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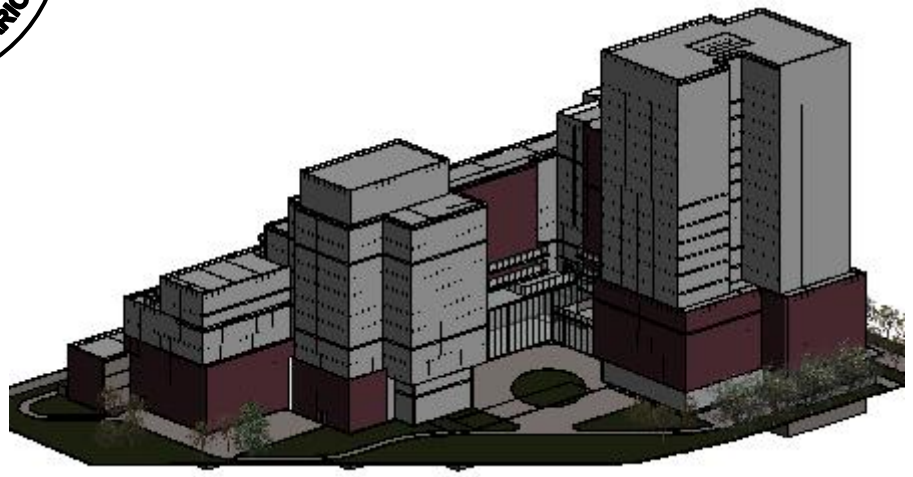
14/09/18
PROVINCE OF ONTARIO

Date: September 14, 2018

To: Amico Properties Inc.
2199 Blackacre Drive
Oldcastle, ON N0R 1L0

Re: **Pedestrian Wind Assessment**
North Shore Development
Burlington, Ontario
Novus Project #18-0085



Credit: Montgomery Sisam Architects Inc.

Novus Team:

Jenny Vesely, P.Eng. Sr. Engineer
Tahrana Lovlin, MAES, P.Eng. Specialist

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1.0 INTRODUCTION

Novus Environmental Inc. (Novus) was retained by Amico Properties Inc. to conduct a pedestrian wind assessment for the proposed North Shore Development in Burlington, Ontario. This report is in support of the Zoning By-law Amendment (ZBA) submission

1.1 Existing Development

The proposed development is located at 1157-1171 North Shore Boulevard East, on the north side of the street between Queen Elizabeth Way (QEW) and Maple Avenue. The site is currently occupied by two four-storey residential buildings and a one-storey garage. **Figure 1** provides an aerial view of the immediate study area. A site visit was conducted by Novus on July 19, 2018 and was supplement by Google Earth Pro™ images dated May 2017. These images are included in **Figures 2a** through **2d**.

Immediately surrounding the site is the QEW to the south through west, low-rise residential buildings to the northwest and north, with mid-rise residential buildings to the northeast and east. To the southeast is a low-rise commercial building. Beyond the immediate surroundings there is low-rise residential buildings to the south through west to north; mid-rise residential buildings to the northeast, along North Shore Boulevard East; and low-rise institutional and residential buildings to the east and southeast. Lake Ontario is 400m to the east and Hamilton Harbour is 500m southwest.

Approved developments and developments under construction in the surrounding area are considered in the analysis. For this project, no approved or under construction developments were found in the area.

Figure 1: Aerial view of existing site and surroundings
Credit: Google Earth Pro™, dated April 13, 2017

Figure 2a: Existing site and neighbouring high-rise, looking north

Figure 2b: Looking northwest at existing site

Figure 2c: Joseph Brant Hospital, looking southeast

Figure 2d: Looking southwest along North Shore Blvd E

1.2 Proposed Development

The proposed residential development ranges in height from two-storeys along the north edge of the site to 18-storeys at the southeast corner of the site. The development is L-shaped, with an approximate footprint of 112m by 87m. A rendering of the development, looking from the west, is shown in **Figure 3**.

The main entrance to the building is in the middle of the east facade. Individual townhouse entrances are along the north facade, with another main entrance and an emergency exit. Emergency exits are also found on the south and west facades.

1.3 Areas of Interest

Areas of interest for pedestrian wind conditions include those areas which pedestrians are expected to use on a frequent basis. Typically these include sidewalks, main entrances, transit stops, plazas and parks. There are several transit stops along North Shore Boulevard East in the vicinity of the proposed development.

There are three outdoor amenity patios on the site: one at the southeast corner, one centrally located on site, and one near the northwest corner. These areas, as well as the numerous entrances, are shown in **Figure 4**. There are also outdoor amenity terraces on Level 2 within the central courtyard.

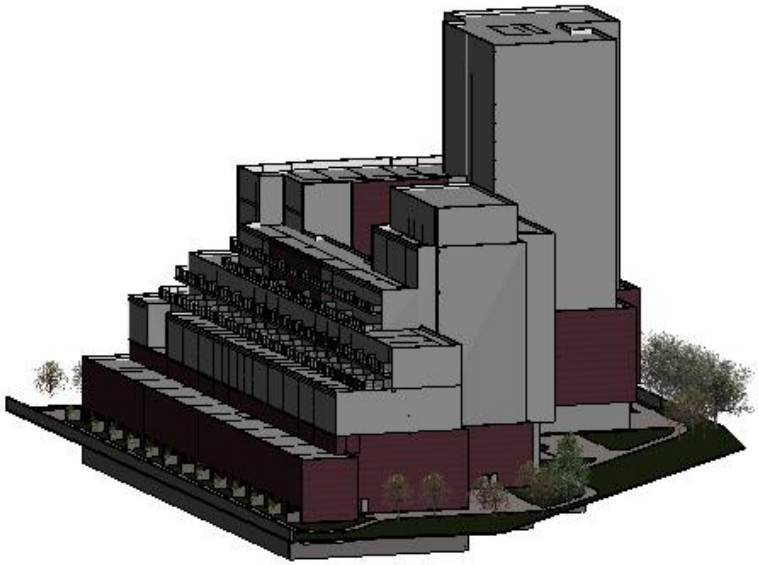

Figure 3: Rendering of Proposed Development
Credit: Montgomery Sisam Architects Inc.

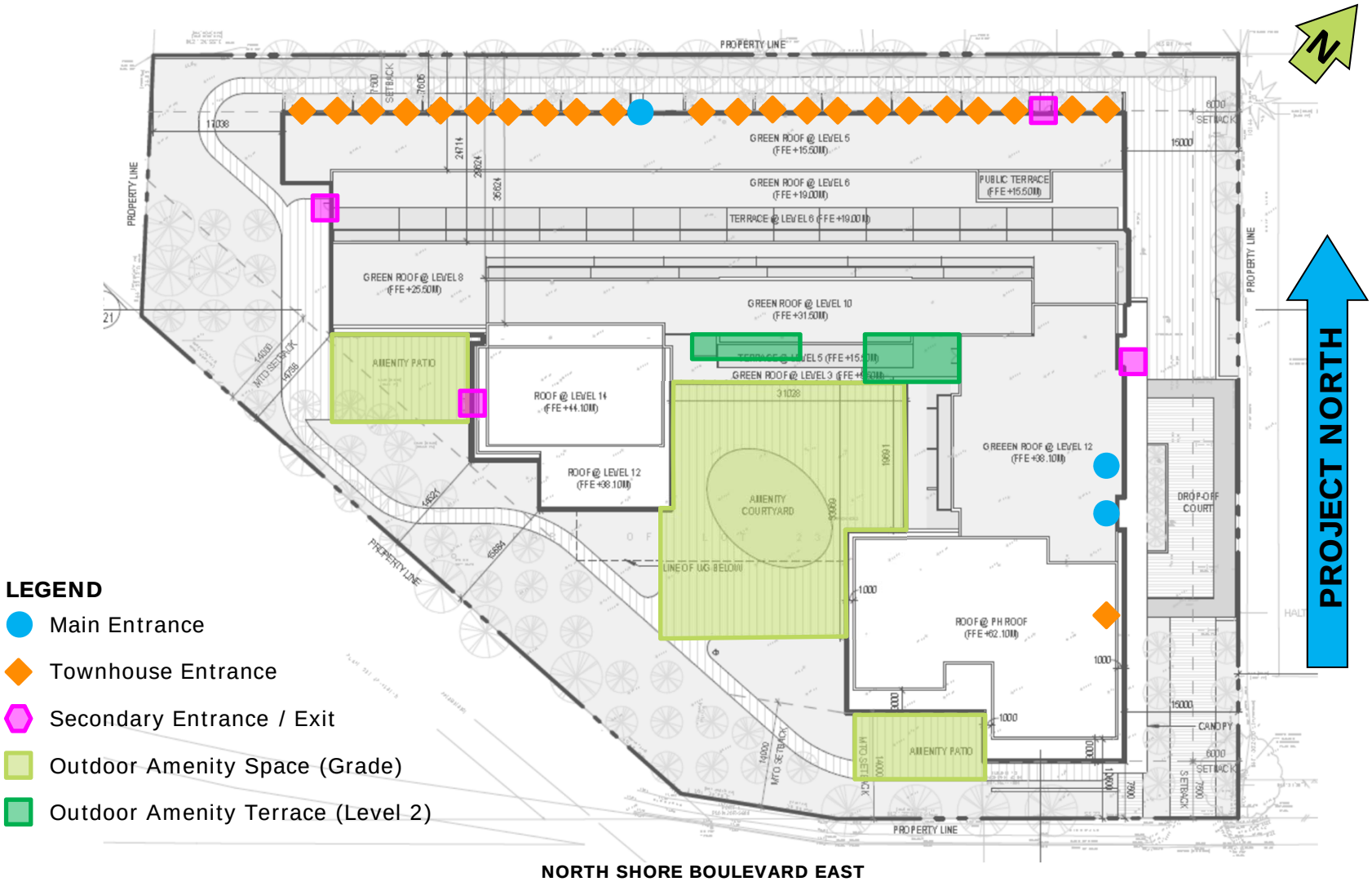

Figure 4: Areas of Interest

2.0 APPROACH

A screening-level assessment was conducted using computational fluid dynamics (CFD). As with any simulation, there are some limitations with this modeling technique, specifically in the ability to simulate the turbulence, or gustiness, of the wind. Nonetheless, CFD analysis remains a useful tool to identify potential wind issues, especially when assessing mean wind speeds. This CFD-based mean wind speed assessment employs a comparable analysis methodology to that used in wind tunnel testing.

2.1 Methodology

Wind comfort conditions for areas of interest were predicted on and around the development site to identify potentially problematic windy areas. A 3D model of the proposed development as well as floor plans and elevations were provided by Montgomery Sisam Architects Inc. on July 11, 2018. A view of the 3D model used in the computer wind comfort analysis is shown in **Figure 5**. This model included surrounding buildings within approximately 450m from the study site. The simulations were performed using CFD software by Meteodyn Inc.

The entire 3D space throughout the modeled area is filled with a three-dimensional grid. The CFD virtual wind tunnel calculates wind speed at each one of the 3D grid points. The upstream "roughness" for each test direction is adjusted to reflect the various upwind conditions and wind characteristics encountered around the actual site. Wind flows for a total of 16 compass directions were simulated. Although wind speeds are calculated throughout the entire modeled area, wind comfort conditions were only plotted for a smaller area immediately surrounding the proposed development.

Wind flows were predicted for both the existing site, as well as with the proposed development for comparison purposes. The CFD-predicted wind speeds for all test directions and grid points were then combined with historical wind climate data for the region to predict the occurrence of wind speeds in the pedestrian realm, and to compare against wind criteria for comfort and safety; these results are shown in the various wind flow images. The analysis of wind conditions is undertaken for four seasons: Winter (January to March), Spring (April to June), Summer (July to September), and Autumn (October to December). However, only the seasonal extremes of summer and winter are discussed within the report. The results of the analysis for spring and autumn can be found in **Appendix A**.

Results are presented through discussion of the wind conditions along major streets and the areas of interest. The comfort criteria are based on predictions of localized wind forces combined with frequency of occurrence. Climate issues that influence a person's overall "thermal" comfort, (e.g., temperature, humidity, wind chill, exposure to sun or shade, etc.) are not considered in the comfort rating.

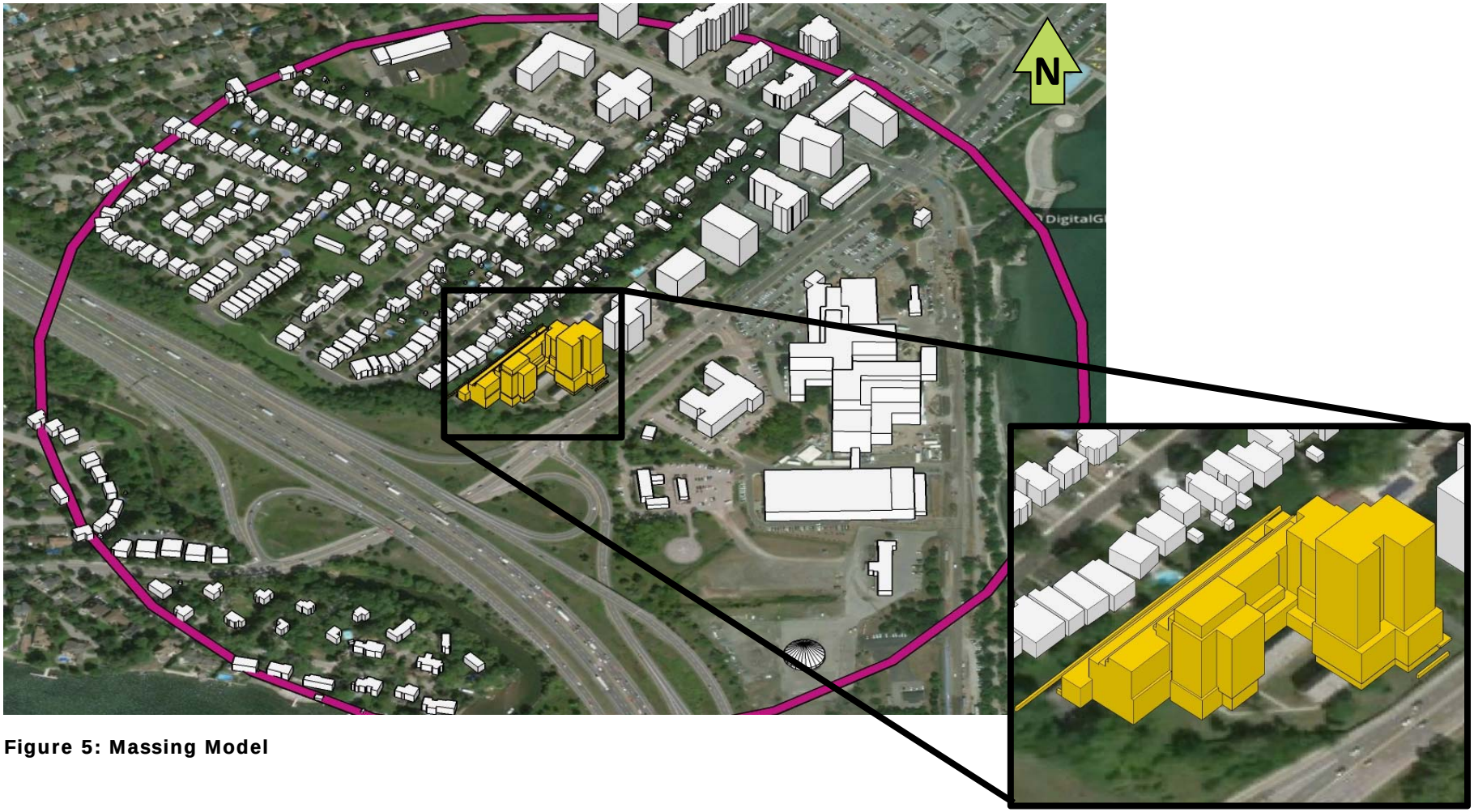

Figure 5: Massing Model

2.2 Wind Climate

Wind data recorded at Burlington Piers for the period of 1991 to 2015 were obtained and analysed to create a wind climate model for the region. Annual and seasonal wind distribution diagrams ("wind roses") are shown in **Figure 6**. These diagrams illustrate the percentage of time wind blows from the 16 main compass directions. Of main interest are the longest peaks that identify the most frequently occurring wind directions. The annual wind rose indicates that wind approaching from the westerly through southwesterly directions are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year.

The directions from which stronger winds (e.g., > 30 km/h) approach are also of interest as they have the highest potential of creating problematic wind conditions, depending upon site exposure and the building configurations. The wind roses in **Figure 6** also identify the directional frequency of these stronger winds, as indicated in the figure's legend colour key. On an annual basis, strong winds occur from the northeast and east sectors. All wind speeds and directions were included in the wind climate model.

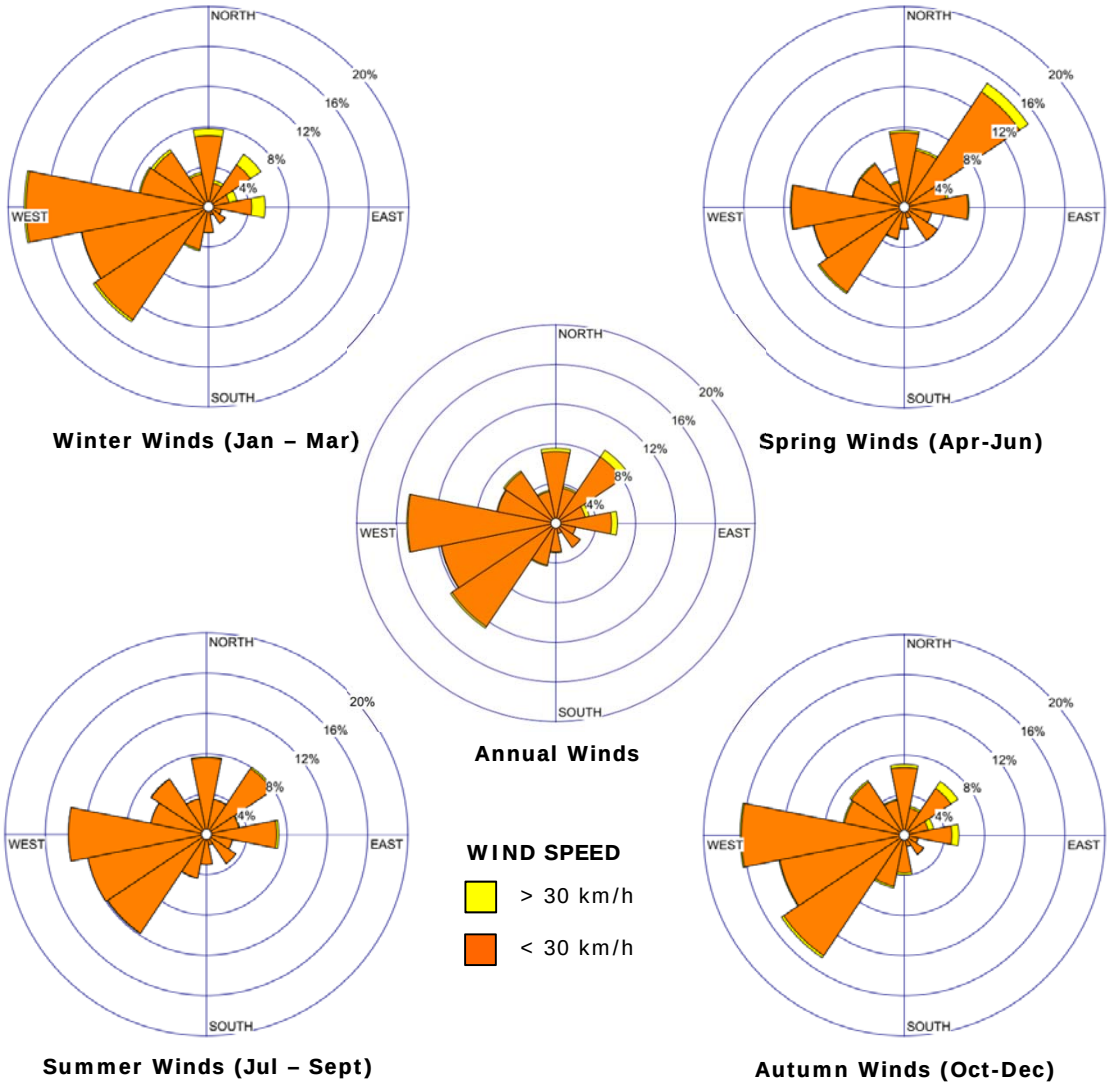

Figure 6: Wind Roses for Burlington Piers (1991-2015)

3.0 PEDESTRIAN WIND CRITERIA

Wind comfort conditions are discussed in terms of being acceptable for certain pedestrian activities and are based on predicted wind force and the expected frequency of occurrence. Wind chill, clothing, humidity and exposure to direct sun, for example, all affect a person's thermal comfort; however, these influences are not considered in the wind comfort criteria.

The comfort criteria, which are based on certain predicted hourly mean wind speeds being exceeded 5% of the time, are summarized in **Table 1**. Very roughly, this is equivalent to a wind event of several hours duration occurring about once per week.

The criterion for wind safety in the table is based on hourly mean wind speeds that are exceeded once per year (approximately 0.01% of the time). When more than one event is predicted annually, wind mitigation measures are then advised. The wind safety criterion is shown in **Table 2**.

The criteria for wind comfort and safety used in this assessment are similar to those developed at the Boundary Layer Wind Tunnel Lab of the University of Western Ontario, together with building officials in London, England. They are broadly based on the Beaufort Scale and on previous criteria that were originally developed by Davenport. Similar criteria are used by the Alan G. Davenport Wind Engineering Group Boundary-Layer Wind Tunnel Laboratory for pedestrian wind study projects located around the globe.

Table 1: Wind Comfort Criteria

Activity	Comfort Ranges for Mean Wind Speed Exceeded 5% of the Time		Description of Wind Effects
Sitting	0 to 14 km/h	0 to 4 m/s	• Light wind felt on face • Leaves rustle
Standing	0 to 22 km/h	0 to 6 m/s	• Hair is disturbed, clothing flaps • Light leaves and twigs in motion • Wind extends lightweight flag
Leisurely Walking	0 to 29 km/h	0 to 8 m/s	• Moderate, raises dust, loose paper • Hair disarranged • Small branches move
Fast Walking	0 to 36 km/h	0 to 10 m/s	• Force of wind felt on body • Trees in leaf begin to move • Limit of agreeable wind on land
Uncomfortable	> 36 km/h	> 10 m/s	• Small trees sway • Umbrella use becomes difficult

Table 2: Wind Safety Criterion

Activity	Safety Criterion Mean Wind Speed Exceeded Once Per Year (0.01%)		Description of Wind Effects
Any [1]	72 km/h	20 m/s	• Difficult to walk straight • Wind noise on ears unpleasant

[1] Equivalent to the "Fair Weather Location" criterion of UWO's Criteria, which applies to frequently accessed areas.

4.0 RESULTS

Figures 7a through **9b** present graphical images of the wind comfort conditions for the summer and winter months around the proposed development. These represent the seasonal extremes of best and worst case. **Appendix A** presents the wind comfort conditions for spring and autumn. The "comfort zones" shown are based on an integration of wind speed and frequency for all 16 wind directions tested with the seasonal wind climate model. The assessment does not account for the presence of mature trees, thus wind comfort conditions for months when foliage is present could be better than those predicted.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. For example, for public sidewalks, wind comfort suitable for **leisurely walking** would be desirable year-round. For main entrances and transit stops, wind conditions conducive to **standing** would be preferred throughout the year, but can be difficult to achieve in regions where winter winds are inherently harsh. For amenity spaces, wind conditions suitable for **sitting** and/or **standing** are generally desirable during the summer months. The most stringent category of **sitting** is considered appropriate for cafes and dedicated seating areas, while for public parks **sitting** and/or **standing** would be appropriate in the summer.

Note that project north is approximately 50° counter-clockwise from true north. References to the building will use project north, while references to wind directions will use true north.

4.1 Existing Wind Conditions

In the Existing Configuration, with the low-rise residential buildings in place, wind conditions on the site are comfortable for sitting or standing throughout the year (**Figures 7a** and **8a**). Along North Shore Boulevard East, wind conditions are suitable for sitting throughout the year; this includes the nearby transit stop. Similar wind conditions, conducive to sitting or standing, occur along Bellview Road in the vicinity of the site.

4.2 Building Entrances & Walkways

In the Proposed Configuration, wind conditions on the walkways surrounding the proposed development are comfortable for sitting or standing throughout the year (**Figures 7b, 8b, 9a** and **9b**). At the main entrances on the east facade wind conditions are conducive to sitting throughout the year. Similarly, wind conditions at the numerous townhouse entrances along the north side of the building are suitable for sitting in both the summer and winter seasons. At the exits on the east, south and west facades, wind conditions are comfortable for sitting year-round (**Figures 9a** and **9b**).

These wind conditions are considered ideal for the intended usage.

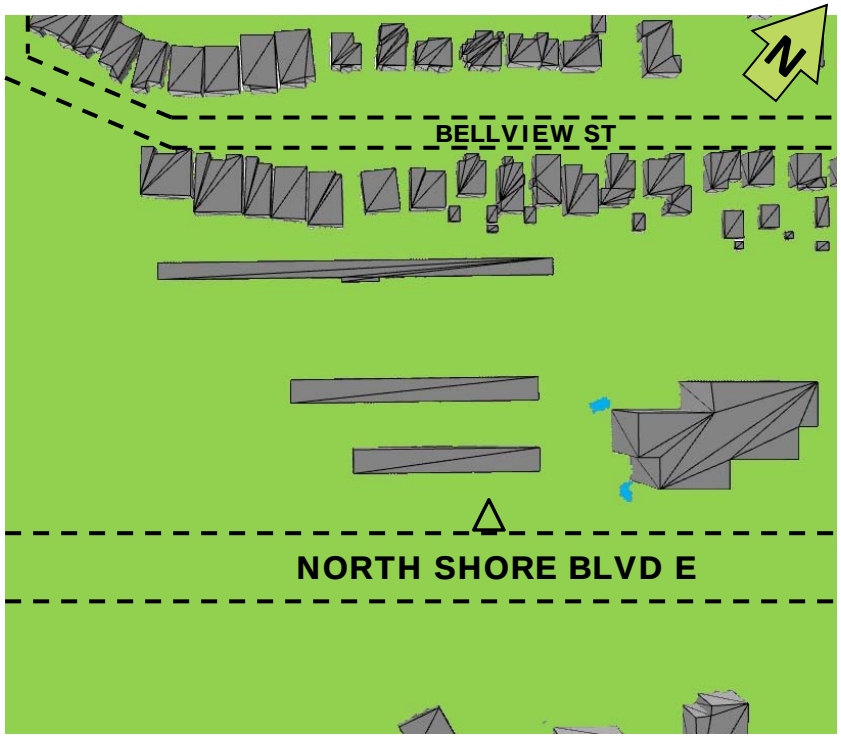

Figure 7a: Existing Conditions – Grade Level – Summer

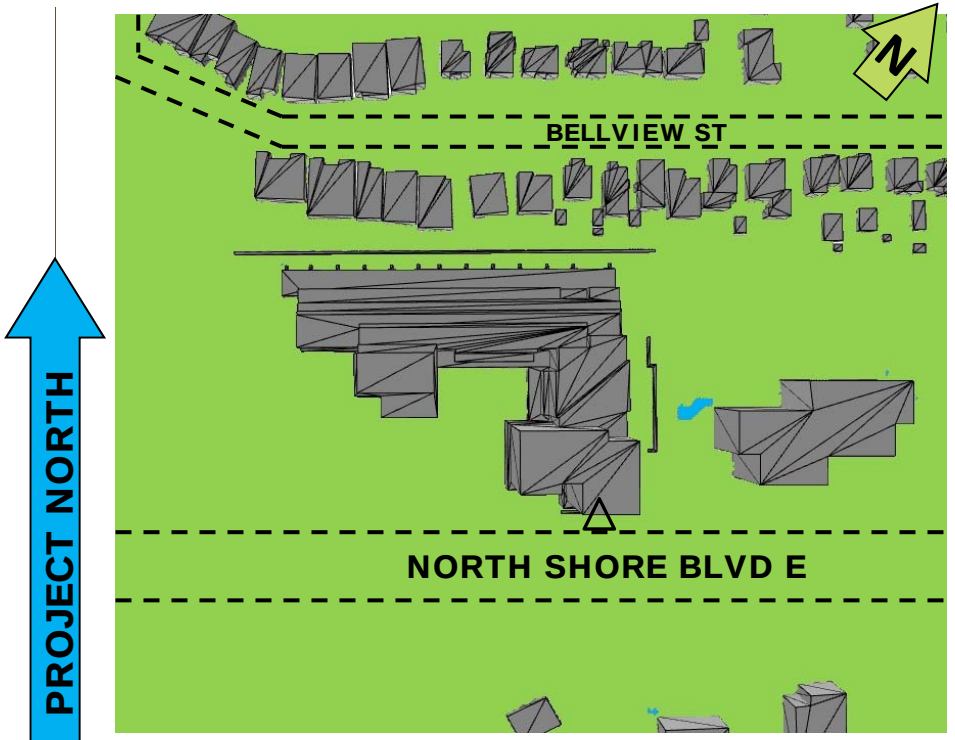

Figure 7b: Proposed Conditions – Grade Level – Summer

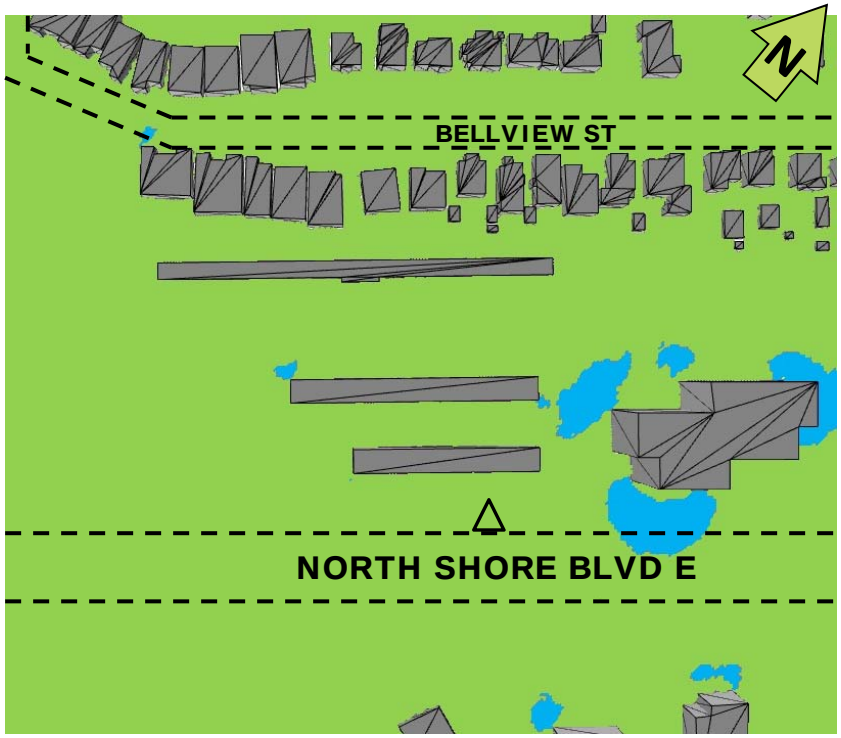

Figure 8a: Existing Conditions – Grade Level – Winter

Figure 8b: Proposed Conditions – Grade Level – Winter

4.3 Amenity Patios & Terraces

All three amenity patios at grade are comfortable for sitting in the summer (**Figure 9a**). In the winter, all three patios are suitable for sitting or standing (**Figure 9b**). These wind conditions are considered ideal for the intended usage.

On the amenity terraces on Level 2, the mass of the building shelters the terraces from the prevailing winds. Hence, wind conditions on the two outdoor amenity terraces on Level 2 (on the north side of the courtyard) are comfortable for sitting in both the summer and winter seasons. These wind conditions are considered ideal for the intended usage.

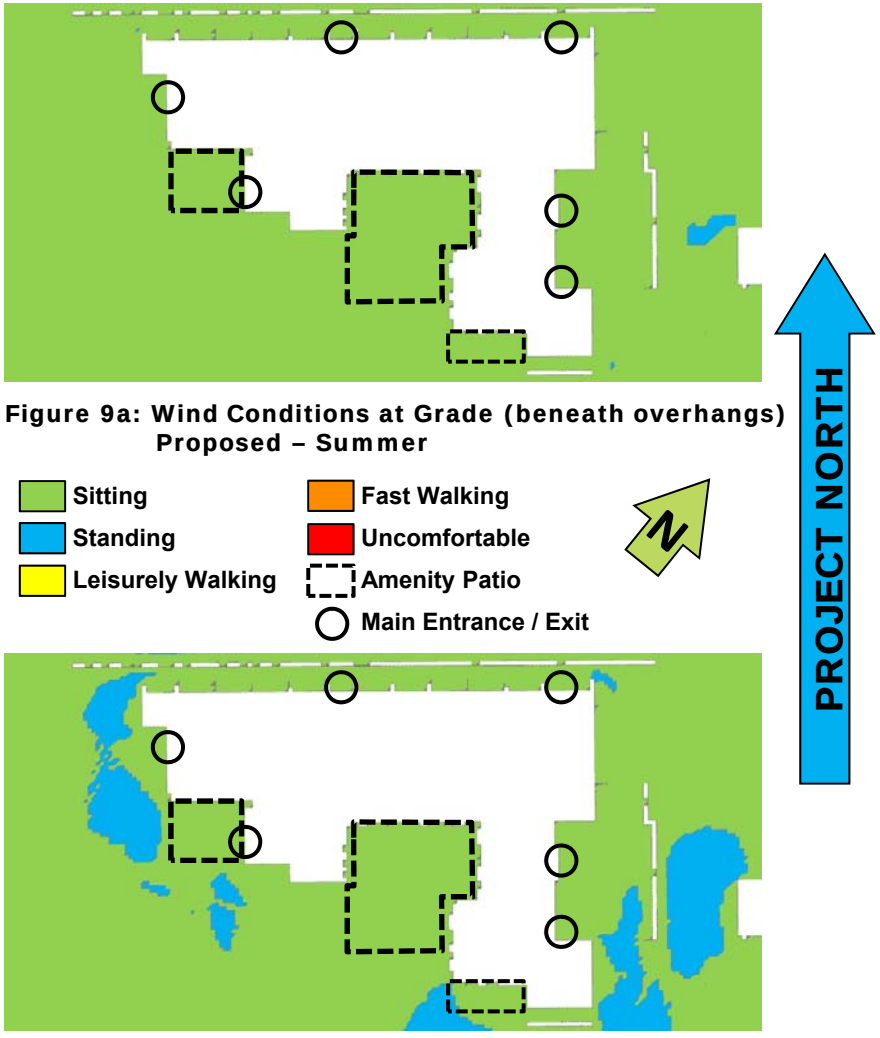

Figure 9a: Wind Conditions at Grade (beneath overhangs) Proposed – Summer

Figure 9b: Wind Conditions at Grade (beneath overhangs) Proposed – Winter

4.4 Surrounding Sidewalks

In the Proposed Configuration, wind conditions along North Shore Boulevard East are conducive to sitting or standing throughout the year in the vicinity of the proposed development (**Figures 7b** and **8b**). At the nearby transit stop, wind conditions remain comfortable for sitting in the summer. In the winter, wind conditions at the transit stop are suitable for standing. On Bellview Street wind conditions are suitable conducive to sitting or standing year-round.

These wind conditions are considered ideal for the intended usage.

4.5 Wind Safety

In both the Existing and Proposed Configurations, the wind safety criterion was met in all areas on and surrounding the site (**Figure 11**).

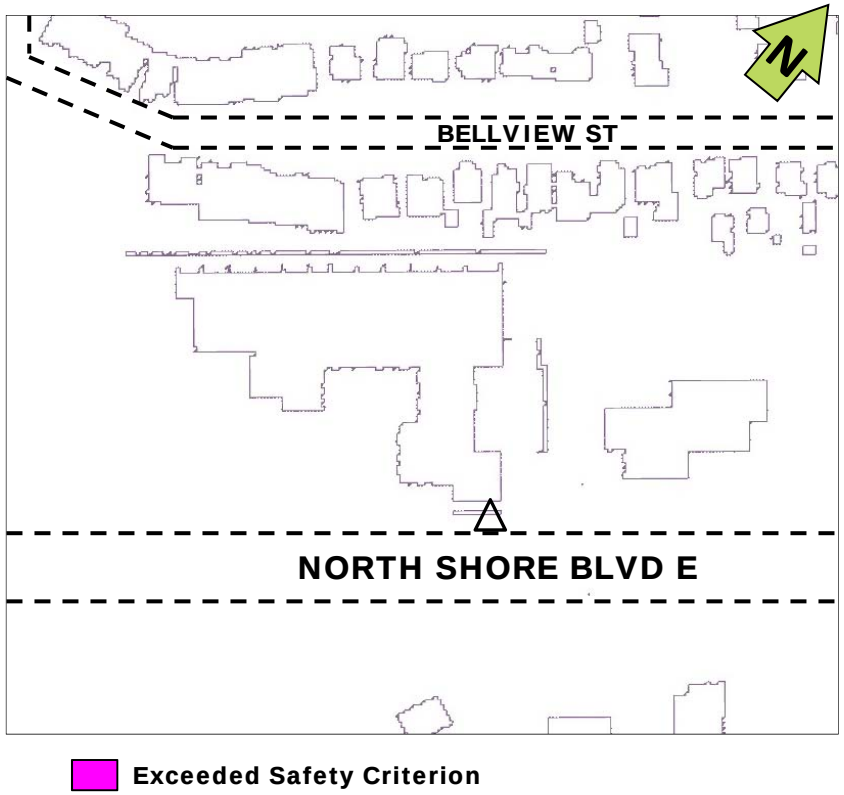

Figure 10: Wind Safety – Proposed Configuration – Grade Level - Annual

5.0 UPDATED ARCHITECTURAL INFORMATION

Updated architectural information was received on September 11, 2018. This information arrived after the modeling analysis had been completed. Upon review of the updated drawings, a few differences were noted:

- The southeast tower had increased in height approximately 3m.
- The shape of the ground floor footprint was altered, resulting in an overall enlarged footprint.
- A large canopy is now included at the southeast corner of the building.
- The footprint of the central amenity courtyard has been altered.
- The amenity patio at the southeast corner of the development has been removed.
- The number of individual unit entrances along the north facade has been reduced.

An updated site plan is shown in **Figure 11**. In our opinion, the height alteration to the southeast tower will have a negligible influence on overall wind conditions at grade or on the surrounding terraces. Similarly, the enlargement of the footprint will have negligible influence on the overall wind conditions on site. However, to confirm wind conditions, particularly in the courtyard, amenity patio, entrances and exits, we recommend the design team conduct an addendum analysis with the revised massing, as well as any potential design changes that arise out of the ZBA application, and prior to Site Plan Approval (SPA).

Figure 11: Roof Site Plan
(Credit: Montgomery Sisam Architects Inc.)

6.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at the North Shore Development in Burlington have been assessed through numerical modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is met at all locations surrounding the development in both the Existing and Proposed Configurations.
- Wind conditions on the site, including the walkways, entrances, exits, amenity patios and amenity terraces are suitable for intended usage throughout the year.
- On the sidewalks surrounding the proposed development, wind conditions generally remain unchanged and are suitable for the intended usage.
- Additional analysis is recommended prior to SPA to confirm the expected wind conditions around the revised massing.

7.0 ASSESSMENT APPLICABILITY

This assessment is based on computer modeling techniques and provides a qualitative overview of the pedestrian wind comfort conditions on and surrounding the proposed development site. Any subsequent alterations to the design may influence these findings, possibly requiring further review by Novus.

Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Sincerely,
Novus Environmental Inc.

Jenny Vesely, P. Eng.
Sr. Engineer – Microclimate

Tahrana Lovlin, MAES, P.Eng.
Specialist - Microclimate

8.0 REFERENCES

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Appendix A

Pedestrian Wind Comfort Analysis

Spring (April – June) and Autumn (October – December)

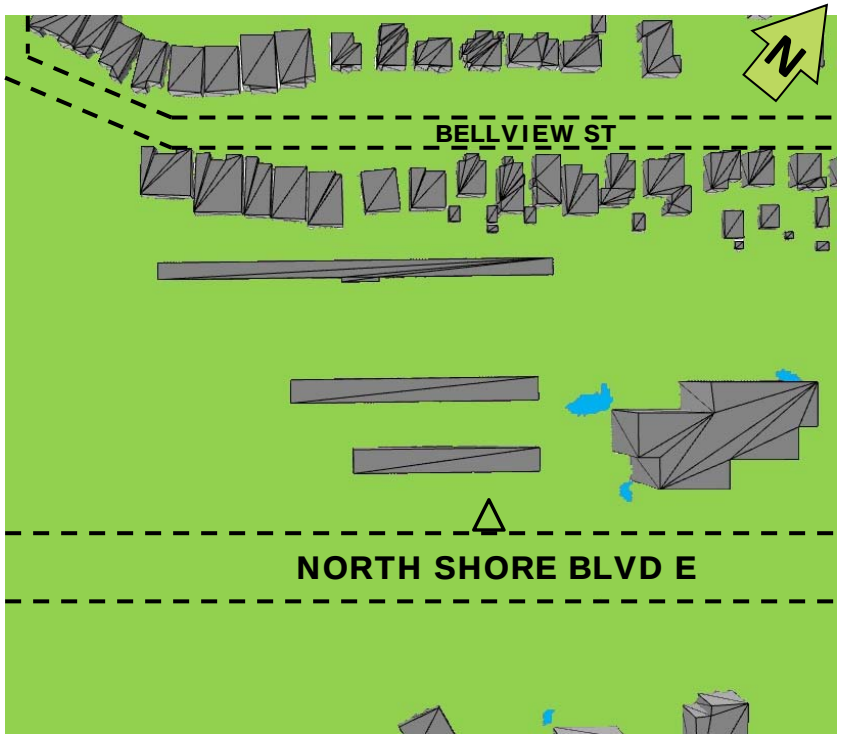
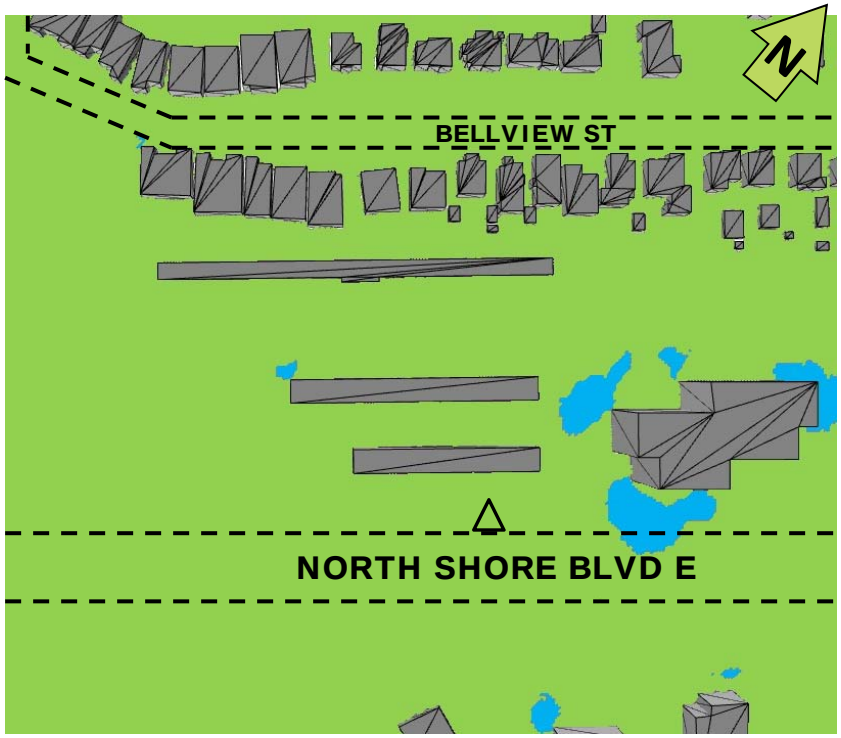


Figure A1a: Existing Configuration – Grade – Spring

Figure A1b: Proposed Configuration – Grade – Spring



Sitting
Standing
Leisurely Walking
Fast Walking
Uncomfortable
Transit Stop

Figure A2a: Existing Configuration – Grade – Autumn

Sitting
Standing
Leisurely Walking
Fast Walking
Uncomfortable
Transit Stop

Figure A2b: Proposed Configuration – Grade – Autumn