8	10.4	9.7	49.3	43.6
59	13.0	11.5	10.8	10.1	50.4	49.7
60	10.4	8.6	9.4	7.2	42.8	37.1

	Mean Wind Speed (km/h)					
	Winter		Summer		Safety	
Probe	Existing	Proposed	Existing	Proposed	Existing	Proposed
61	11.5	9.4	10.1	7.9	49.7	43.6
62	11.9	9.4	9.7	7.9	54.7	48.2
63	12.6	9.0	10.4	7.6	49.3	37.8
64	13.0	9.0	10.4	7.9	52.2	37.1
65	13.0	8.6	10.4	7.2	52.6	37.1
66	12.2	7.6	10.1	6.1	47.2	32.4
67	13.7	11.9	11.2	10.1	55.1	68.0
68	14.0	8.6	11.2	7.2	57.6	35.6
69	14.0	8.6	11.5	7.6	57.2	35.6
70	13.7	9.0	11.2	7.9	55.1	36.0
71	14.0	9.0	11.5	7.9	58.3	34.9
72	13.7	10.4	11.2	9.0	56.9	45.7
73	14.0	10.4	11.5	9.4	57.2	46.8
74	13.7	9.7	11.2	8.6	54.7	37.1
75	14.0	9.0	11.2	7.9	56.2	35.3
76	14.0	8.6	11.5	7.2	58.3	35.6
77	14.0	8.3	11.2	7.2	56.2	31.0
78	14.4	8.6	11.5	7.6	59.8	38.5
79	13.3	18.7	10.8	15.1	52.6	81.4
80	13.3	13.3	10.8	11.5	52.6	54.7
81	13.0	9.0	10.8	8.3	50.4	34.9
82	13.3	11.2	11.2	9.7	54.4	56.5
83	13.7	15.5	11.2	13.3	53.6	64.1
84	13.7	15.8	11.2	13.0	54.7	65.9
85	13.3	13.7	10.8	10.8	54.0	62.3
86	13.7	10.8	10.8	8.6	55.8	47.5
87	13.7	10.1	10.8	8.3	55.4	41.4
88	14.0	9.4	11.2	8.6	58.7	42.1
89	13.0	14.4	10.4	11.9	51.1	54.0
90	13.3	12.2	10.8	10.4	53.3	47.5
91	13.3	14.8	10.8	12.6	54.7	57.6
92	13.0	14.4	10.4	11.5	51.1	53.6
93	13.3	17.3	10.8	14.0	52.6	72.4
94	14.0	15.8	11.2	13.7	58.0	61.9
95	11.5	13.3	9.7	10.8	48.2	59.0
96	12.6	12.6	10.4	10.4	51.1	49.3
97	11.9	11.2	9.7	9.4	49.0	44.3
98	12.2	11.5	10.1	9.7	52.6	50.0
99	12.2	10.8	10.1	9.7	47.5	52.9
100	12.6	12.2	10.4	10.4	52.9	51.8
101	12.2	11.9	10.1	9.7	52.2	47.9
102	13.0	14.0	10.4	11.5	52.9	55.8
103	8.6	11.2	6.8	10.1	43.2	51.1
104	10.1	11.5	7.6	10.1	50.4	50.0
105	0.0	11.2	0.0	10.4	0.0	46.4
106	9.4	15.5	7.9	11.9	41.4	79.6
107	10.1	13.3	8.3	10.8	39.6	56.5
108	10.1	13.7	8.6	10.4	43.2	75.2
109	10.8	16.2	9.0	12.6	45.0	73.1
110	11.5	16.6	9.4	14.0	46.1	71.6
111	10.8	13.3	8.6	11.5	45.0	55.4
112	9.0	15.8	7.9	12.6	41.0	76.7
113	10.8	15.1	8.6	12.2	42.8	59.8
114	10.8	14.4	8.6	11.5	42.5	69.5
115	10.8	12.6	9.0	10.1	46.1	57.2
116	10.4	9.7	8.6	7.9	43.6	41.0
117	11.5	10.1	9.7	8.6	51.8	43.9
118	12.2	10.8	9.7	9.0	50.4	43.2
119	11.2	13.0	9.7	11.5	47.2	58.0
120	10.4	10.4	9.0	9.4	49.0	44.3

	Mean Wind Speed (km/h)					
	Winter		Summer		Safety	
Probe	Existing	Proposed	Existing	Proposed	Existing	Proposed
121	10.4	11.9	8.6	10.1	47.2	48.2
122	11.2	11.5	9.4	9.7	50.4	51.5
123	10.1	11.2	8.3	9.4	43.2	51.5
124	10.8	10.8	9.0	9.0	45.0	45.7
125	11.9	10.4	9.7	9.0	52.9	49.0
126	12.2	10.4	10.1	9.0	52.9	41.4
127	13.0	11.2	10.4	9.4	55.8	42.8
128	12.2	11.2	10.1	9.4	49.7	45.7
129	10.8	11.5	9.0	9.7	49.7	48.6
130	10.4	10.8	8.6	9.0	47.9	46.4
131	9.7	9.4	7.9	7.6	43.6	40.7
132	0.0	9.0	0.0	8.3	0.0	37.8
133	0.0	11.2	0.0	9.0	0.0	46.1
134	0.0	22.7	0.0	19.1	0.0	83.2
135	0.0	17.6	0.0	14.8	0.0	74.2
136	0.0	9.7	0.0	8.6	0.0	50.0
137	0.0	13.3	0.0	11.5	0.0	56.5
138	0.0	15.1	0.0	12.2	0.0	65.9
139	0.0	17.3	0.0	14.4	0.0	75.2
140	0.0	11.5	0.0	9.4	0.0	54.7
141	0.0	17.6	0.0	14.4	0.0	77.0
142	0.0	17.6	0.0	14.8	0.0	77.4
143	0.0	10.8	0.0	9.4	0.0	58.7
144	0.0	13.0	0.0	10.4	0.0	63.4
145	0.0	16.9	0.0	14.0	0.0	68.4
146	0.0	12.2	0.0	9.7	0.0	49.3
147	0.0	14.8	0.0	11.9	0.0	64.4
148	0.0	16.6	0.0	13.7	0.0	64.1
149	0.0	9.7	0.0	7.9	0.0	38.9
150	0.0	12.2	0.0	10.1	0.0	48.2
151	0.0	15.5	0.0	12.6	0.0	61.2
152	0.0	14.0	0.0	11.2	0.0	66.2
153	0.0	11.2	0.0	9.4	0.0	56.5
154	0.0	13.3	0.0	11.2	0.0	64.4
155	0.0	11.5	0.0	9.4	0.0	55.1
156	0.0	6.1	0.0	5.0	0.0	22.0
157	0.0	8.3	0.0	6.8	0.0	34.9
158	0.0	10.8	0.0	9.0	0.0	45.7
159	0.0	11.5	0.0	10.8	0.0	57.6
160	0.0	7.9	0.0	6.5	0.0	30.6
161	0.0	7.2	0.0	6.1	0.0	31.7
162	0.0	7.2	0.0	6.5	0.0	28.4
163	0.0	10.8	0.0	9.4	0.0	45.0
164	0.0	13.0	0.0	10.8	0.0	58.3
165	0.0	18.0	0.0	14.8	0.0	76.3
166	0.0	7.9	0.0	6.8	0.0	37.8
167	0.0	16.2	0.0	13.7	0.0	72.7
168	0.0	10.4	0.0	9.0	0.0	47.5
169	0.0	7.6	0.0	6.5	0.0	29.9
170	0.0	0.0	0.0	0.0	0.0	0.0
171	0.0	0.0	0.0	0.0	0.0	0.0
172	0.0	0.0	0.0	0.0	0.0	0.0
173	0.0	0.0	0.0	0.0	0.0	0.0
174	0.0	0.0	0.0	0.0	0.0	0.0
175	0.0	0.0	0.0	0.0	0.0	0.0
176	0.0	0.0	0.0	0.0	0.0	0.0
177	0.0	0.0	0.0	0.0	0.0	0.0
178	0.0	0.0	0.0	0.0	0.0	0.0
179	0.0	0.0	0.0	0.0	0.0	0.0
180	0.0	0.0	0.0	0.0	0.0	0.0

Comfort (km/h)				Safety (km/h)	
0 - 10	Sitting	15 - 20	Walking	0 - 90	Pass
10 - 15	Standing	20 +	Uncomf	90 +	Exceed

7. APPENDIX

BACKGROUND AND THEORY OF WIND MOVEMENT

During the course of a modular analysis of an existing or proposed site, pertinent wind directions must be analysed with regard to the macroclimate and microclimate. In order for the results of the study to be valid, the effects of both climates must be modelled in test procedures.

Macroclimate

Wind velocity, frequency and directions are used in tests with models to establish part of the macroclimate. These variables are determined from meteorological data collected at the closest weather monitoring station. This information is used in the analysis of the site to establish upstream (approach) wind and weather conditions.

When evaluating approach wind velocities and characteristic profiles in the field it is necessary to evaluate certain boundary conditions. At the earth's surface, "no slip" conditions require the wind speed to be zero. At an altitude of approximately one kilometre above the earth's surface, the motion of the wind is governed by pressure distributions associated with large-scale weather systems. Consequently, these winds, known as "geostrophic" or "freestream" winds, are independent of the surface topography. In model simulation, as in the field, the area of concern is the boundary layer between the earth's surface and the geostrophic winds. The term boundary layer is used to describe the velocity profile of wind currents as they increase from zero to the geostrophic velocity.

The approach boundary layer profile is affected by specific surface topography upstream of the test site. Over relatively rough terrain (urban) the boundary layer is thicker and the wind speed increases rather slowly with height. The opposite is true over open terrain (rural). The following power law equation is used to represent the mean velocity profile for any given topographic condition:

$$\frac{U}{U_F} = \left(\frac{z}{z_F}\right)^a$$

where U = wind velocity (m/s) at height z (m)
a = power law exponent
and subscript $_F$ refers to freestream conditions

Typical values for a and z_F are summarized below:

Terrain	a	z_F **(**m**)**
Rural	0.14 - 0.17	260 - 300
Suburban	0.20 - 0.28	300 - 420
Urban	0.28 - 0.40	420 - 550

Wind data is recorded at meteorological stations at a height z_{ref} , usually equal to about 10m above grade. This historical mean wind velocity and frequency data is often presented in the form of a wind rose. The mean wind velocity at z_{ref} , along with the appropriate constants based on terrain type, are used to determine the value for U_F , completing the definition of the boundary layer profile specific to the site. The following Figure shows representations of the boundary layer profile for each of the above terrain conditions:

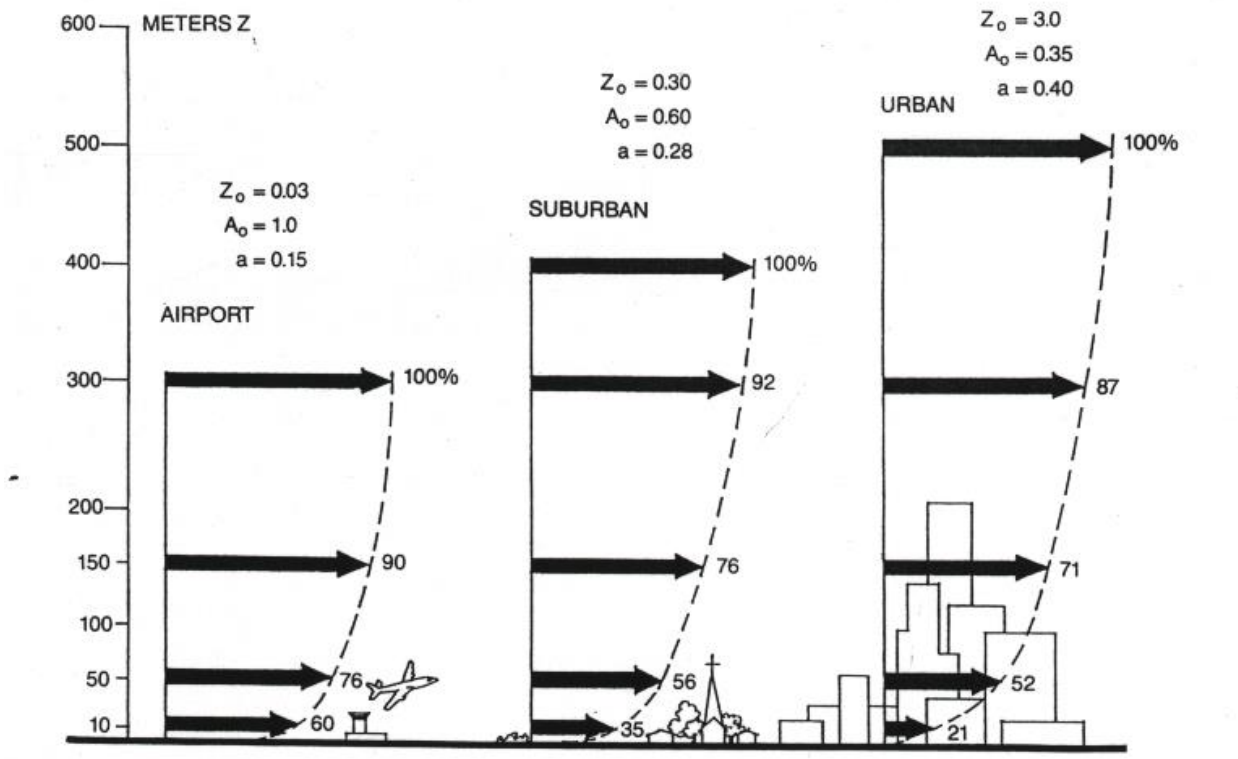


Figure A: Mean wind speed profiles for various terrain (from ASHRAE 1989).

For the above velocity profiles, ground level velocities at a height of $z = 2m$, for an urban macroclimate are approximately 52% of the mean values recorded at the meteorological station at a height equal to $z_{ref} = 10m$. For suburban and rural conditions, the values are 63% and 78% respectively. Thus, for a given wind speed at z_{ref} open terrain or fields (rural) will experience significantly higher ground level wind velocities than suburban or urban areas.

When a boundary layer wind flows over one terrain onto another, the boundary layer profile shape rapidly changes to that dictated by the new terrain. If the preceding wind flow is over rough suburban terrain and an open area is encountered a rapid increase in ground level winds will be realized. A similar effect will occur when large low-density residential areas are demolished to accommodate high-rise developments. The transitional open area will experience significantly higher pedestrian level winds than the previous suburban setting. Once the high-rise development is established, ground level winds will moderate with localized areas of higher pedestrian level winds likely to occur. Pedestrian level wind velocities respond to orientation and shape of the development and if the site is not appropriately engineered or mitigated, pedestrian level wind may be problematic.

Microclimate

The specific wind conditions related to the study site are known as the microclimate, which are dictated mainly by the following factors:

- The orientation and conformation of buildings within the vicinity of the site.
- The surrounding contours and pertinent landscape features.

The microclimate establishes the effect that surrounding buildings or landscape features have on the subject building and the effect the subject building has on the surrounds. For the majority of urban test sites the proper microclimate can be established by modelling an area of 300*m* in radius around the subject building. If extremely tall buildings are

present then the study area must be larger, and if the building elevations are on the order of a few floors, smaller areas will suffice to establish the required microclimate.

General Wind Flow Phenomena

Wind flow across undulating terrain contains parallel streamlines with the lowest streamline adjacent to the surface. These conditions continue until the streamlines approach vertical objects. When this occurs there is a general movement of the streamlines upward ("Wind Velocity Gradient") and as they reach the top of the objects turbulence is generated on the lee side. This is one of the reasons for unexpected high wind velocities as this turbulent action moves to the base of the objects on the lee side.

Other fluid action occurs through narrow gaps between buildings (Venturi Action) and at sharp edges of a building or other vertical objects (Scour Action). These conditions are predictable at selected locations but do not conform to a set direction of wind as described by a macroclimate condition. In fact, the orientation and conformation of buildings, streets and landscaping establish a microclimate.

Because of the "Wind Velocity Gradient" phenomena, there is a "downwash" of wind at the face of buildings and this effect is felt at the pedestrian level. It may be experienced as high gusty winds or drifting snow. These effects can be obviated by windbreak devices on the windward side or by canopies over windows and doors on the lee side of the building.

The intersection of two streets or pedestrian walkways have funnelling effects of wind currents from any one of the four directions and is particularly severe at corners if the buildings project to the street line or are close to walkways.

Some high-rise buildings have gust effects as the wind velocities are generated suddenly due to the orientation and conformation of the site. Since wind velocities are the result of energy induced wind currents the solution to most problems is to reduce the wind energy at selected locations by carefully designed windbreak devices, often landscaping, to blend with the surrounds.

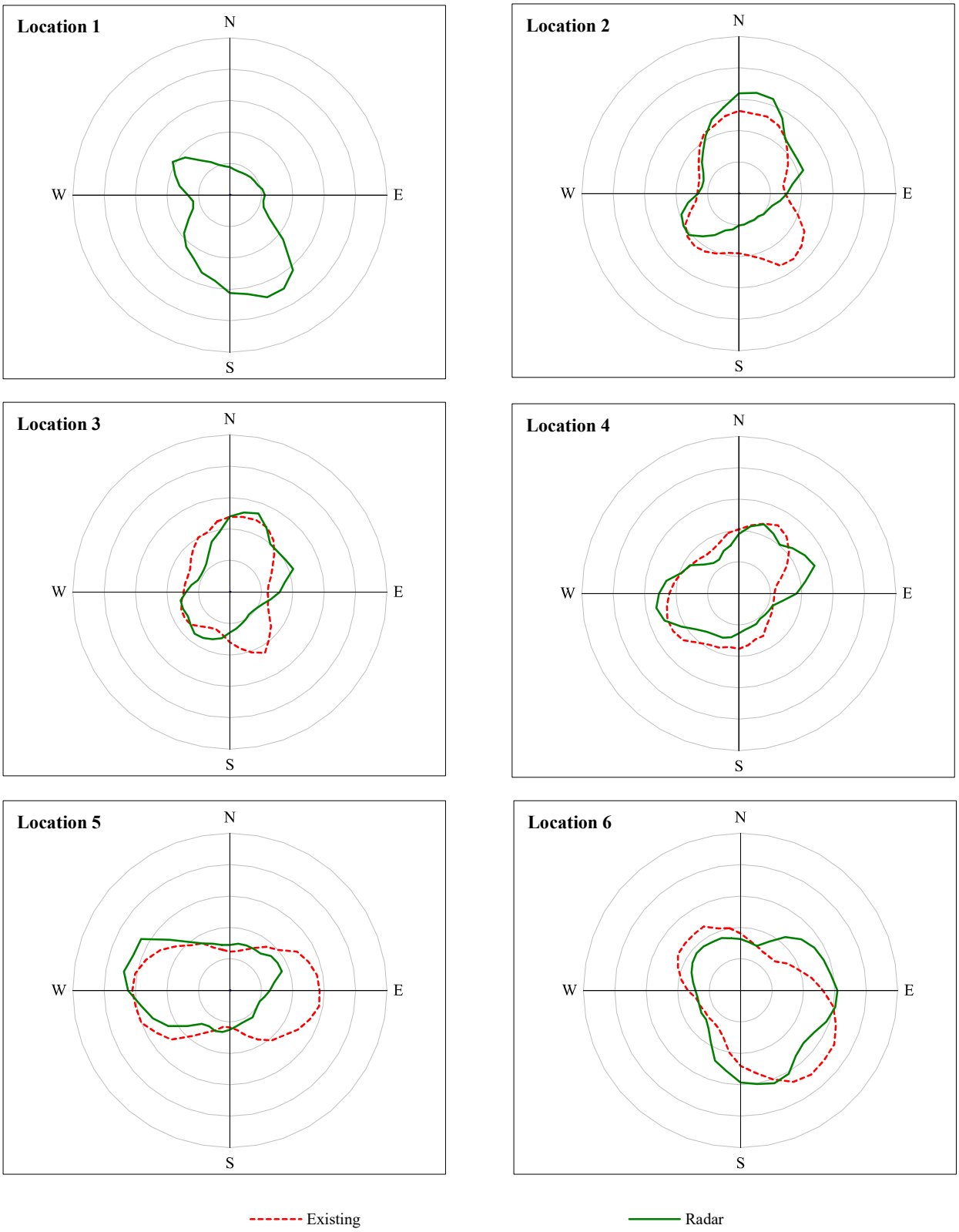
The Beaufort Scale is often used as a numerical relationship to wind speed based upon an observation of the effects of wind. Rear-Admiral Sir Francis Beaufort, commander of the Royal Navy, developed the wind force scale in 1805, and by 1838 the Beaufort wind force scale was made mandatory for log entries in ships of the Royal Navy. The original scale was an association of integers from 0 to 12, with a description of the effect of wind on the behaviour of a full-rigged man-of-war. The lower Beaufort numbers described wind in terms of ship speed, mid-range numbers were related to her sail carrying ability and upper numbers were in terms of survival. The Beaufort Scale was adopted in 1874 by the International Meteorological Committee for international use in weather telegraphy and, with the advent of anemometers, the scale was eventually adopted for meteorological purposes. Eventually, a uniform set of equivalents that non-mariners could relate to was developed, and by 1955, wind velocities in knots had replaced Beaufort numbers on weather maps. While the Beaufort Scale lost ground to technology, there remains the need to relate wind speed to observable wind effects and the Beaufort Scale remains a useful tool.

Abbreviated Beaufort Scale

Beaufort Number	Description	Wind Speed			Observations
		km/h	*m/s*	h=2*m* for Urban *m/s*	
2	Slight Breeze	6-11	1.6-3.3	< ~2	Tree leaves rustle; flags wave slightly; vanes show wind direction; small wavelets or scale waves.
3	Gentle Breeze	12-19	3.4-5.4	< ~3	Leaves and twigs in constant motion; small flags extended; long unbreaking waves.
4	Moderate Breeze	20-28	5.5-7.9	< ~4	Small branches move; flags flap; waves with whitecaps.
5	Fresh Breeze	29-38	8.0-10.7	< ~6	Small trees sway; flags flap and ripple; moderate waves with many whitecaps.
6	Strong Breeze	39-49	10.8-13.8	< ~8	Large branches sway; umbrellas used with difficulty; flags beat and pop; larger waves with regular whitecaps.
7	Moderate Gale	50-61	13.9-17.1	< ~10	Sea heaps up, white foam streaks; whole trees sway; difficult to walk; large waves.
8	Fresh Gale	62-74	17.2-20.7	> ~10	Twigs break off trees; moderately high sea with blowing foam.
9	Strong Gale	75-88	20.8-24.4		Branches break off trees; tiles blown from roofs; high crested waves.

Wind speeds indicated above, in *km/h* and *m/s*, are at a reference height of 10 metres, as are the wind speeds indicated on the Figure 5 wind roses. The mean wind speeds at pedestrian level, for an urban climate, would be approximately 56% of these values. The 3rd column for wind speed is shown for reference, at a height of 2*m*, in an urban setting. The approximate Comfort Category Colours are shown above. The relationship between wind speed and height relative to terrain is discussed in the appendices.

Figure B : Ground level wind velocity as a ratio of gradient wind velocity.



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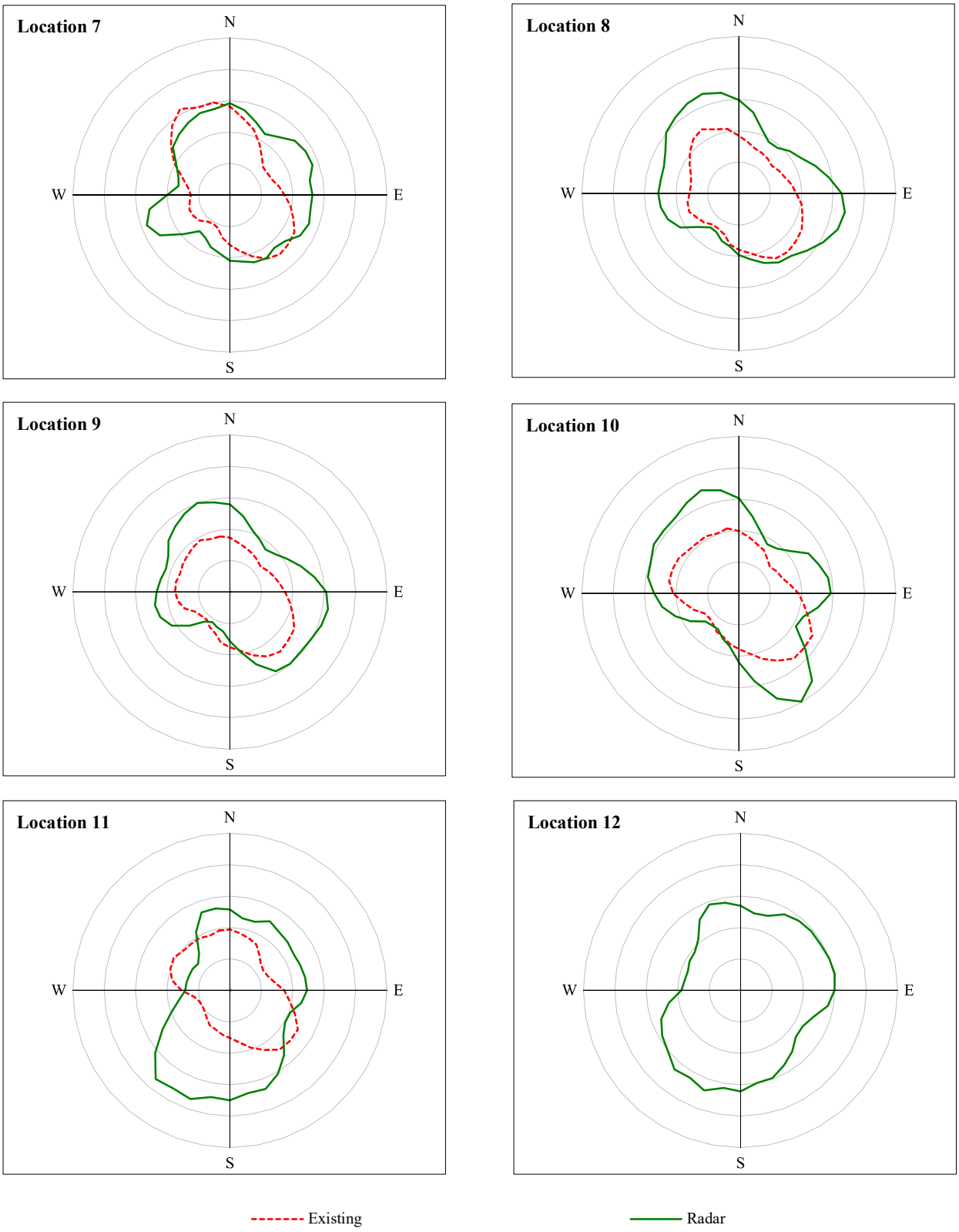

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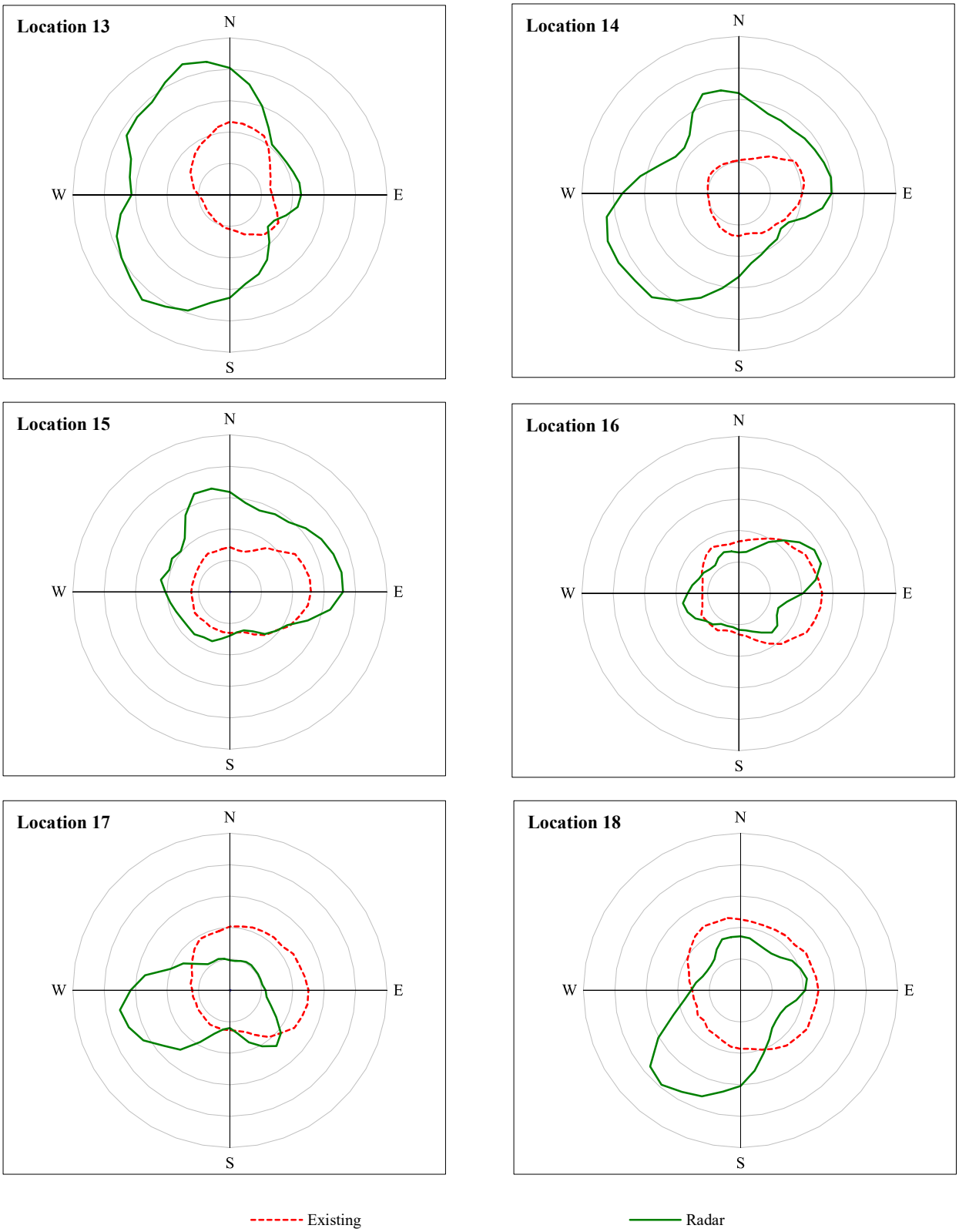

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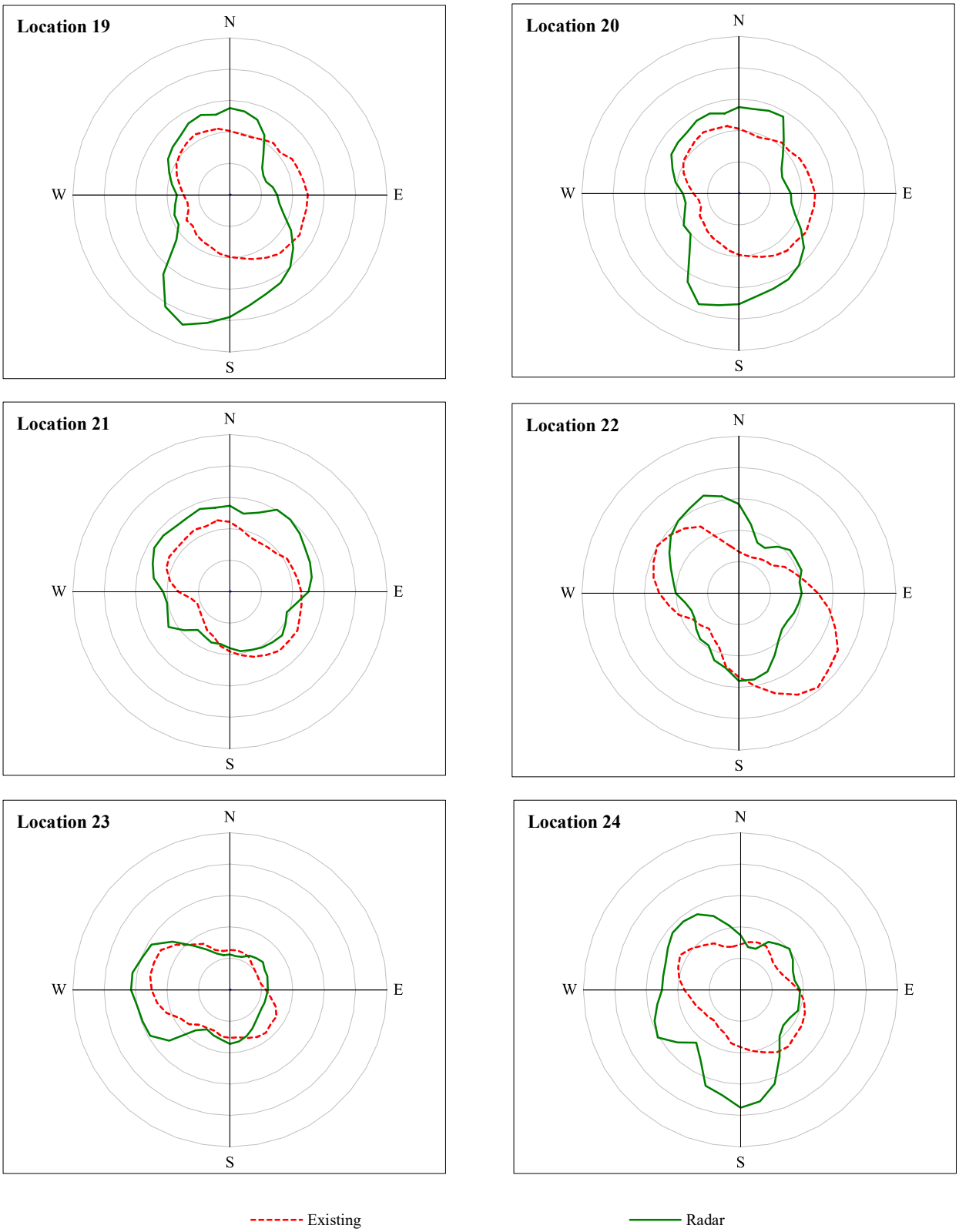

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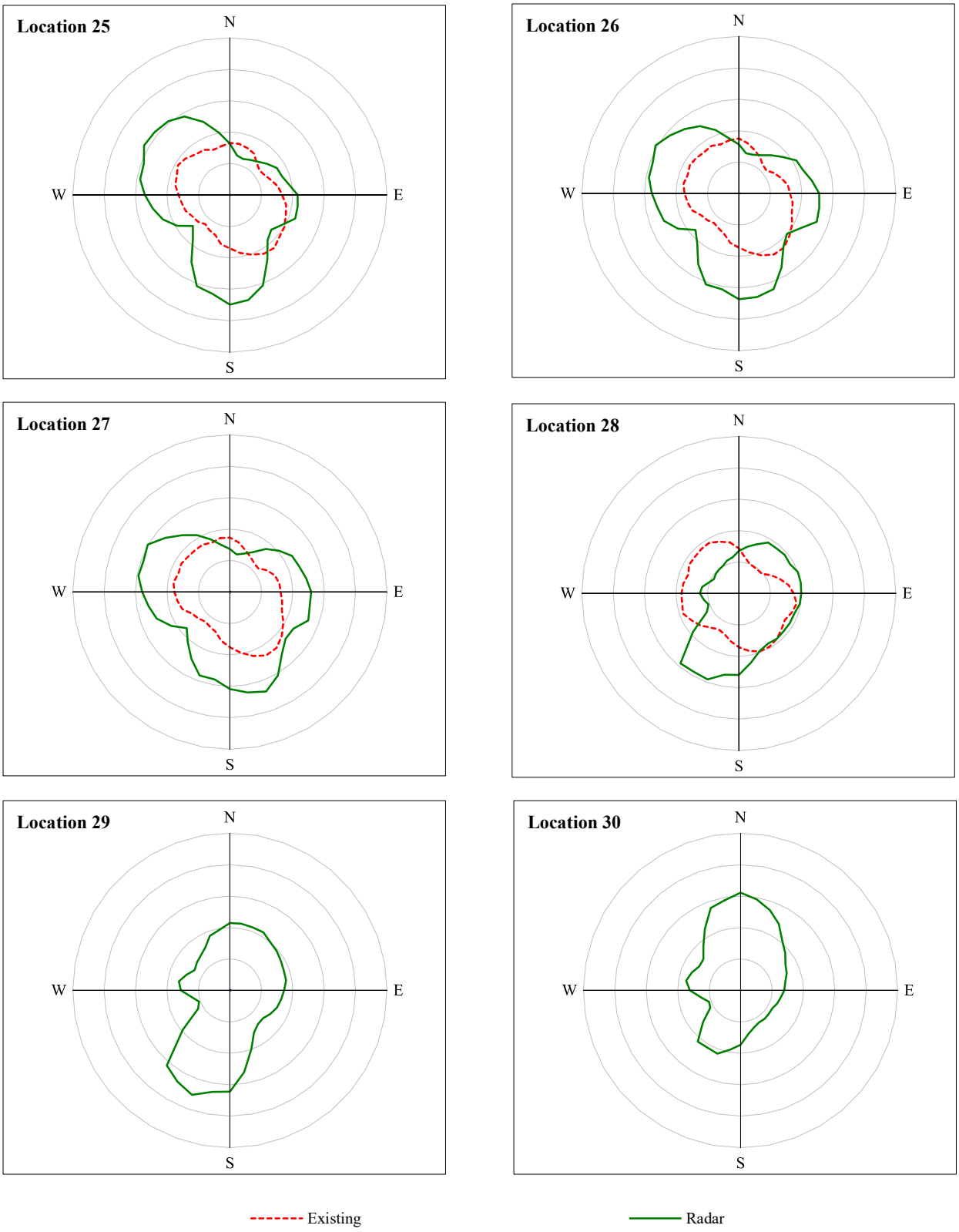

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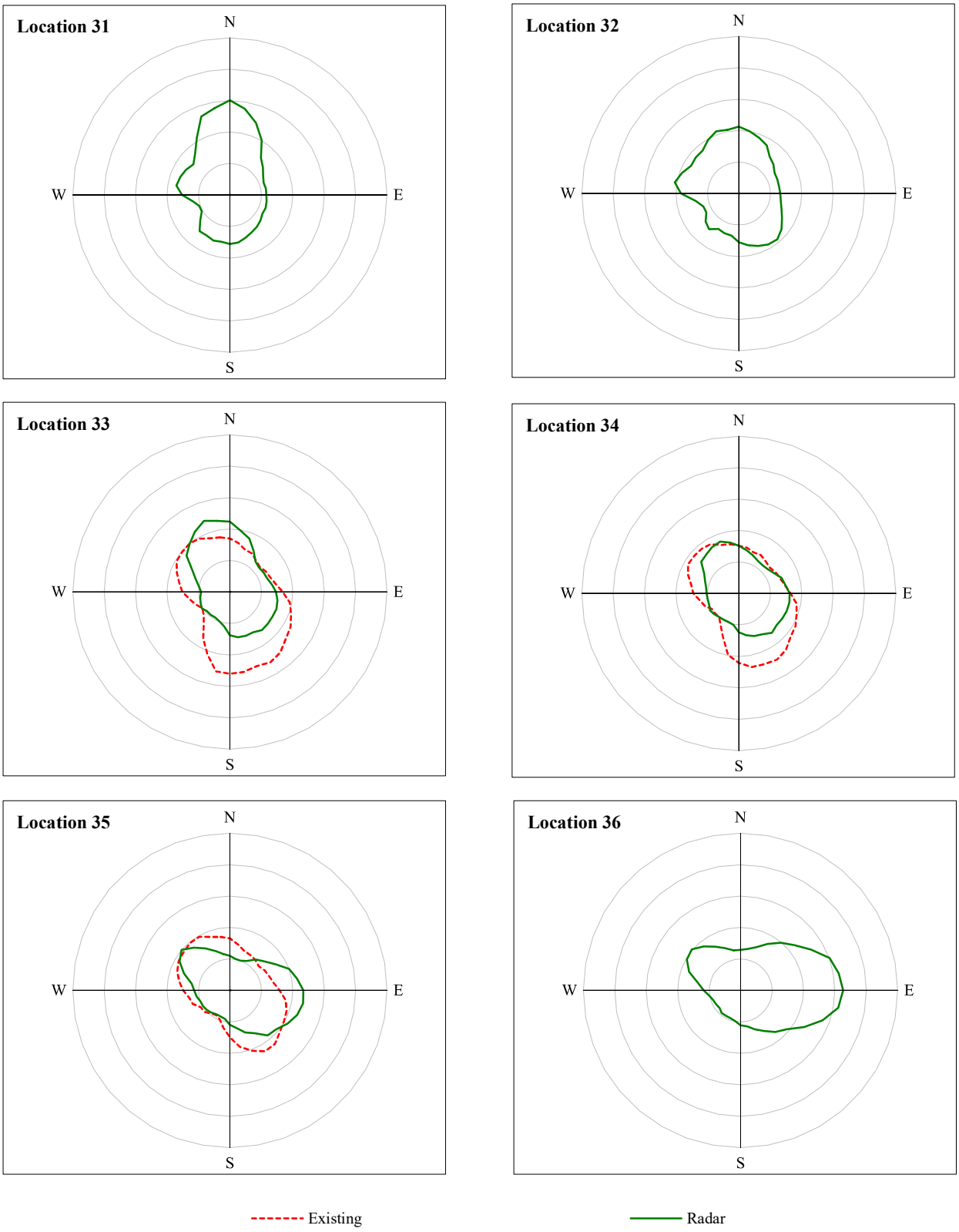

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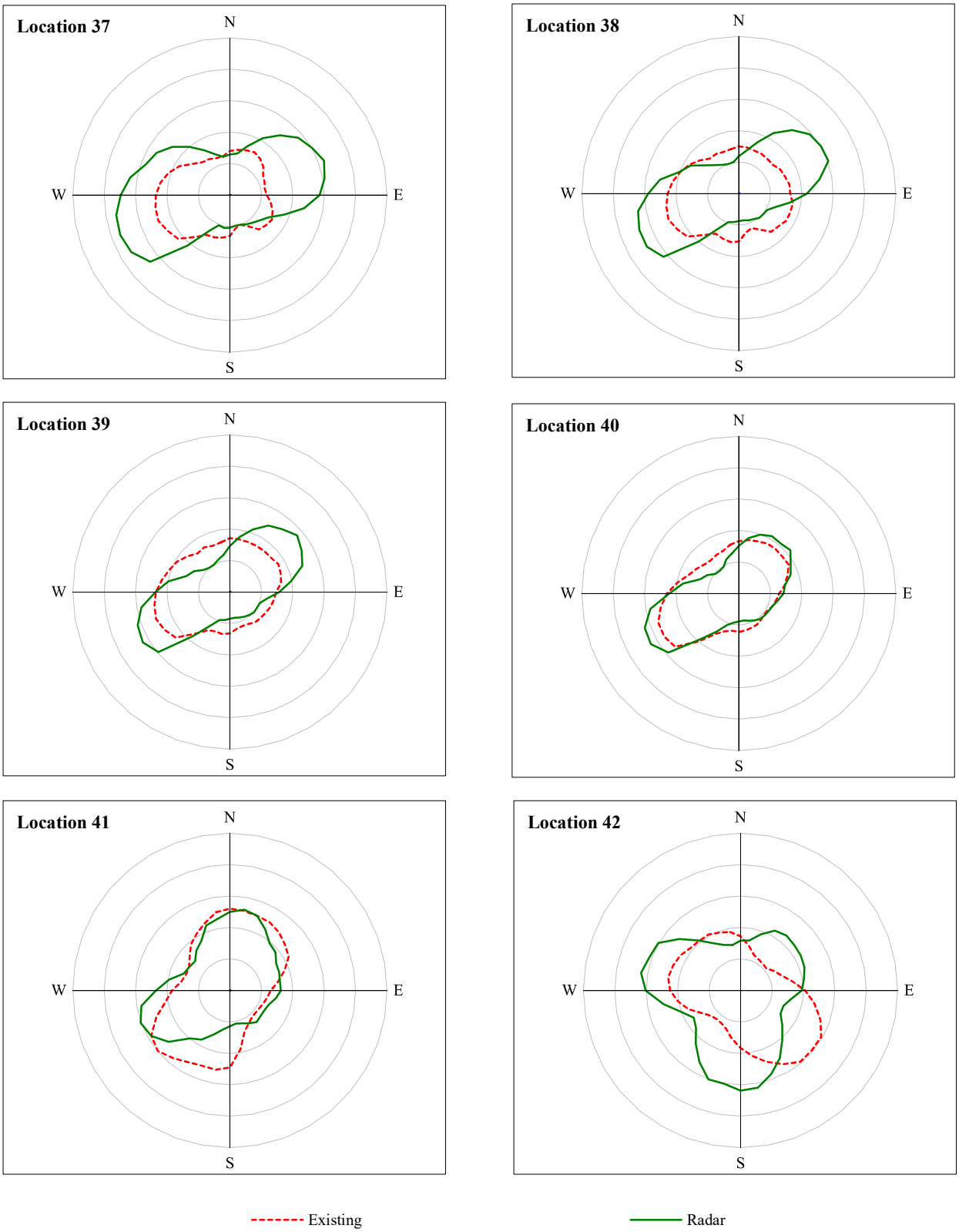

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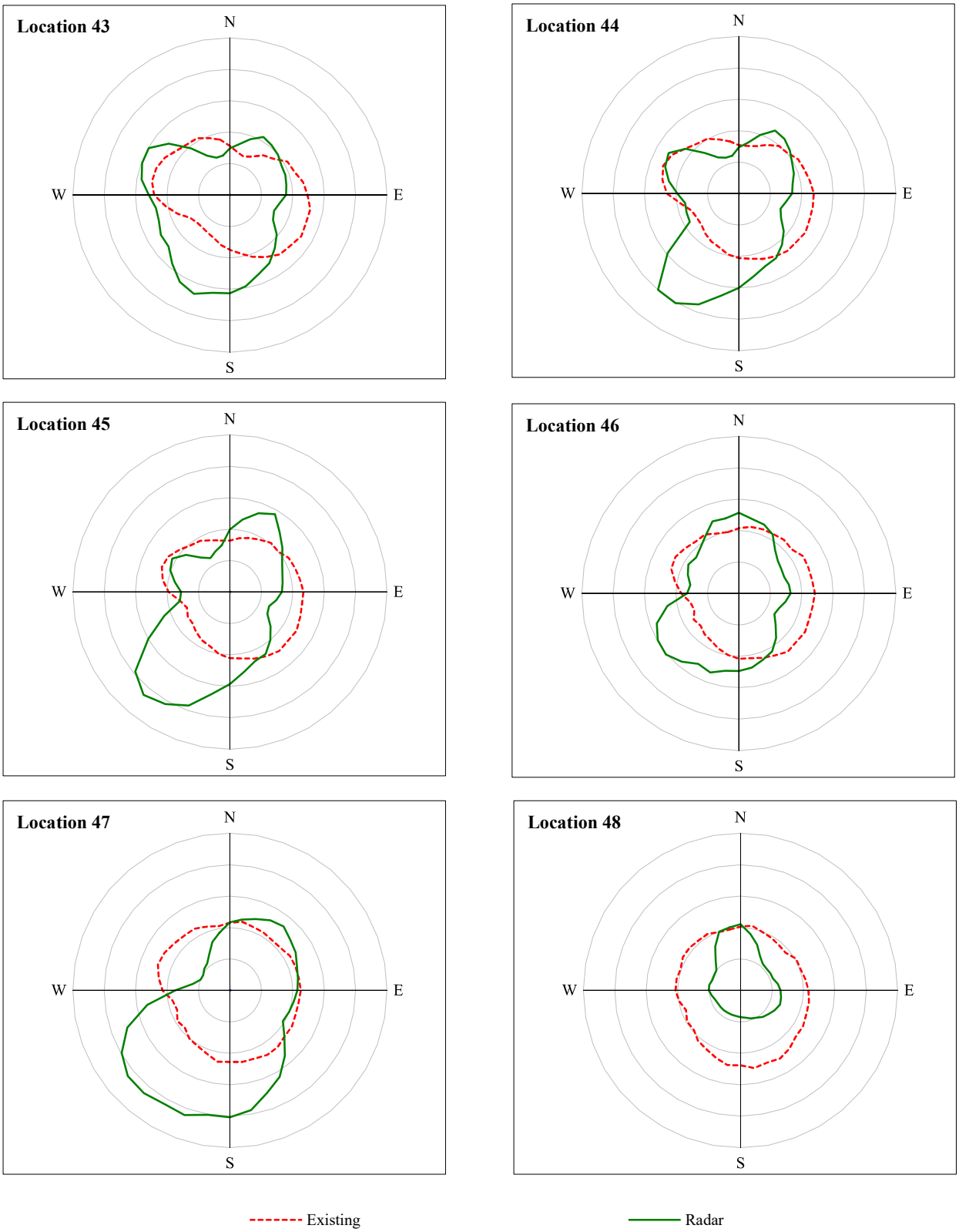

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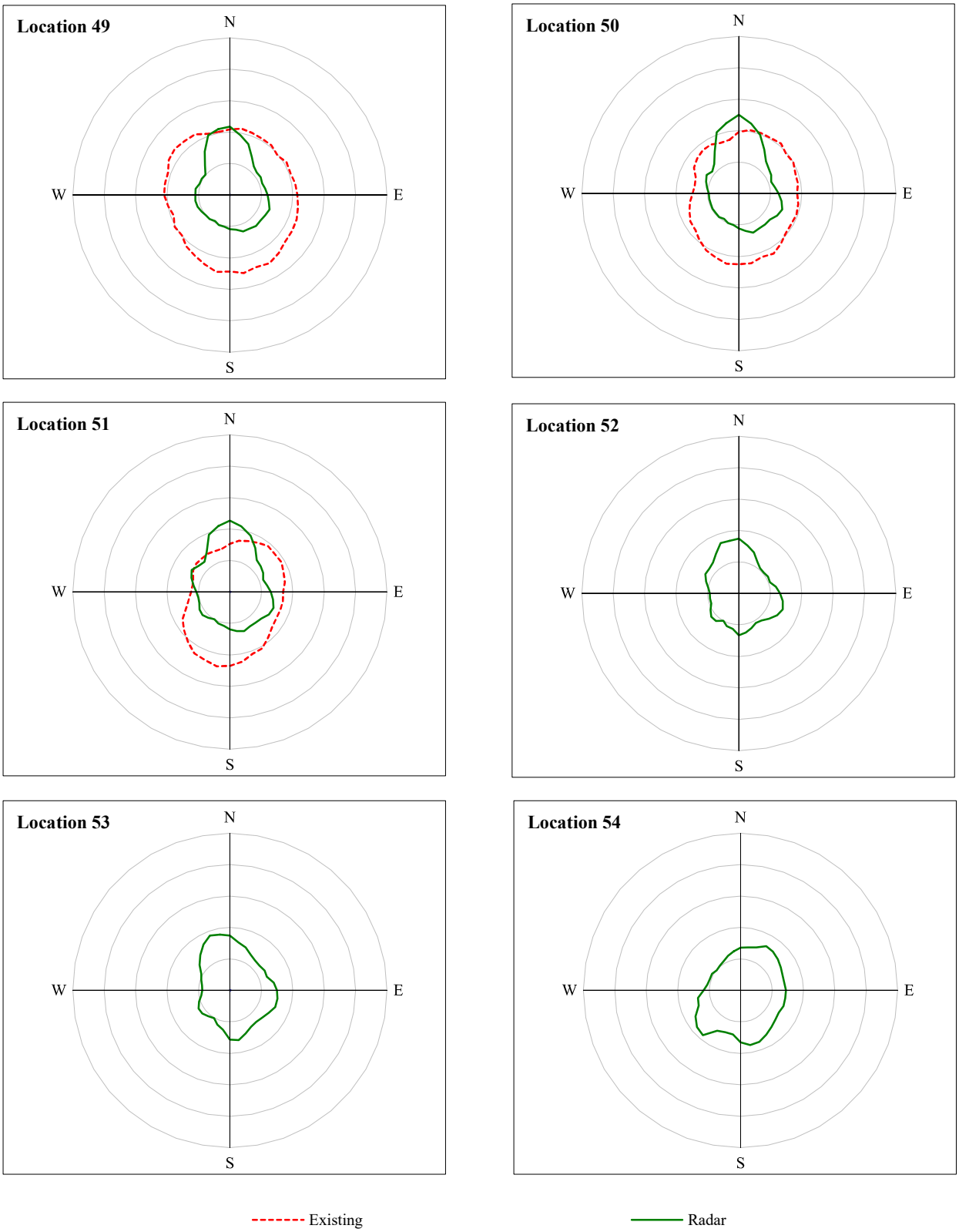

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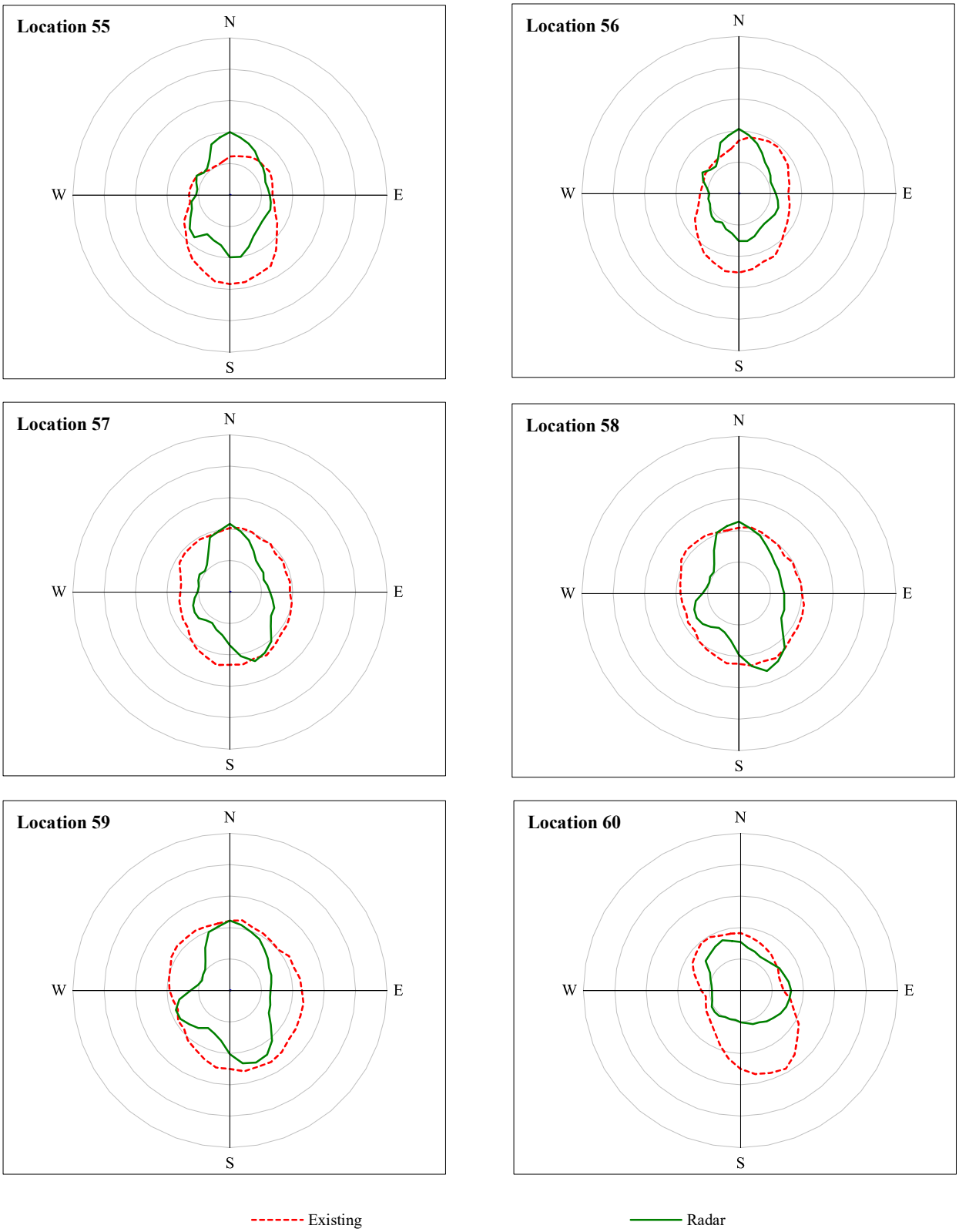

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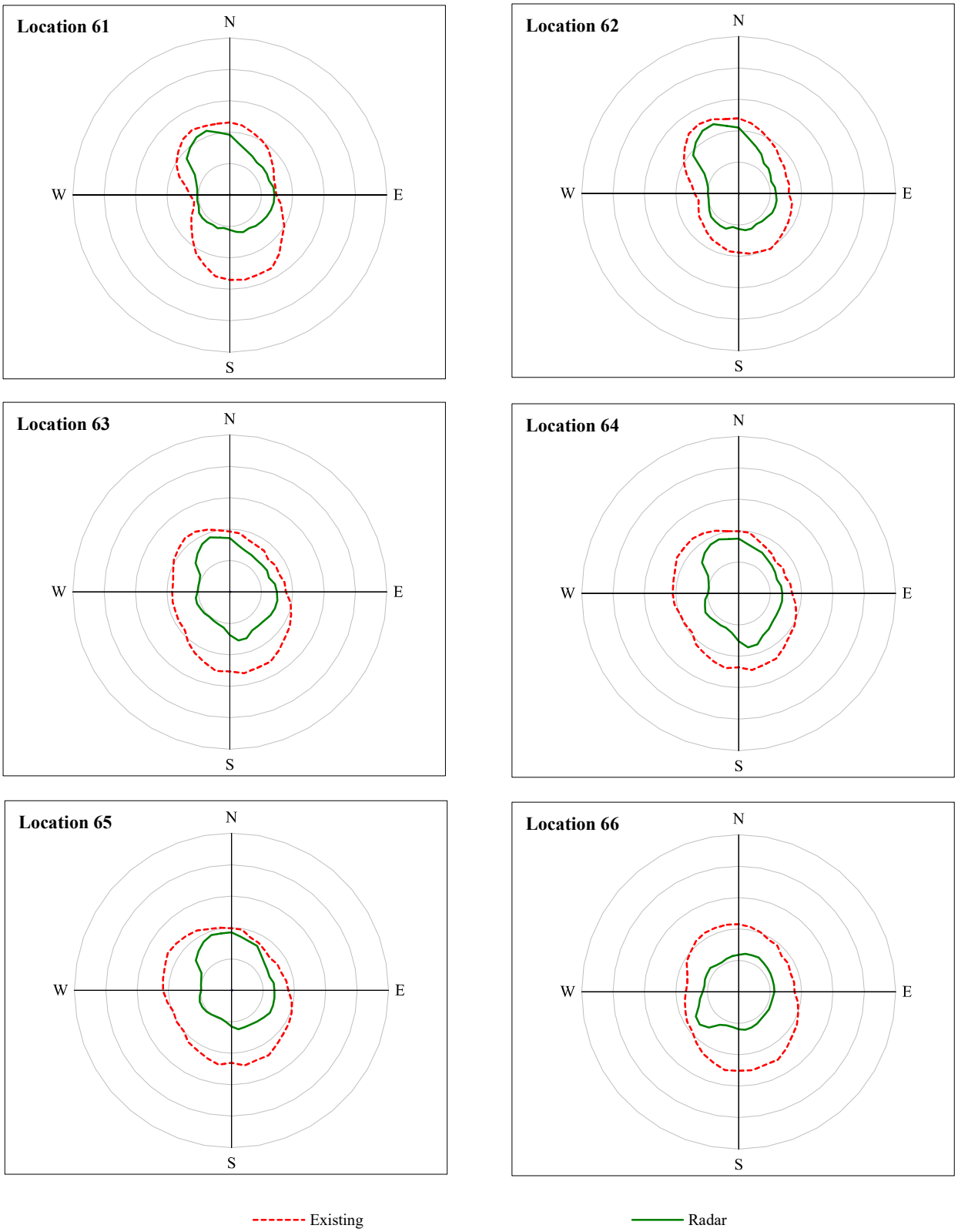

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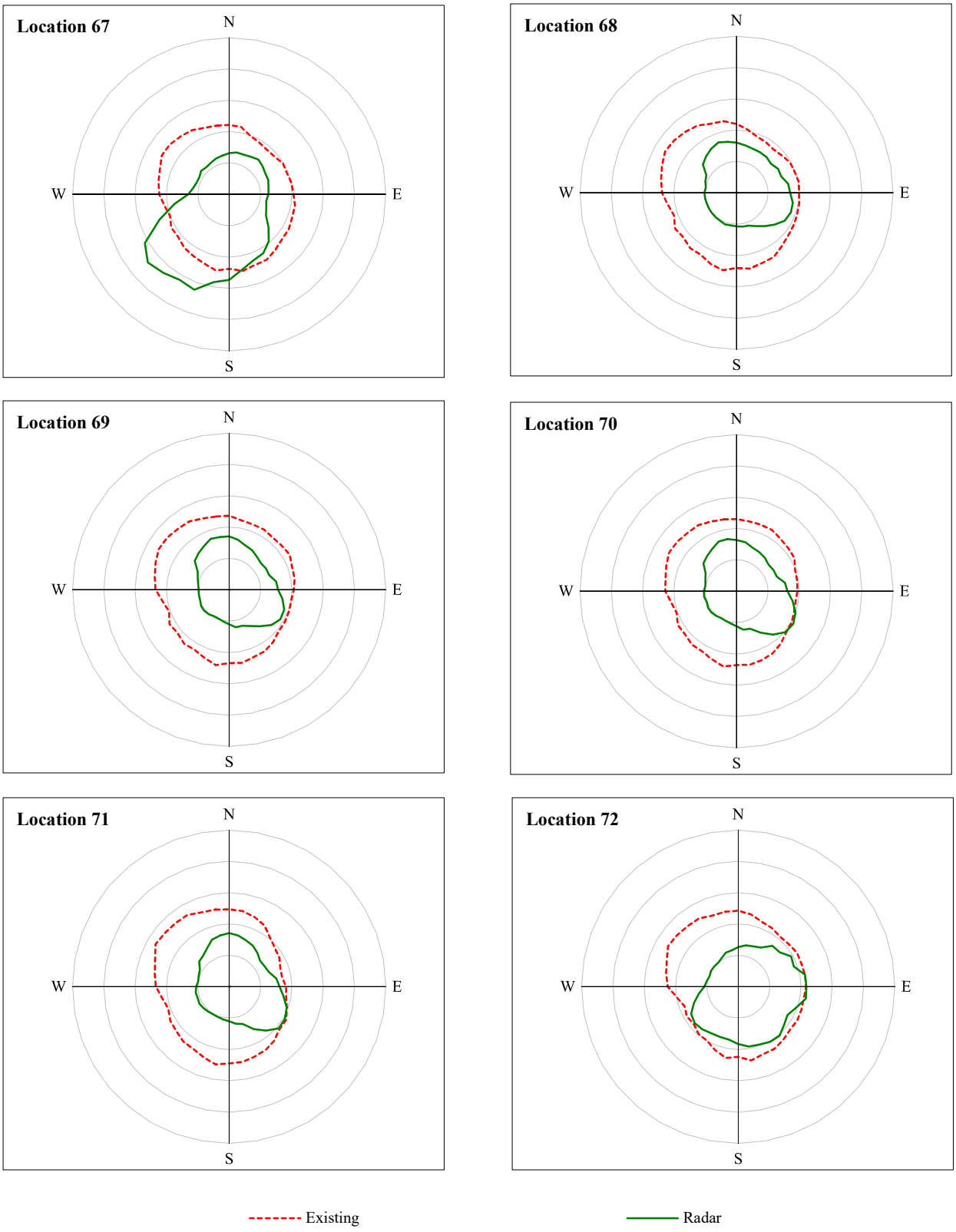

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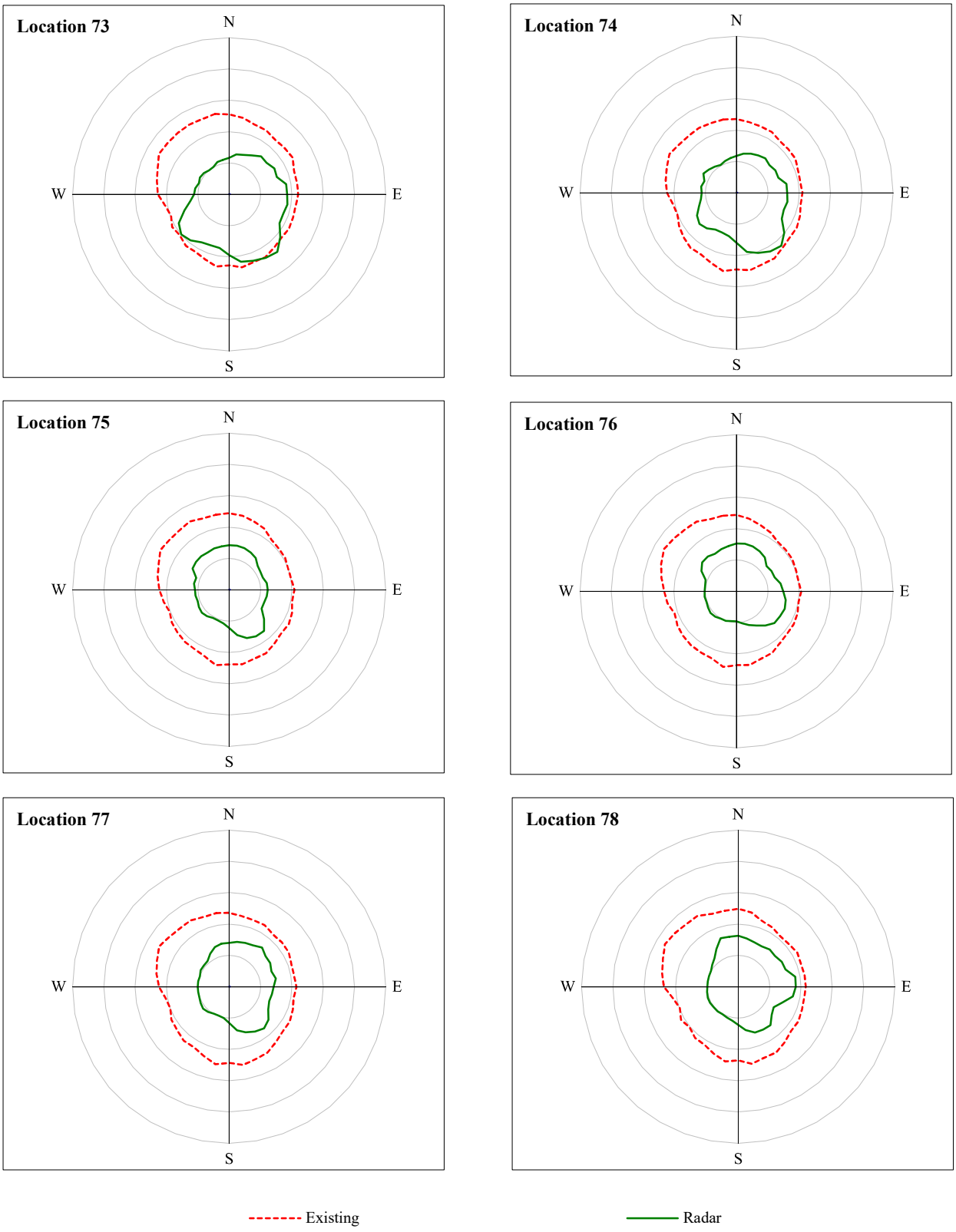

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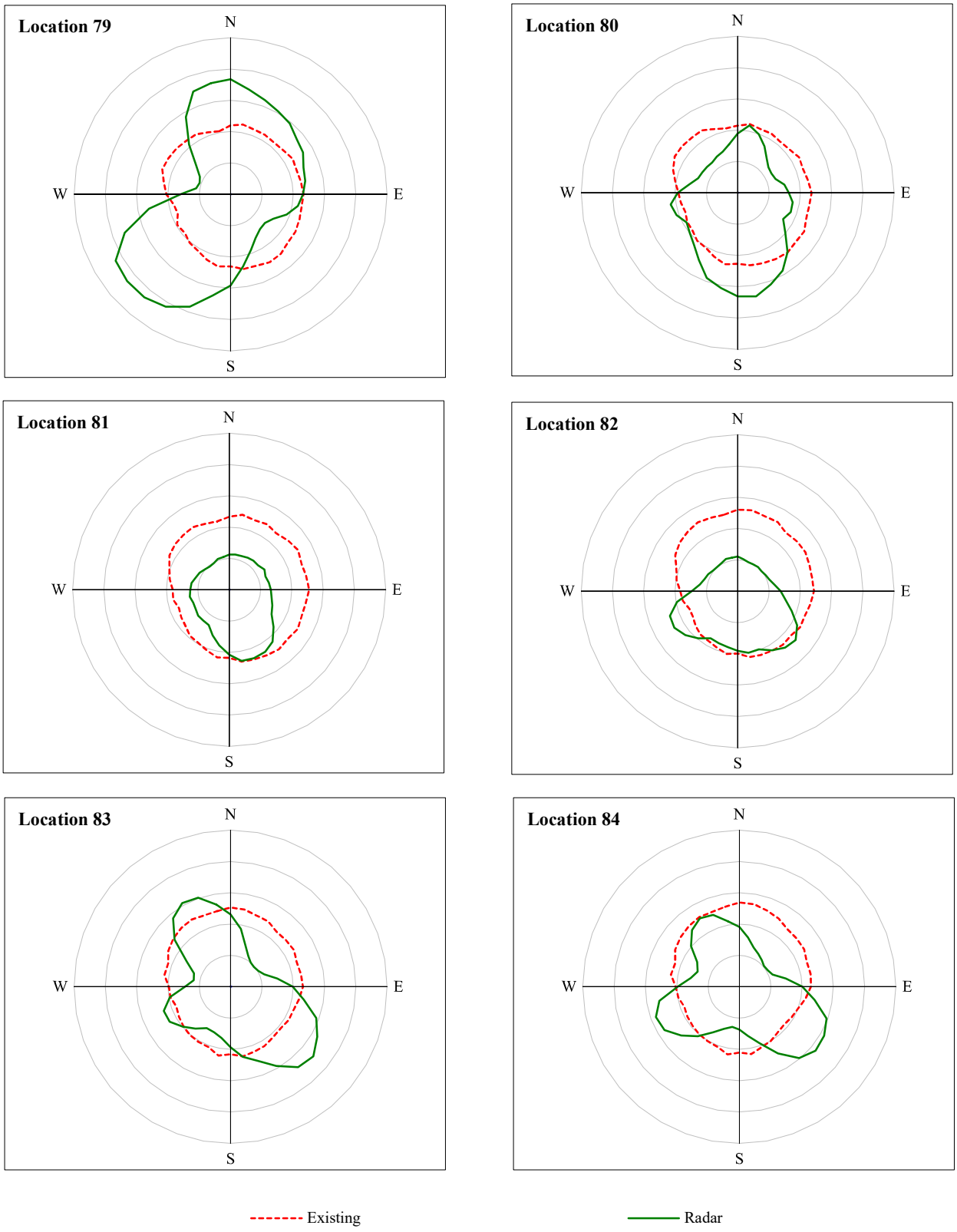

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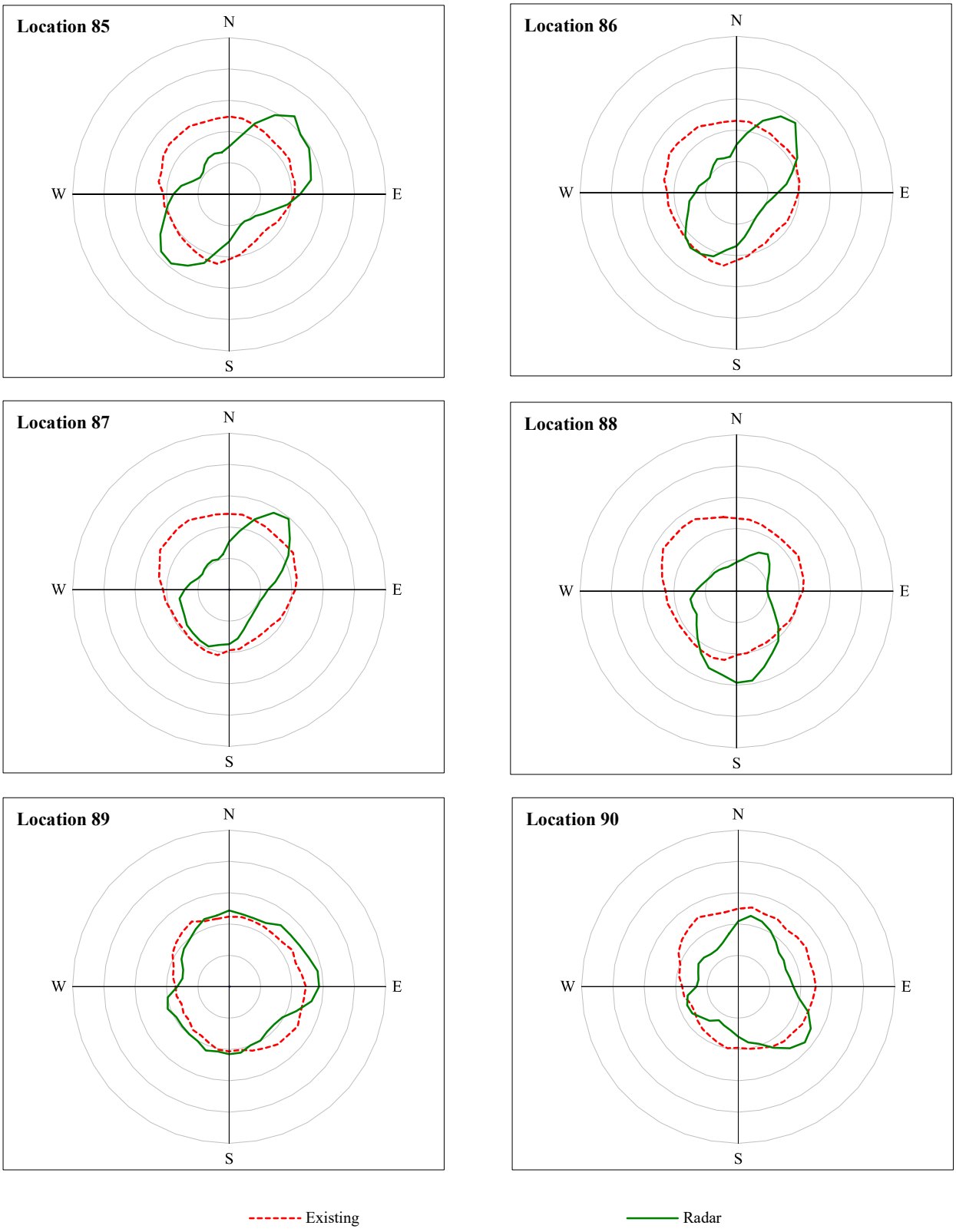

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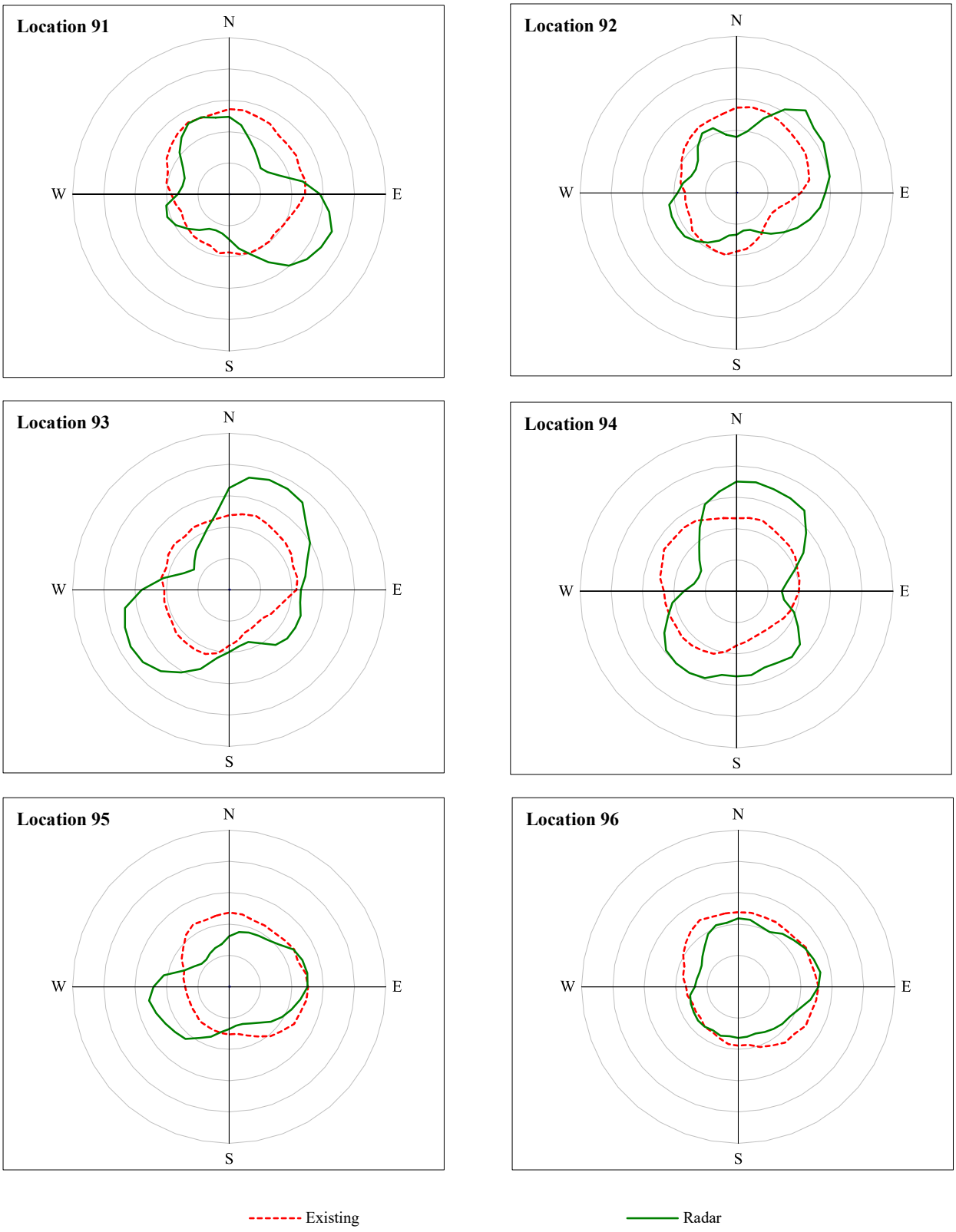

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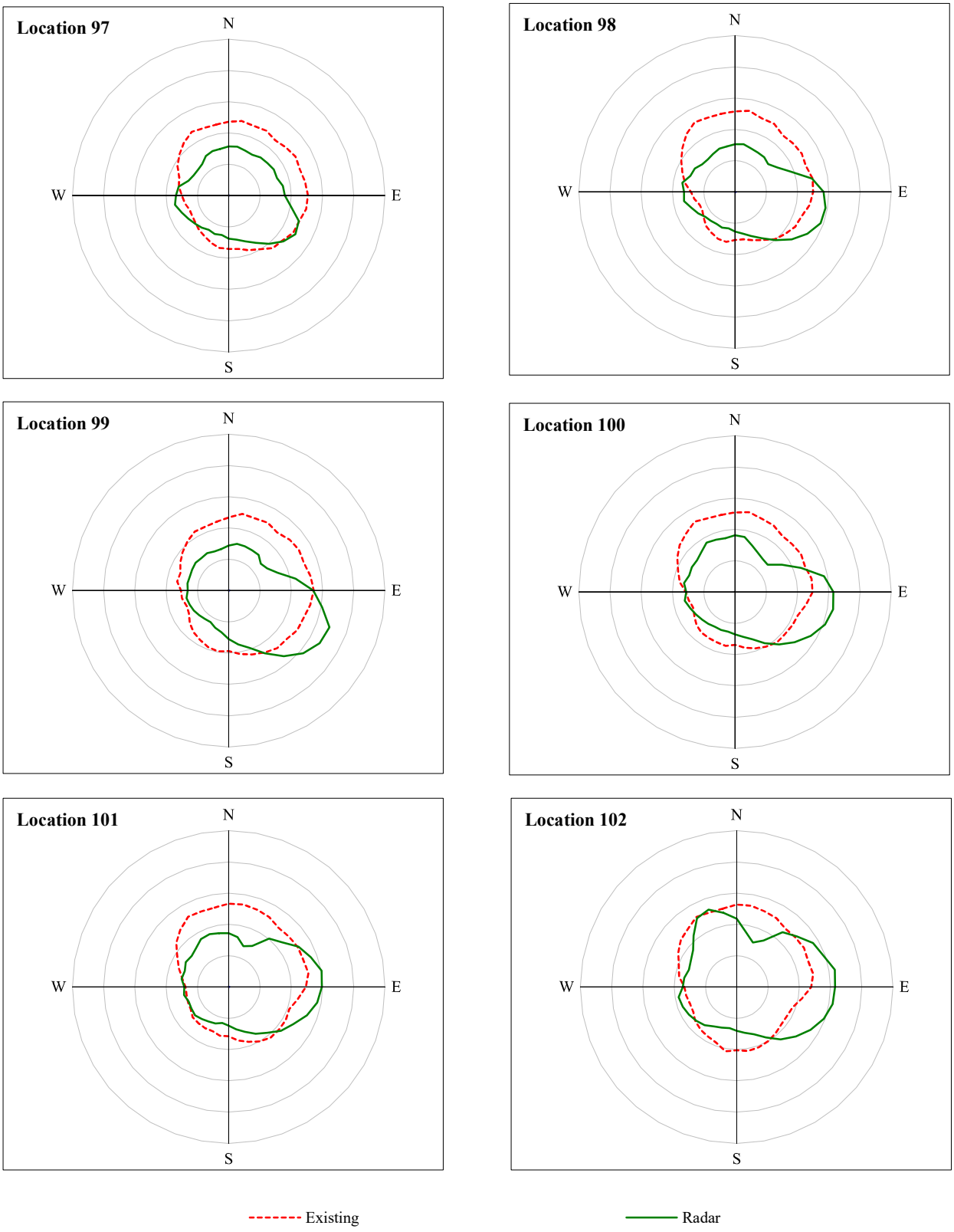

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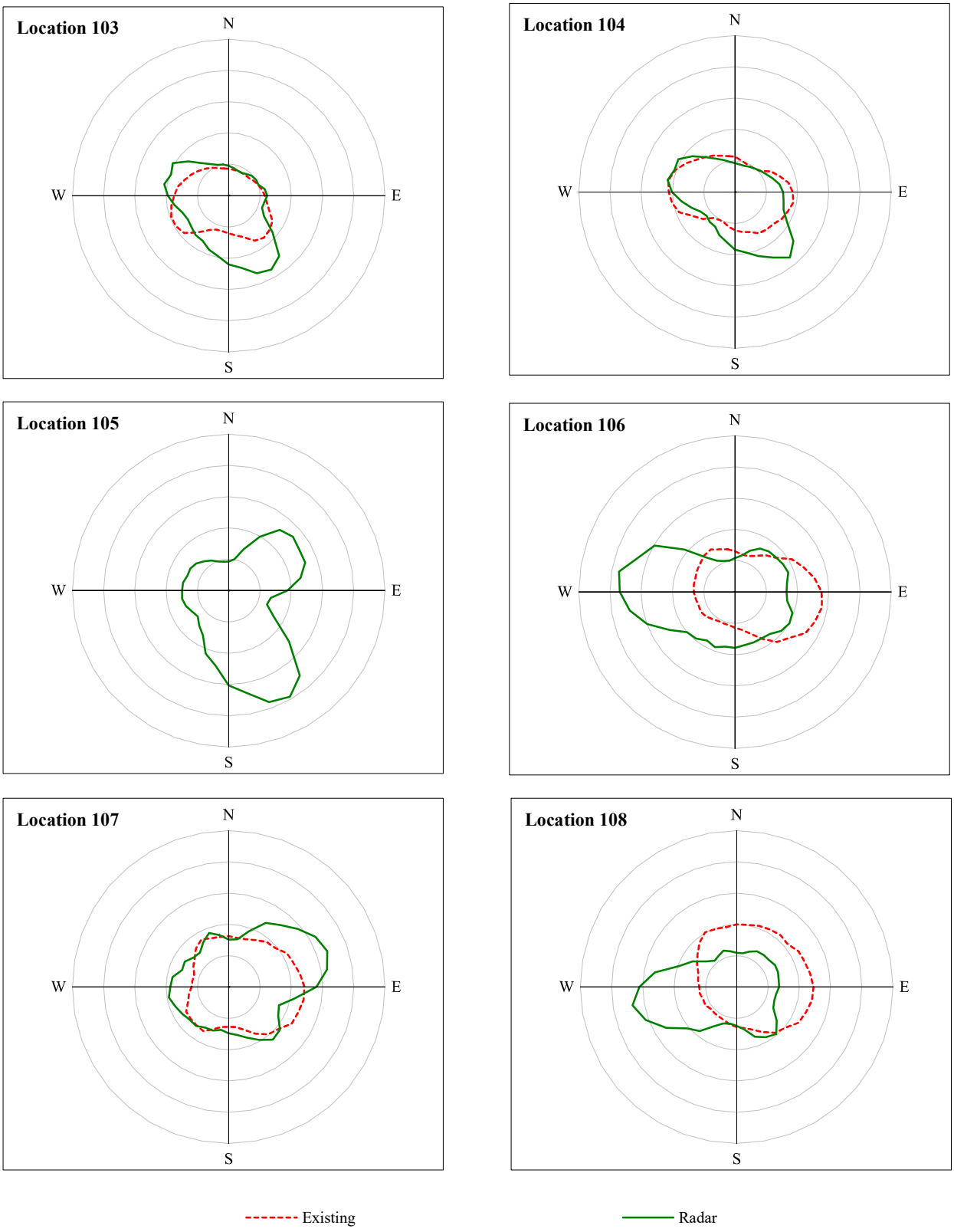

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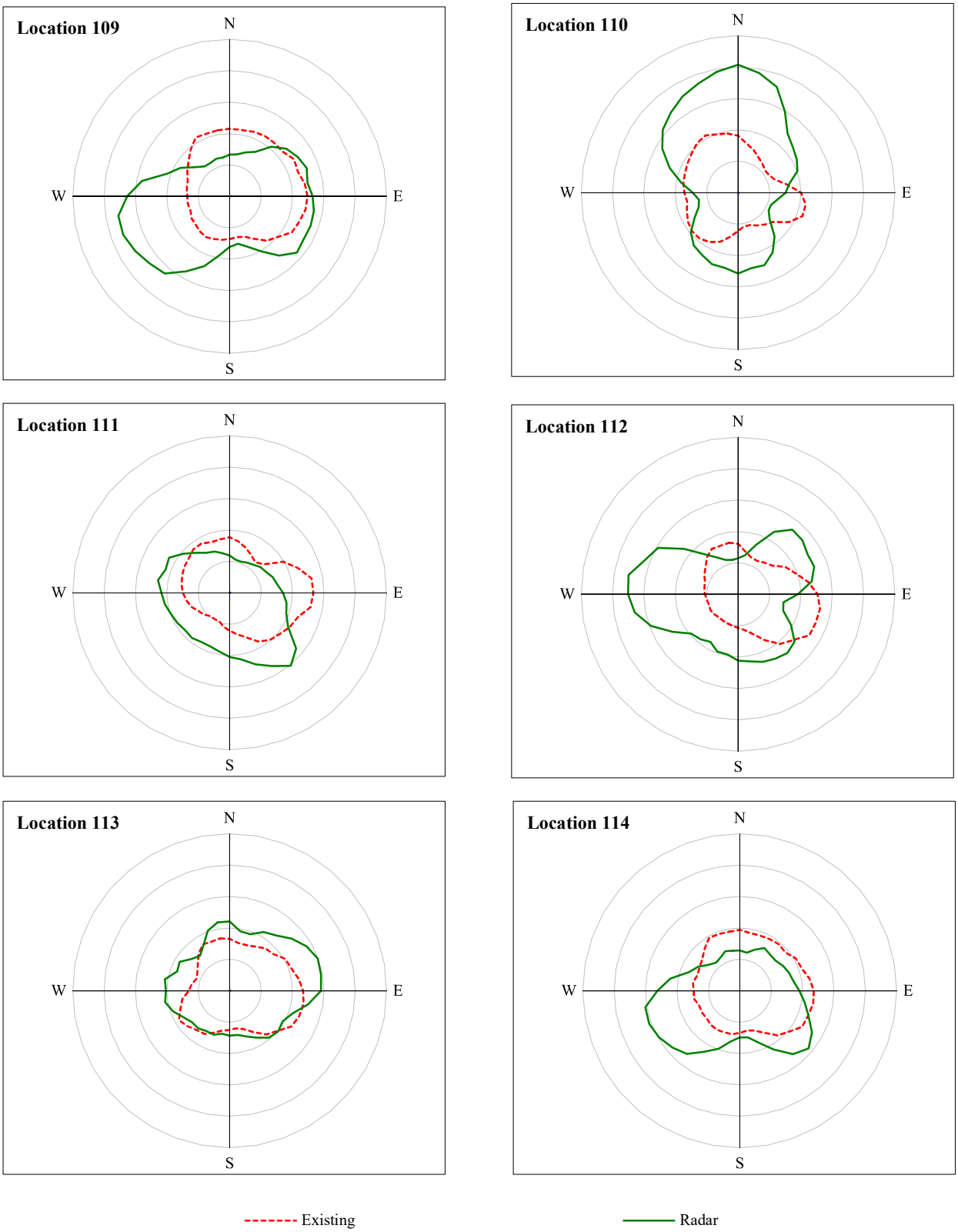

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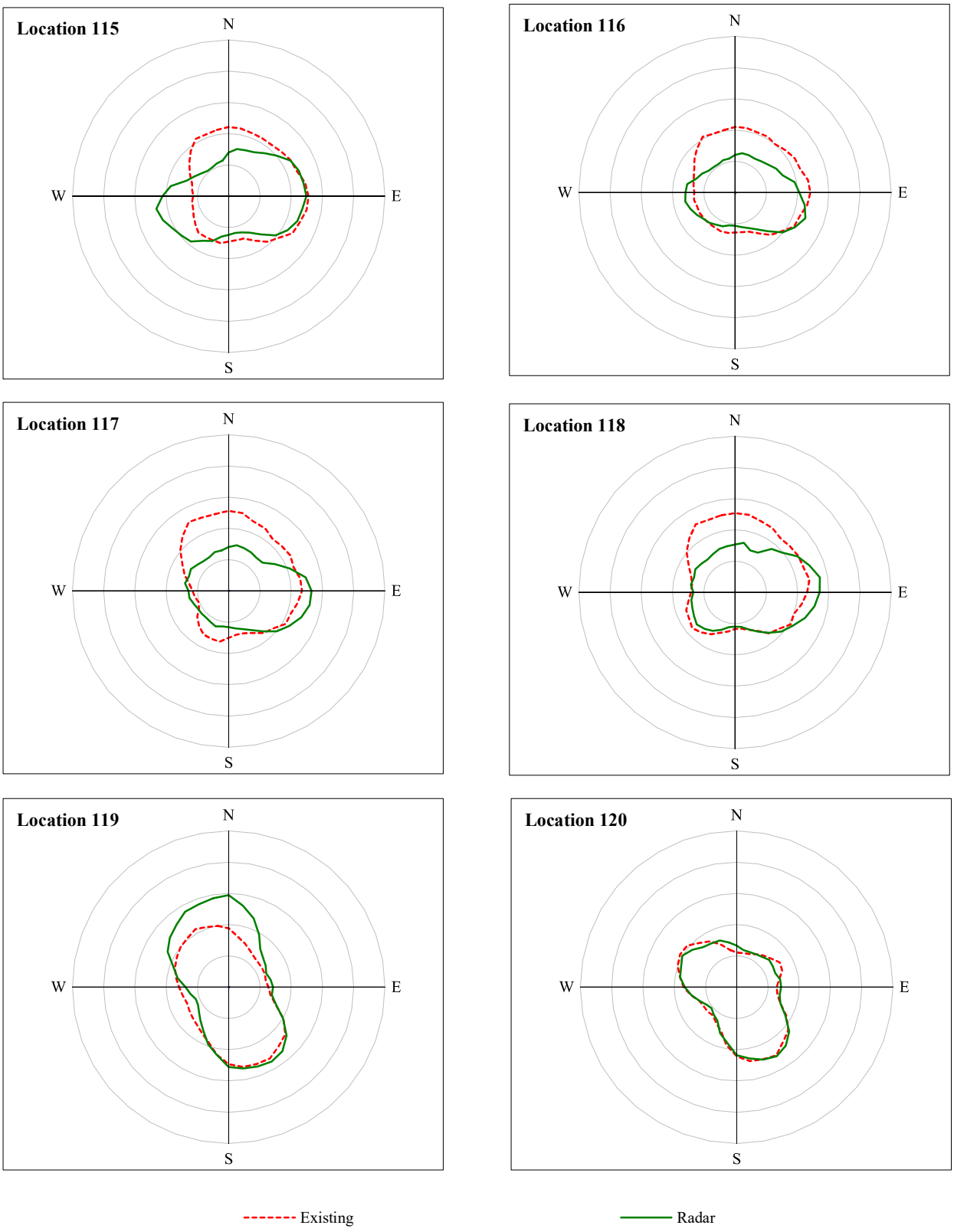
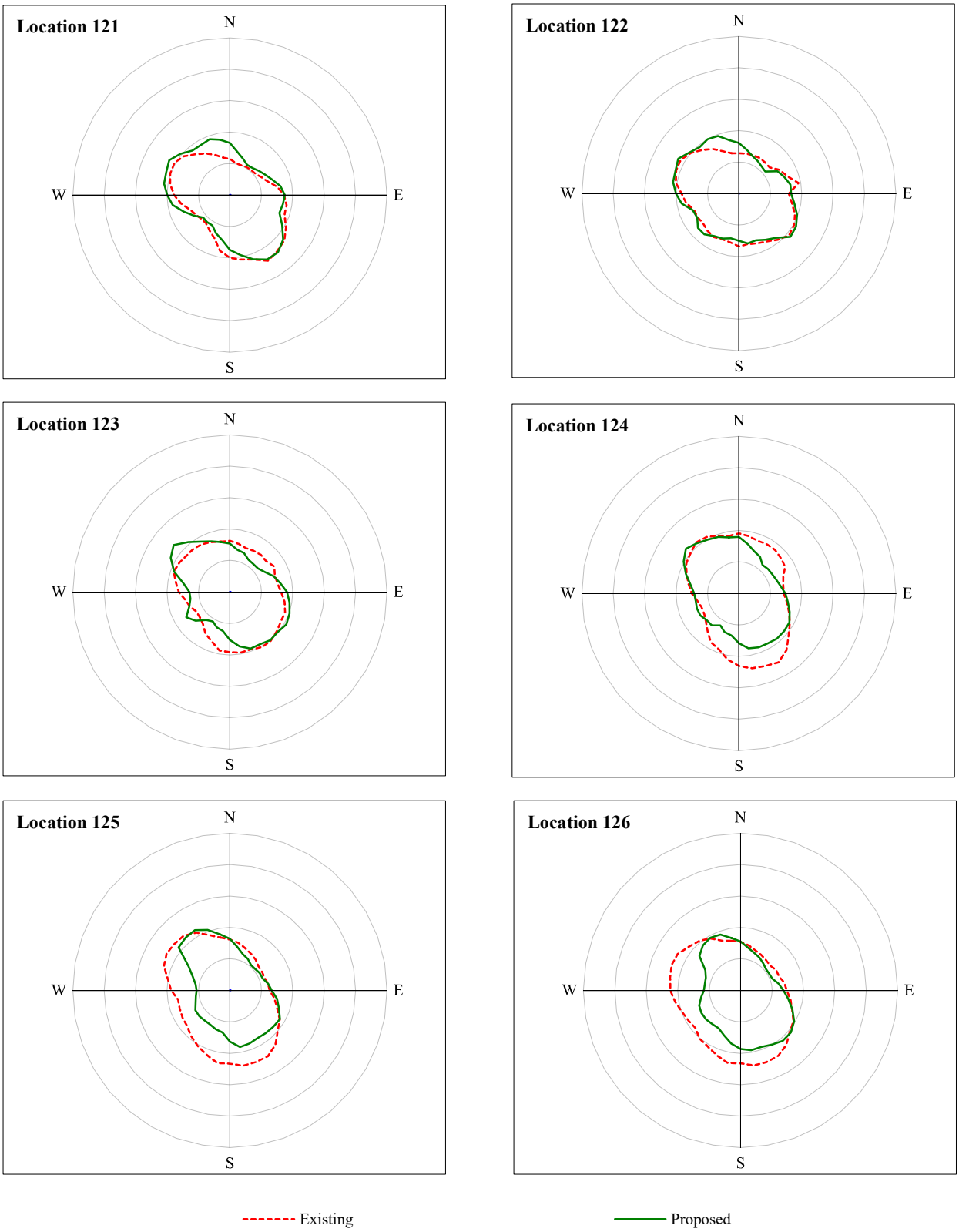


Figure B : Ground level wind velocity as a ratio of gradient wind velocity.



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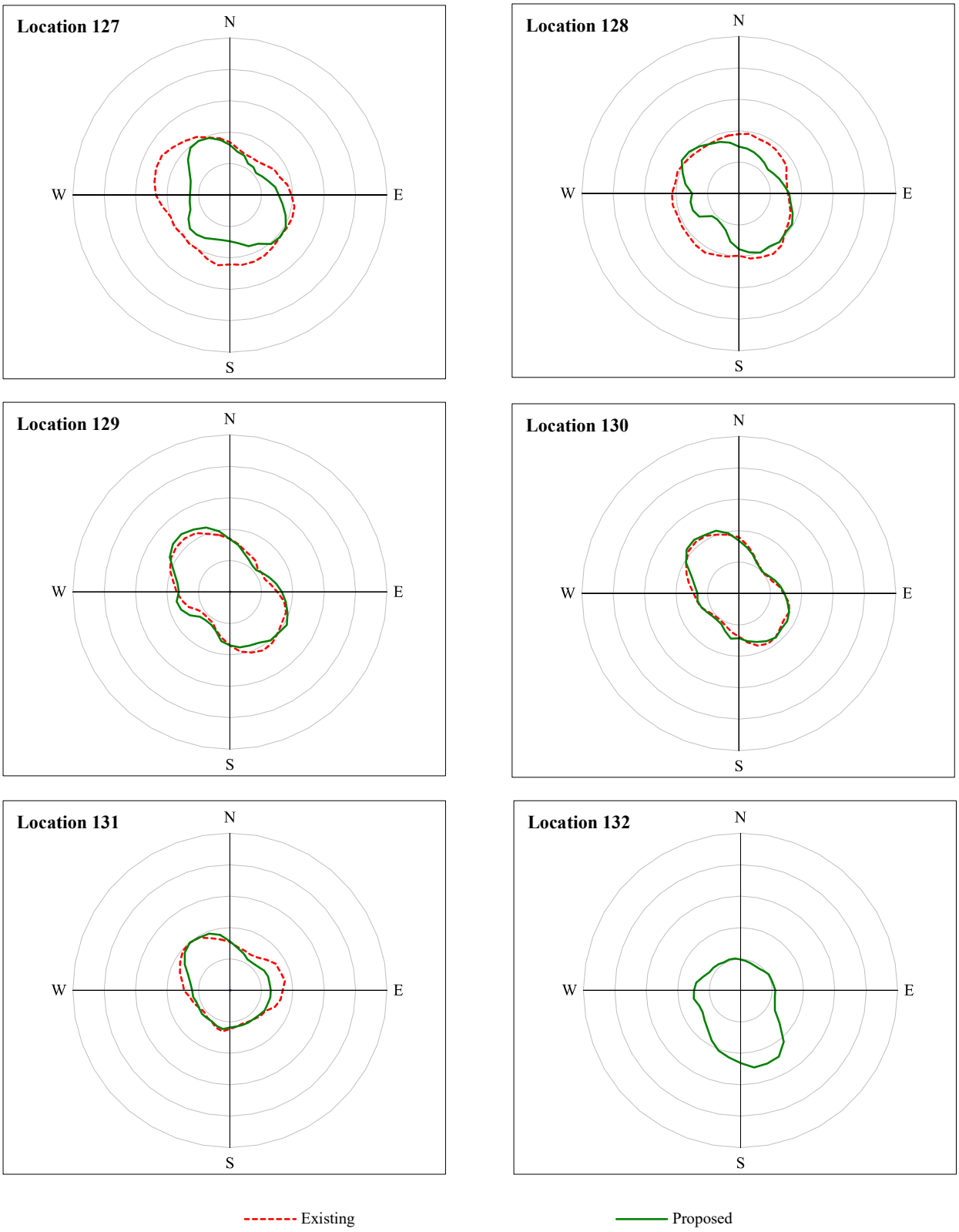

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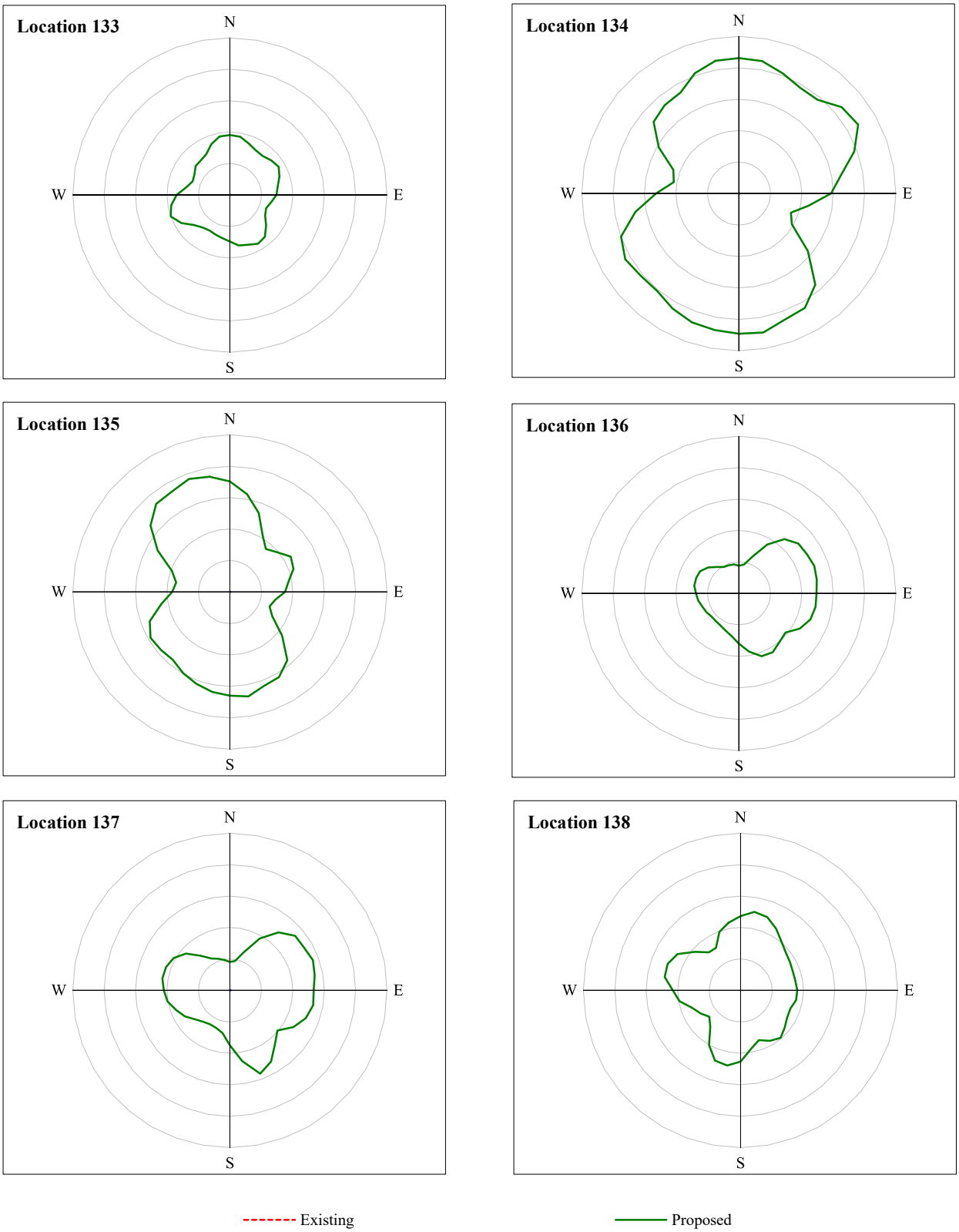

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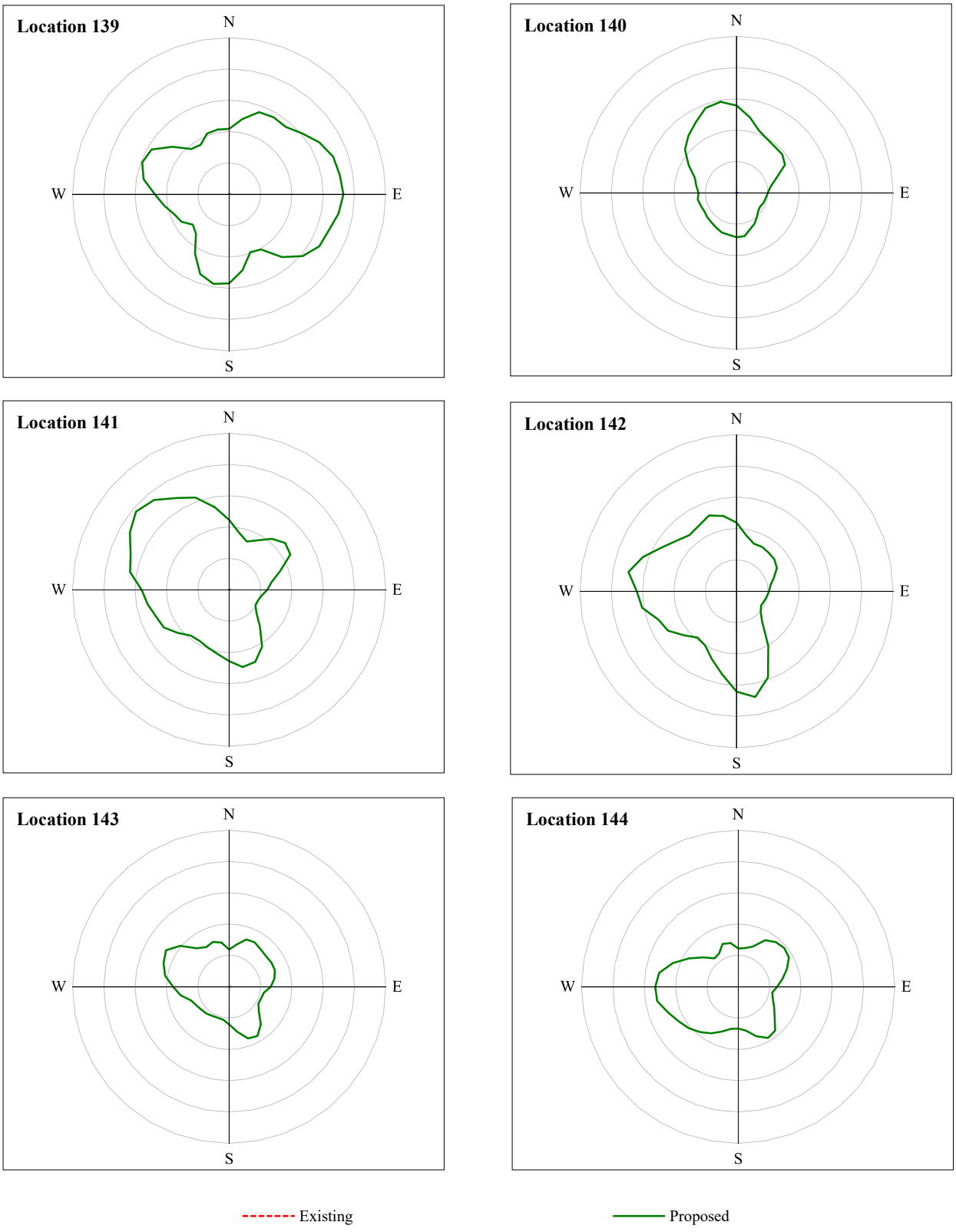

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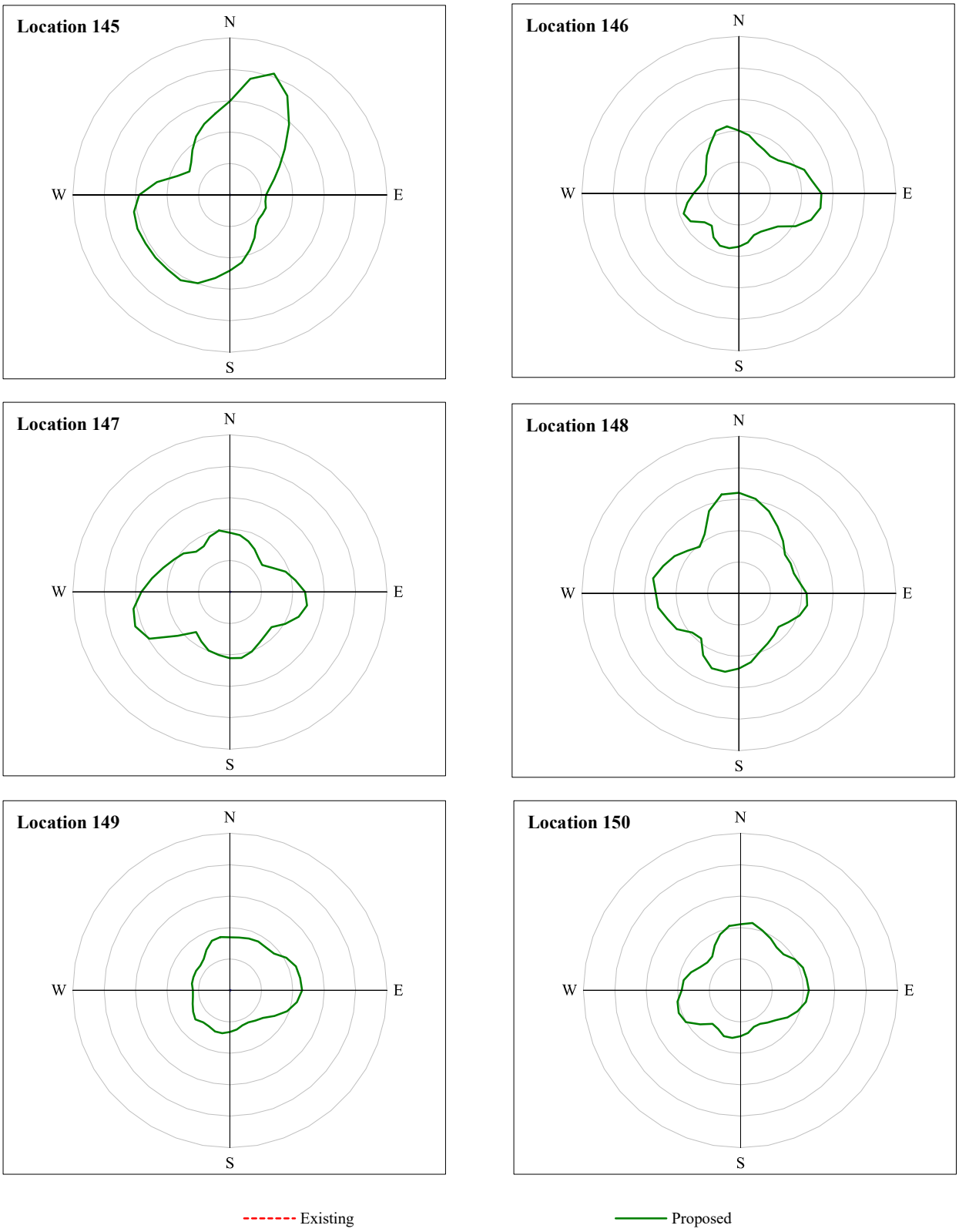

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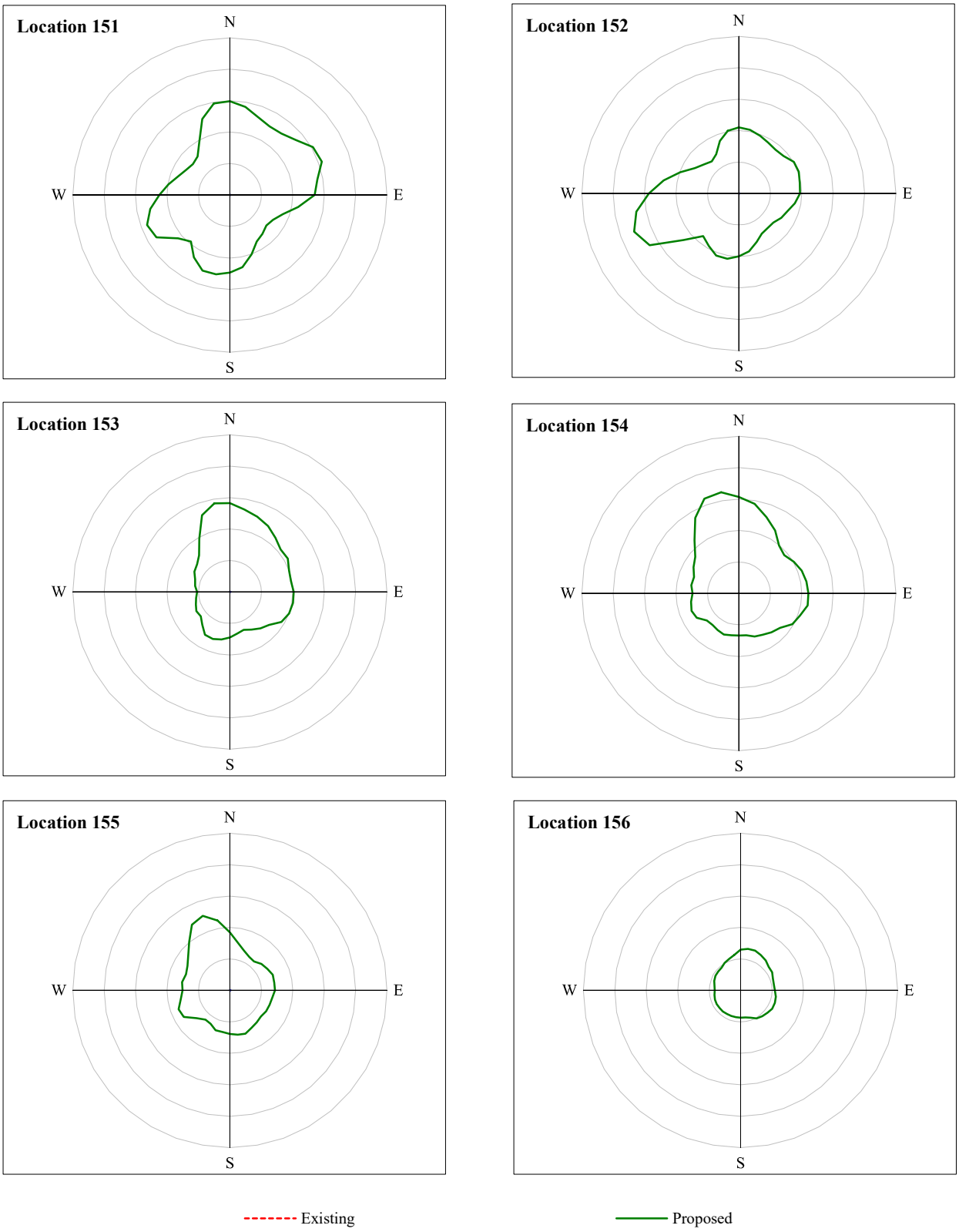

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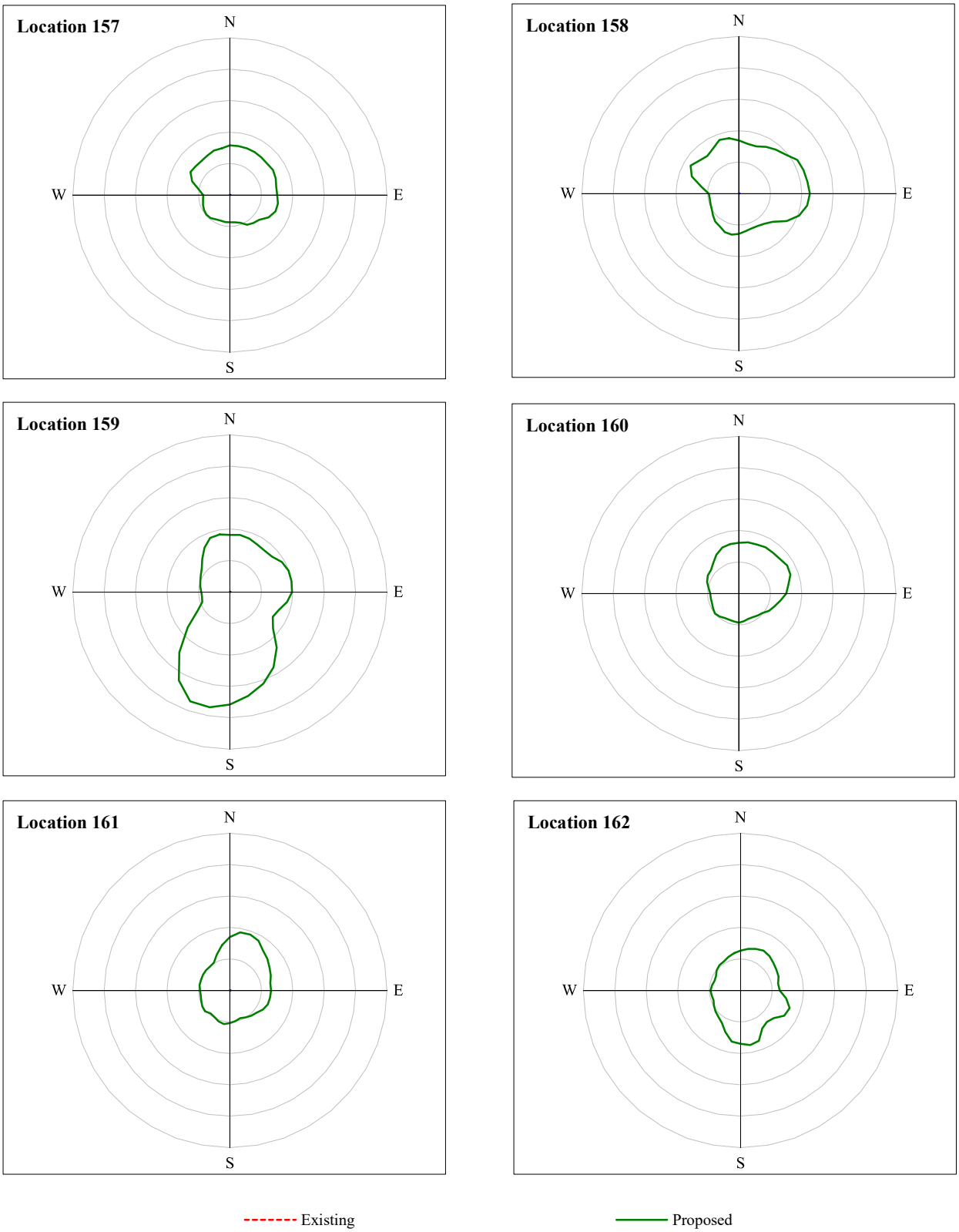

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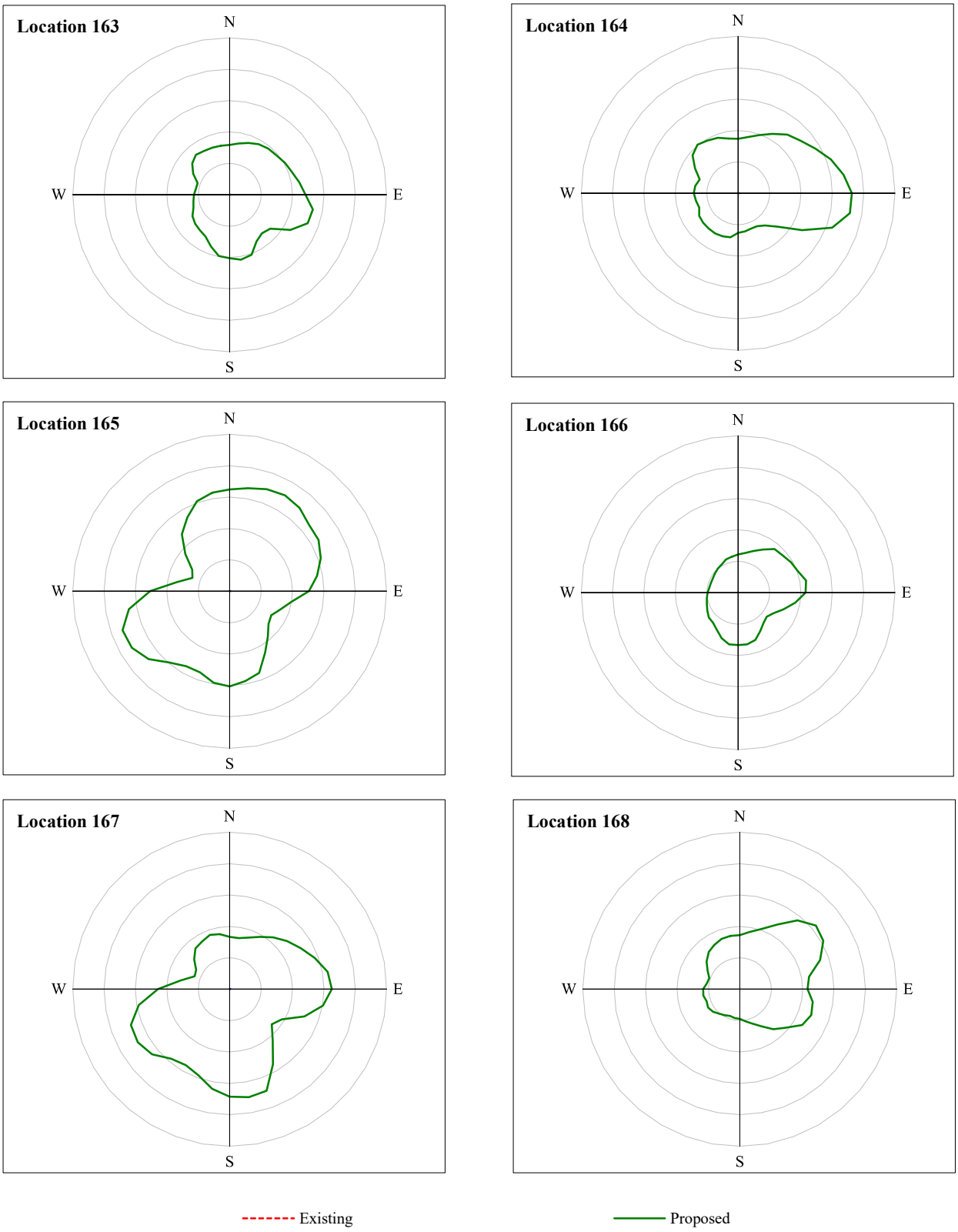

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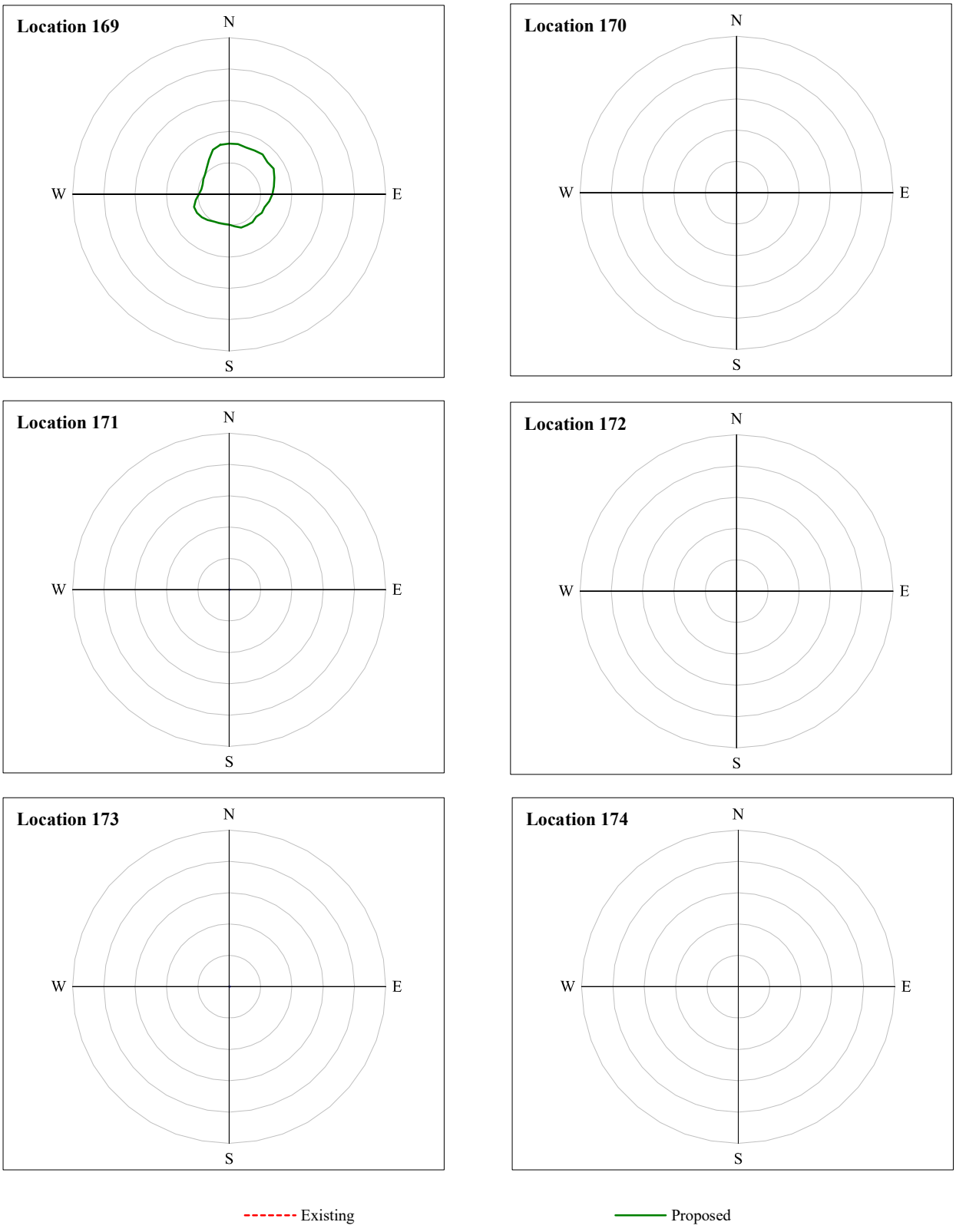

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