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Date: April 24, 2020

To: Redwood Properties
330 New Huntington Road, Suite 201
Vaughan, ON L4H 4C9

Re: **Pedestrian Wind Assessment**
7085 Goreway Drive
Mississauga, ON
SLR Project #241.20055.00000

Team: Tahrana Lovlin, MAES, P.Eng.
Jenny Graham, P.Eng.

Credit: IBI Group

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1.0 INTRODUCTION

SLR Consulting (SLR) was retained by Redwood Properties to conduct a pedestrian wind assessment for the development site at 7085 Goreway Drive in Mississauga, Ontario. This report is in support of the Zoning By-law Amendment (ZBA) application for the development.

1.1 Existing Development

The proposed development is located at 7085 Goreway Drive, on the east side, north of Derry Road East. The site is currently occupied by a grocery store and parking lot. Figure 1 provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth images dated August 2019; these images are included in Figures 2a through 2d.

Immediately surrounding the site are low-rise commercial and residential developments to the south, southwest and northwest, while to the west is Fire Station #105. To the north through east to south is the Malton Greenway. Beyond the immediate surroundings there are low-rise residential buildings to the southwest through northwest to northeast, with low-rise commercial developments to the east through south. There are also mid-rise towers are to the southeast, along Derry Road East, just beyond the greenway.

Approved developments and developments under construction in the surrounding area are included as existing surroundings for the analysis. For this assessment, no nearby approved developments were identified.

Figure 1: Aerial view of existing site & surroundings
Credit: Google Earth Pro, dated 6/9/2018

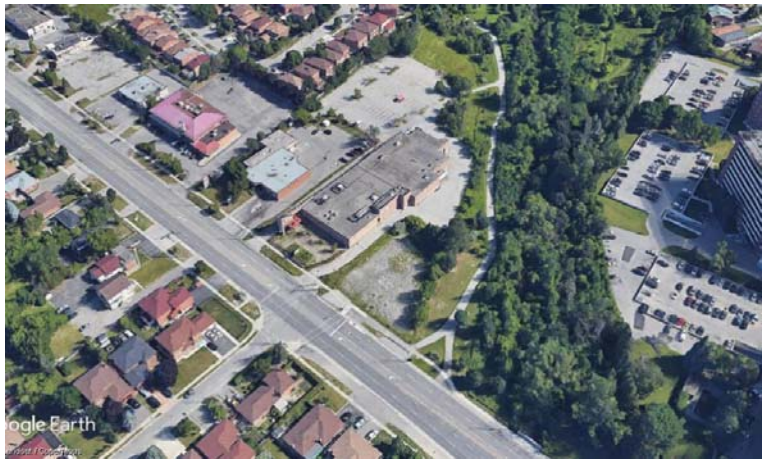


Figure 2a: Site bird's eye view, looking north

Figure 2b: Goreway Drive, looking northwest

Figure 2c: Goreway Drive, looking southeast

Figure 2d: Malton Greenway trailhead, looking north

1.2 Proposed Development

The proposed development, shown in Figure 3, consists of two towers on a two-storey podium on the south half of the site with three low-rise townhouse blocks on the north half. The West Tower is 18 storeys tall, plus a mechanical penthouse, for a total height of approximately 60 m. The East Tower is 16 storeys tall, plus a mechanical penthouse, for a total height of approximately 53 m. The two-storey townhouse blocks are approximately six metres tall, with 12 units over three blocks.

The main entrance to the West Tower is located at the southwest corner of the podium, while the entrance to the East Tower is located at the northeast corner. There are additional secondary entrances and exits around the base of the podium. There is also outdoor amenity space on Level 3, atop the podium (Figure 4). Additional outdoor amenity spaces are located the northeast and northwest corners of the townhouse area, as well as at the southeast corner of the East Tower.

Wind screens (50% solid) are included along the west side of the West Tower, between the columns. There is also a canopy above the main entrance to the West Tower. On the podium, a wind screen (50% solid) was included along a portion of the north edge of the space, in addition to canopies at the northeast corner of the West Tower and the northwest corner of the East Tower (Figure 5).

Figure 3: Rendering of Proposed Development
Credit: IBI Group

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.

In addition to the areas described in Section 1.2, there are two transit stops along Goreway Drive are within the analysis area. Also, the proposed development is adjacent to the Malton Greenway.

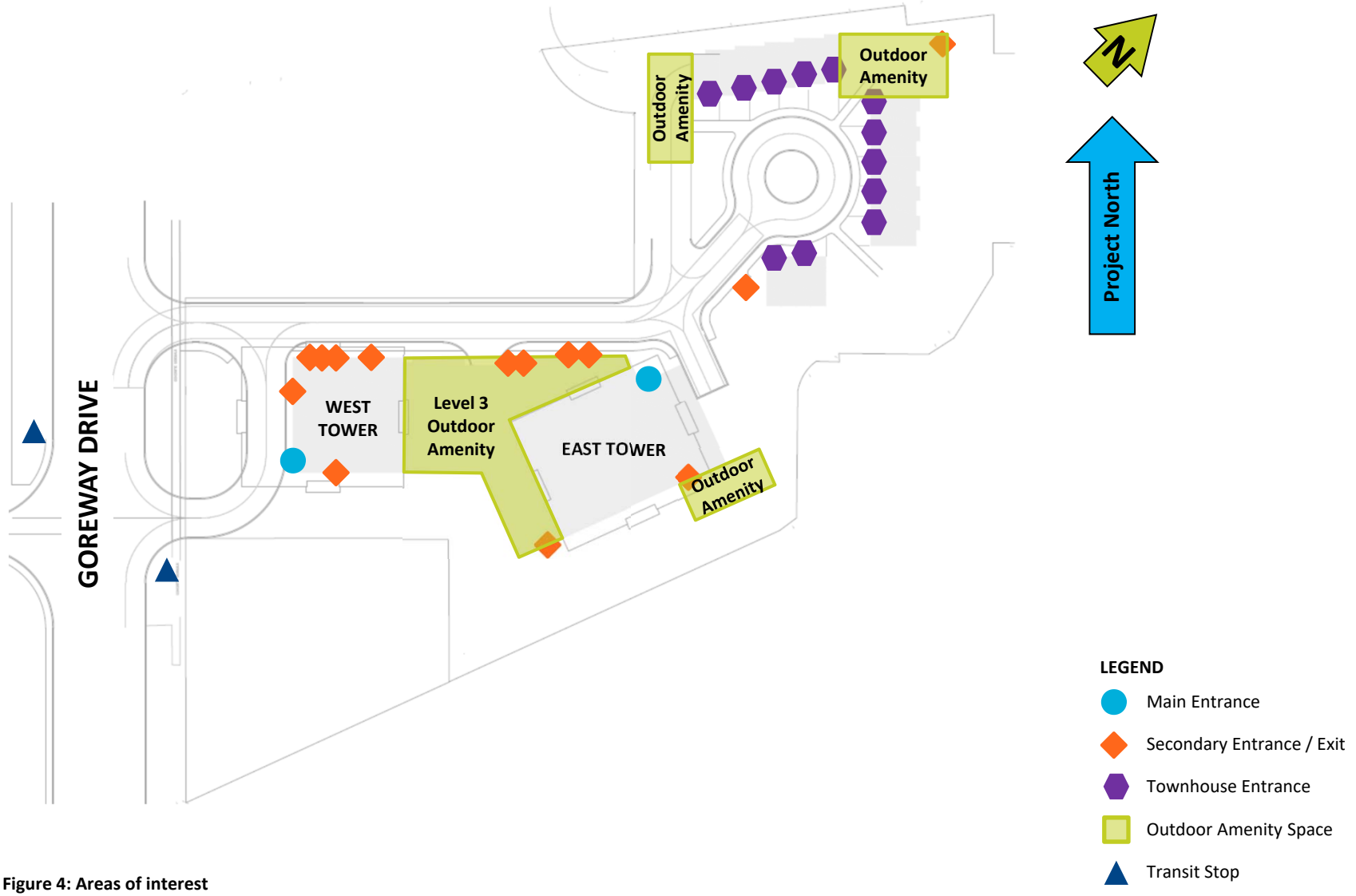


Figure 4: Areas of interest

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. The results of CFD modeling are also an excellent means of readily identifying relative changes in wind conditions associated with different site configurations or with alternative built forms.

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 IBI Group on March 13th and April 9th, 2020. 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 450 m 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 two seasons: Winter (November to April) and Summer (May to October).

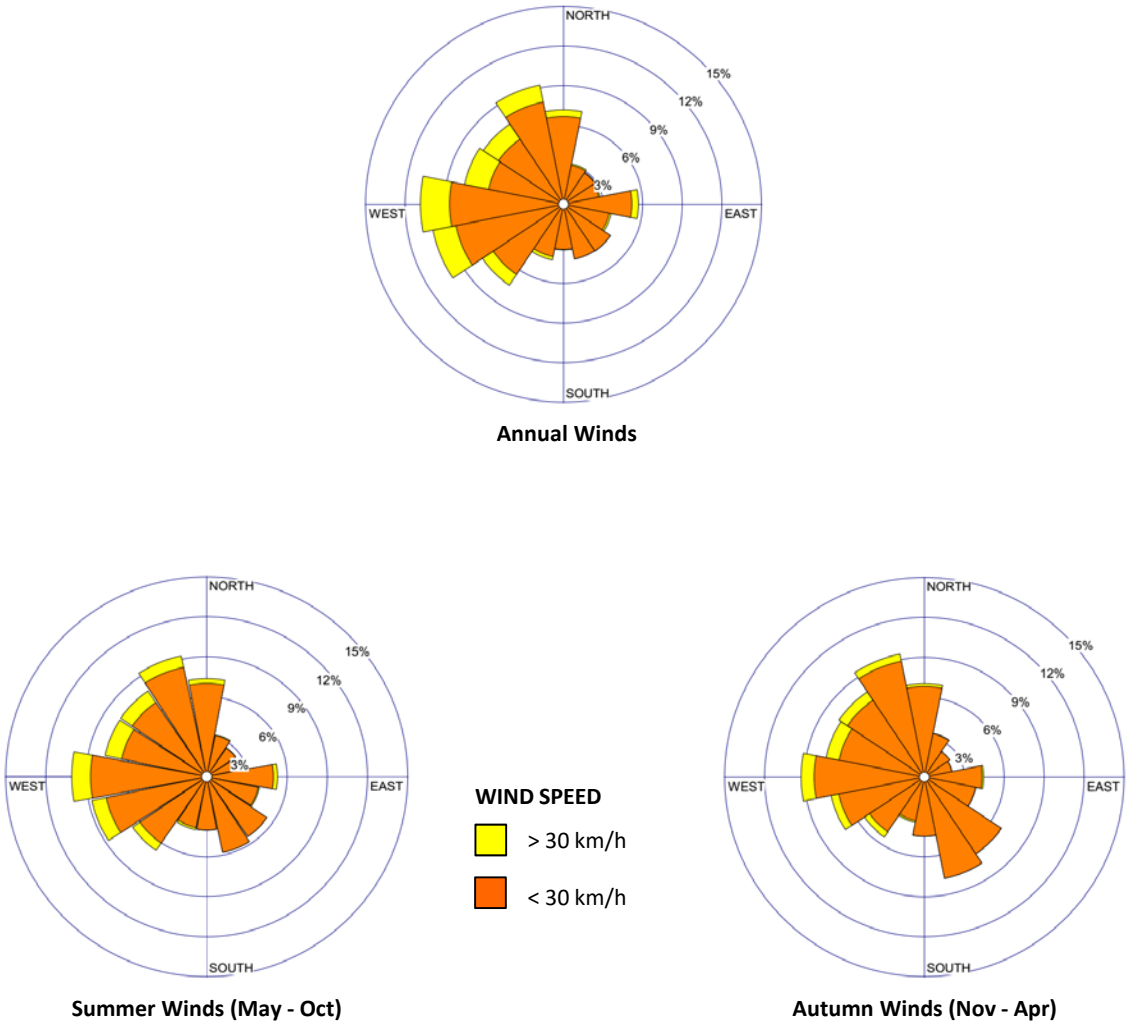
Results are presented through discussion of the wind conditions along major streets and the areas of interest. The comfort criteria are based on predictions of localized wind forces combined with frequency of occurrence. Climate issues that influence a person's overall "thermal" comfort, (e.g., temperature, 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 Pearson International Airport in Toronto for the period of 1986 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 northerly through westerly directions are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year. The seasonal wind roses show daytime winds, from 6:00 – 23:00, while the annual wind rose shows all hours.

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 northwesterly and westerly sectors. All wind speeds and directions were included in the wind climate model.



Annual Winds

Summer Winds (May - Oct)

Autumn Winds (Nov - Apr)

Figure 6: Wind Roses for Toronto Pearson International Airport (1986-2015, 6am–11pm)

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 criteria utilized for this analysis is provided by the City of Mississauga, in the document *Urban Design Terms of Reference – Pedestrian Wind Comfort and Safety Studies* (June 2014). The comfort criteria, which is based on certain predicted hourly gust-equivalent mean (GEM) wind speeds being exceeded 20% of the time, are summarized in Table 1. By allowing for a 20% exceedance, it assumes wind speeds will be comfortable for the corresponding activity at least four out of five days. The comfort criteria consider only daytime hours, between 6:00am and 11:00pm. GEM is defined as the maximum mean wind speed or the gust wind speed divided by 1.85.

The criterion for wind safety in the table is based on hourly gust wind speeds that are exceeded nine hours per year (approximately 0.1% 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.

Table 1: Wind Comfort Criteria

Activity	Comfort Ranges for GEM Wind Speed Exceeded 20% of the Time		Description of Wind Effects
Sitting	0 to 10 km/h	0 to 2.8 m/s	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away.
Standing	0 to 15 km/h	0 to 4.2 m/s	Gentle breezes suitable for main building entrances and bus stops.
Walking	0 to 20 km/h	0 to 5.6 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	> 20 km/h	> 5.6 m/s	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

Table 2: Wind Safety Criterion

Activity	Safety Criterion Gust Wind Speed Exceeded Once Per Year (0.1%)		Description of Wind Effects
Any	90 km/h	25 m/s	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

4.0 RESULTS

Figures 7a through 10b present graphical images of the wind comfort conditions for the summer and winter months around the proposed development. 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.

Appendix A includes graphical images of the annual wind safety for the Existing and Proposed Configurations. Appendix B includes vertical slices of the wind flows around the building.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. For example, for public sidewalks, wind comfort suitable for **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 parks **sitting** and/or **standing** would be appropriate in the summer.

Note, Project North is 45° counter-clockwise from True North. When referring to winds, True North is used; for building facades, Project North is used.

4.1 Existing Wind Conditions

In the Existing Configuration wind conditions on the site are expected to be comfortable for sitting or standing throughout the year (Figures 7a and 8a).

Along nearby Goreway Drive and Dorcas Street, wind conditions are predicted to be conducive to sitting or standing year-round. Along the nearby trail in the Malton Greenway, as well as at the nearby transit stops, wind conditions are predicted to be suitable for sitting in both the summer and winter seasons.

4.2 Building Entrances & Walkways

In the Proposed Configuration, wind conditions on the site are predicted to be suitable for walking or better year-round (Figures 7b and 8b). At the main entrances to the West and East Towers wind conditions are expected to be comfortable for sitting or standing throughout the year (Figures 9a and 9b). At the townhouse entrances on the north facade, wind conditions are expected to be conducive to sitting year-round. At the numerous exits and secondary entrances around the building, wind conditions are anticipated to be comfortable for sitting in both the summer and winter seasons. Wind conditions on the walkways surrounding the towers are predicted to be suitable for walking or better throughout the year.

For the individual townhouses on the east side of the site, wind conditions are anticipated to be suitable for sitting or standing year-round (Figures 7b and 8b). In the amenity space at the northeast corner of the townhouses, wind conditions are expected to be comfortable for sitting throughout the year.

These wind conditions are considered suitable for the intended usage.

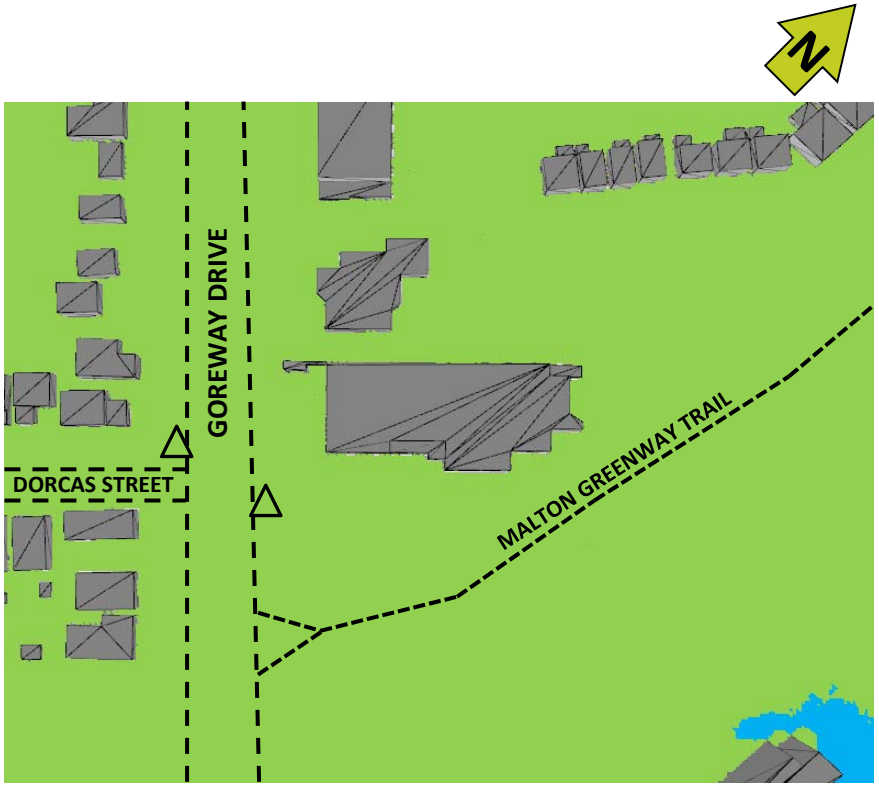


Figure 7a: Existing Configuration – Wind Comfort – Summer

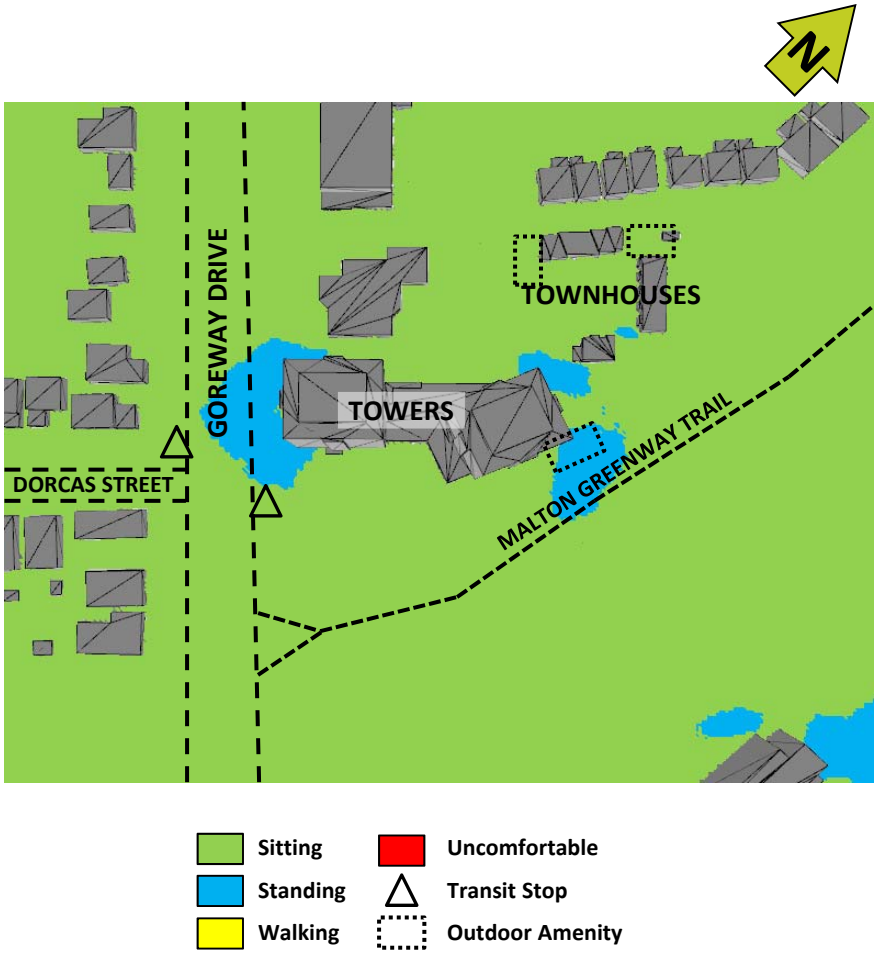


Figure 7b: Proposed Configuration – Wind Comfort – Summer

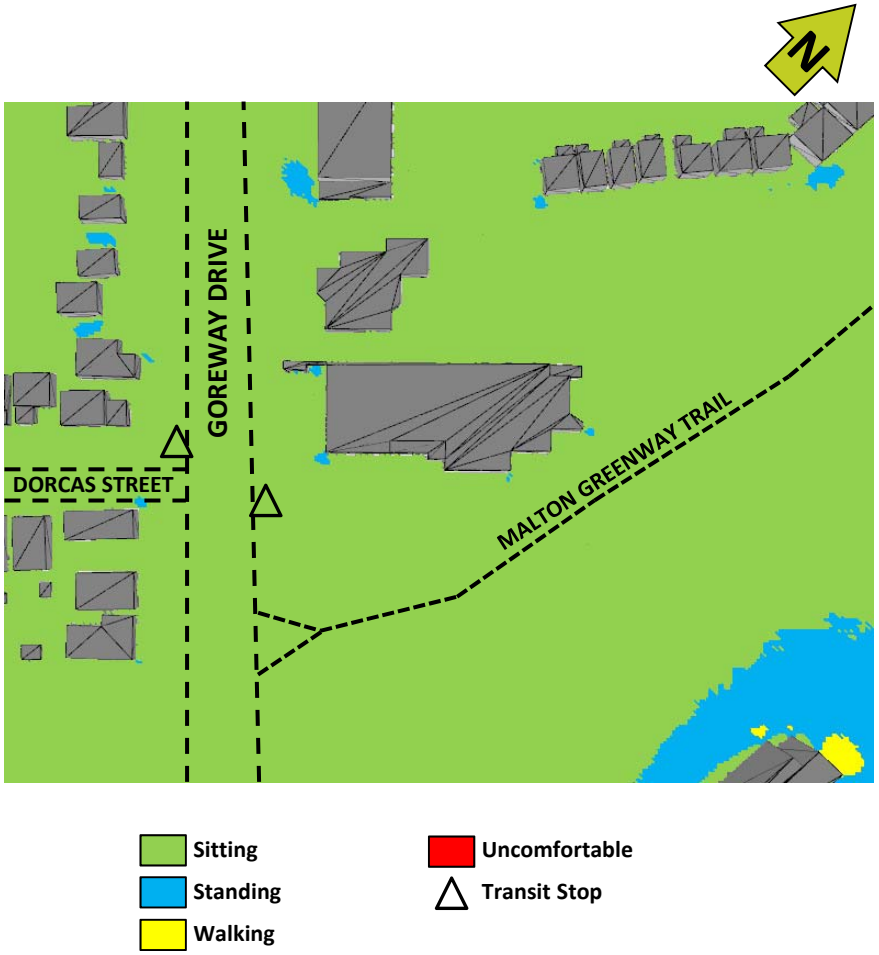


Figure 8a: Existing Configuration – Wind Comfort – Winter

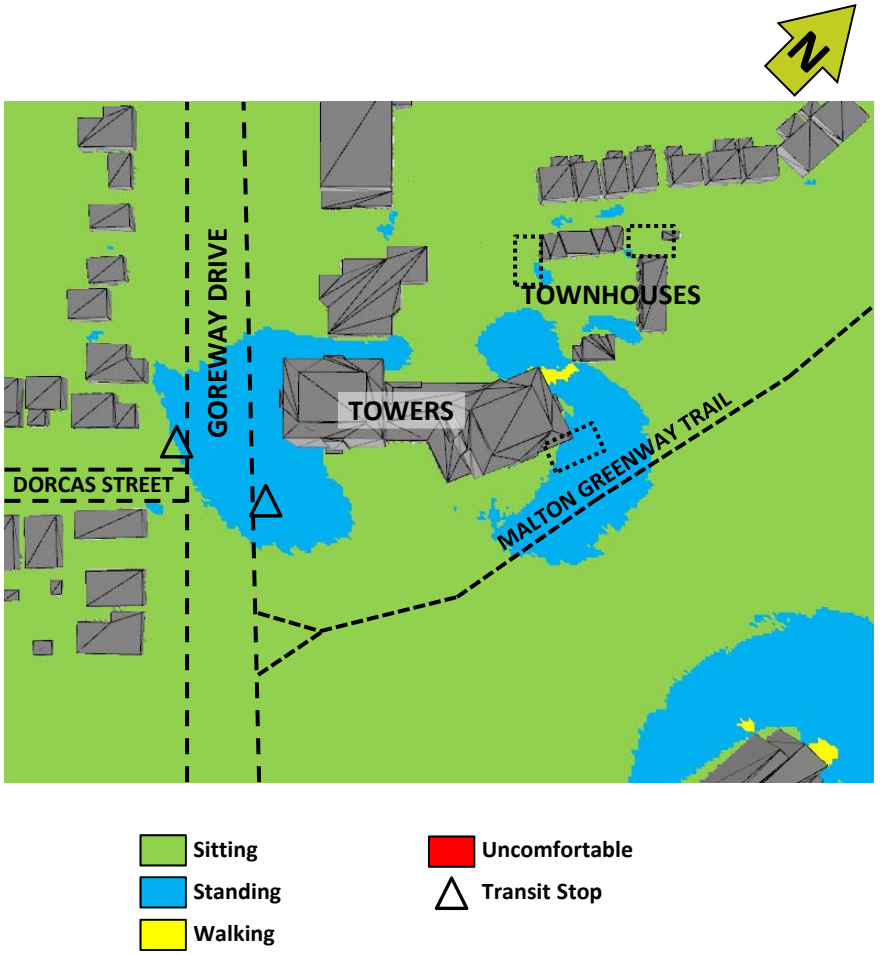


Figure 8b: Proposed Configuration – Wind Comfort – Winter

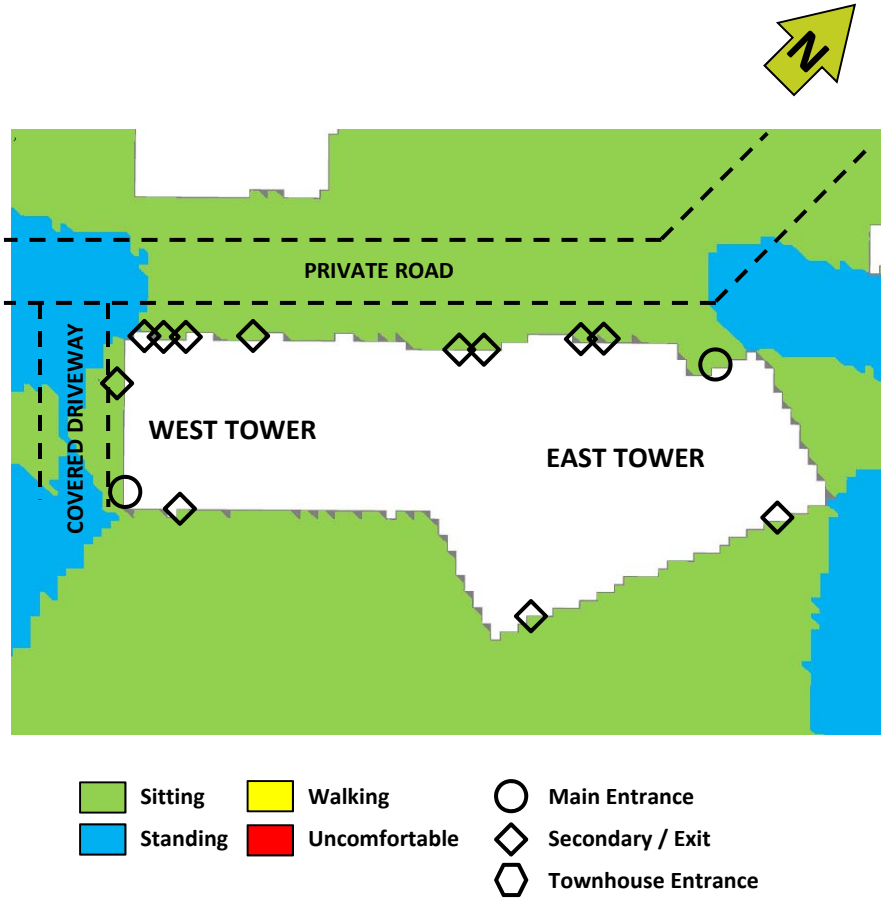


Figure 9a: Proposed Configuration – Wind Comfort – Grade – Summer

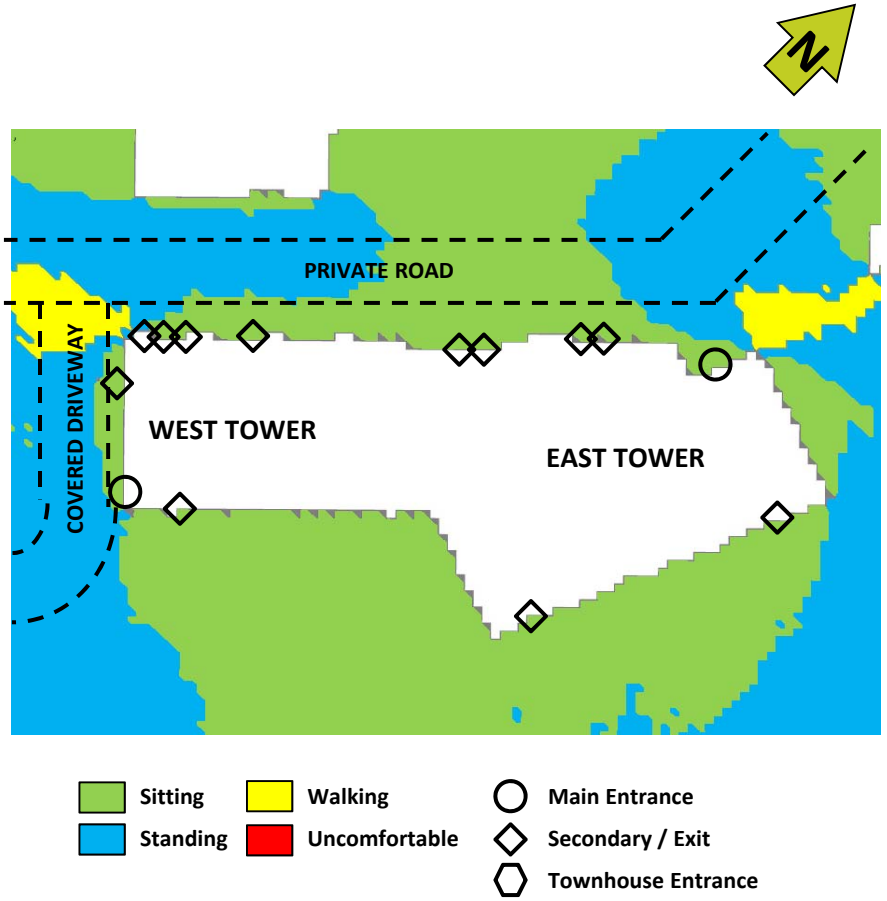


Figure 9b: Proposed Configuration – Wind Comfort – Grade – Winter

4.3 Outdoor Amenity Spaces

In the Proposed Configuration there is an outdoor amenity terrace on Level 3, between the towers. Wind conditions on the terrace are generally expected to be conducive to sitting or standing throughout the year (Figures 10a and 10b). The exception is at the northwest corner of the East Tower, where wind conditions are expected to be suitable for walking or are uncomfortable.

The design team included a semi-porous wind screen along part of the north edge of the terrace, connecting to the West Tower. There was also a canopy at this corner. These are positive design features as they provide shelter, hence this area is expected to be comfortable for sitting or standing year-round. However, results of the assessment show that the inclusion of a canopy at the northwest corner of the East Tower has negligible influence on the wind conditions in the area. Therefore, as the design progresses SLR will aid the design team in determining where vertical wind mitigation features (i.e., dense landscaping, vertical wind screens, etc.) should be installed on the terrace; this will be dependent on the anticipated programming of the space.

At grade, there is an outdoor amenity space at the northeast corner of the townhouses. Wind conditions in this area are expected to be comfortable for sitting or standing throughout the year. Similar wind conditions are predicted for the amenity area at the northwest corner of the townhouses. At the southeast corner of the East Tower, wind conditions are anticipated to be suitable for sitting and/or standing year-round.

Example of Landscaped Vertical Screen

4.4 Surrounding Sidewalks

On the nearby sidewalks of Goreway Drive and Dorcas Street wind conditions are expected to be comfortable for sitting or standing throughout the year (Figures 7b and 8b). At the nearby transit stops, wind conditions are predicted to be suitable for sitting or standing year-round. In the Malton Greenway, wind conditions are expected to be conducive to sitting or standing year-round.

These wind conditions are satisfactory for the anticipated usage.

4.5 Wind Safety

In both the Existing and Proposed Configurations, the wind safety criterion are expected to be met on an annual basis.

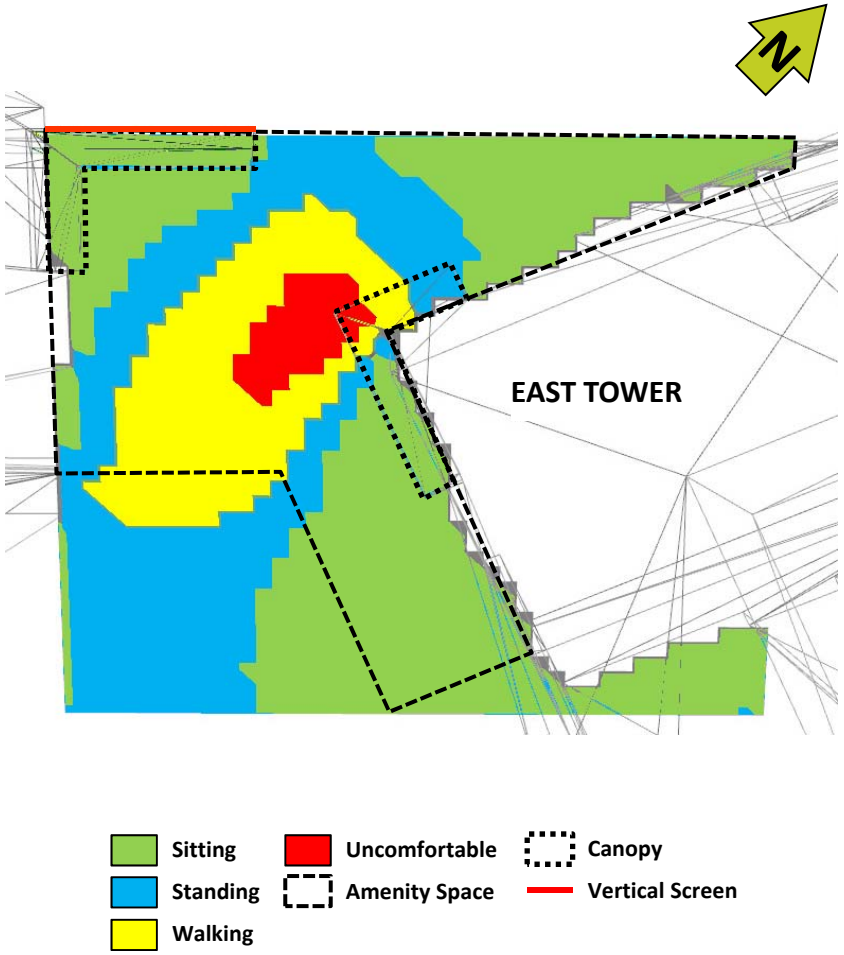


Figure 10a: Proposed Configuration – Wind Comfort – Level 3 – Summer

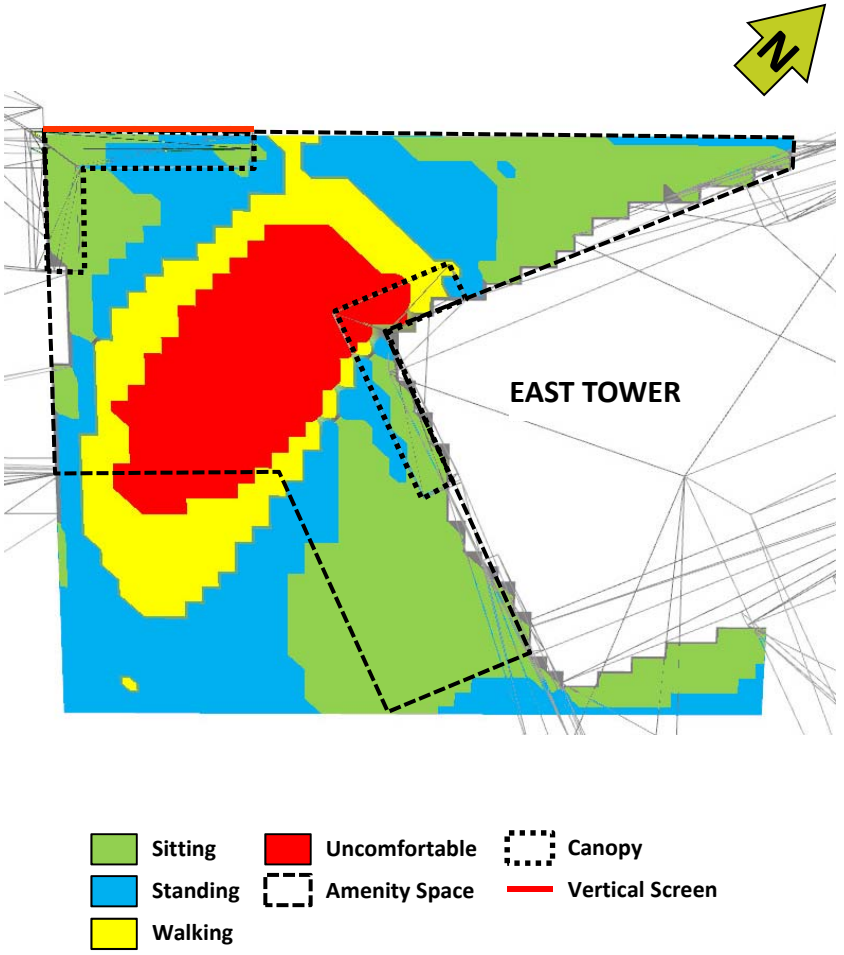


Figure 10b: Proposed Configuration – Wind Comfort – Level 3 – Winter

5.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 7085 Goreway Drive in Mississauga have been assessed through computational fluid dynamics modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- In both the Existing and Proposed Configurations, we expect the wind safety criterion to be met on an annual basis.
- Wind conditions at the main entrances, secondary entrances, exits and individual townhouse entrances are expected to be comfortable for the intended usages year-round. For walkways and grade level amenity spaces, similar wind conditions are anticipated.
- At the outdoor amenity terraces on Level 3, wind conditions are generally suitable for sitting or standing year-round. Additional wind mitigation features are described; SLR will work with the design team during the Site Plan Approval (SPA) process to refine details of these features.
- On the sidewalks surrounding the proposed development, wind conditions remain similar between the Existing and Proposed Configurations, and are suitable for the intended usage.

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

Sincerely,

SLR Consulting (Canada) Ltd.

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

Jenny Graham, P. Eng.
Senior Engineer

7.0 REFERENCES

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Appendix A

Pedestrian Wind Safety Analysis

Annual

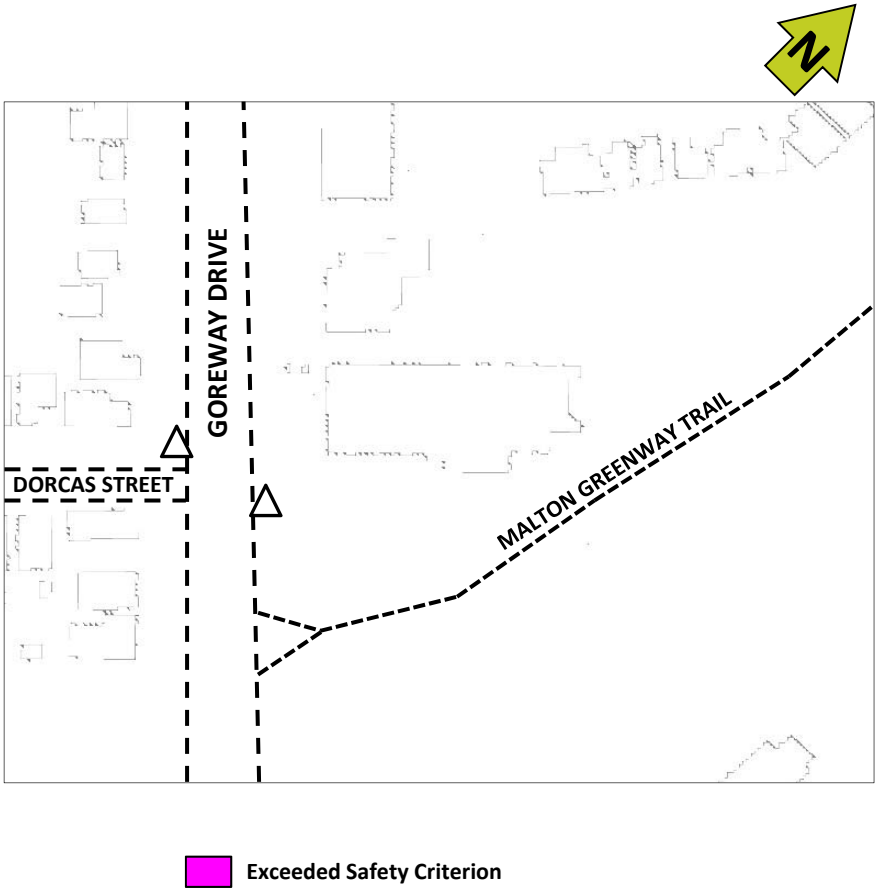

Figure B1a: Existing Configuration – Safety – Annual

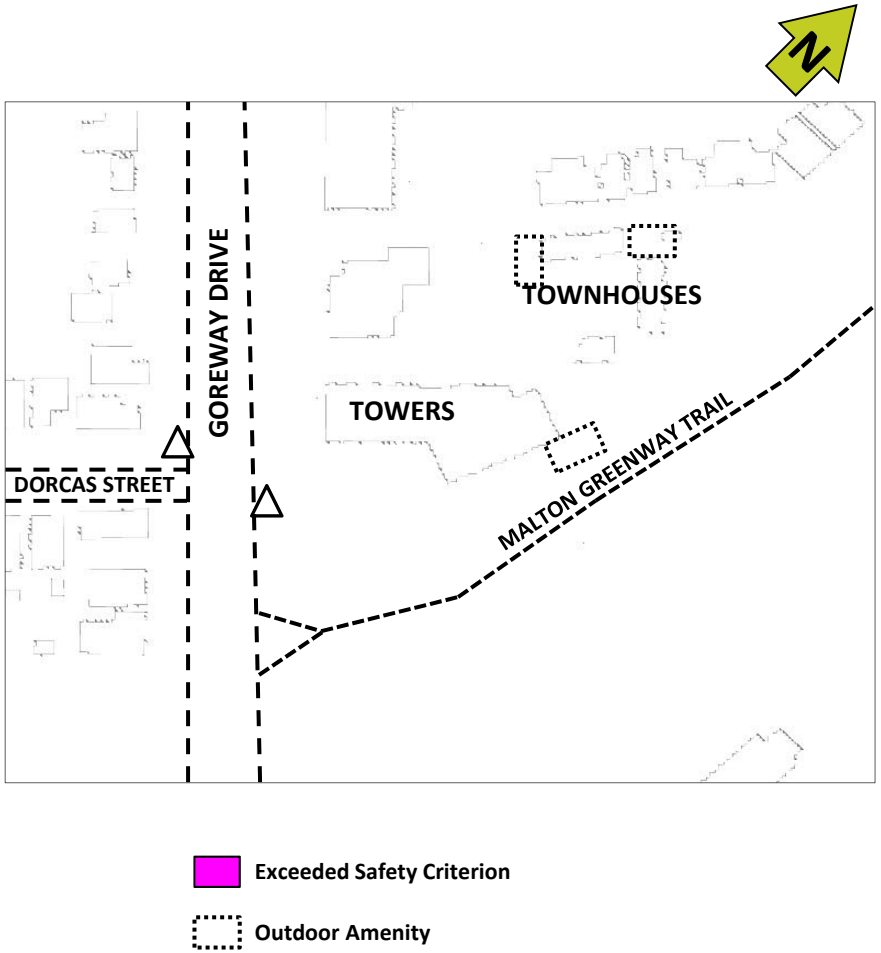

Figure B1b: Proposed Configuration – Safety – Annual

Appendix B

Wind Flow Vectors – Proposed Configuration

Vertical Slices

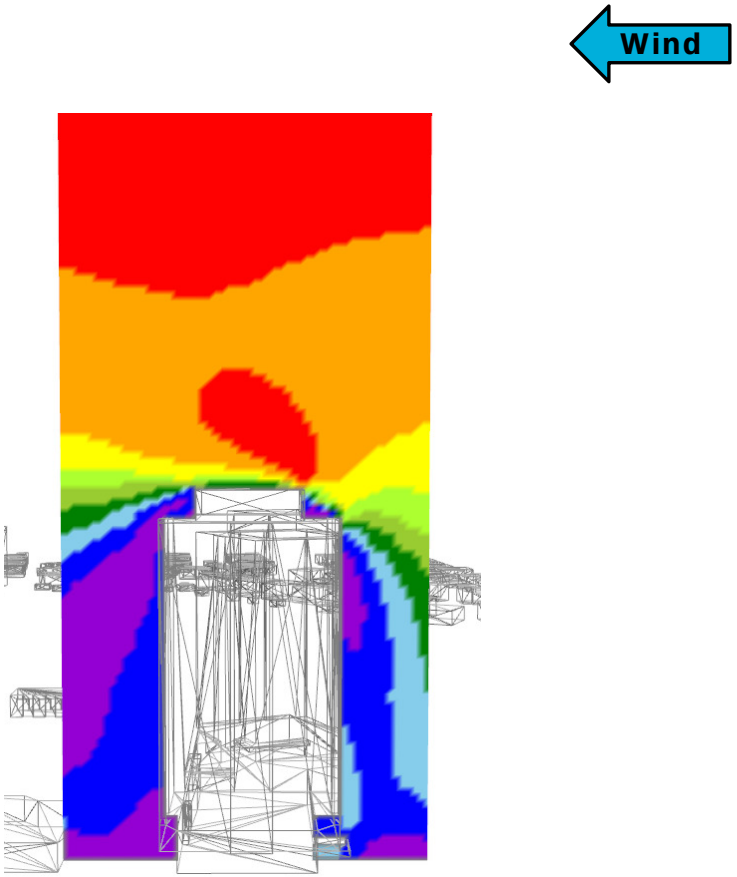

**Figure A1a: Proposed Configuration – Vertical Slice through West Tower
Wind from Southeast – View from West**

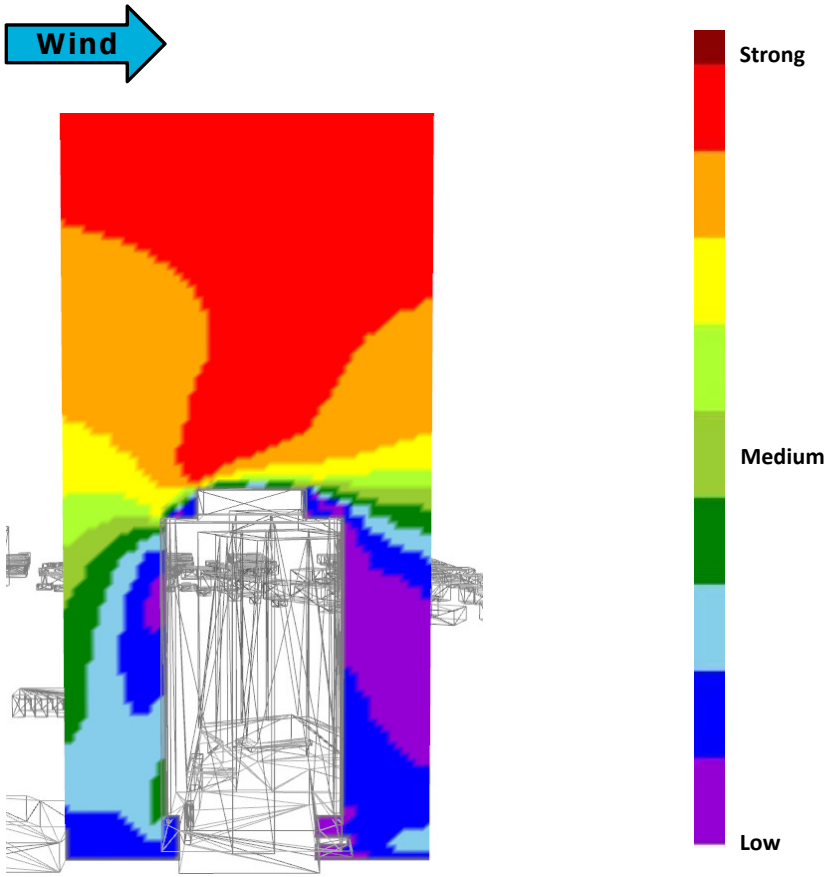

**Figure A1b: Proposed Configuration – Vertical Slice through West Tower
Winds from Northwest – View from West**

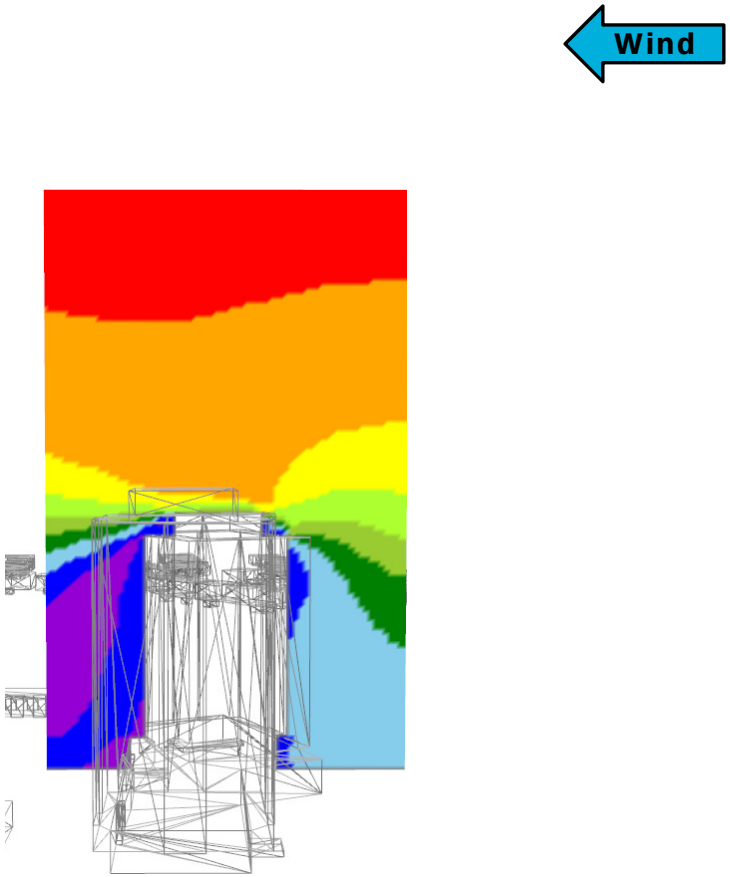

**Figure A2a: Proposed Configuration – Vertical Slice through East Tower
Wind from Southeast – View from West**

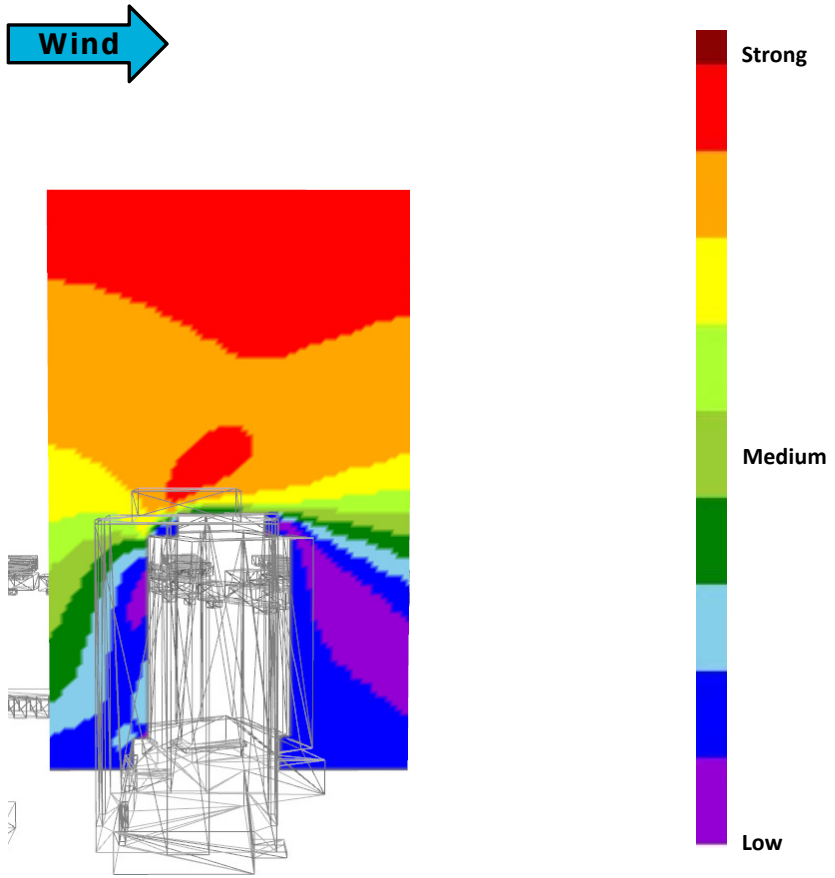

**Figure A2b: Proposed Configuration – Vertical Slice through East Tower
Winds from Northwest – View from West**

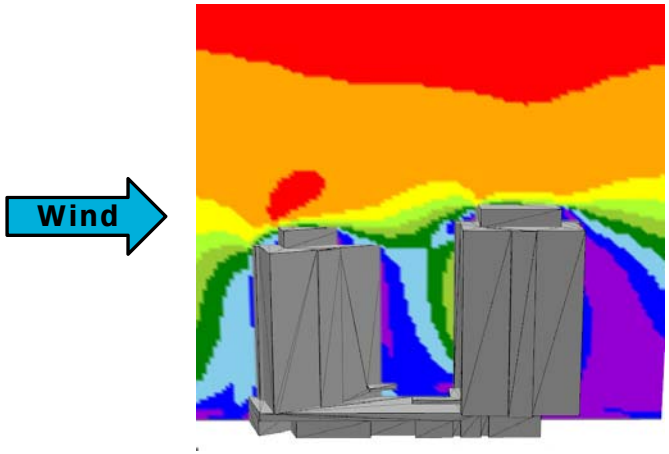

Figure A3a: Proposed Configuration – Vertical Slice through Towers
Wind from Northeast – View from North

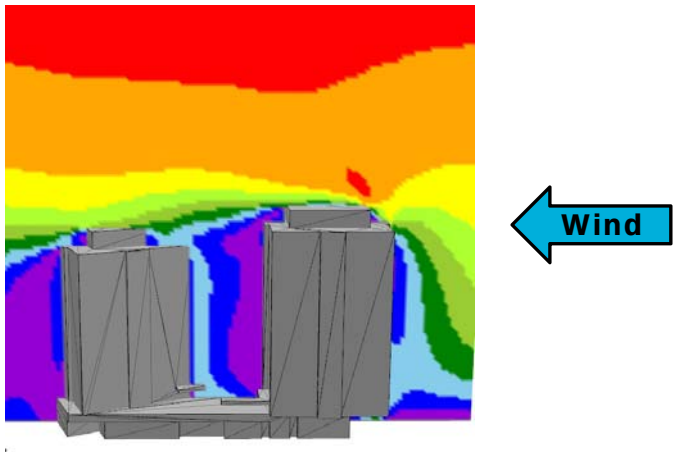

Figure A3b: Proposed Configuration – Vertical Slice through Towers
Wind from Southwest – View from North

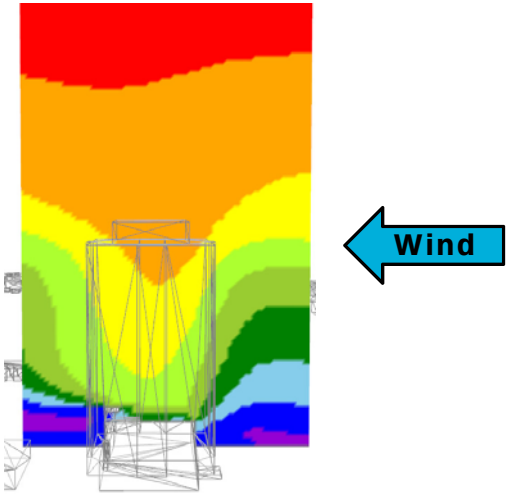

Figure A4a: Proposed Configuration – Vertical Slice through Amenity
Wind from Southeast – View from West

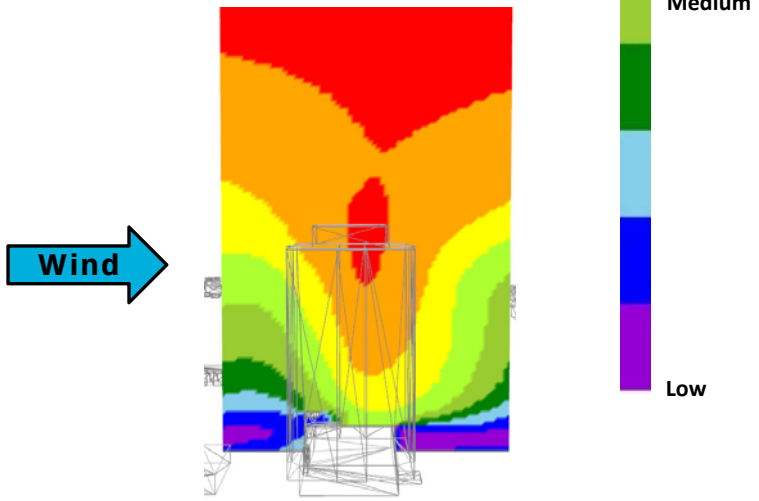

Figure A4b: Proposed Configuration – Vertical Slice through Amenity
Wind from Northwest – View from West