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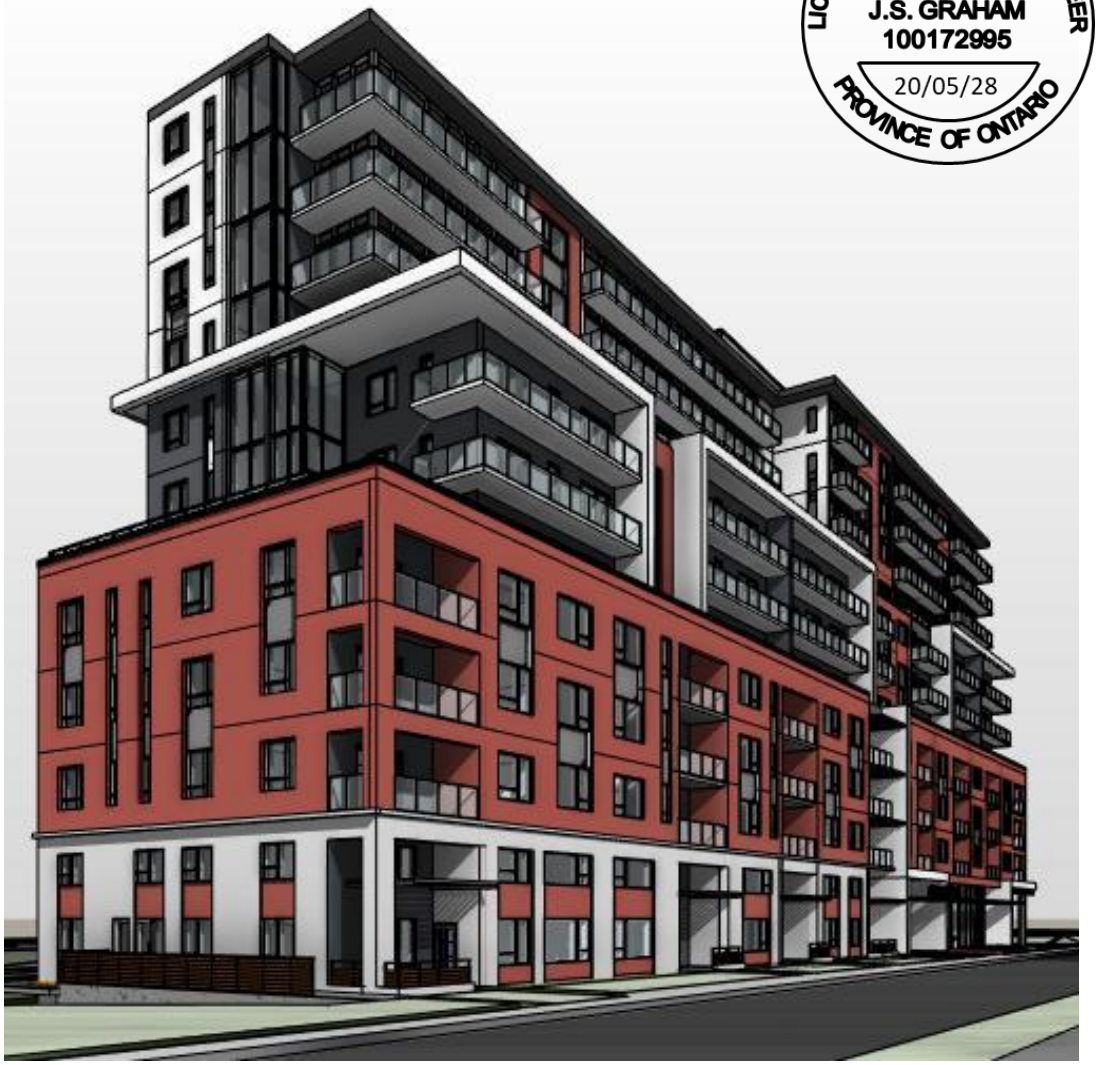
Date: May 28, 2020

To: Landform Development Group Inc.
3390 South Service Road, Suite 205
Burlington, ON L7N 3J5

Re: **Pedestrian Wind Assessment**
401-417 Martha Street
Burlington, Ontario
SLR Project #241.17185.A0000

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1.0 INTRODUCTION

SLR Consulting (SLR), formerly Novus Environmental Inc., was retained by Landform Development Group Inc. to conduct a pedestrian wind assessment for the 401-417 Martha Street development in Burlington, Ontario. This report is in support of the Zoning Bylaw Amendment (ZBA) application for the development.

1.1 Existing Site

The proposed development is located between Pine Street and the Waterfront Trail on the east side of Martha Street in Burlington. The site is currently occupied by low-rise residential buildings. Figure 1 provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth images; some of these images, dated June 2018 and July 2019, are included in Figures 2a through 2d.

Immediately surrounding the proposed development there is a high-rise to the southeast, low-rise residential buildings to the south and southwest, a parking lot to the west, low-rise residential buildings to the northwest and north, and treed lands to the northeast and east. Beyond the immediate surroundings there is a mix of low to high-rise residential and commercial buildings to the southwest, west and east, with low-rise residential to the northwest through northeast, and Lake Ontario to the southeast and south. Lake Ontario is approximately 250 m south of the proposed site.

SPA-approved developments and developments under construction are typically included in the vicinity as existing surroundings for the analysis. For this assessment, the following developments were included, as per direction from City of Burlington staff: 2042 Lakeshore Road, 421 Brant Street, 2069 Lakeshore Road, 2096-2100 Lakeshore Road, 409 Brant Street, 2082, 2086 & 2090 James Street, 2085 Pine Street, 374 Martha Street, and 2027 Maria Street.

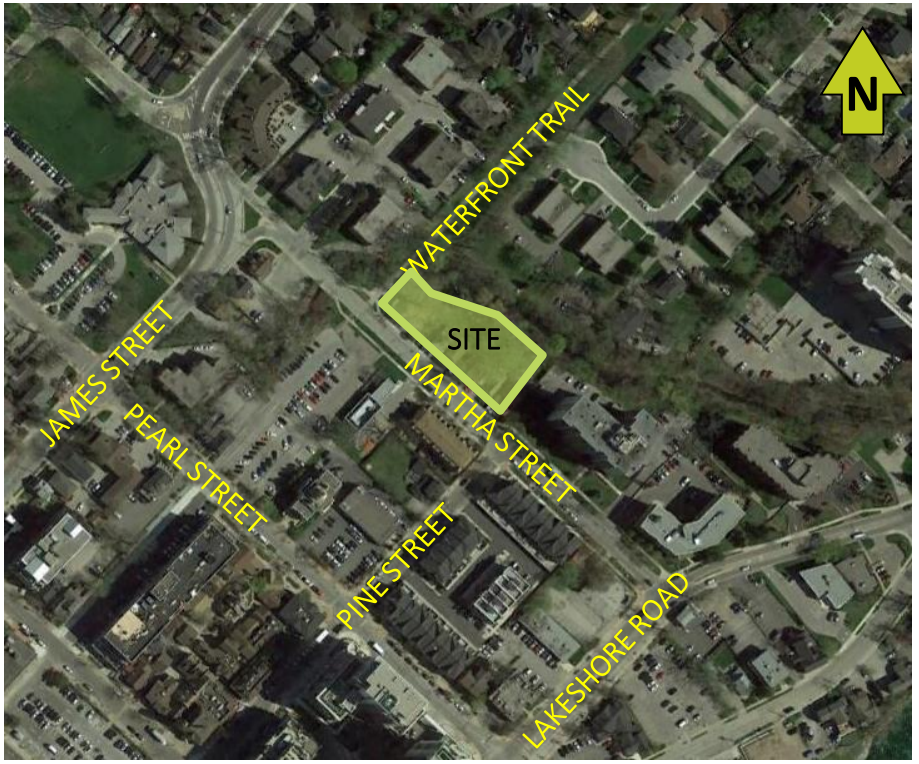


Figure 1: Aerial view of existing site and surroundings
Credit: Google Earth, dated August 7, 2018

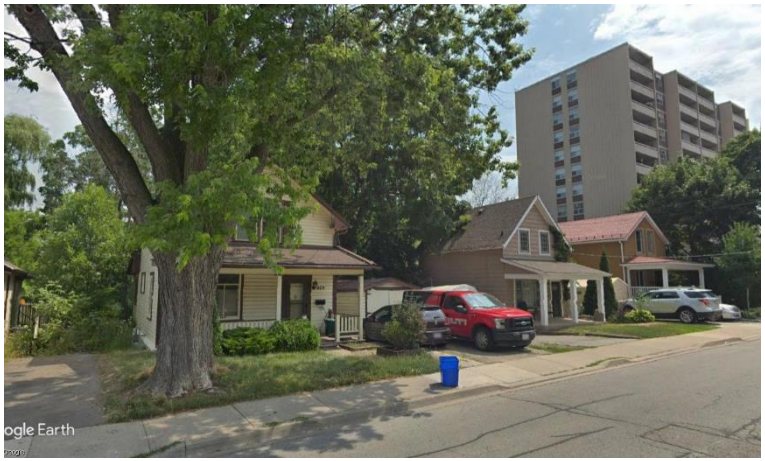


Figure 2a: Looking east at existing site



Figure 2b: Looking southwest along Pine Street



Figure 2c: Looking northeast at nearby retirement complex

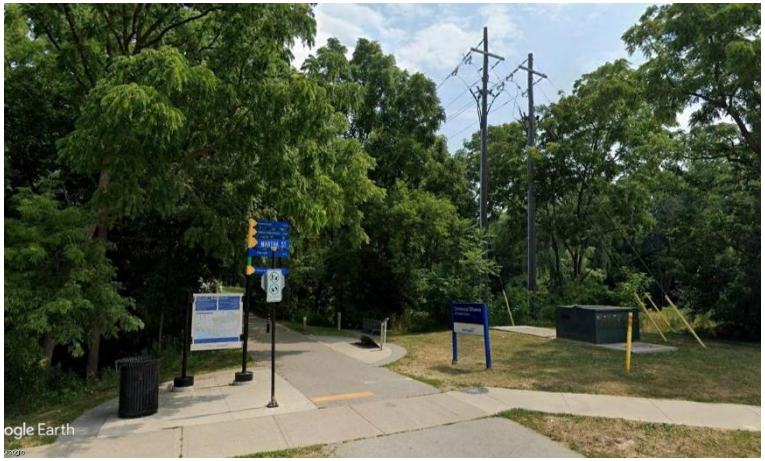


Figure 2d: Looking east at entrance to Waterfront Trail

1.2 Proposed Development

The proposed residential development is 11-storeys tall, plus a mechanical penthouse, for a total height of approximately 40 m. The building has a footprint of approximately 69 m by 30 m, with the long axis parallel to Martha Street. The main entrance is located in the middle of the west façade. There are also individual townhouse entrances and secondary entrance/exits along the west facade. On Level 5, there is an outdoor amenity terrace along the north edge of the building. Figure 3 shows a rendering of the proposed development.

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. The Waterfront Trail is immediately adjacent to the site.

Areas of interest for pedestrian wind conditions are identified on the site plan on Figure 4.



Figure 3: Rendering of proposed development

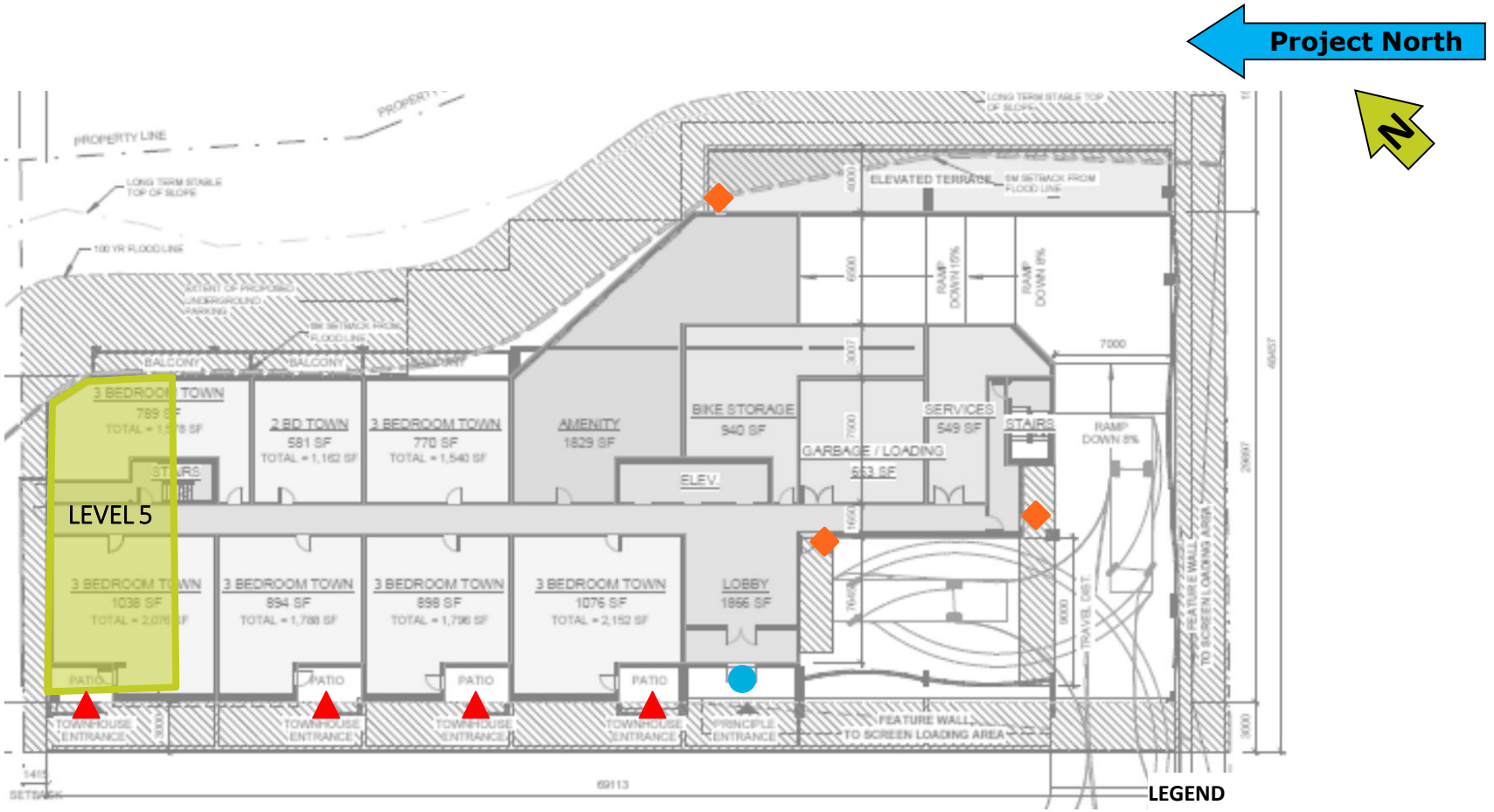


Figure 4: Areas of interest (Ground Floor Plan)

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 srm Architects Inc. on February 13 and March 4, 2020. A view of the 3D model used in the computer wind comfort analysis is shown in Figure 5. Note, the dark blue buildings in Figure 5 are future developments, included at the request of the City of Burlington. 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 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 seasonal extremes. 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 winds approaching from the southwest through west 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 building massing/alignment. 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 north-easterly and easterly directions. All wind speeds and directions were included in the wind climate model.

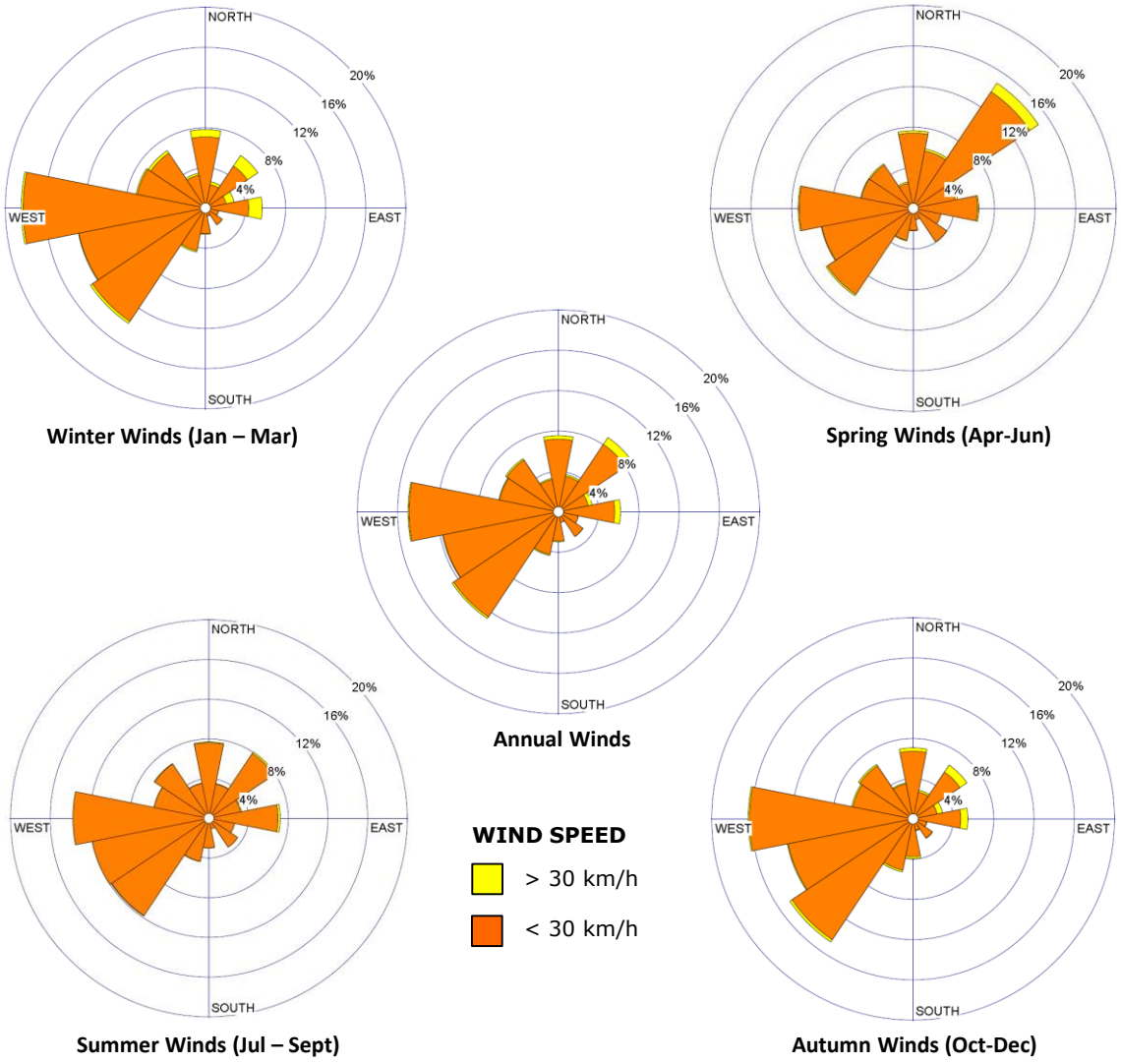


Figure 6: Wind Roses for Burlington Piers Station (1991-2015)

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. Generally, 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. For a list of references, describing the criteria and history of its development see Section 7.0.

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 10b 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. Appendix B presents the wind safety conditions on an annual basis.

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 parks **sitting** and/or **standing** would be appropriate in the summer.

4.1 Building Entrances & Walkways

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

In the Proposed Configuration, wind conditions surrounding the site are predicted to be comfortable for sitting or standing throughout the year (Figures 7b and 8b). At the main entrance, as well as the individual townhouse entrances and secondary entrance/exits on the west and east facades, wind conditions are anticipated to be comfortable for sitting throughout the year (Figures 9a and 9b).

Overall, these wind conditions are expected to be ideal for the intended usage.

4.2 Amenity Terraces (Podiums & Roofs)

On the Level 5 amenity terrace, wind conditions are generally expected to be comfortable for sitting, except along the southern edge of the space, where wind conditions are predicted to be comfortable for standing (Figure 10a). In the winter, wind conditions on the terrace are predicted to be comfortable for sitting or standing (Figure 10b). These wind conditions are considered ideal for an outdoor amenity space.

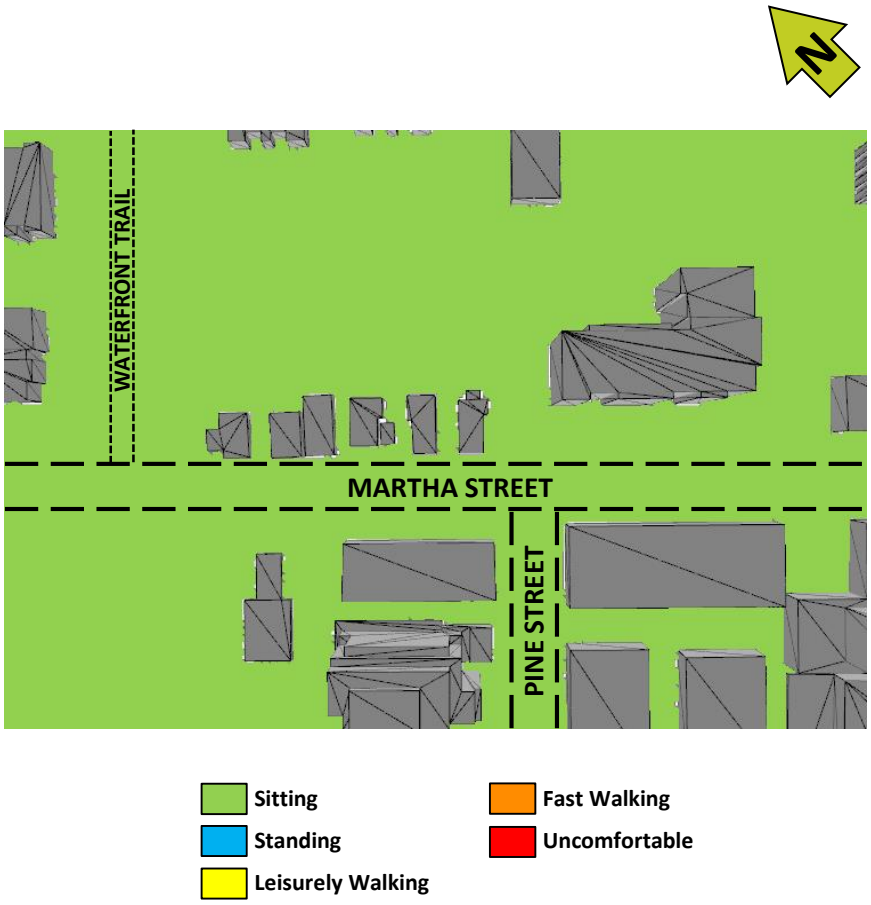


Figure 7a: Existing Configuration – Wind Comfort – Summer

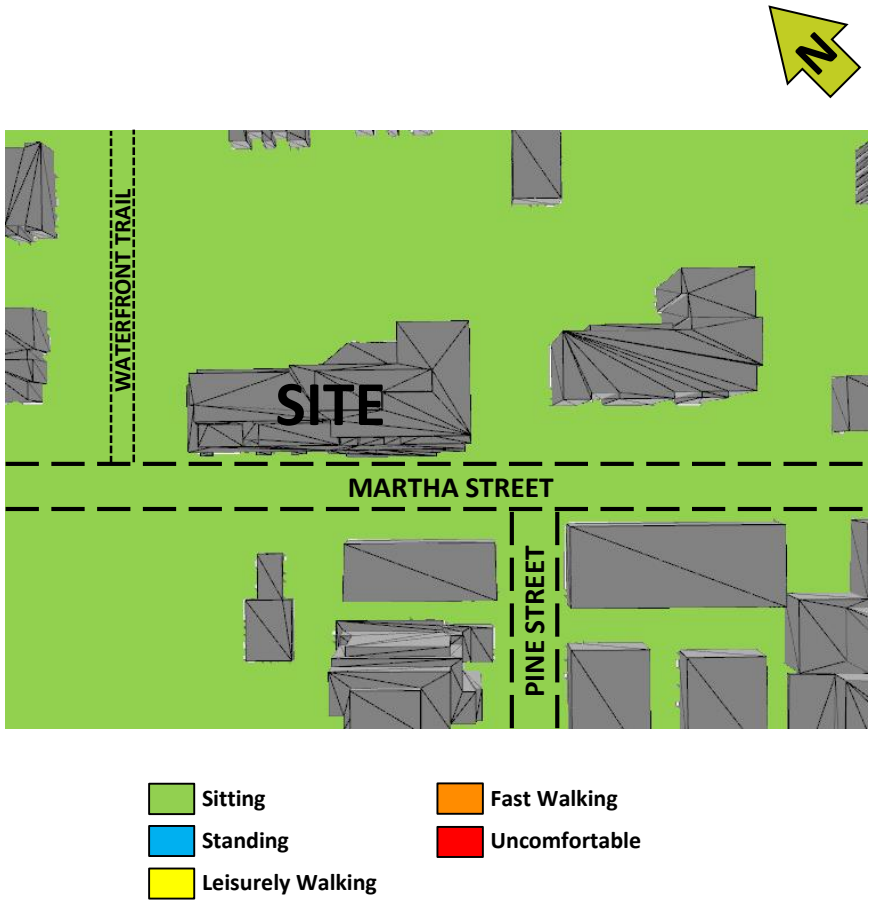


Figure 7b: Proposed Configuration – Wind Comfort – Summer

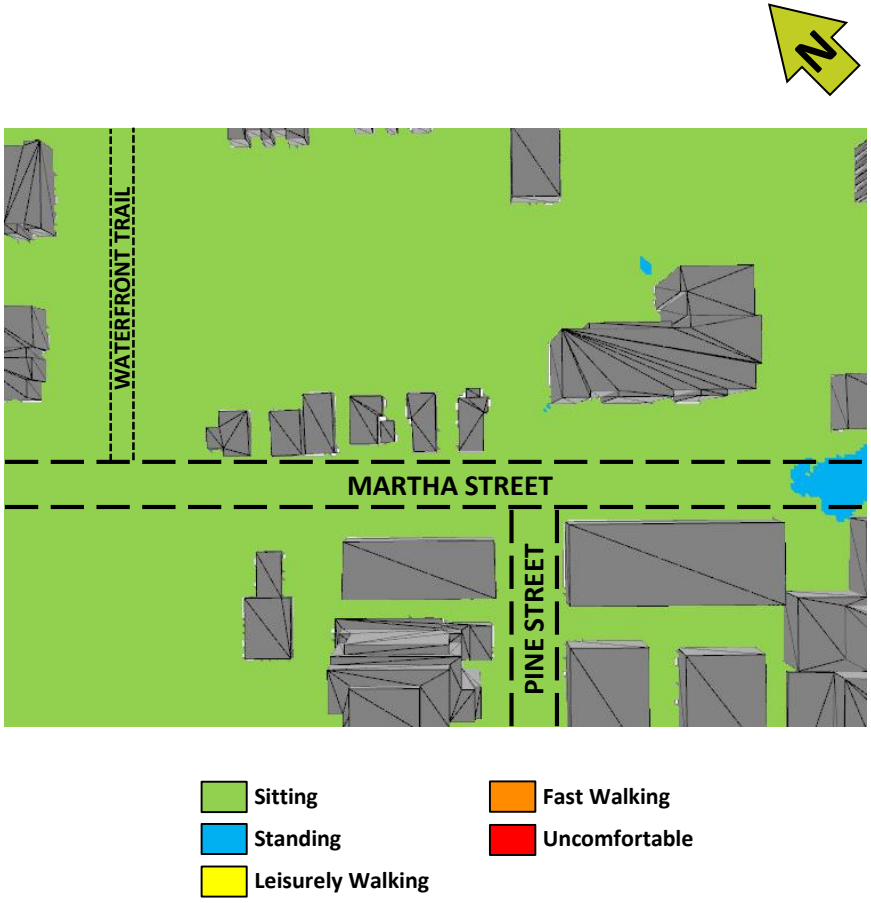


Figure 8a: Existing Configuration – Wind Comfort – Winter

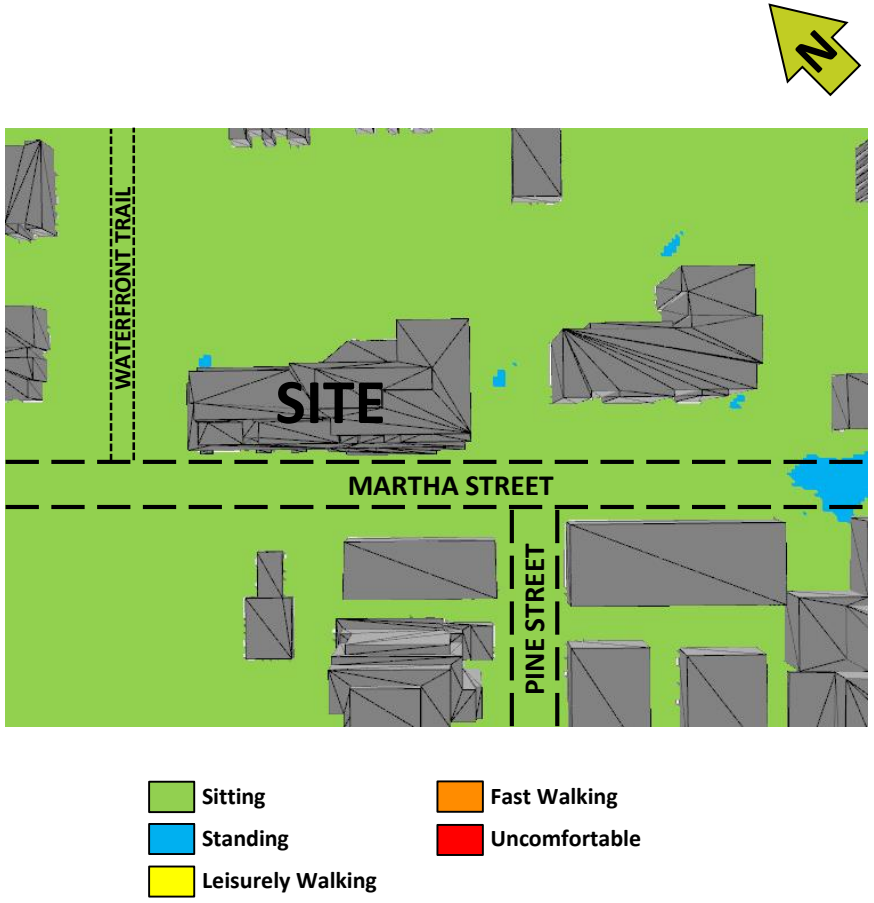


Figure 8b: Proposed Configuration – Wind Comfort – Winter

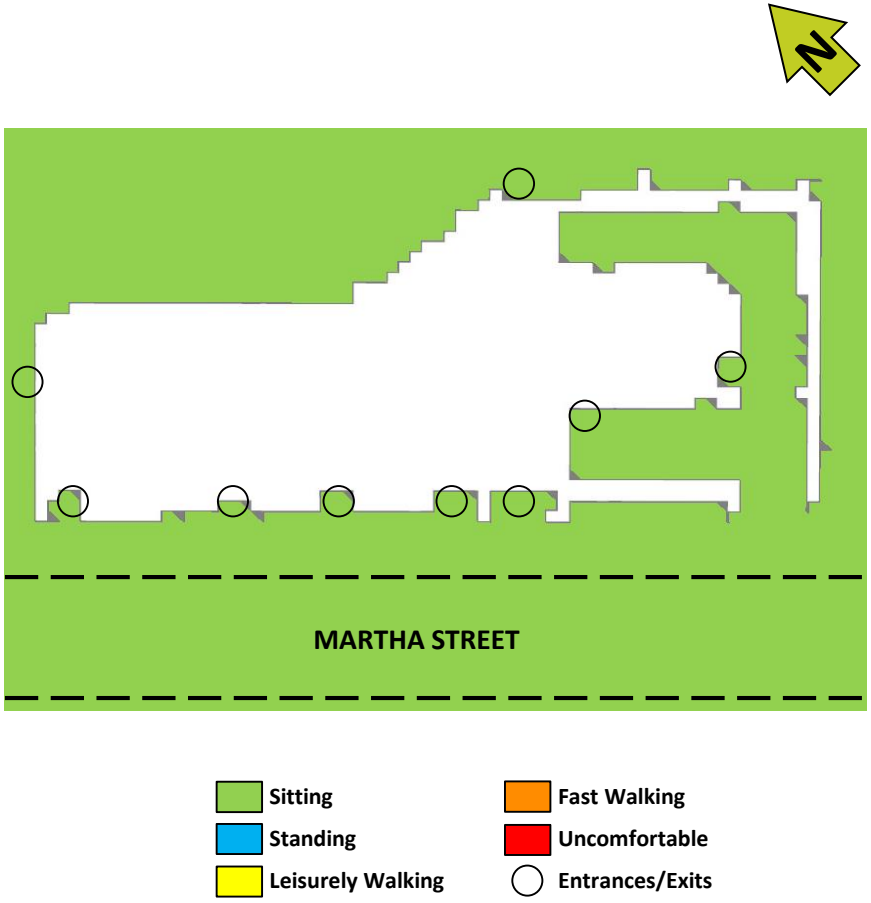


Figure 9a: Proposed Configuration – Wind Comfort – At Grade – Summer

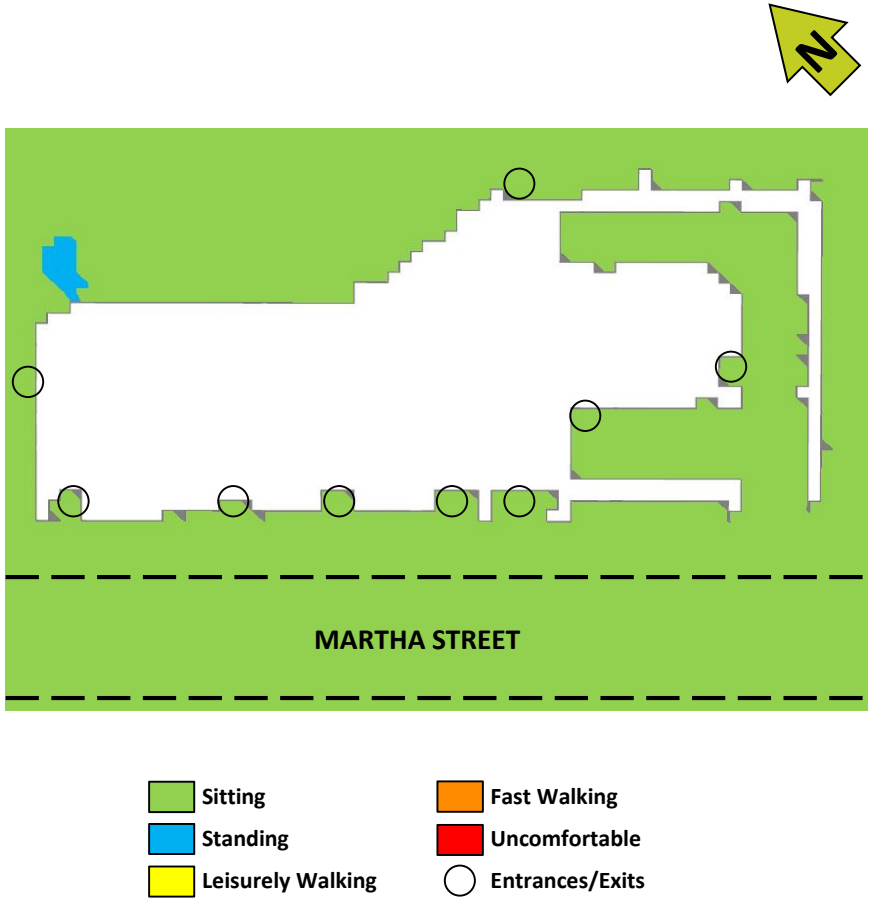


Figure 9b: Proposed Configuration – Wind Comfort – At Grade – Winter

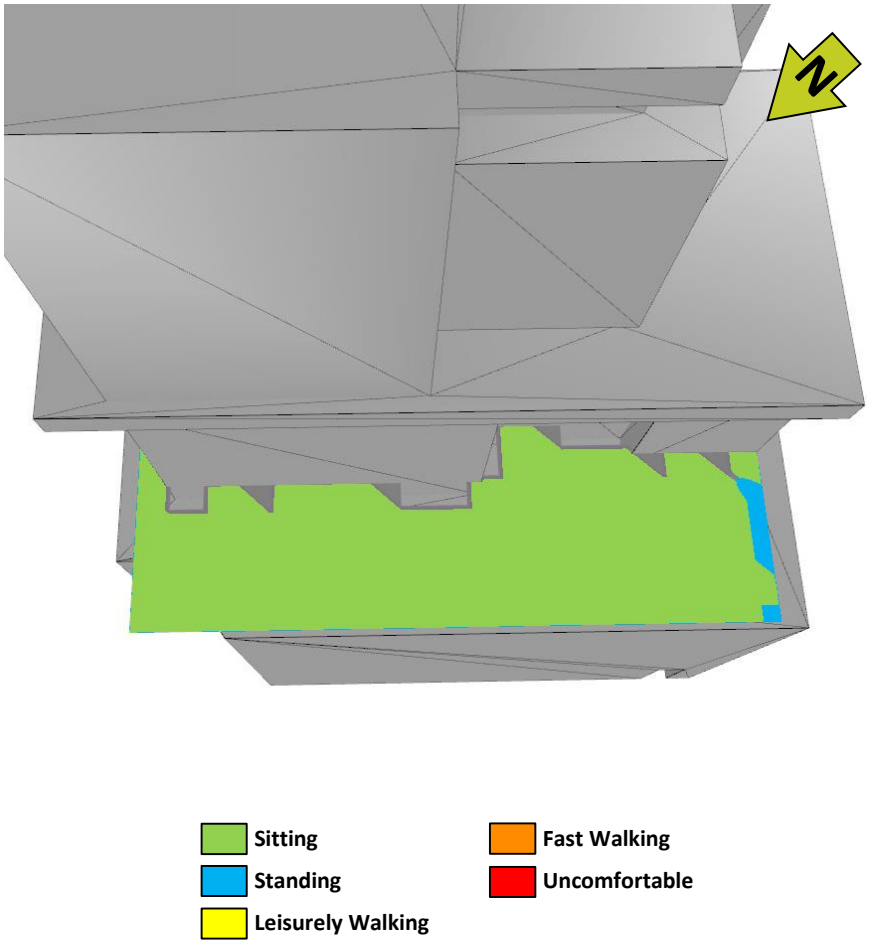


Figure 10a: Proposed Configuration – Wind Comfort – Amenity Terrace – Summer

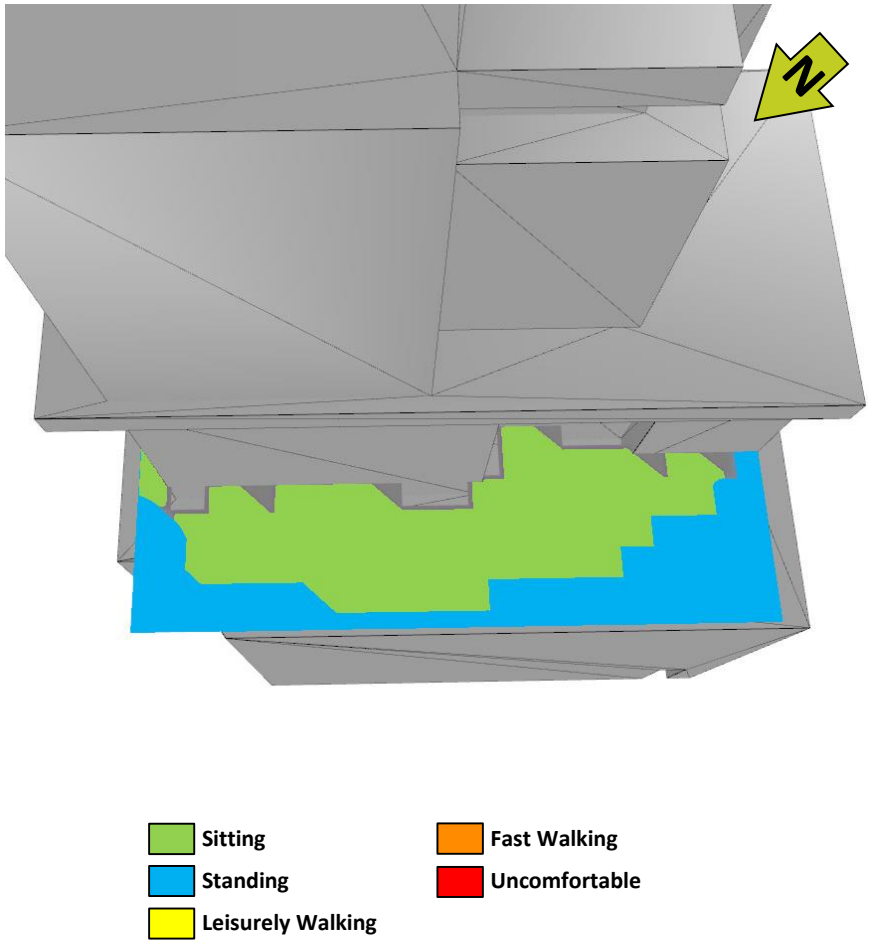


Figure 10b: Proposed Configuration – Wind Comfort – Amenity Terrace – Winter

4.3 Surrounding Sidewalks

On the sidewalks surrounding the proposed development, including Martha Street and Pine Street, wind conditions are expected to be comfortable for sitting or standing throughout the year (Figures 7a and 8a). On the waterfront trail to the north of the proposed site, wind conditions are anticipated to be comfortable for sitting throughout the year.

In the Proposed Configuration, wind conditions on the surrounding sidewalks are expected to remain comfortable for sitting or standing throughout the year (Figures 7b and 8b). On the waterfront trail, wind conditions are predicted to remain comfortable for sitting throughout the year.

These wind conditions are considered ideal for the intended usage.

4.4 Wind Safety

The wind safety criterion is predicted to be met in an all areas in both the Existing and Proposed Configurations (Appendix B).

5.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 401-407 Martha Street have been assessed through computational fluid dynamics modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is met in all areas in both the Existing and Proposed Configuration.
- Wind conditions at all of the building entrances are suitable for the intended usage throughout the year.
- On the Level 5 amenity terrace, wind conditions are suitable for the intended usage throughout the year.
- On the surrounding sidewalks, wind conditions are similar between the Existing and Proposed Configurations, and are considered ideal 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.



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Specialist – Microclimate



Jenny Graham, P. Eng.
Senior Engineer

7.0 REFERENCES

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Appendix A

Pedestrian Wind Comfort Analysis

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

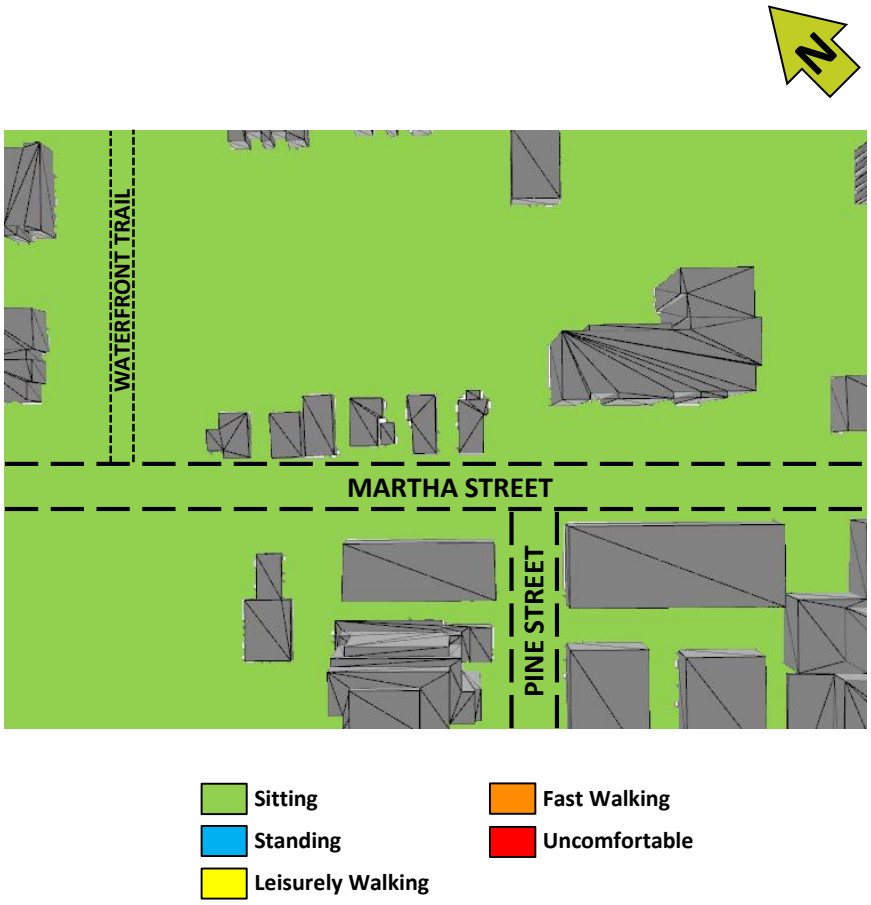


Figure A1a: Existing Configuration – Wind Comfort – Spring

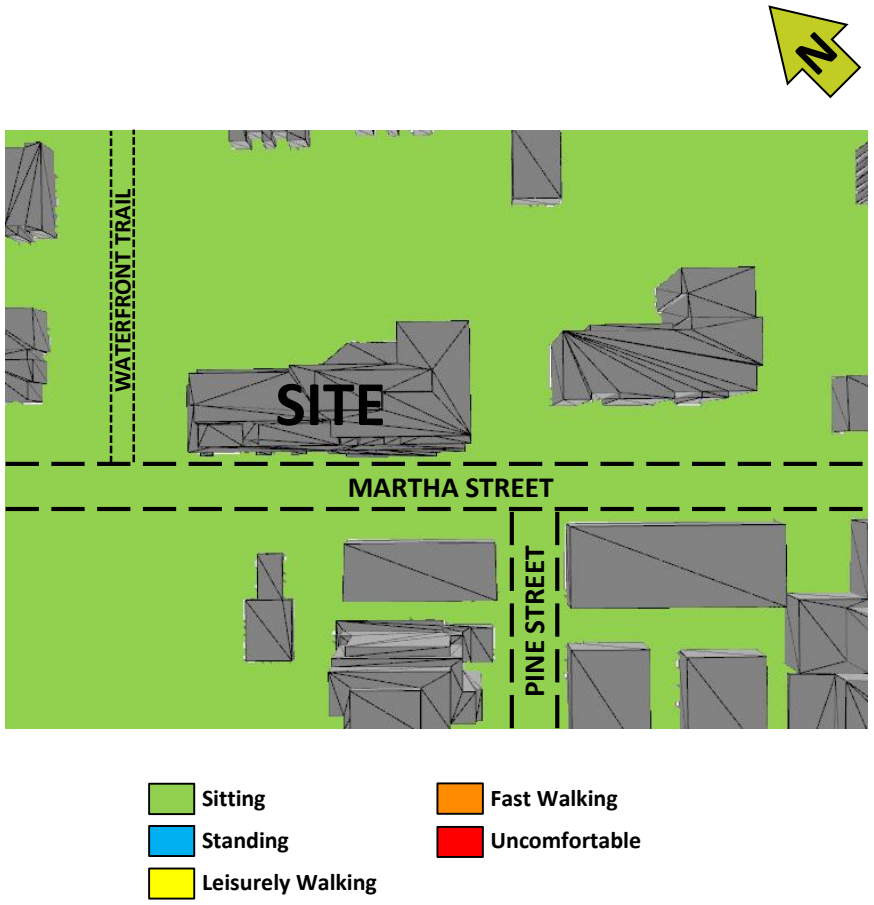


Figure A1b: Proposed Configuration – Wind Comfort – Spring

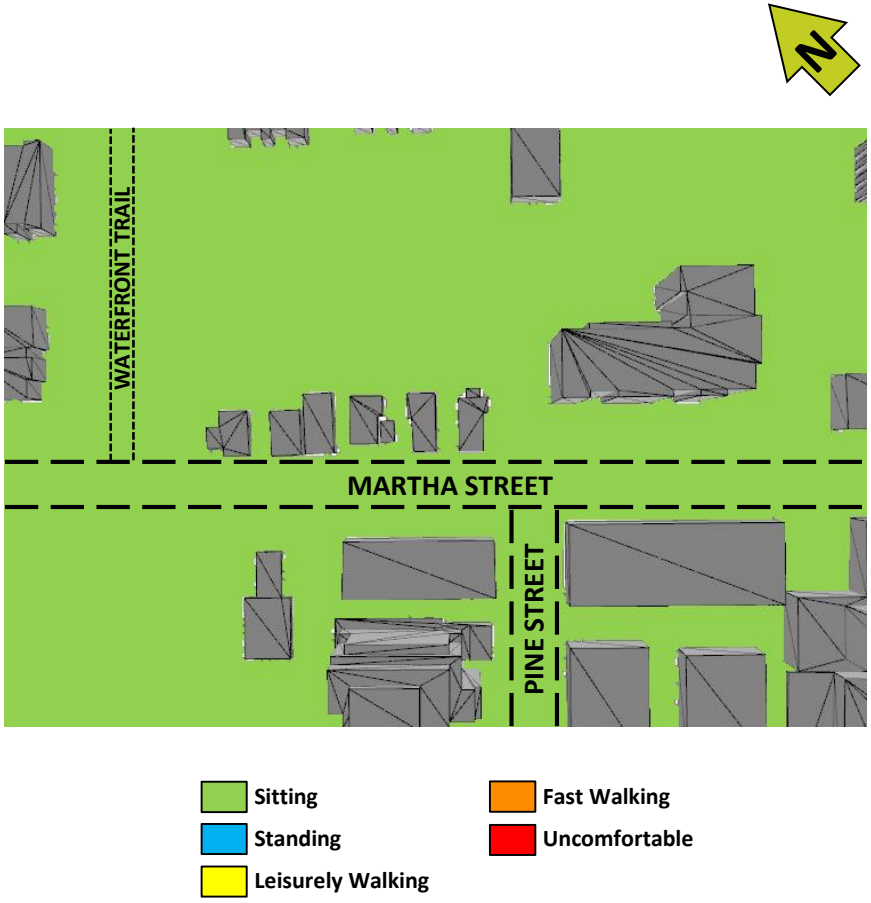


Figure A2a: Existing Configuration – Wind Comfort – Autumn

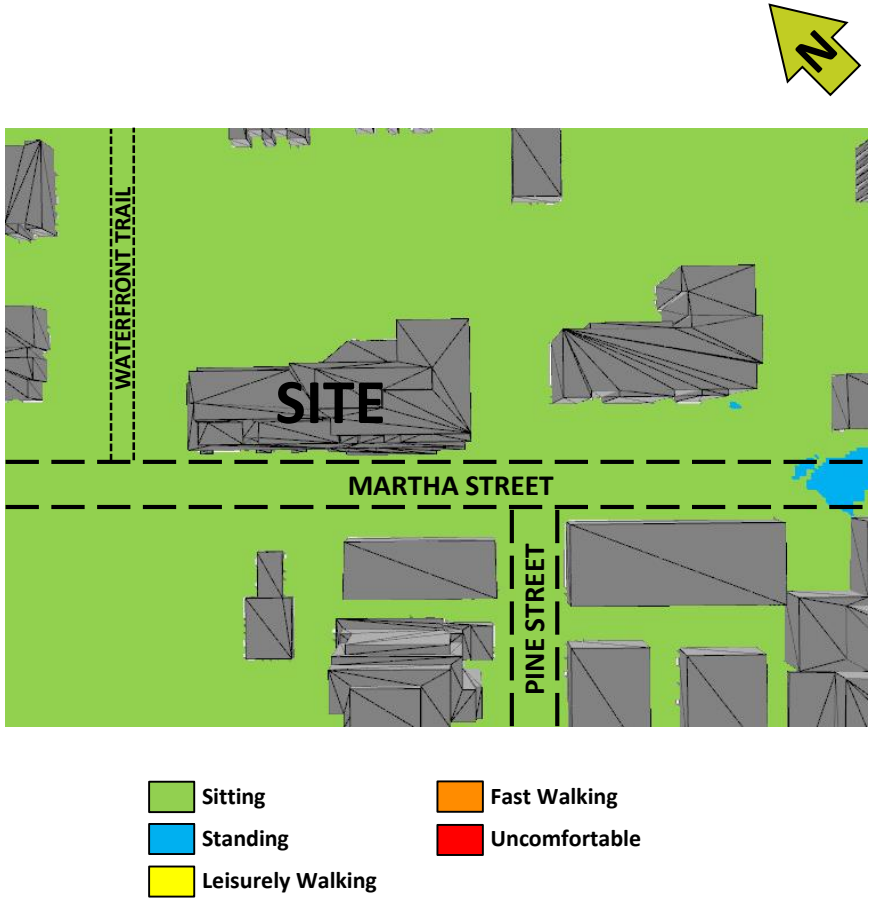


Figure A2b: Proposed Configuration – Wind Comfort – Autumn

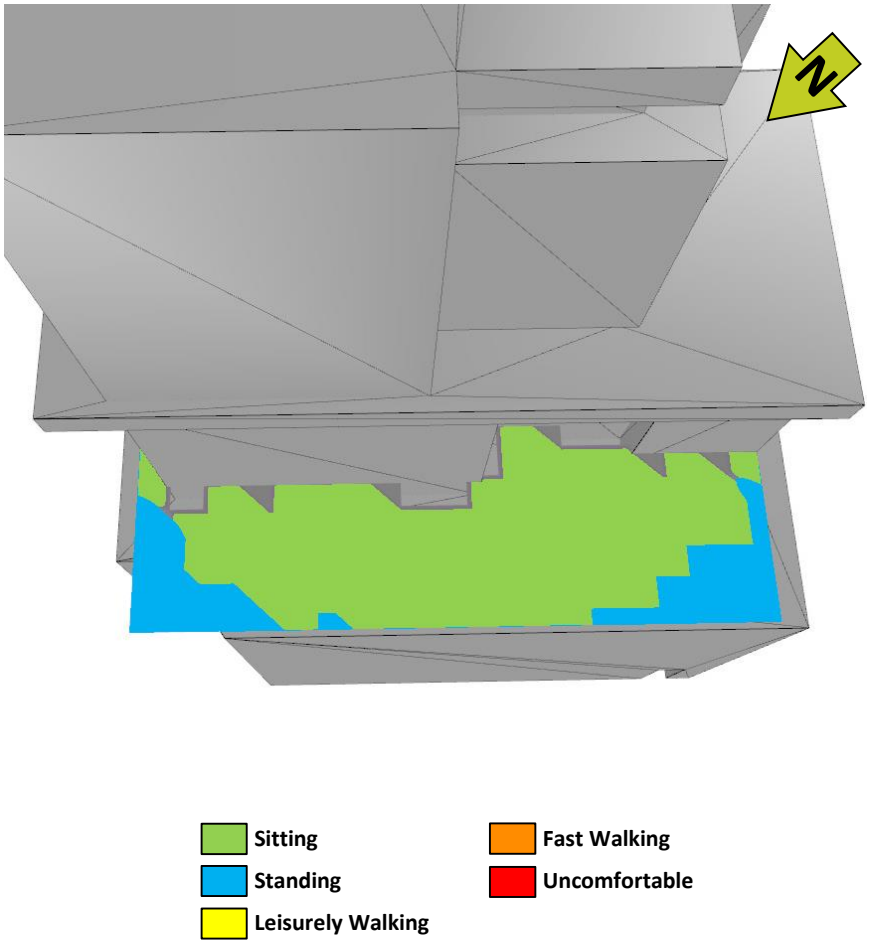


Figure A2a: Proposed Configuration – Wind Comfort – Amenity Terraces – Spring

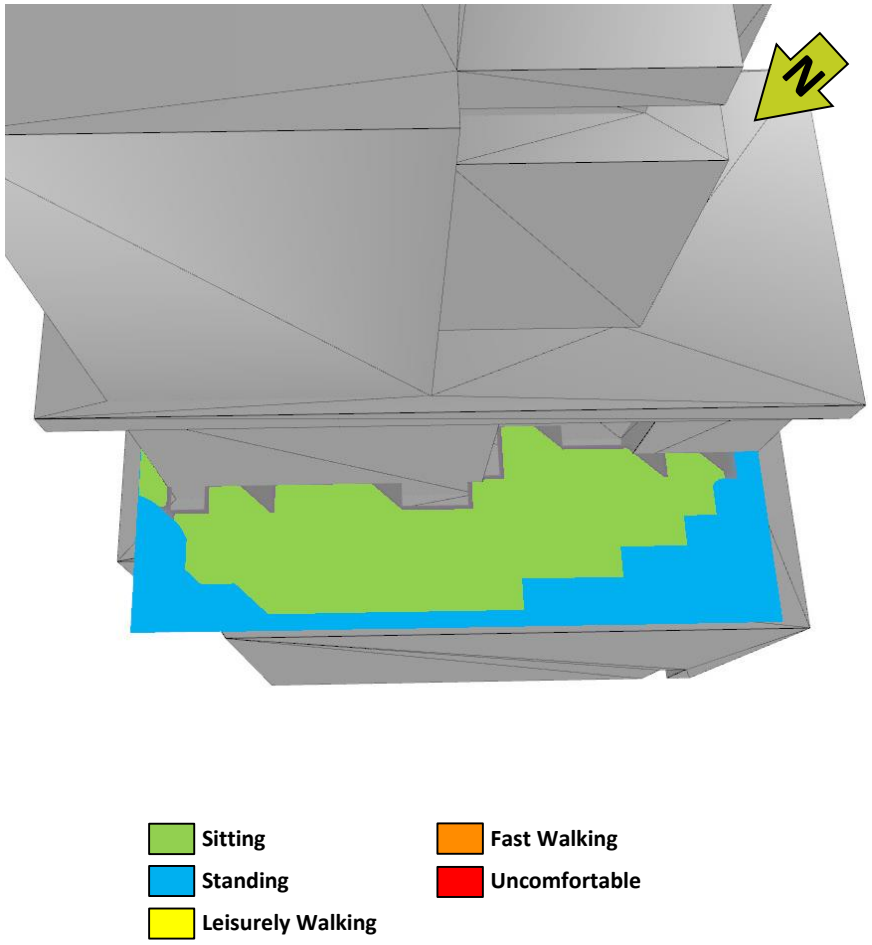


Figure 10b: Proposed Configuration – Wind Comfort – Amenity Terraces – Autumn

Appendix B

Pedestrian Wind Safety Analysis

Annual

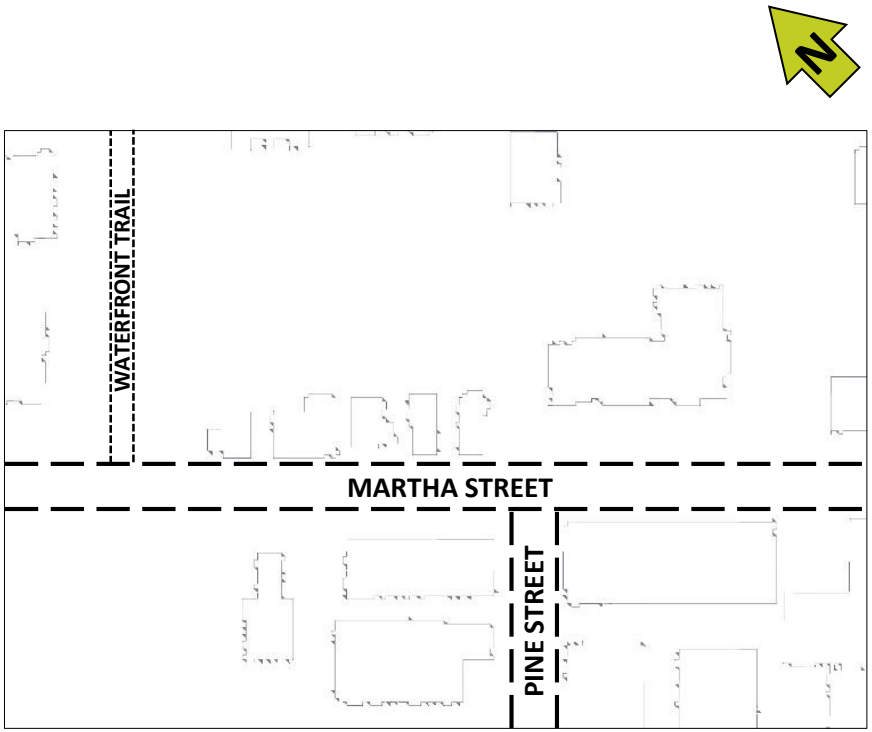


Figure B1a: Existing Configuration – Safety – Annual



Figure B1b: Proposed Configuration – Safety – Annual

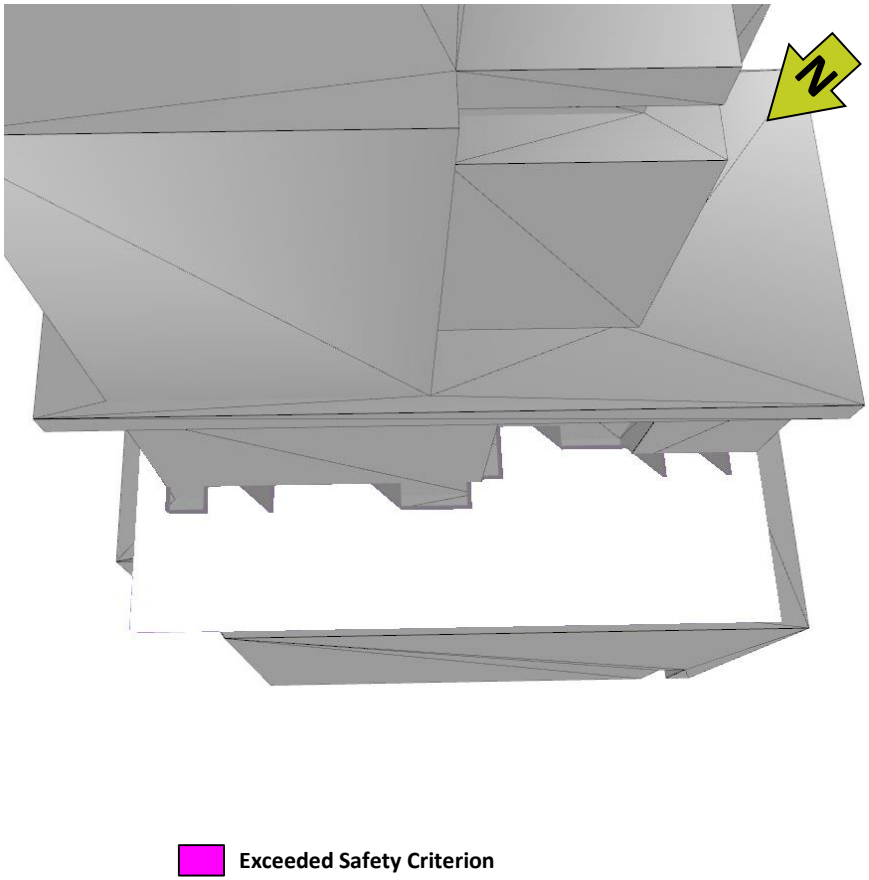


Figure B2: Proposed Configuration – Amenity Terrace – Safety – Annual