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Date: September 18, 2019

To: Urban Capital Property Group
17 Nelson Street
Toronto, ON M5V 0G2

Re: **Pedestrian Wind Assessment**
390 Bank Street
Ottawa
Novus Project #19-0172

Credit: Raw Architects

Team:

Senior Engineer:	Jenny Vesely, P. Eng.
Specialist:	Tahrana Lovlin, MAES, P.Eng.

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1.0 INTRODUCTION

Novus Environmental Inc., now a part of SLR Consulting (Canada) Ltd. (NovusSLR) was retained by Urban Capital Property Group to conduct a pedestrian wind assessment for the proposed development at 390 Bank Street in Ottawa, Ontario. This report is in support of the Zoning Bylaw Amendment (ZBA) application for the development.

1.1 Existing Development

The proposed development is located on the west side of Bank Street, between James Street and Florence Street. The site is currently occupied by low rise commercial buildings and an outdoor patio. **Figure 1** provides an aerial view of the immediate study area. A virtual site visit was conducted by Novus using Google Earth images dated July, 2018 and images are included in **Figures 2a** through **2d**.

Immediately surrounding the site are low-rise commercial buildings in all directions. Beyond the immediate surroundings is a mix of low-rise commercial and residential buildings and mid-rise residential buildings.

Approved developments and developments under construction in the surrounding area were also included as existing surroundings for the analysis. For this assessment approved developments included: 425-443 Kent Street, 488 & 500 Bank Street, 235-320 Bank Street, 412 Lisgar Street, 517 Gladstone Avenue and 506 Gladstone Avenue.

Figure 1: Aerial view of existing site & surroundings

Credit: Google Earth Pro, dated 6/8/2018

Figure 2a: Existing Site, Looking South

Figure 2b: Bank Street, Looking Southeast

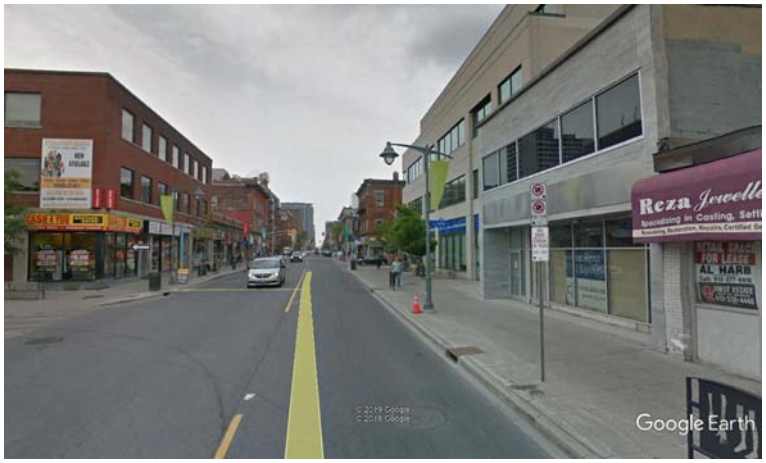

Figure 2c: Bank Street, Looking Northwest

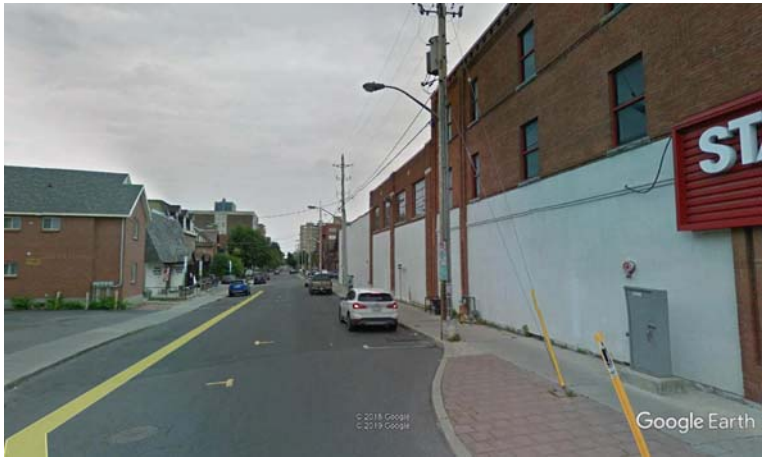

Figure 2d: Waverley Street, looking East

1.2 Proposed Development

The proposed development is nine-storeys tall (approximately 30 m), plus a mechanical penthouse (approximately 6.5 m tall) for a total height of approximately 37 m. The building will include retail space at grade with residential units above. The building footprint is approximately 49 m by 32 m with the long axis parallel to Bank Street. There are retail entrances along Bank Street, with the main residential entrance located on James Street. There is outdoor amenity space at grade level and on the building rooftop. A rendering of the proposed development is shown in **Figure 3**.

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, outdoor amenity spaces, transit stops, plazas and parks. There are nearby transit stops on the east side of Bank Street. The areas of interest for this development are identified on **Figure 4**.

Figure 3: Rendering of Proposed Development

Credit: Raw Design

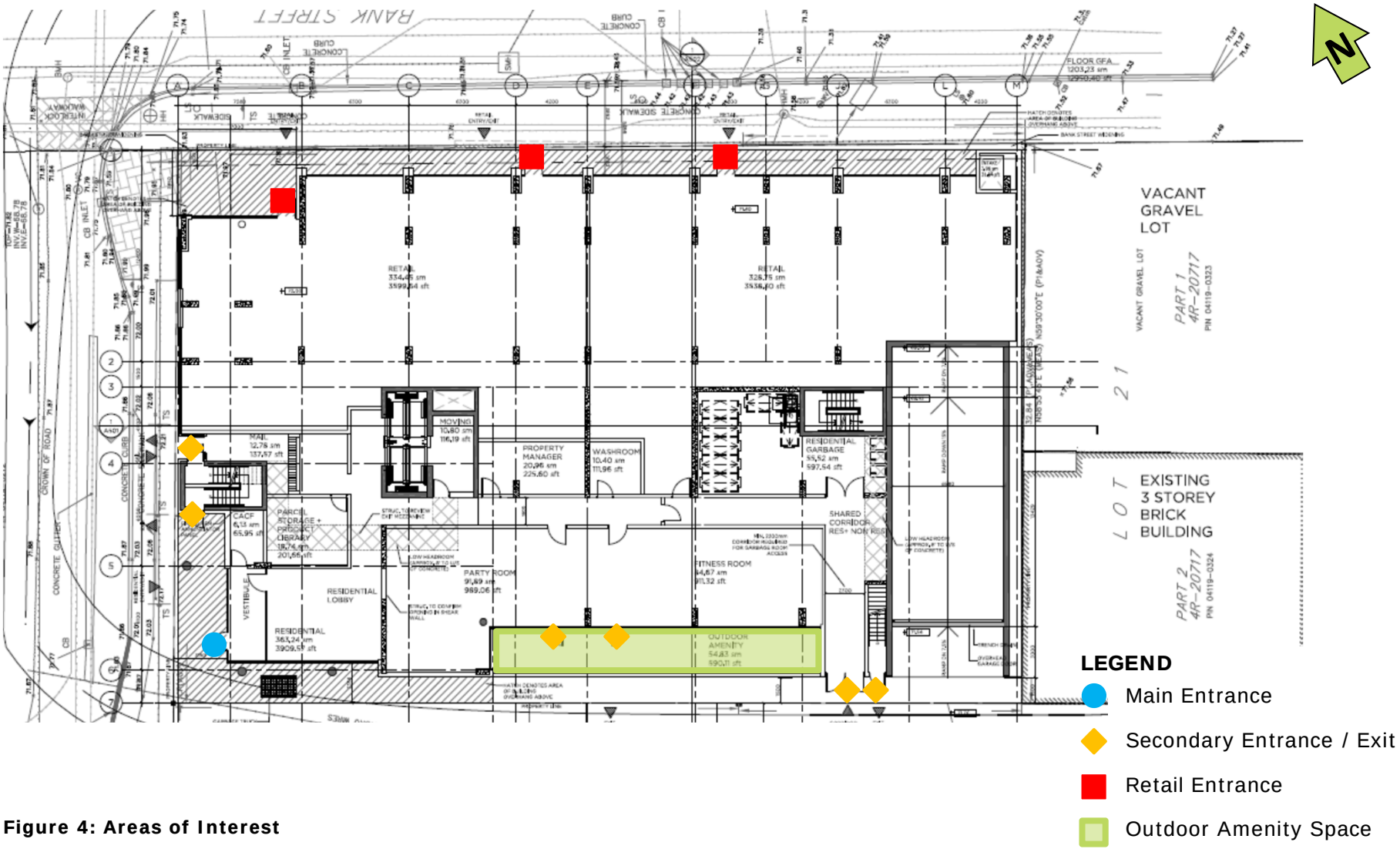

Figure 4: Areas of Interest

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 Raw Architects on June 21, 2019. 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 four seasons: Winter (December-February), Spring (March - May), Summer (June - August), and Autumn (September - November). 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 Ottawa International Airport 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 south through west and northwesterly 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 northwesterly and westerly sectors. All wind speeds and directions were included in the wind climate model.

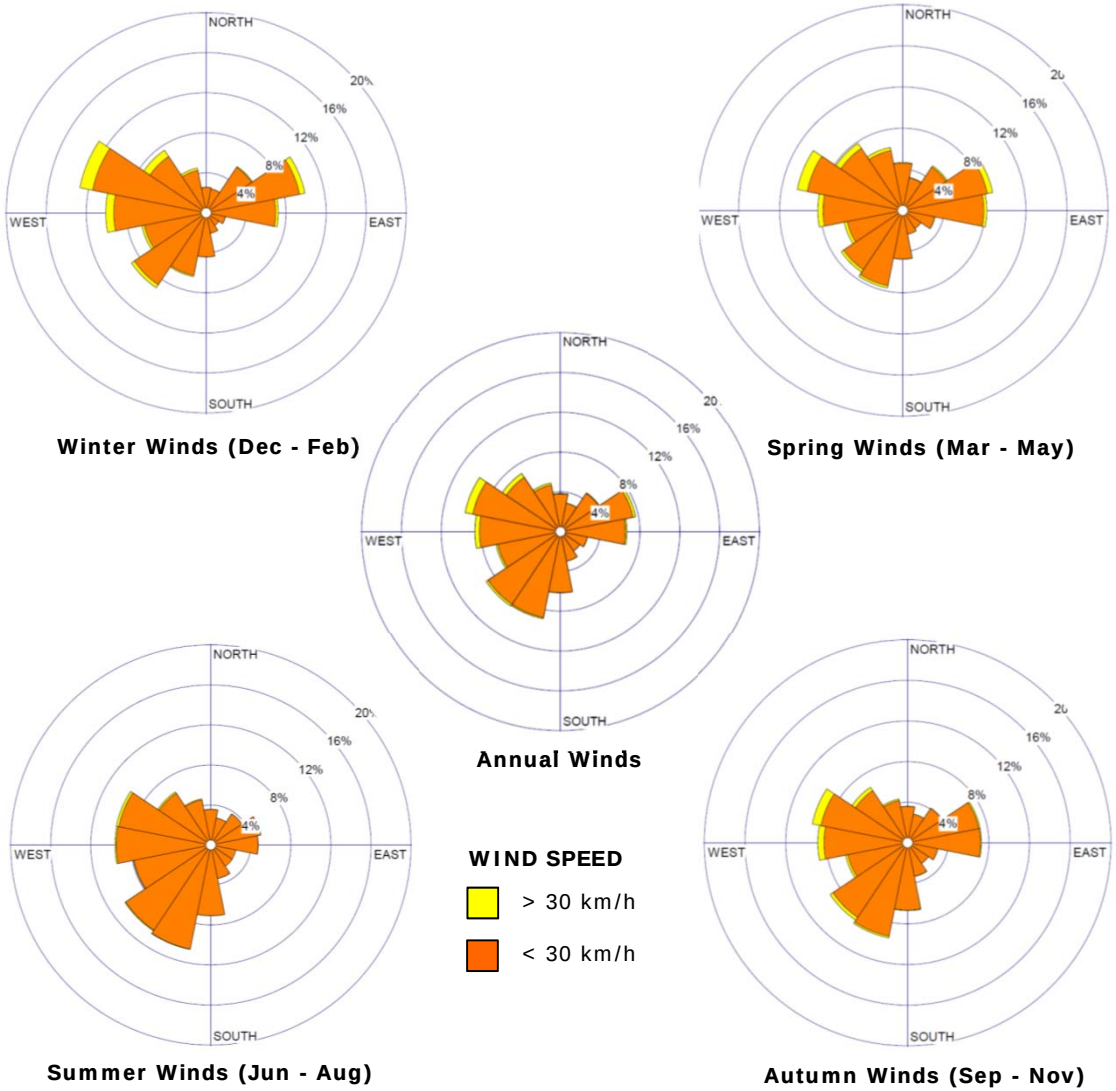

Figure 6: Wind Roses for Ottawa International Airport (1986-2015)

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 criteria utilized for this analysis is provided by the City of Ottawa, in the document *Terms of Reference –Wind Analysis*. 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) assuming a 24 hour day. 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 Mean Wind Speed Exceeded 20% of the Time		Description of Wind Effects
Sitting	0 to 10 km/h	0 to 3 m/s	• Light wind felt on face • Leaves rustle
Standing	0 to 14 km/h	0 to 4 m/s	• Hair is disturbed, clothing flaps • Light leaves and twigs in motion • Wind extends lightweight flag
Strolling	0 to 17 km/h	0 to 5 m/s	• Moderate, raises dust, loose paper • Hair disarranged • Small branches move
Walking	0 to 20 km/h	0 to 6 m/s	• Force of wind felt on body • Trees in leaf begin to move • Limit of agreeable wind on land
Uncomfortable	> 20 km/h	> 6 m/s	• Small trees sway • Umbrella use becomes difficult

Table 2: Wind Safety Criterion

Activity	Safety Criterion Mean Wind Speed Exceeded Once Per Year (0.1%)		Description of Wind Effects
Any [1]	90 km/h	25 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. **Appendix C** presents vertical slices to show wind flow over the building, on a vertical plane.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. For example, for public sidewalks, wind comfort suitable for **strolling** or **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.

4.1 Existing Wind Conditions

In the Existing Configuration, wind conditions on the proposed site are comfortable for sitting or standing throughout the year (**Figures 7a** and **8a**). On the streets surrounding the proposed development, including Bank Street, James Street, Waverley Street, Florence Street, Frank Street and Gladstone Avenue, existing wind conditions are generally suitable for strolling or better through the year. The exception is at the intersection of Bank Street and Gladstone Avenue, where wind conditions are comfortable for walking during the winter.

4.2 Building Entrances & Walkways

The main residential entrance for the building is located at the northwest corner, on James Street. Wind conditions here are comfortable for standing/strolling in the summer and walking in the winter (**Figures 9a** and **9b**). We recommend relocating this entrance as close to Gridline 5 as possible, well away from the accelerated wind flows that occur at the building corner. In this alternative location, wind conditions are comfortable for sitting or standing throughout the year and better suited for a main entrance.

At the retail entrances along Bank Street, wind conditions are comfortable for sitting or standing throughout the year. Similar wind conditions occur at the various secondary entrances on the west and north building facades. These wind conditions are considered suitable for entrances.

In the grade-level amenity space on the west side of the building, wind conditions are suitable for sitting throughout the year (**Figures 9a** and **9b**). These wind conditions are considered ideal for an outdoor amenity space.

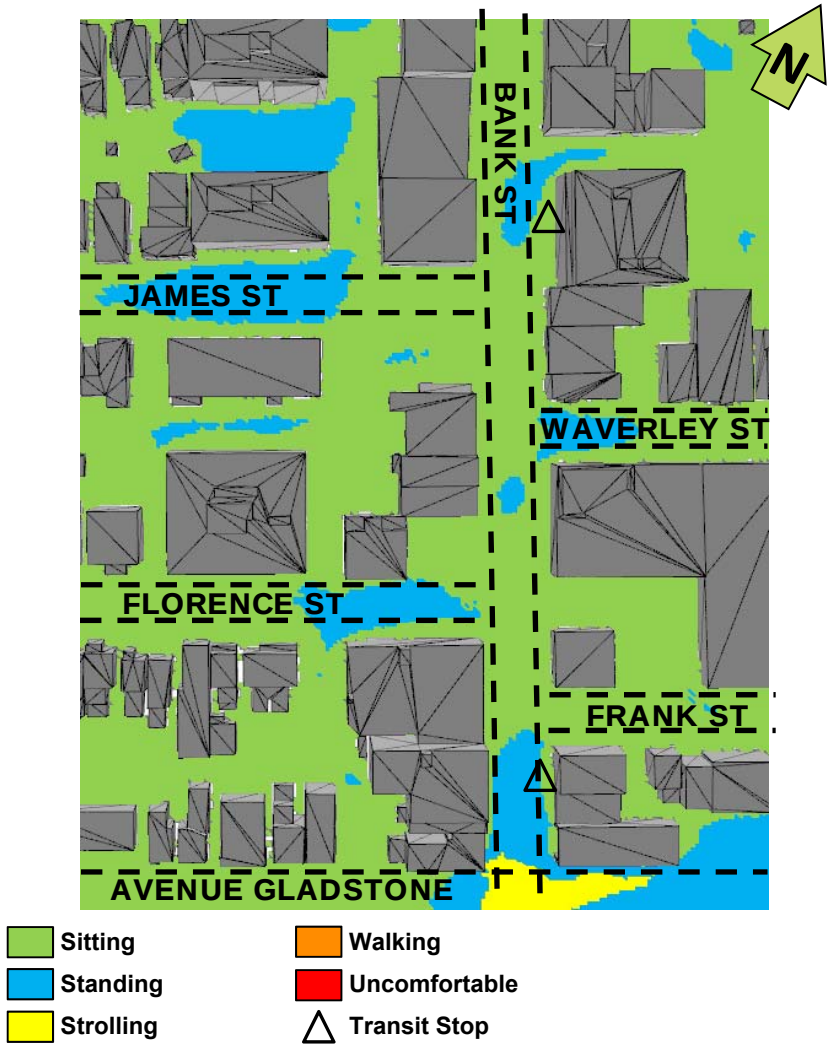

Figure 7a: Existing Conditions – Grade Level – Summer

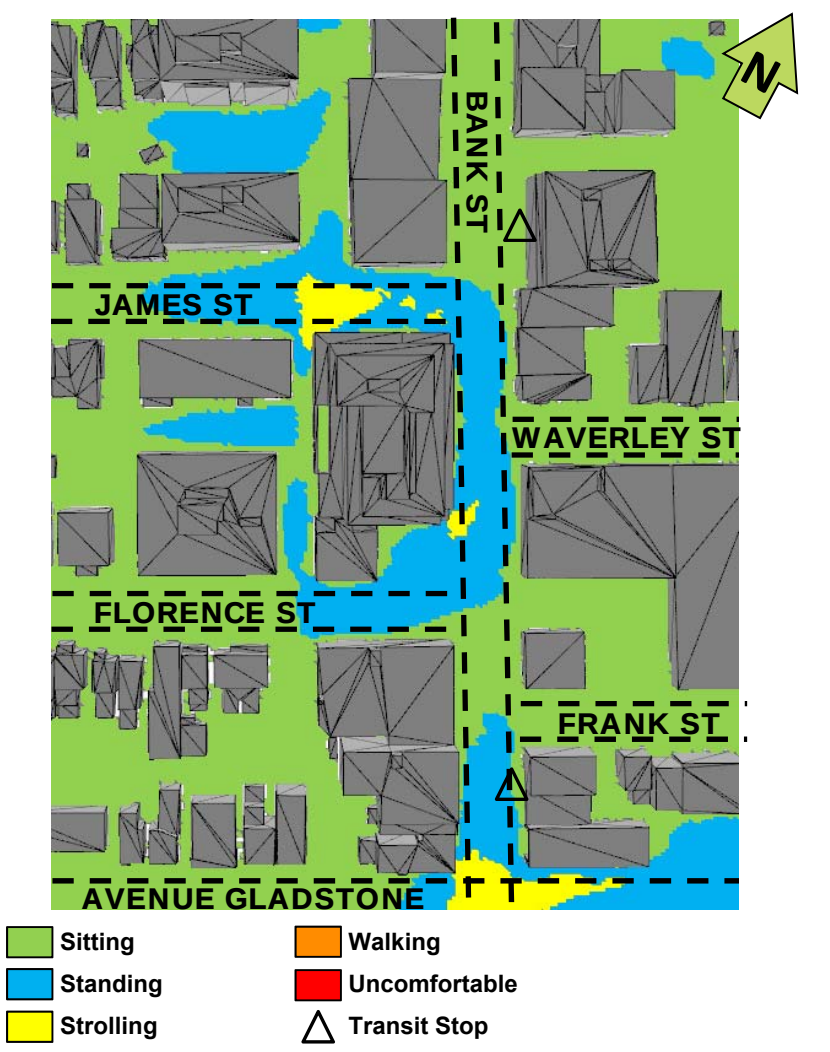

Figure 7b: Proposed Conditions – Grade Level – Summer

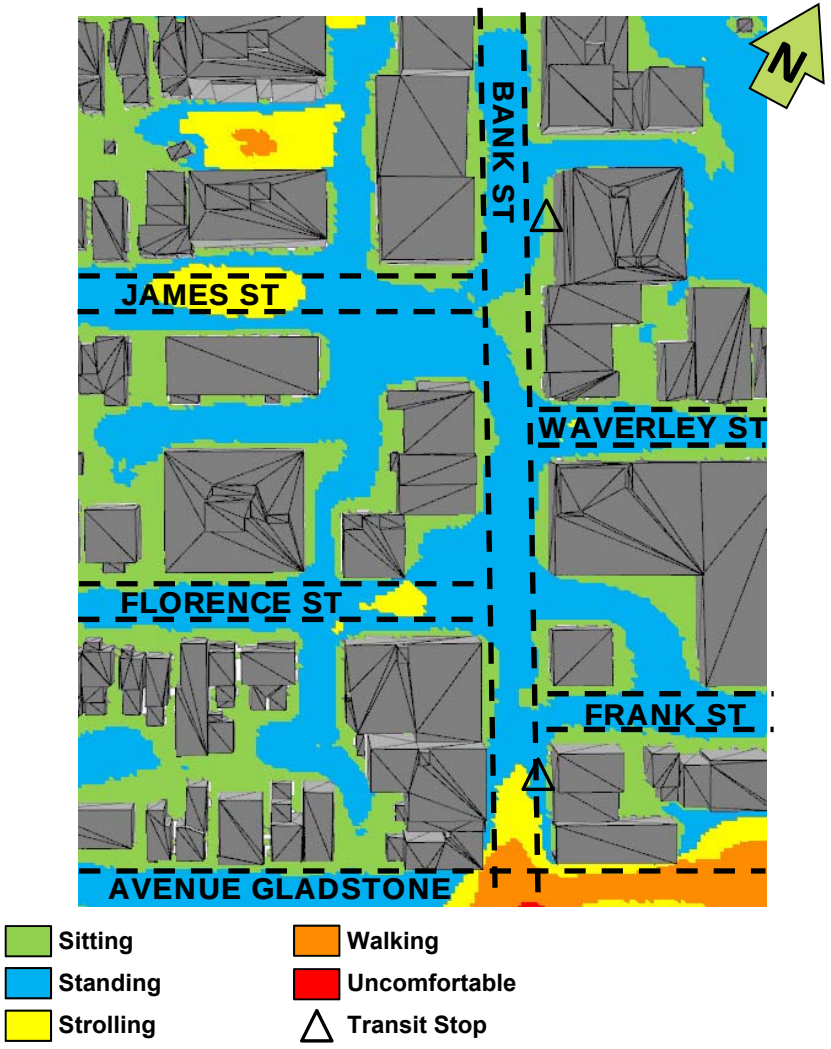

Figure 8a: Existing Conditions – Grade Level – Winter

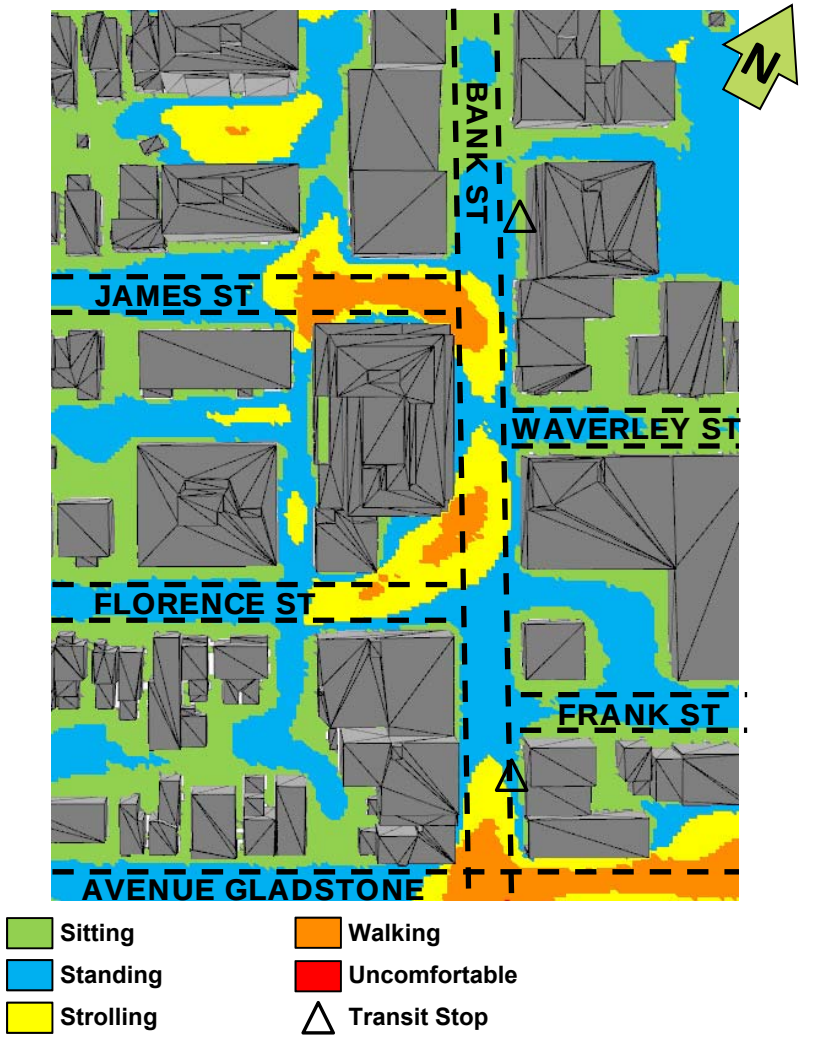

Figure 8b: Proposed Conditions – Grade Level – Winter

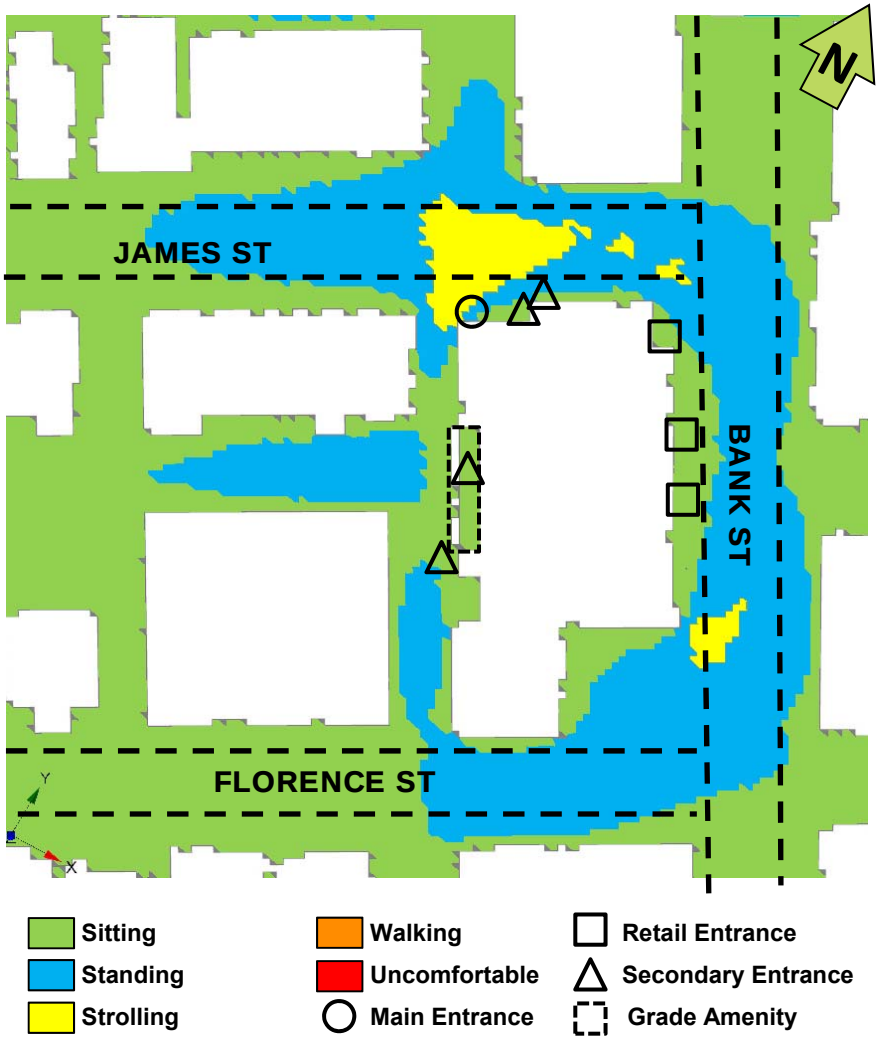

Figure 9a: Proposed Conditions – Grade – Summer

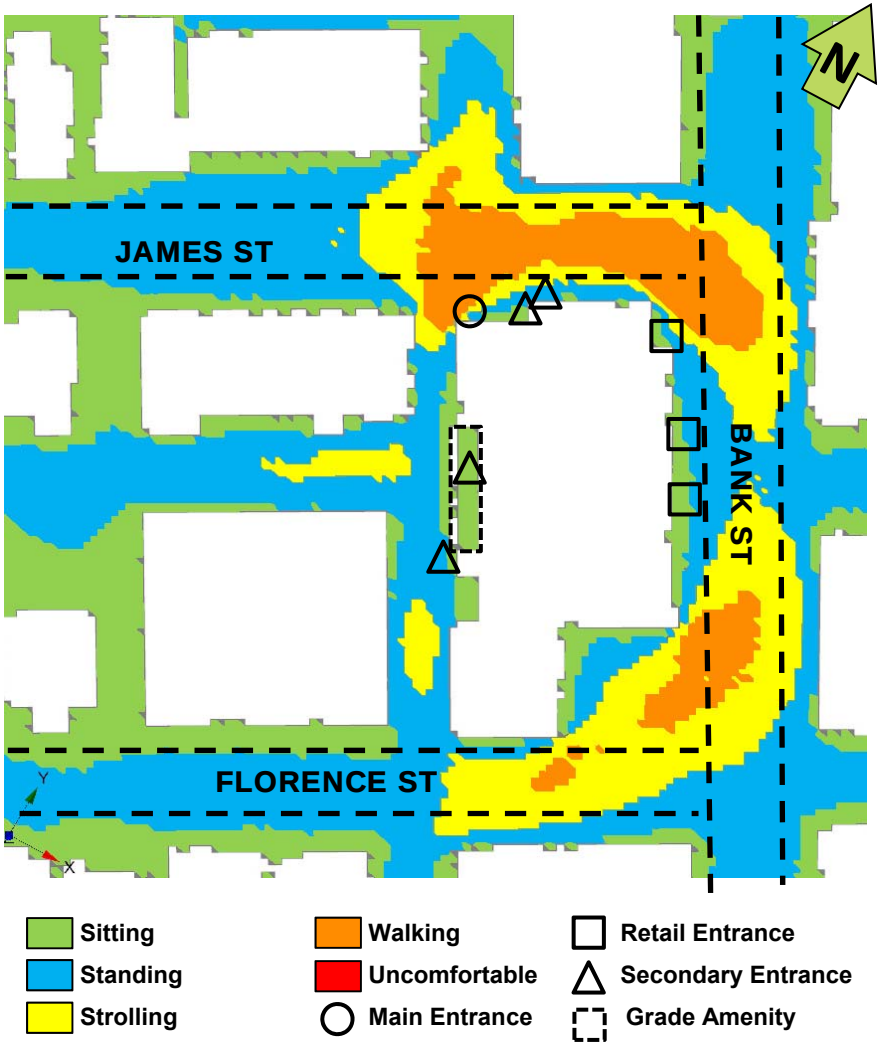

Figure 9b: Proposed Conditions – Grade – Winter

Around the proposed building, wind conditions on the nearby sidewalks of James Street and Bank Street are mainly comfortable for strolling or better throughout the year (**Figures 8b** and **9b**). Near the northwest, northeast and southeast corners of the building, wind conditions on the sidewalk are comfortable for walking.

4.3 Rooftop Amenity Terrace

Wind conditions on the rooftop terrace during the summer range from being comfortable for standing near the north and east roof edge, to uncomfortable along the west side of the terrace (**Figure 10a**). During the winter season, wind conditions are mainly considered uncomfortable on the rooftop terrace (**Figure 10b**).

To improve wind conditions on the terrace, we recommend that strategically placed wind screening features be considered. This may include, for example, placing a vertical wind screen along the west edge of the terrace. Such a wind screen should be approximately 2.5m tall and be 50-70% solid. Wind screening elements, such as landscape planters with tall shrubs, for example, or perhaps additional vertical screening, could also be used on the terrace to locally shelter areas where enhanced wind comfort is required.

4.4 Nearby Streets

On the surrounding sidewalks, including Bank Street, James Street, Waverley Street, Florence Street, Frank Street and Gladstone Avenue, wind conditions remain generally suitable for strolling or better throughout the year (**Figures 7b** and **8b**). The exception is at the intersection of Bank Street and Gladstone Avenue, where wind conditions are suitable for walking in the winter and are unaffected by the proposed development.

4.5 Wind Safety

The wind safety criterion is met in all locations in both the Existing and Proposed Configurations, including on the rooftop amenity terrace (**Appendix B**).

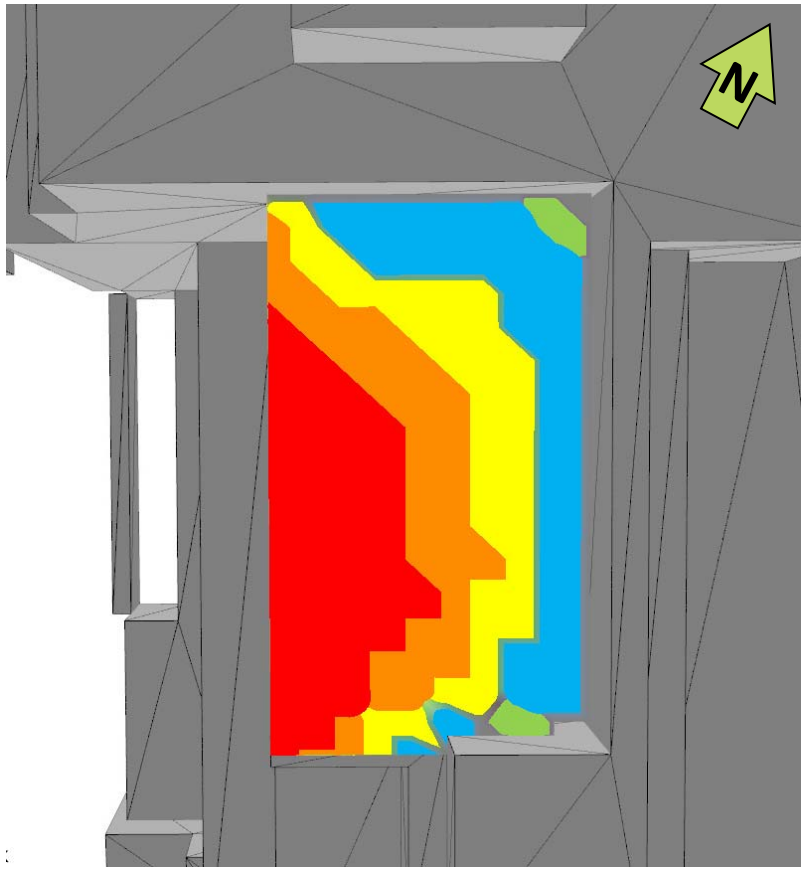

Figure 10a: Proposed Conditions – Rooftop Amenity – Summer

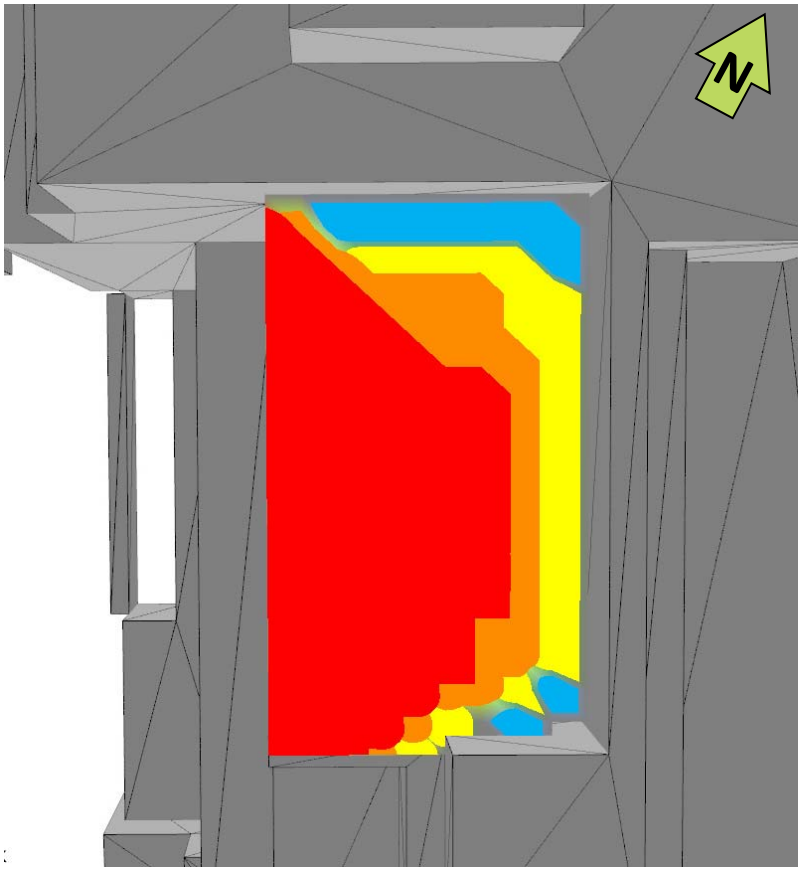

Figure 10b: Proposed Conditions – Rooftop Amenity – Winter

5.0 UPDATED ARCHITECTURAL INFORMATION

NovusSLR received updated architectural information (dated August 17, 2019) on September 12, 2019. This information showed the following changes had been made to the building since the analysis was conducted in late June:

- The main entrance has been relocated approximately 4 m away from the northwest corner of the building, along the north facade.
- There is now one door, instead of two, into the grade level outdoor amenity space.

We understand no massing changes were made to the proposed development. Therefore, the wind conditions presented in the report are still valid. With regards to the main entrance, it has been relocated away from the northwest corner of the building, close to Gridline 5, as per our recommendation. This is a positive design feature as it removes the entrance from the windy area near the corner.

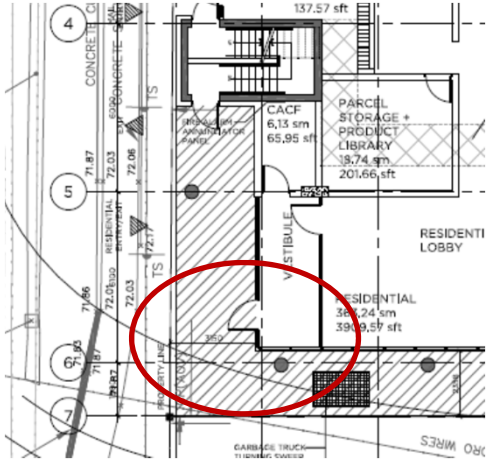

Figure 11a: Original Ground Floor Plan – Main Entrance
Credit: Raw Design, August 17, 2019

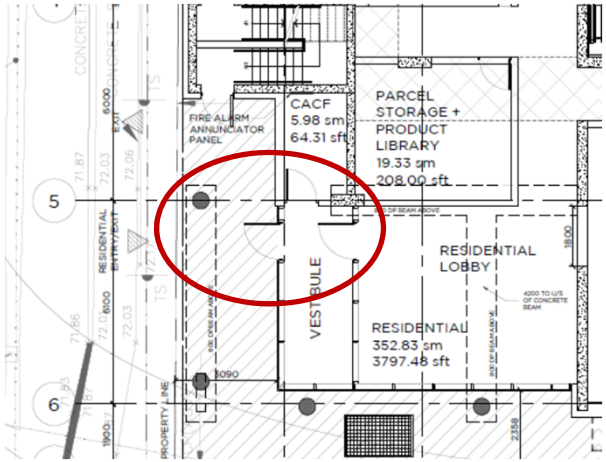

Figure 11b: Updated Ground Floor Plan – Main Entrance
Credit: Raw Design, August 17, 2019

6.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 390 Bank Street in Ottawa 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 in both the Existing and Proposed Configurations.
- The main entrance location is windier than desired. It is recommended that this entrance be relocated close to Gridline 5, which is approximately 5m away from the building corner.
- Wind conditions surrounding the proposed development are comfortable for walking or better throughout the year and are suitable for the intended usage.
- Wind conditions in the grade level amenity space are suitable for the intended usage throughout the year.
- The rooftop amenity terrace is windier than desired; the development of mitigation measures is recommended.
- Surrounding the proposed development, wind conditions are generally similar between the Existing and Proposed Configurations.

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.
Senior Engineer

8.0 REFERENCES

Blocken, B., and J. Carmeliet (2004) "Pedestrian Wind Environment around Buildings: Literature Review and Practical Examples" *Journal of Thermal Environment and Building Science*, 28(2).

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Appendix A

Pedestrian Wind Comfort Analysis

Spring (March - May) and Autumn (September - November)

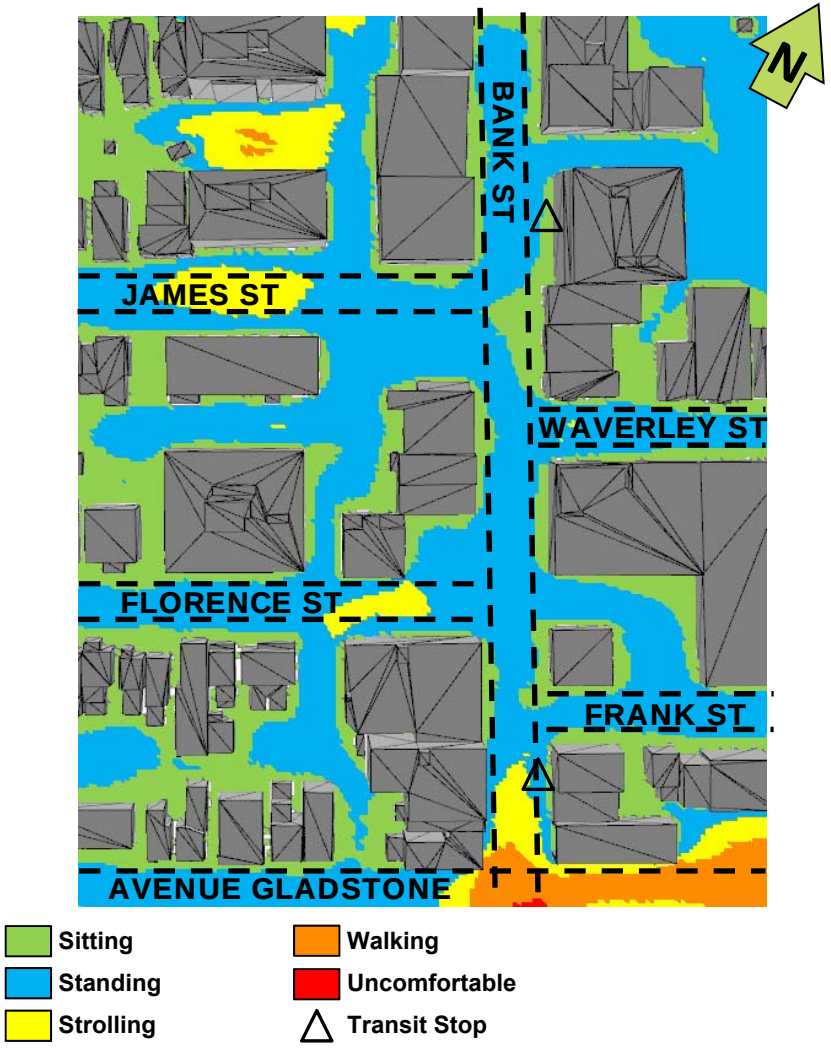


Figure A1a: Existing Configuration – Grade – Spring

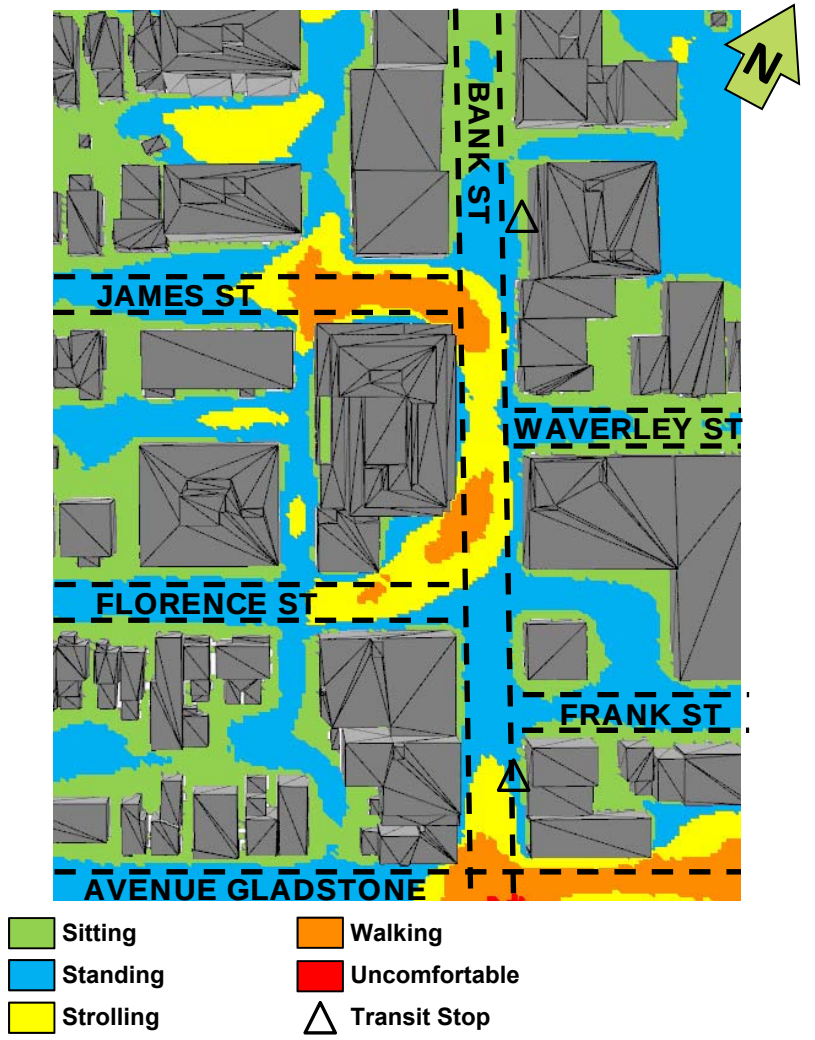


Figure A1b: Proposed Configuration – Grade – Spring

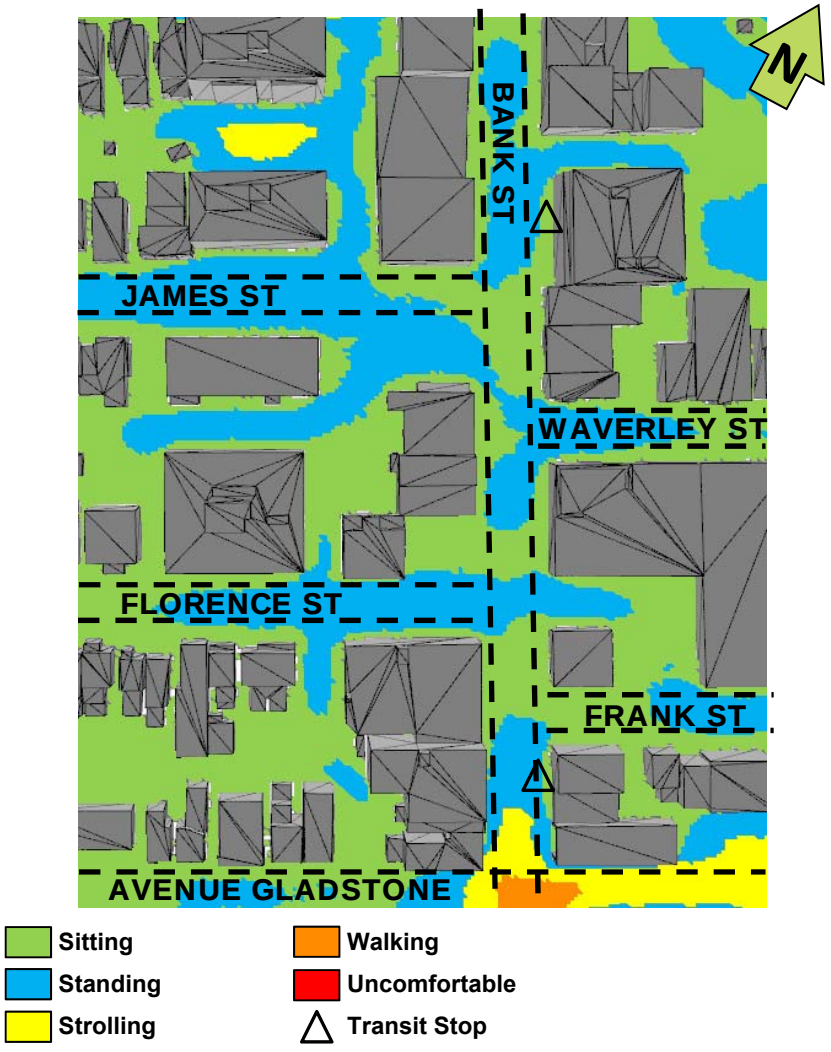


Figure A2a: Existing Configuration – Grade – Autumn

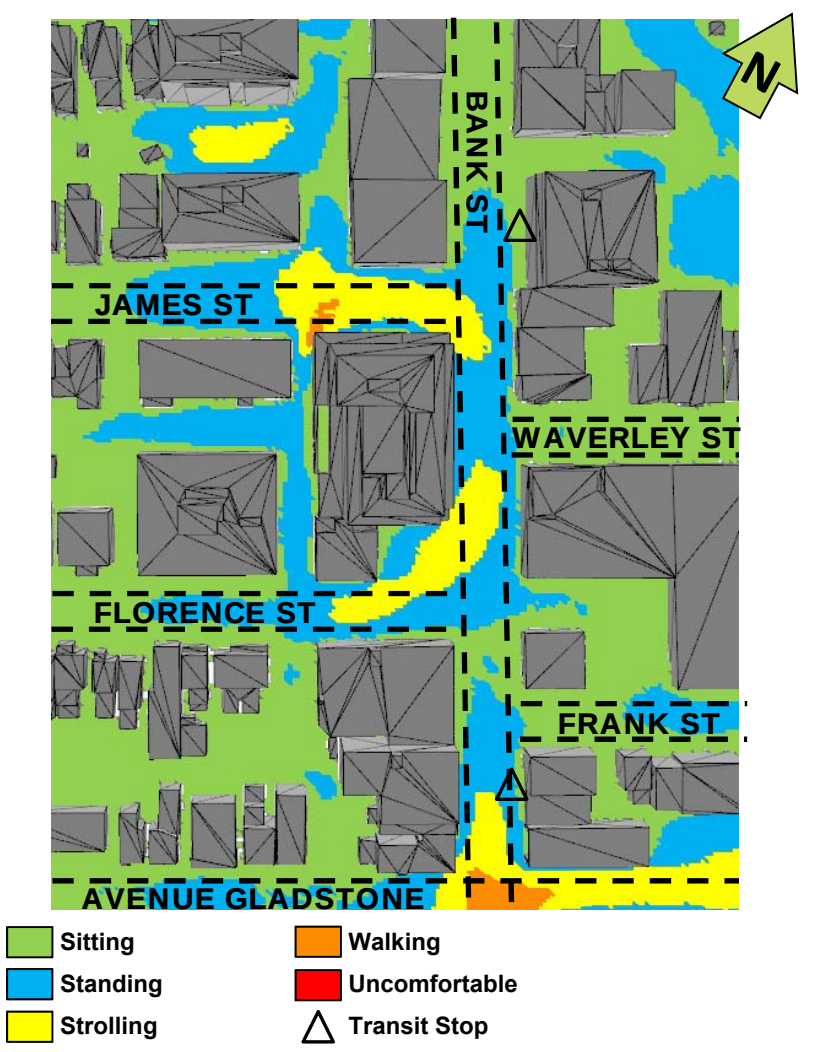


Figure A2b: Proposed Configuration – Grade – Autumn

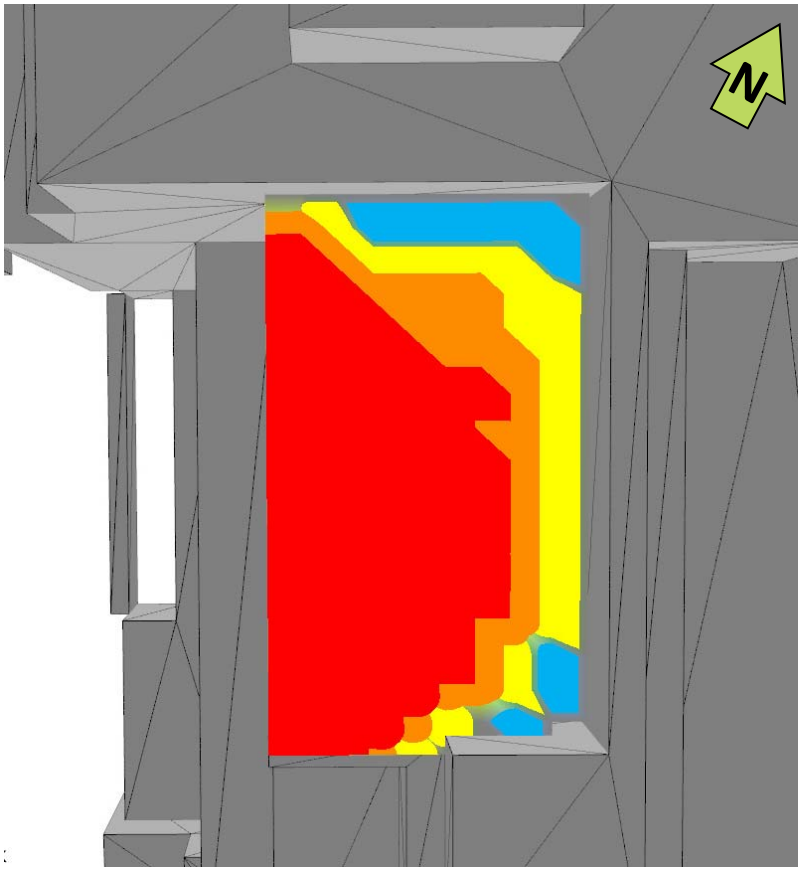


Figure A3a: Proposed Conditions – Rooftop Amenity – Spring

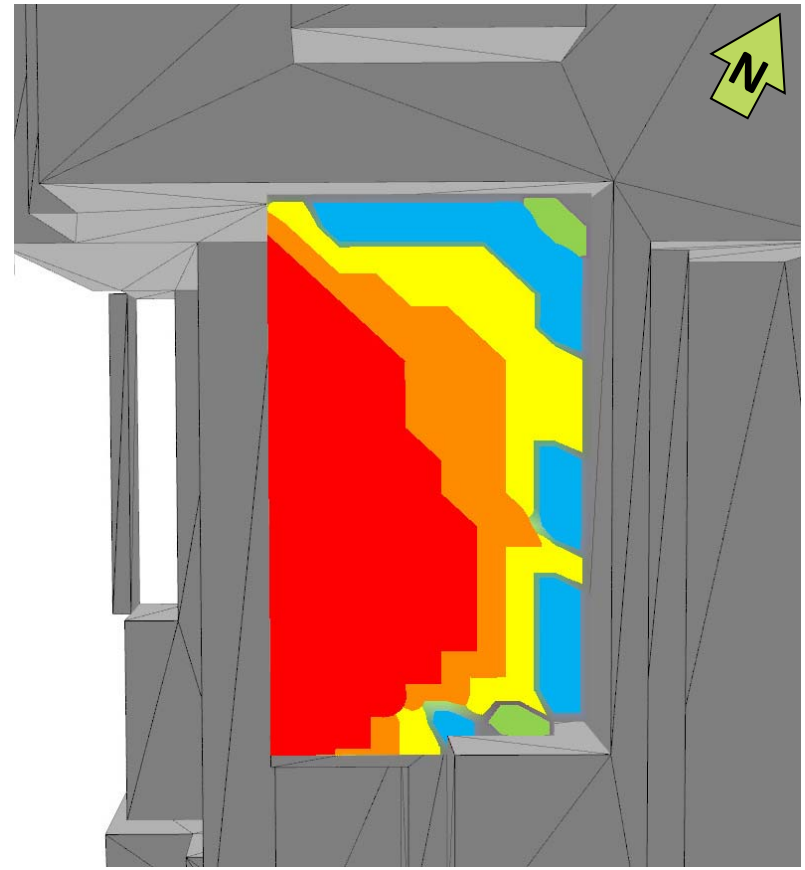


Figure A3b: Proposed Conditions – Rooftop Amenity – Autumn

Appendix B

Pedestrian Wind Safety Analysis

Annual

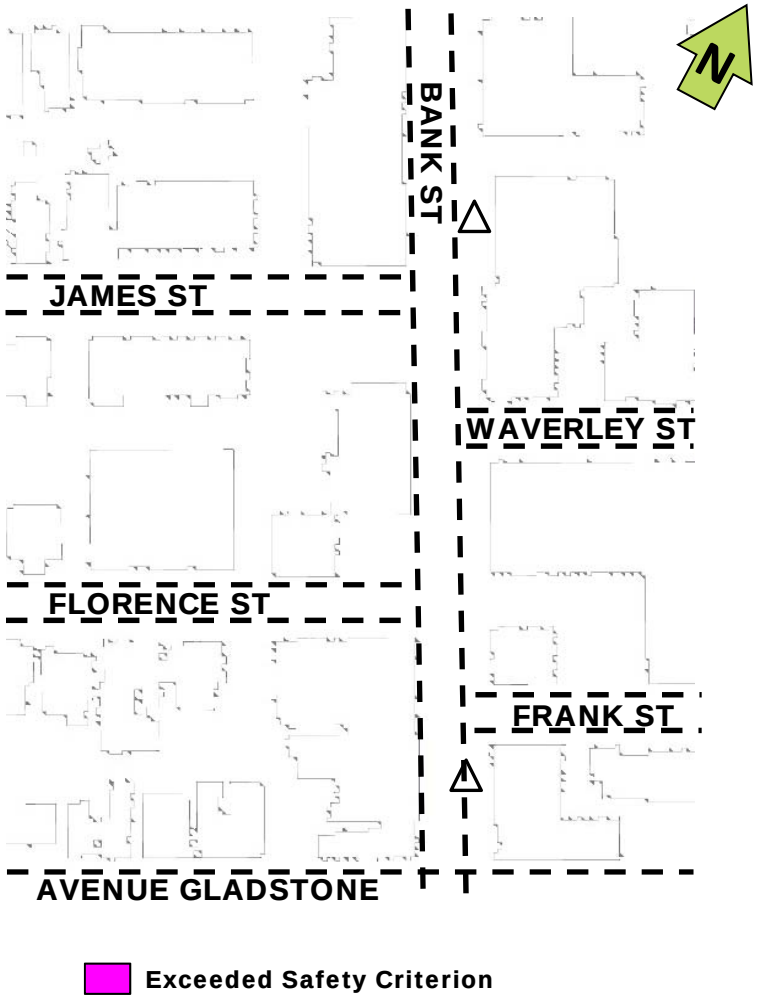


Figure B1a: Wind Safety – Existing Configuration – Grade – Annual

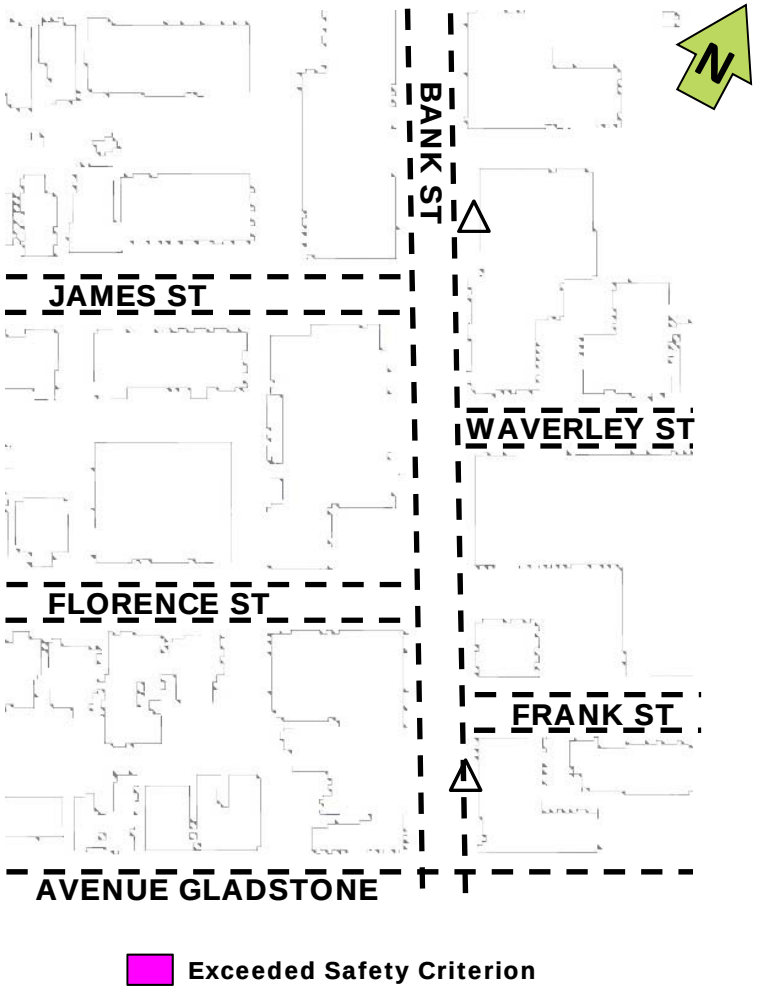
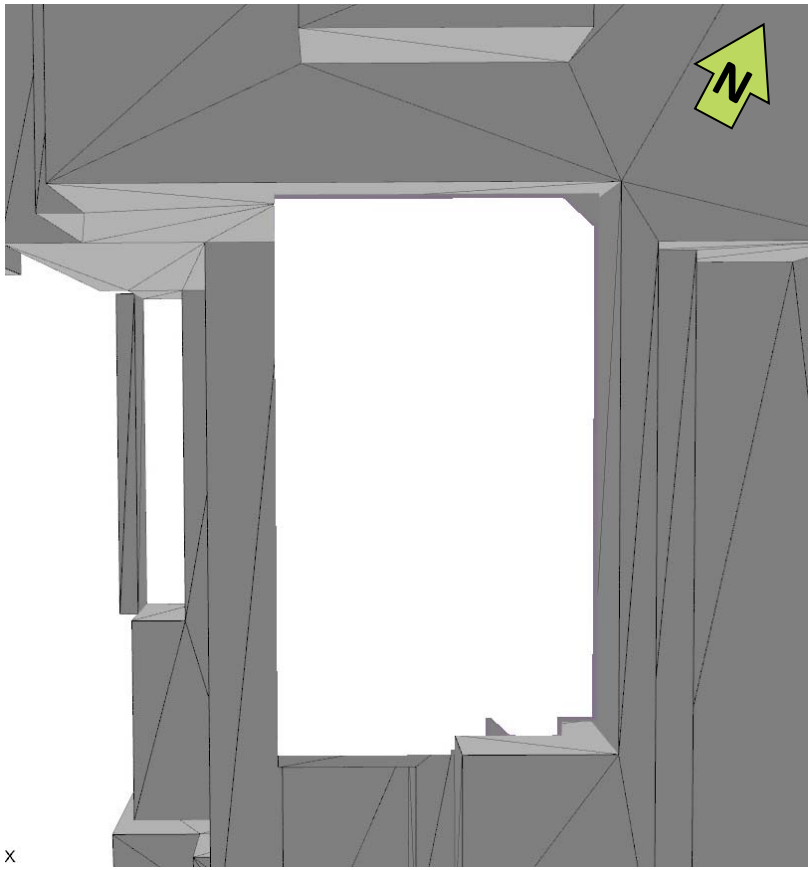


Figure B1b: Wind Safety – Proposed Configuration – Grade – Annual



Exceeded Safety Criterion

Figure B2: Wind Safety – Existing Configuration – Rooftop Amenity – Annual

Appendix C

Wind Flow Vectors – Proposed Configuration

Vertical Slices

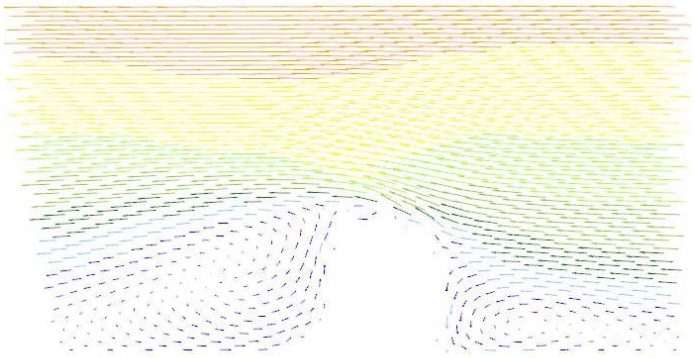


Figure C1: Wind Flow Vectors – Vertical Slice (E/W) – Wind from east northeast

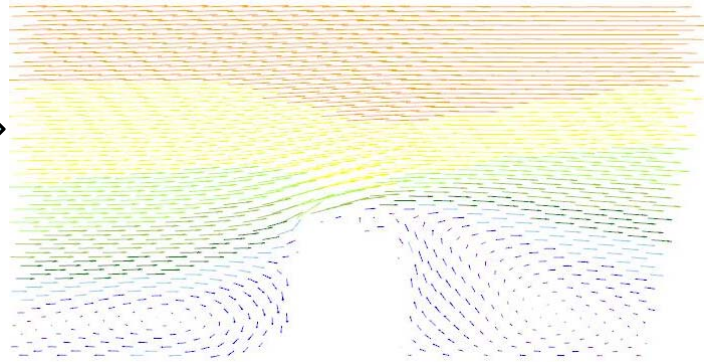


Figure C2: Wind Flow Vectors – Vertical Slice (E/W) Hotel Building - Wind from south southeast

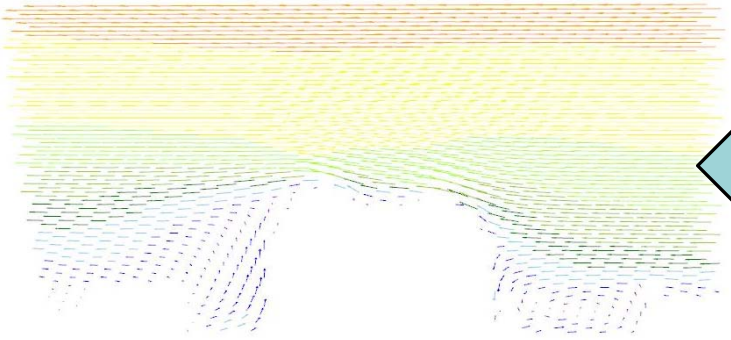


Figure C3: Wind Flow Vectors – Vertical Slice (N/S) Event Centre – Wind from south southeast

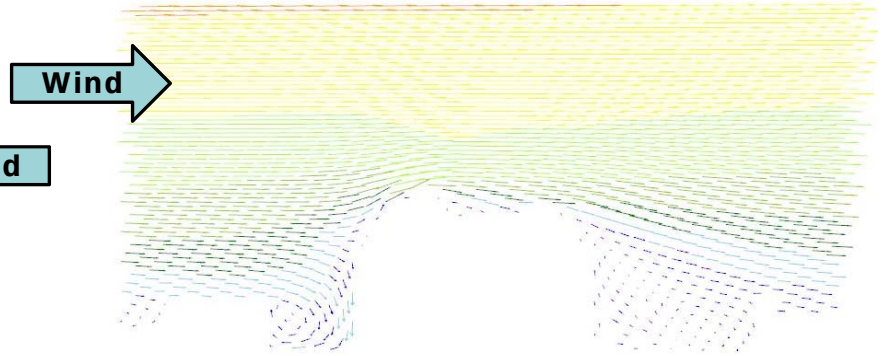


Figure C4: Wind Flow Vectors – Vertical Slice (N/S) Event Centre – Wind from north northwest