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Preliminary Pedestrian Level Wind Study
Welwyn Interests Inc.
2095 Prospect Street
Burlington, Ontario

Theakston Project No. 17291

Submitted To:

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1. EXECUTIVE SUMMARY

The proposed 2095 Prospect Street Development, herein referred to as the Development, involves a proposal to build 2 three-storey townhouse blocks on lands that are currently occupied by 2 two-storey fourplex apartment buildings. Said development is on lands to the northwest of an eight-storey apartment building that is to remain. Based upon our analysis, wind conditions on and around the proposed Development are predicted to be suitable for walking, standing, or better, year round, under normal to high ambient wind conditions.

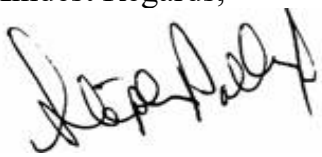
The surrounding lands pertinent to prevailing windward directions, for all intents and purposes, present a relatively coarse suburban terrain to approaching winds, limiting the wind's opportunity to accelerate upon approach from most directions. The proposed Development utilises wind friendly design elements. These include the orientation and conformation of the townhomes relative to the surroundings and prevailing wind directions, stepped façades, terraces, landscaping, and others. When considered in concert these elements allow much of the impending wind climate opportunity to flow over and around, as opposed to down, the building. These elements effectively reduce the incidence of downwash, and related pedestrian level wind effects, attributable to the proposed.

With the introduction of the new buildings, there will be a realignment of winds over the site at the pedestrian level. This is well managed by the layout of the proposed Development, and as such, comfort conditions are predicted similar to those in the current setting over most of the site for much of the prevailing wind climate. Under strong or gusty wind conditions, higher than the prevailing average ground level wind will be encountered over portions of the adjacent parking lot, although the site will remain suitable to the area's intended purpose. Comfort conditions expected at the proposed Development site are considered better than those required to suit the urban context, based upon qualitative analysis. Additional wind mitigation is not required at this stage.

Wind conditions on the proposed Development site's exterior amenity space are predicted suitable for sitting under normal ambient wind conditions. Pedestrian comfort conditions within the amenity space as proposed will be seasonally suitable for passive recreational uses. A mitigation plan may be considered if it is desirable to extend the usefulness of the space further into the shoulder seasons.

Should you have questions or comments, please do not hesitate to call.

Kindest Regards,



Stephen Pollock P.Eng

2. INTRODUCTION

Jack Neal of Ruth Victor and Associates requested a preliminary pedestrian level wind study for the Proposed 2095 Prospect Street Development, based upon project plans prepared by Icon Architects Inc. The objective of this primary analysis is to estimate pedestrian level wind conditions resulting from inclusion of the proposed development, relative to comfort and safety. The analysis is based upon historical meteorological data of wind conditions for the Burlington area, architectural plans dated November 24, 2017, a site visit conducted on July 31, 2017, our experience with similar microclimatic analyses that were conducted on other properties in the area, and/or similar projects, and our understanding of wind flows around buildings. The qualitative assessment utilises numerical analysis of local wind data predicted at the site and provides a synopsis of pedestrian comfort conditions anticipated on, and adjacent to, the property. It is a precursor to physical scale model testing, the quantitative analysis that will further define anticipated wind conditions, and mitigation, should such measures be required.

3. SITE INFORMATION

The 2095 Prospect Street property occupies portions of a block of lands bound by Maplewood Drive to the northwest, Robinson Street to the southwest, Joyce Street to the northeast and Prospect Street to the southeast, in the City of Burlington. The property is mid-block, facing Prospect Street, and is currently occupied by an eight-storey apartment building fronting Prospect Street and 2 two-storey fourplexes to the rear, or along the northwest boundary of the site. The latter will be removed to accommodate the 2 proposed three-storey townhouse blocks. The subject site is for all intents and purposes flat, and immediate surroundings are gently sloping to the southeast, towards Lake Ontario. As such, for assessment purposes the grade of the lands within the zone of influence of the proposed Development are considered flat and any grade changes will pose limited influence upon prevailing wind conditions.

4. SURROUNDING AREA

The 2095 Prospect Street property is surrounded to prevailing windward directions by an urban mix of low through mid-rise residential buildings, related open areas, and mature vegetation, as indicated in Figure 1. The most significant urban development in the immediate surroundings is to the southwest along Prospect Street where sister properties comprised of 2 eight-storey apartment buildings, municipally known as 2051- 2085 Prospect Street, and 4 two-storey fourplexes along the northwest boundary of the site, reside. An application is on file for this property for replacement of the fourplexes with 4 three-storey stacked townhouse blocks. Paradigm Condos, which is comprised of three towers ranging in height from 19 to 24

storeys, is under construction to the north by northwest along Fairview Street. To the immediate northeast, beyond Optimist Park, there is a Public School and low-rise residential ranging from 2 to 4 storeys in height. Immediately to the northwest of the proposed is a residential area comprised of single detached 2 storey homes, followed by low-rise retail, the Burlington GO Station and the proposed Paradigm Condo Development beyond Fairview Street. As such, the site exposures are, for all intents and purposes, considered urban for all wind azimuths. With respect to pedestrian level wind comfort, the areas of concern include the building entrances, perimeter sidewalks, pathways, and amenity terraces as noted above.



View of the 2095 Prospect Street Development Site looking northwest.

5. METEOROLOGICAL DATA

For studies in the City of Burlington, historical weather data recorded at Burlington Piers were analysed annually and for the winter, spring, summer, and fall seasons, January through March, April through June, July through September, and October through December respectively, and the resulting wind roses are presented as velocity and percent frequency in Figures 3a and 3b. The 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). The Burlington Piers weather station is not ideally situated for predicting wind conditions at the site, and as such, historical weather data recorded at the Toronto Island Airport as well as Pearson International Airport was also considered in this analysis.

Although mainly suburban, the macroclimate for this area is dependent upon wind direction and varies, to a degree, with direction. Winds from the west through south are predominant annually as well as during the summer months with westerly and southwesterly directions most significant, as indicated in Figure 3b - Summer. Winds from the same quadrants dominate the winter with westerly directions most significant during the winter, as indicated in Figure 3b - Winter. Figure 3, also depicts wind velocity categories relative to directionality at the airport with strong winds, greater than 30*km/h* (8.5*m/s*) occurring approximately 4% of the time during the summer and 9% during the winter, and emanating from the aforementioned quadrants during both the winter and summer seasons, with calm conditions occurring approximately 6% of the time.

6. 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. The effects of mean and gust wind conditions are described as suitable for Sitting or Standing or Walking over 80% of the time. In order for a point to be rated as suitable for Sitting, for example, the wind conditions must be less than 10 km/h. The rating would include conditions ranging from calm up to wind speeds that would rustle tree leaves or wave flags slightly. As the name infers, the category is recommended for outdoor space such as terraces and patios where people might sit for extended periods and generally applied to the summer months.

The Standing category is slightly more tolerant of wind, including wind speeds from calm up to 14km/h. In this situation, the wind would rustle tree leaves and, on occasion, move smaller branches while flags would be partially extended. This category would be suitable for locations where people might sit for short periods or stand in relative comfort, such as building entrances and drop-off areas. The Walking category includes wind speeds from calm up to 19km/h. These winds would set tree limbs in motion, lift leaves, litter and dust, and the locations are suitable for sidewalks and parking. The Uncomfortable category covers a broad range of wind conditions, including wind speeds above 19km/h. These winds would set trees in motion, cause inconvenience when walking, and are not generally suitable to activities. Safety concerns are

associated with wind speeds that are beyond the uncomfortable category, being sufficient to affect a person's balance.

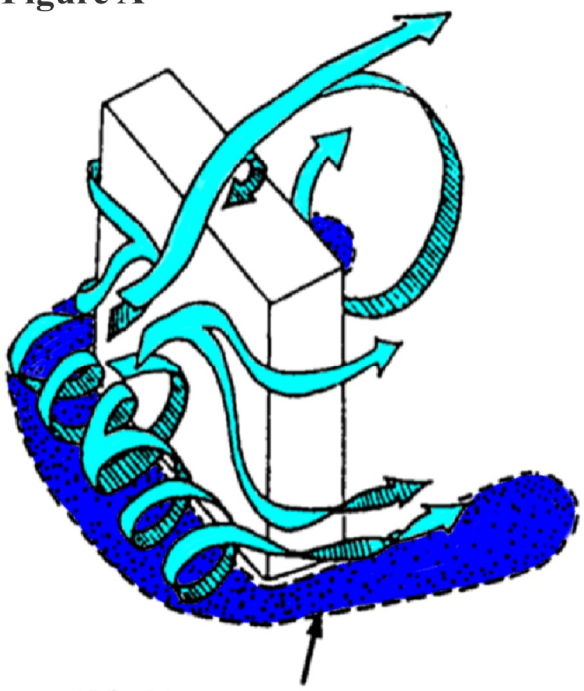
Many variables contribute to a person's perception of the wind environment beyond the seasonal variations presented. While people are generally more tolerant of wind during the summer months, than during the winter, due to the wind cooling effect, people become acclimatized to a particular wind environment. 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.

7. PEDESTRIAN LEVEL WIND ASSESSMENT

Variables beyond the orientation and conformation of a proposed development must be considered in predicting wind speed and occurrence at a given location. These include the previously discussed historical wind climate, surrounding terrain, and neighbouring buildings, each of which is quantified and/or analysed in the microclimatic analysis of pedestrian level winds. The results of such quantitative analyses have afforded a knowledge base that allows an estimation of pedestrian level wind conditions.

The site and the surrounds in the present circumstances, as a mix of urban residential neighbourhoods, commercial and industrial developments, and open spaces, have a sympathetic relationship with the existing wind climate. Urban development provides turbulence inducing surface roughness that can be wind friendly, while open settings afford wind the opportunity to accelerate as the wind's boundary layer profile thickens at the pedestrian level, owing to lack of surface roughness. Transition zones from open to urban settings can prove problematic, as winds exacerbated by the open setting are redirected to flow over, down, around and between buildings.

Figure A



Area of Strong Surface Wind

High-rise buildings may exacerbate wind conditions within their immediate vicinity, to varying degrees, by redirecting wind currents to the ground level and along streets and open areas. In general, wind will split upon impact with a high-rise building, with portions flowing down the face of the building to the pedestrian level as downwash, where it is deflected, or

otherwise redirected to flow along the building and around its corners, creating localized zones of increased pedestrian level wind (Figure A). Conversely, points situated to the leeside, or in the wake of buildings will often enjoy an improvement in pedestrian comfort. As such, it is reasonable to expect inclusion of the proposed development will alter wind conditions under specific wind directions and velocities from those of the existing site condition, resulting in an improvement over the existing conditions at some points, with more windy conditions at others.

Discussion of Northerly Winds

Northerly winds make up a significant percentage of the prevailing wind climate; they tend to be of moderate velocity, particularly during the winter months, and are favourably preconditioned upon approach by a predominantly low -rise residential context interspaced with green spaces supporting mature coniferous and deciduous vegetation, and related parking. The immediate low-density residential neighbourhood to the north, comprised of single storey resident dwellings along Maplewood Drive and Edinburgh Drive, presents a relatively coarse approach that effectively reduces the wind's energy at the pedestrian level, resulting in comfortable wind conditions in the existing setting, most of the time. As such, comfort conditions along Prospect Street, proximate to the existing eight-storey apartment building are comfortable, suitable for Sitting during the summer months, Standing during the winter. The proposed development site for the 2 three-storey stacked townhouse blocks is slightly more comfortable, but remains in the same comfort categories, suitable for suitable for Sitting during the summer months, Standing during the winter.

Northerly winds approaching with westerly components will be deflected by the eight-storey slab style apartment building on site, to flow over, around and down the building, the latter as downwash to the pedestrian level where it will flow out from the base of the building before turning and ultimately flowing around the corners of the building and over the leeward portions off the site. Said winds will combine with winds that are downwashed and redirected by the eight-storey slab style building to the southwest of the subject property, at 2085 Prospect Street, to flow over the southwest extremities of the proposed Development site, resulting in windy conditions in this area from time to time. As such, strong northerly winds with westerly components will cause the area leeward to the gap between the buildings along Prospect Street to be windy from time to time, and this area is rated as suitable for walking during the winter months, in the existing setting.

Given the proposed townhouse development is 3 storeys in height, Northerly winds approaching in higher streamlines, will pass over the Proposed Development. Northerly winds approaching the proposed 2095 Prospect Street Development at lower elevations, over the windward rooftops of the low-rise residential dwellings along Maplewood Drive, and similar residential dwellings to the north beyond, will come into contact with the north façade of the Proposed Development at a slightly skewed angle. These winds will tend to

be deflected to flow along the townhouses in a southwesterly direction, around their corners and over the grounds towards the eight-storey apartment buildings flanking Prospect Street.

Northerly winds with westerly components will, given the height differential of the windward dwellings and proposed townhouse blocks, display a propensity to flow up and over the buildings, as opposed to down and around. Once over the townhouses and immediate leeward grounds said winds will again deflect upon contact with the eight-storey apartment building to flow around the building, where it will combine with winds deflected by the neighbouring slab style building to flow through the area, resulting in localised windy conditions at the windward corners of the apartment buildings that moderate quickly with distance from the corners. Given the size of the townhouses and wind mitigative design features, the pedestrian comfort conditions are predicted to remain suitable for walking during the winter, and appropriate for activities requiring longer exposures during the balance of the seasons.

The leeward grounds adjacent to the townhouses will realize relatively more comfortable conditions in the proposed setting, owing to the proposed development creating a windward blocking effect, the increased resistance of the proposed buildings moderating the wind effects. The pedestrian comfort conditions adjacent to the townhomes will remain comfortable, suitable for standing during the winter months and for activities requiring longer exposure times, such as sitting, during the summer.

Discussion of Westerly Winds

Westerly winds make up a more significant percentage of the prevailing wind climate; they can be of higher velocity, particularly during the winter months, and are favourably preconditioned upon approach by the same residential context as northerly winds, low-density residential interspaced with green spaces, mature vegetation and related parking. The neighbourhood presents a relatively coarse approach that effectively reduces the wind's energy at the pedestrian level, resulting in comfortable wind conditions in the existing setting, most of the time. As such, comfort conditions along Prospect Street, proximate to the existing eight-storey apartment building are comfortable, suitable for Sitting during the summer months, Standing during the winter. The proposed development site for the 2 three-storey stacked townhouse blocks is again slightly more comfortable, but remains in the same comfort categories, suitable for Sitting during the summer months, Standing during the winter.

Westerly winds approaching with southerly components will be deflected by the neighbouring windward eight-storey slab style apartment building at 2051 Prospect Street to flow down the building as downwash to the pedestrian level where it will flow out from the base of the building before turning and ultimately flowing around the corners and along

Prospect Street and/or over the site's parking lot. The grounds along Prospect Street support numerous mature coniferous and deciduous trees that will effectively moderate winds deflected towards the street resulting in the street retaining appropriate comfort levels, suitable for walking during the winter months and for activities requiring longer exposure during the summer and shoulder seasons. The component deflected to flow in a northwesterly direction, over the site's parking lot will mix with winds similarly deflected by the windward 3 ½ storey apartment buildings to flow along the parking lot, resulting in windy winter conditions from time to time, however, comfort conditions will remain appropriate to the area's intended purpose, suitable for walking during the winter months and for standing during the summer and part of the spring and fall. The existing fourplexes are for the most part removed from westerly through southwesterly wind streams and as such will be comfortable, suitable for standing during the winter months and for activities requiring longer exposures during the balance of the seasons.

With inclusion of the proposed three-storey townhouse blocks westerly winds will, given the height differential of the windward dwellings and proposed townhouse blocks, again display a propensity to flow up and over the buildings. Once over the townhouses and immediate leeward grounds said winds will again deflect upon contact with the eight-storey apartment building to flow along the building, and ultimately through the tree line adjacent to Optimist Park. This will result in localised windy conditions at the northmost corner of the apartment building that moderate quickly with distance from the corner; the wind being diffused by the trees along the park boundary. The leeward grounds adjacent to the townhouses will realize relatively more comfortable conditions in the proposed setting, owing to the proposed development creating a windward blocking effect, the increased resistance of the proposed buildings moderating the wind effects. The pedestrian comfort conditions adjacent to the townhomes will remain comfortable, suitable for standing during the winter months and for activities requiring longer exposure times, such as sitting, during the summer. Westerly winds with southerly components will flow in approximate alignment with the subject and windward parking lots resulting in similar comfort conditions in the existing and proposed settings.

The Proposed townhouse Development, given its situation in the aerodynamic shade region of the windward buildings, of the same or similar massing, and resulting from earlier approvals, feature similar wind mitigative design features, and being removed from the street, do not make an appreciable contribution to westerly winds. As such, the influence of the Proposed Development on pedestrian comfort anticipated at the pedestrian level is near inconsequential, with westerly through southwesterly winds, relative to the existing setting, and pedestrian comfort conditions will remain comfortable, suitable for walking during the winter months and for activities requiring longer exposure times, such as standing or sitting, during the summer.

Discussion of Southerly Winds

Southerly winds make up a less significant percentage of the prevailing wind climate, tend to be of lower velocity, and are favourably preconditioned upon approach by the windward terrain flanking Prospect Street and Ghent Avenue and others comprised of, for all intents and purposes, a mix of low-rise apartment buildings, townhomes and 1-2 storey single family dwellings. There are no significant urban buildings in the immediate surroundings that will influence winds on and about the Development site. The orientation and conformation of the existing eight-storey apartment building on site is such that southerly winds will, upon contact with it's broad façade, be deflected to flow along and around the building and over the east side of the subject property, resulting in windy, though not uncomfortable, conditions on the driveway near the east corner of the building that will moderate as they flow over the leeward portion of Optimist Park and the related tree line, resulting in conditions suitable for walking in the winter months.

The grouping of buildings to the southwest at 2051- 2085 Prospect Street will similarly deflect southerly winds to flow along their façades and ultimately through the gaps between. However, winds deflected to flow through said gaps will realise resistance as they are diffused by mature vegetation on the grounds proximate to and through the gaps. This will result in occasional localized windy conditions along the west side of the existing eight-storey apartment building, which will extend over the parking lot and to the existing fourplex occupying the northmost corner of the property. Resulting comfort conditions on site will be suitable within this zone for walking during the winter months and Prospect Street suitable for standing or walking during the winter.

Southerly winds approaching the proposed townhouse development at the pedestrian level must approach through the gap between the eight-storey 2085 and 2091 Prospect Street apartment buildings. Once upon the proposed townhouses slightly windier conditions will be realised, owing to the higher façade of the proposed townhouses deflecting said winds to flow along the buildings, however, comfort conditions are predicted to remain suitable for walking during the winter and appropriate to the intended purpose. The Development will contribute a region of relative calm that extends to the north over neighbouring residential dwellings along Maplewood Drive. As such, comfort conditions realised on site with inclusion of the proposed Development will remain, for all intents and purposes, similar to those of the existing setting.

Discussion of Easterly Winds

Easterly winds are infrequent, however, they can be strong and are often associated with storms. Easterly winds are also favourably preconditioned upon approach by terrain similar to southerly winds, a mix of low-rise apartment buildings, townhomes and 1-2 storey single-

family dwellings, and again there are no significant urban buildings in the immediate surroundings that will influence winds on and about the Development site. The orientation and conformation of the existing eight-storey apartment building on site is such that easterly winds will, upon contact with it's broad façade, be deflected to flow along the building and over the west side of the subject property, contributing to windy conditions in the gap between the 2051- 2085 Prospect Street buildings that will moderate as they diffuse over the leeward parking lot. Easterly winds will approach the existing fourplexes from over Optimist Park. The related tree line between the subject and windward neighbouring properties, including the triplexes along Prospect Street, and related mature vegetation, will moderate easterly winds resulting in generally comfortable conditions, suitable for standing or walking during the winter months and for activities requiring longer exposures during the balance of the seasons in the existing setting.

Easterly winds approaching the proposed townhouse development from over the aforementioned terrain will, upon contact with the broad façades of the townhouses, deflect to flow along the buildings over the sidewalks and related parking lot. This will result in slightly windier conditions in the proposed setting, owing to the slightly higher façade of the proposed townhouses deflecting said winds to flow along the buildings, however, comfort conditions will remain suitable for walking during the winter and appropriate to the intended purpose. The Development will similarly create a region of relative calm that extends to the north over neighbouring residential dwellings along Maplewood Drive. As such, comfort conditions realised on site with inclusion of the proposed Development will remain, for all intents and purposes, similar to those of the existing setting.

Discussion of Ordinal Winds

Ordinal Winds approaching from remaining directions, northwesterly, northeasterly, southeasterly, and southwesterly directions, will approach from over similar terrain types, and will contact the façades of the Proposed Development at angles similarly skewed to those discussed above. As such, a downwash of wind to the pedestrian level is not likely with ordinal winds, but may occur with wind emanating from directions near perpendicular to the buildings' façades. The magnitude of the resulting downwash is dependent upon several variables; those commanding primary consideration are the building height, and the effective width of the presented façade. It is intuitive that short and/or narrow façades reduce the propensity for downwash, and the façades of the Proposed Development will display a marked tendency to deflect wind to flow over and around, as opposed to down the buildings, for these directions. Situating the townhomes as proposed, in alignment with the other townhomes, creates a barrier to winds, for leeward buildings. The reasonable setbacks and/or stepped conditions, and punctuated building façades with indentations, and other design features, as illustrated in the drawings further mitigates the propensity of wind to flow along the buildings.

Exterior Amenity

An outdoor amenity space is proposed for the slightly raised area near grade along the northwest façade of the eight-storey apartment building. The Amenity space, or portions thereof, is in the wake of the subject and/or neighbouring towers for much of the prevailing wind climate. This will result in comfortable wind conditions over specific portions of the space much of the time. On the occasion of strong winds emanating from northwesterly, directions, a portion of the wind will be deflected to flow down and around the apartment building, with a portion circulating into the amenity space, resulting in moderately windy conditions on occasion. Remaining wind directions, for all intents and purposes, are mitigated to varying degrees, by windward towers, the townhomes, and landscaping resulting in comfortable conditions, most of the time. As such, the area is predicted seasonably suitable to its intended purpose, with the above-noted exception. A mitigation plan may be considered if it is desirable to extend the usefulness of the space further into the shoulder seasons. This can be accomplished with screen walls, plantings, trellises, and others appropriately located about the space.

Townhouse Residential Entrances

The Residential Entrances are located along the southeast façade of the townhouses and accessed from the parking lot. The entrances are recessed into the façades of the buildings, and as such are removed from most of the wind climate, and will be comfortable, suitable for standing during the winter months. However, strong or gusty winds approaching from southwesterly, and to a lesser degree, northeasterly directions, in approximate alignment with the townhomes, will result in windy conditions along the sidewalks adjacent to the entrances, from time to time. The pedestrian comfort conditions at the entrances are rated as comfortable, suitable for standing during the winter months, most of the time, and the sidewalks beyond, for standing or walking, the rating dependent upon wind directionality and strength.

Pedestrian comfort conditions will be generally comfortable, suitable for standing or walking during the winter months, and as such, the entrances are suitable to the area's intended purpose.

8. MITIGATION STRATEGIES

The Proposed Development, as reflected in the plans reviewed, employs wind mitigative design features that include:

- stepped building façades
- terraces
- railings
- landscaping

and others, that will increase surface roughness apparent to the wind.

Comfort conditions expected at the Proposed Development site are considered better than those required to suit the urban context, based upon qualitative analysis. Additional wind mitigation is not required at this point.

Figure 1: Site Aerial Photo

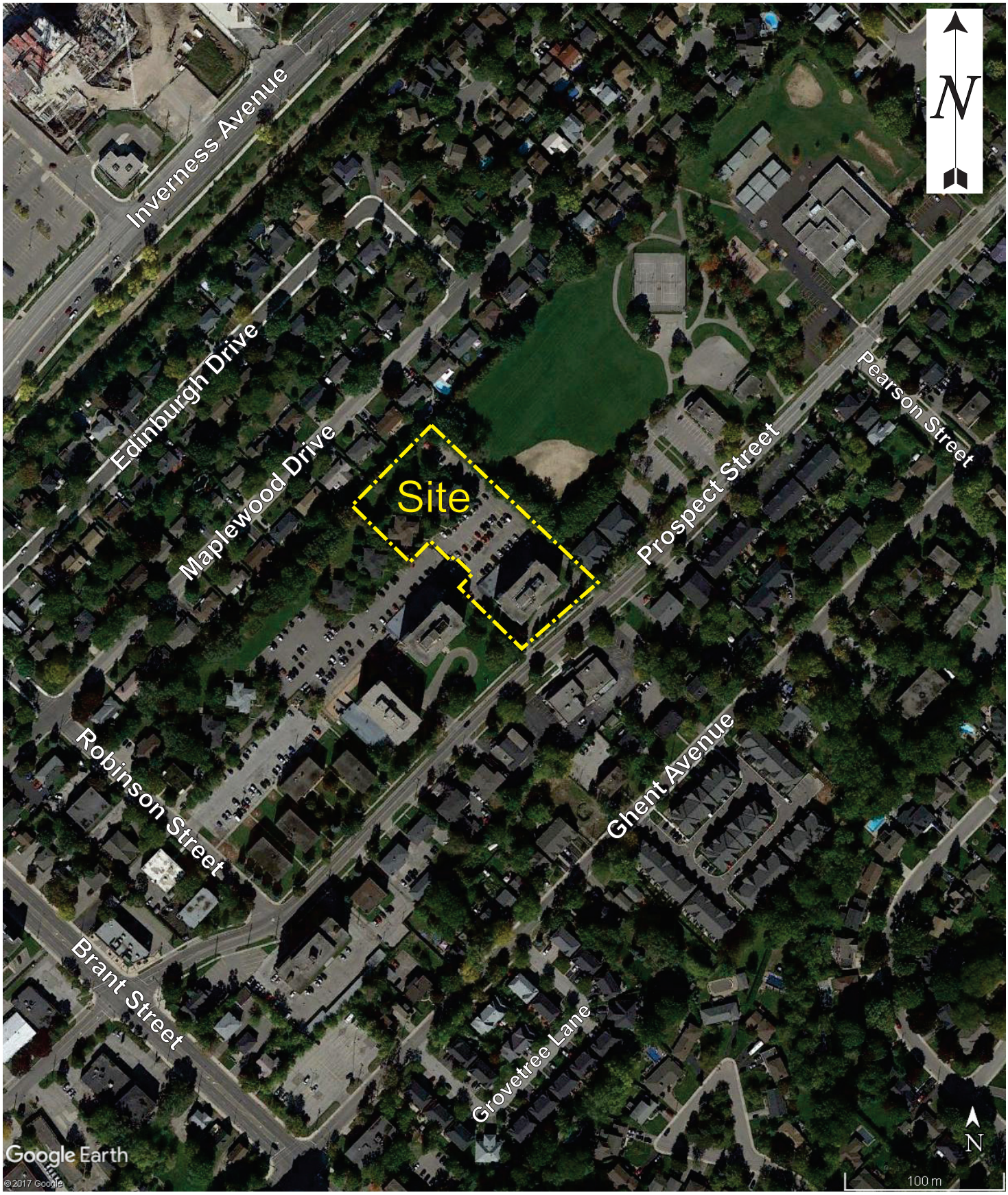


Figure 2: Site Plan

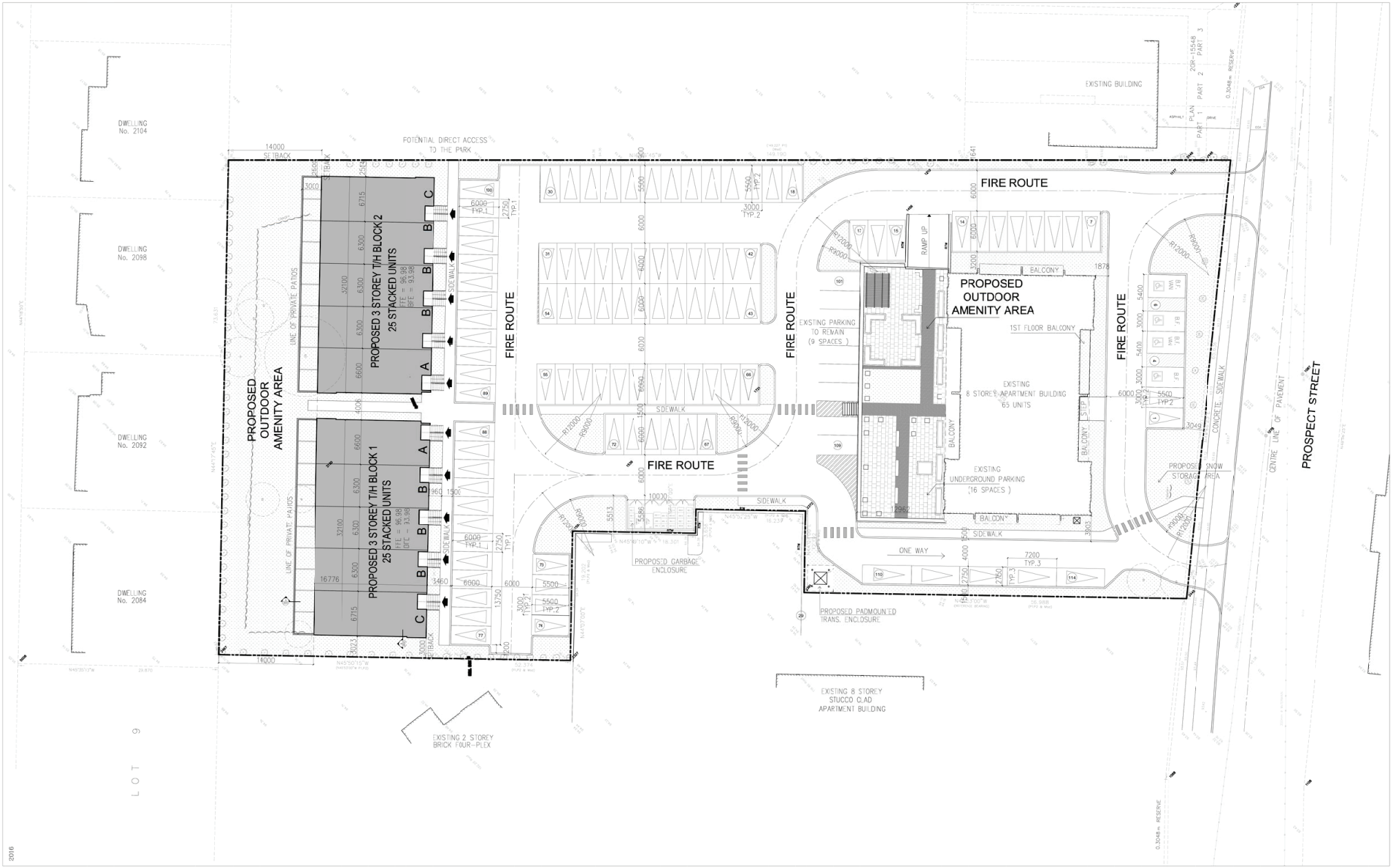


Figure 3a: Annual Windrose - Burlington Piers (1991 - 2011)

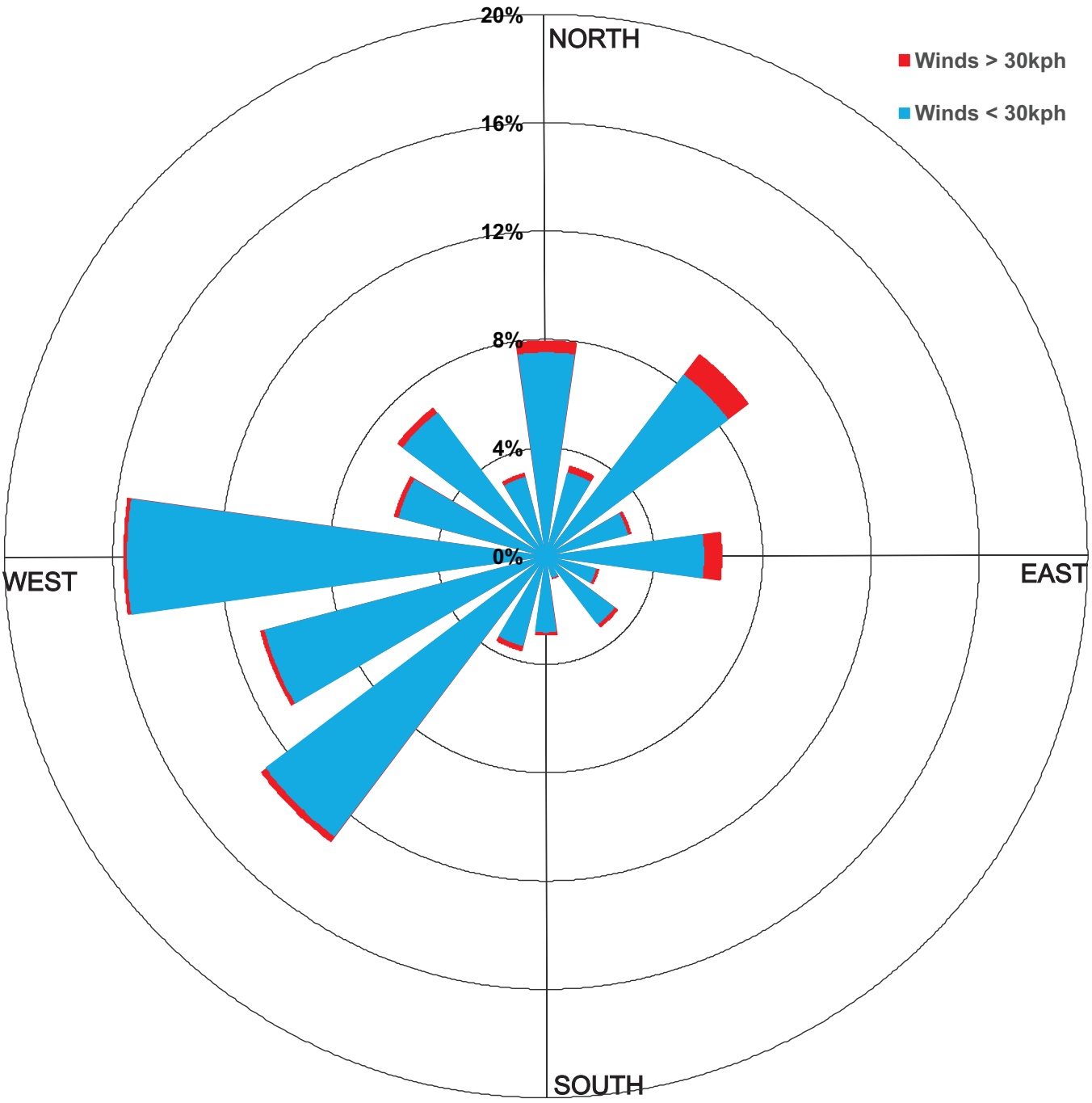
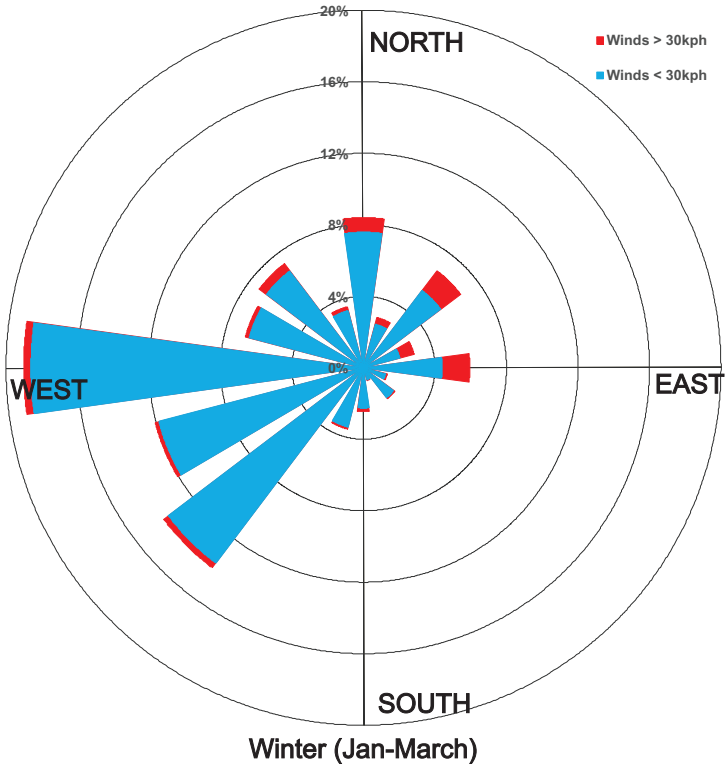
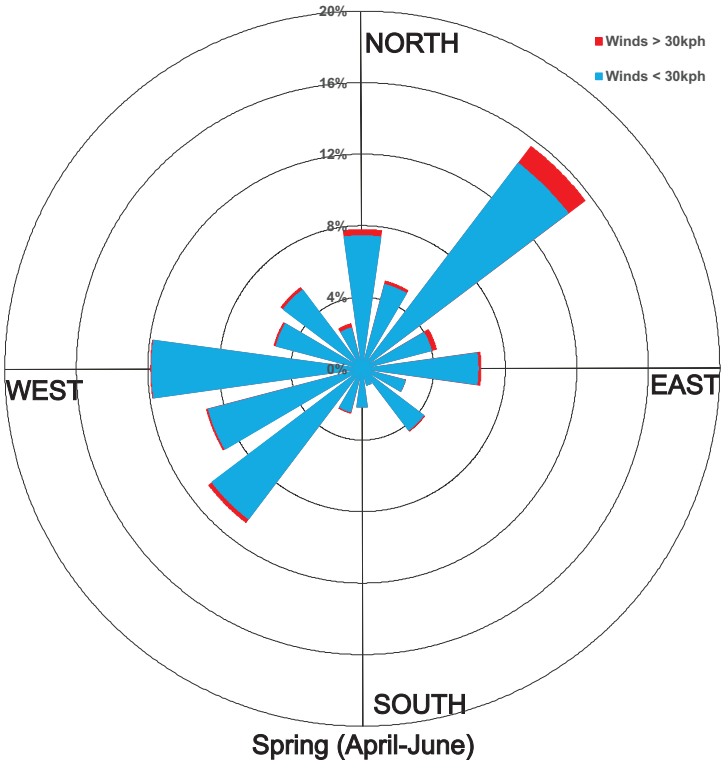


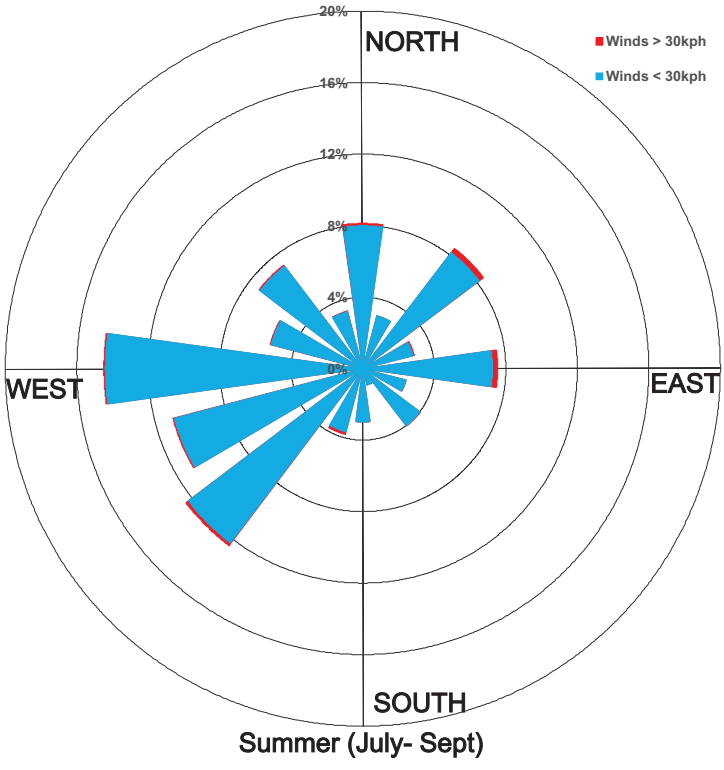
Figure 3b: Seasonal Windroses - Burlington Piers (1991 - 2011)



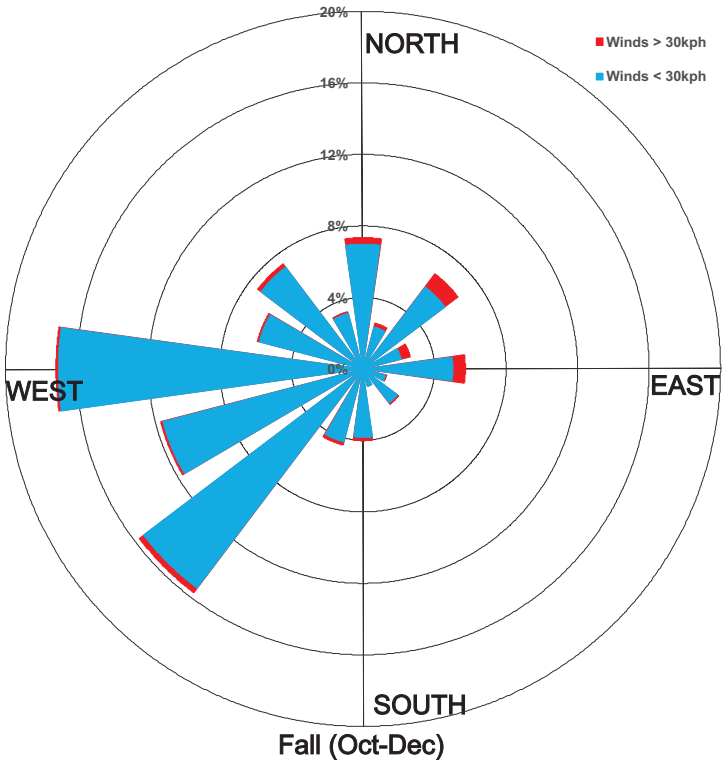
Winter (Jan-March)



Spring (April-June)



Summer (July- Sept)



Fall (Oct-Dec)