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Date: December 19, 2017

To: Spallacci and Sons Limited
1 James St S - 8th Floor
Hamilton, Ontario L8P 4R5

Re: **Pedestrian Wind Assessment**
299-307 John Street South
Hamilton, Ontario
Novus Project #17-0165

Novus Team:

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Credit: SRN Architects Inc.

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Credit: SRN Architects Inc.

1.0 INTRODUCTION

Novus Environmental Inc. (Novus) was retained by Spallacci and Sons Limited to conduct a pedestrian wind assessment for the proposed 299-307 John Street South development in Hamilton, Ontario. This report is in support of the Official Plan Amendment (OPA) and Zoning By-Law Amendment (ZBA) submission for the development.

1.1 Existing Development

The proposed development is located at 299-307 John Street South, on the east side of John Street, between Charlton Avenue East and St Josephs Drive in Hamilton. The site is currently occupied by a parking lot and a low-rise residential building. **Figure 1** provides an aerial view of the immediate study area. A virtual site visit was conducted by Novus using Google Earth images dated April and June 2016 and images are included in **Figures 2a** through **2d**.

Immediately surrounding the proposed site is St Joseph's Hospital to the west, which includes several mid-rise buildings, low and mid-rise residential to the north, Woolverton Park to the east, and low-rise residential to the south. Beyond the immediate surroundings there are low and mid-rise commercial and residential space to the northwest through northeast, forested space to the east and low-rise residential buildings to the southeast through south to west.

Approved developments and developments under construction were reviewed for inclusion as existing surroundings for the analysis. For this assessment, no approved developments were identified.

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

Figure 2a: Looking north at existing site

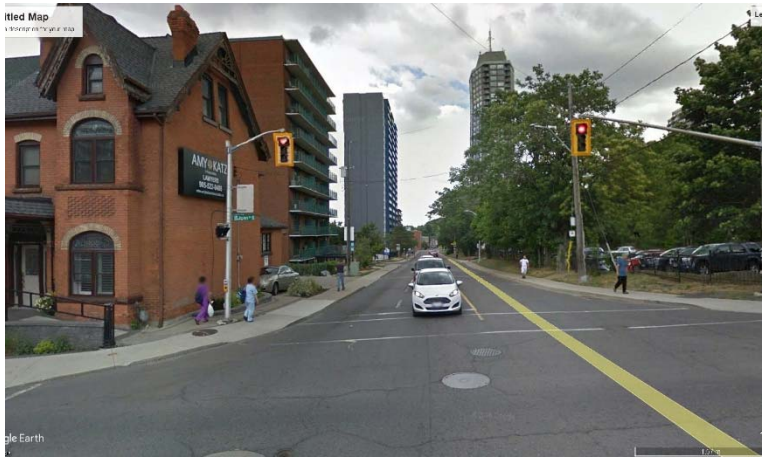

Figure 2b: Looking east along Charlton Avenue East

Figure 2c: Looking west along St Josephs Drive

Figure 2d: Looking south at Woolverton Park

1.2 Proposed Development

The proposed development includes three towers:

- Tower A, at the corner of John Street South and Charlton Street East is 26 storeys in height (94.3m plus a mechanical penthouse)
- Tower B is 30 storeys in height (106.8m plus a mechanical penthouse)
- Tower C, at the south edge of the property, is 36 storeys in height (112.6m plus a mechanical penthouse).

All towers are located on a shared podium, which due to the slope of the site, ranges from eight-storeys in height at the north end to one-storey tall at the south end. The podium includes parking, commercial, and residential spaces, with residential units in the towers above. Due to the slope of the site, the top floor of the podium is also referred to as 'Tower Level 1'. 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, transit stops, plazas and parks. There is one nearby transit stop on John Street, in front of the proposed Tower A.

The main entrances to each of the towers is located on Tower Level 1, and are shown in **Figure 4**. Tower A also has an entrance on Charlton Street, on Parking Level 4. Along John Street South there will be several entrances to retail space. There are three outdoor amenity spaces associated with the development, located on Tower Levels 1, 3 and 5 (as shown in **Figure 4**).

Figure 3: Rendering of Proposed Development
Credit SRN Architects Inc.

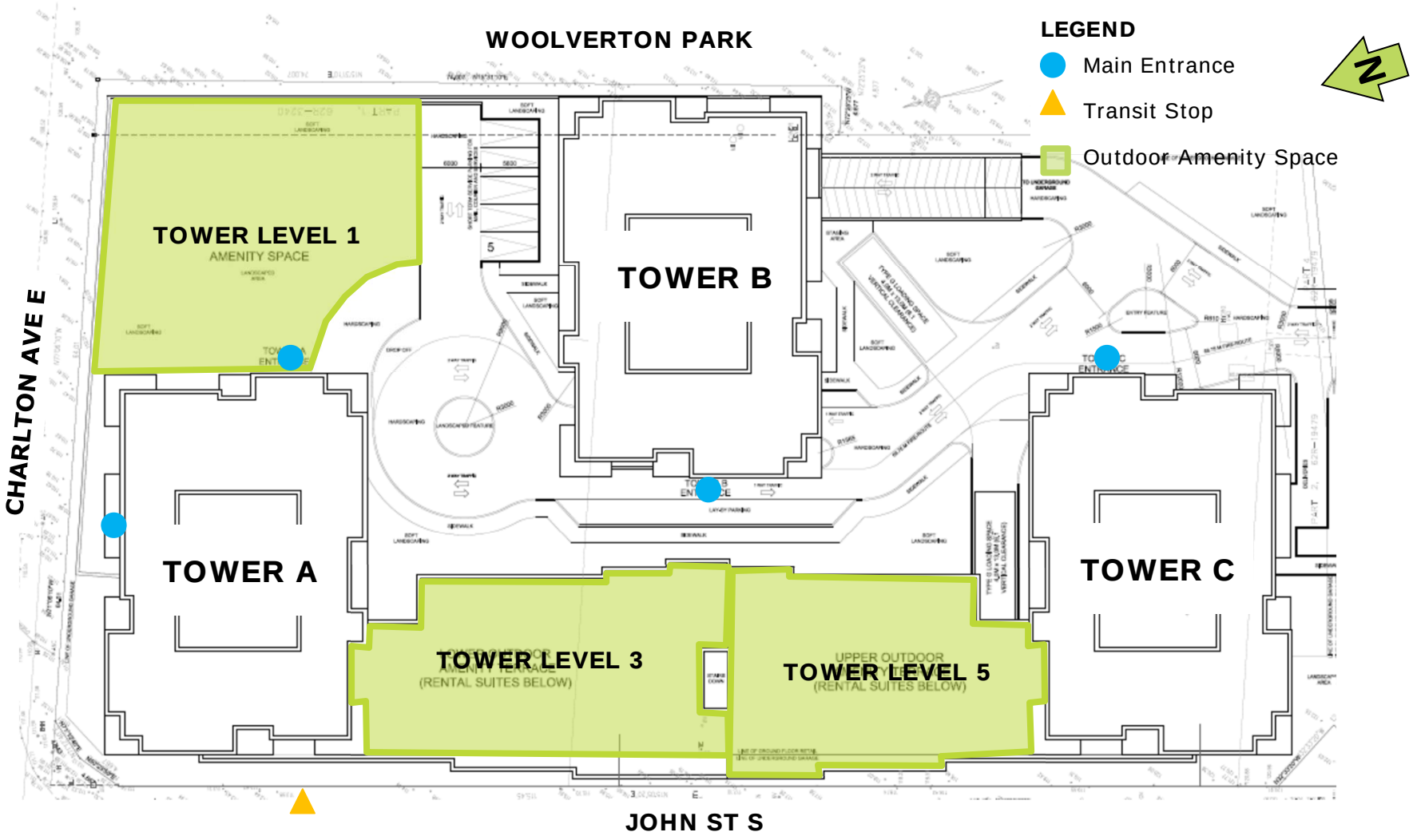

Figure 4: Areas of Interest

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. 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 SRN Architects Inc. on November 30, 2017. 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 (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 winds approaching from the west through southwest 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.

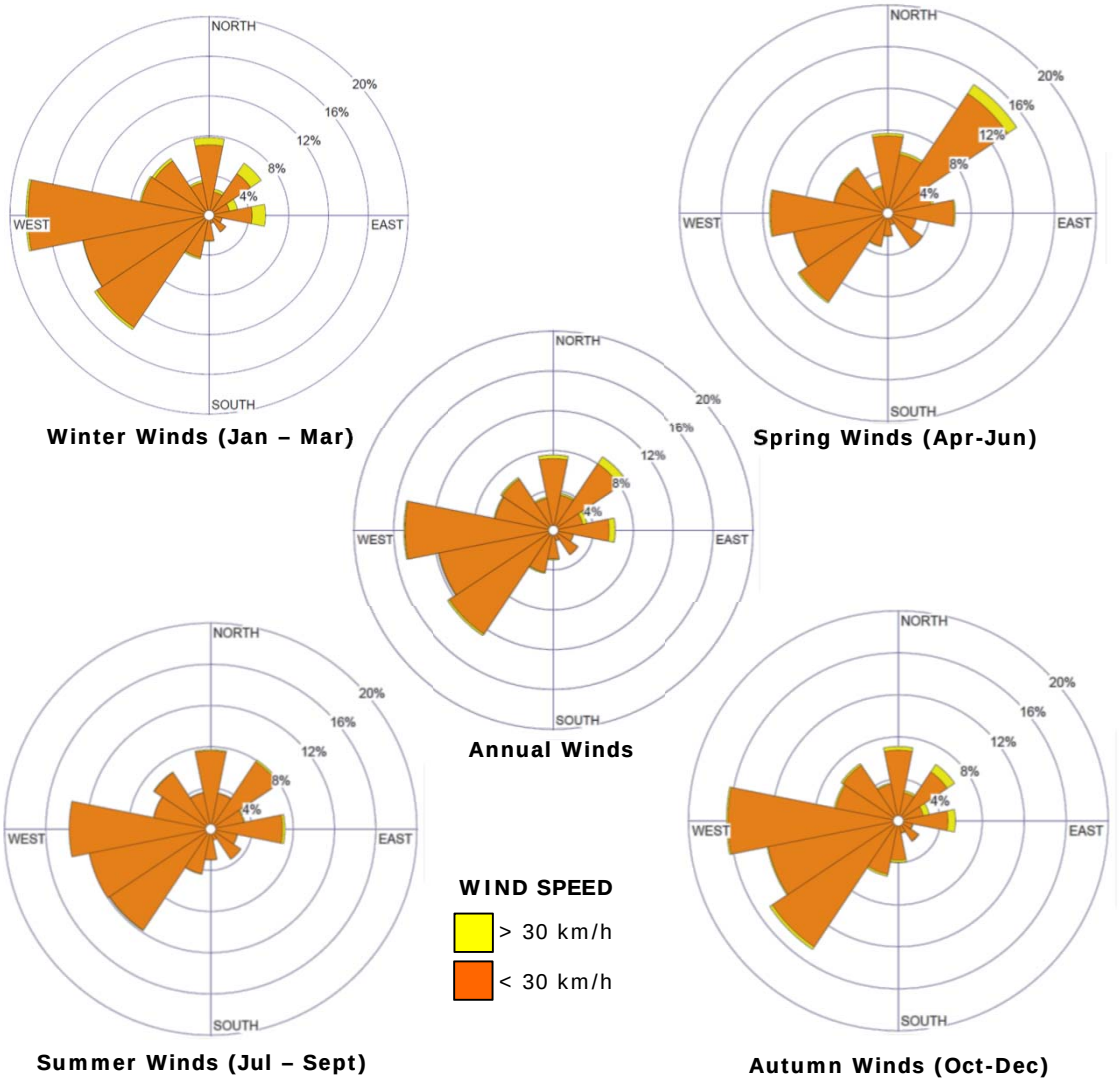

Figure 6: Wind roses for Burlington Piers (1991-2015)

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 based on 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. The 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 **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.

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.

4.1 Existing Wind Conditions

In the Existing Configuration, wind conditions on the proposed site are comfortable for sitting throughout the year (**Figures 7a** and **8a**). On the sidewalks surrounding the proposed site, including John Street South, Charlton Avenue East, St Josephs Drive and Arkledun Avenue, wind conditions are comfortable for sitting or standing throughout the year. At the transit stop on John Street South, wind conditions are comfortable for sitting throughout the year (**Figures 7a** and **8a**). In Woolverton Park, wind conditions are also comfortable for sitting throughout the year.

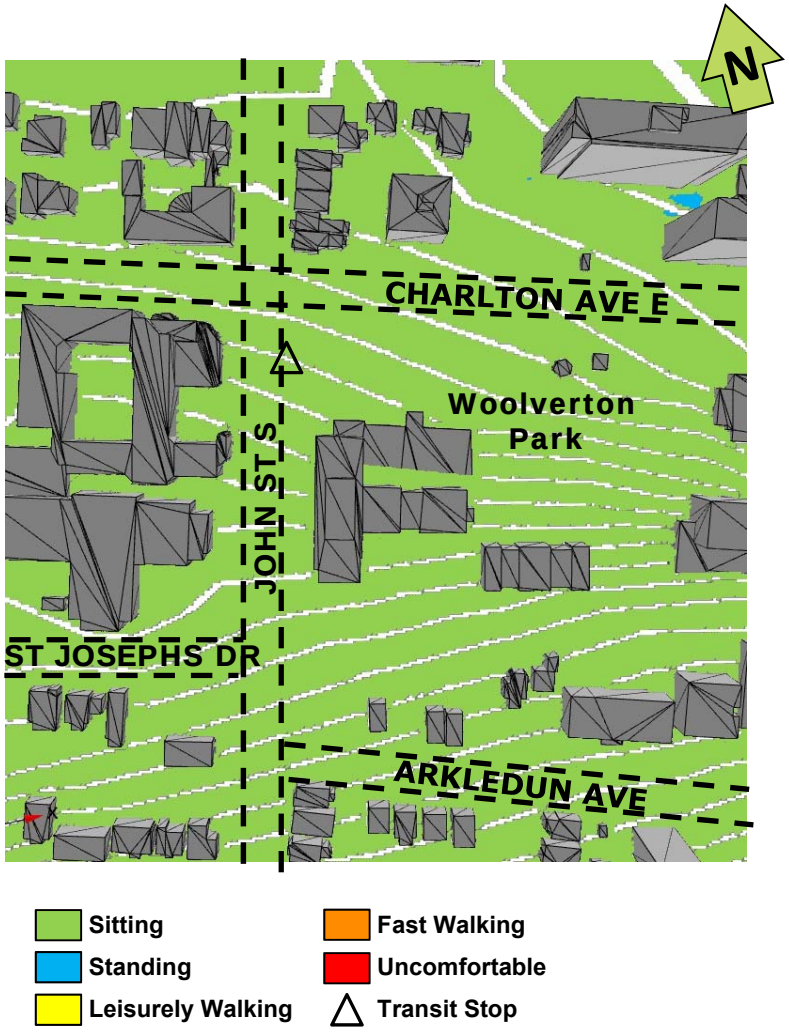

Figure 7a: Existing Conditions – Grade Level – Summer

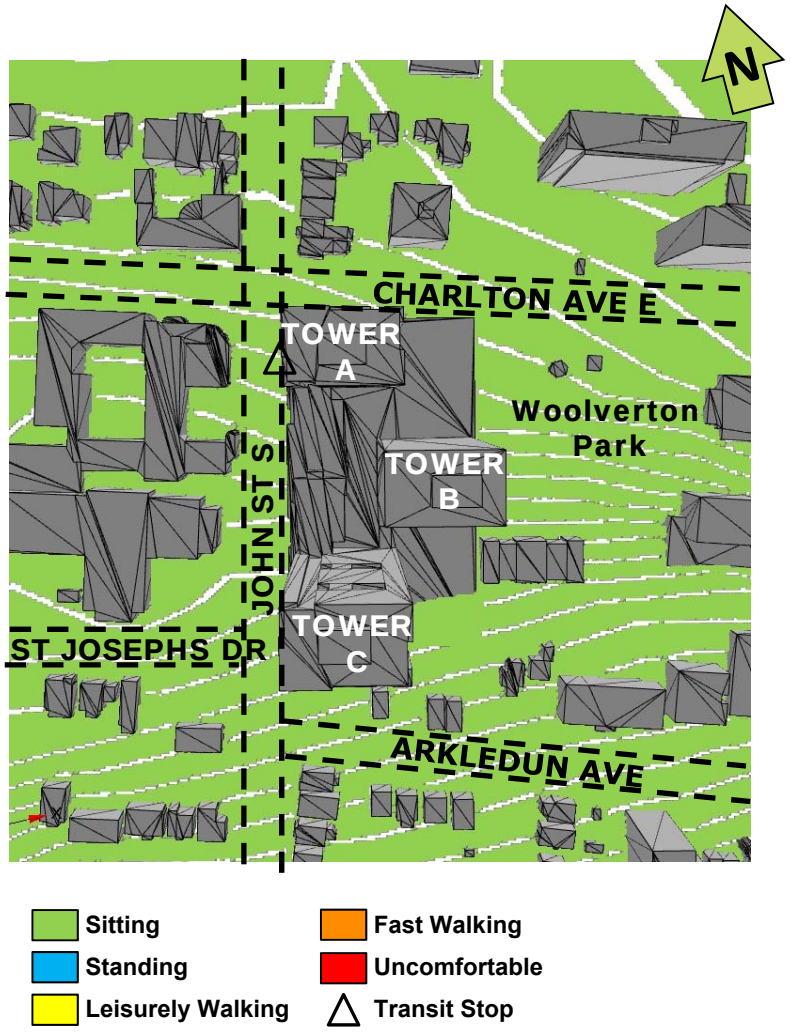

Figure 7b: Proposed Conditions – Grade Level – Summer

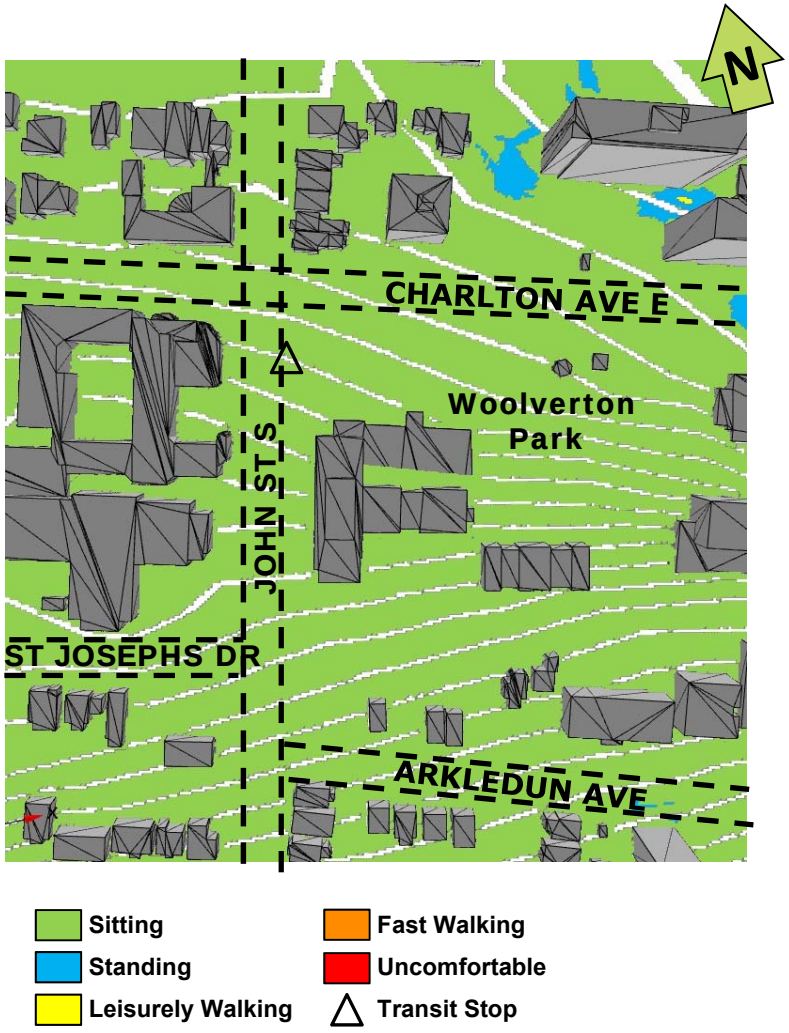

Figure 8a: Existing Conditions – Grade Level – Winter

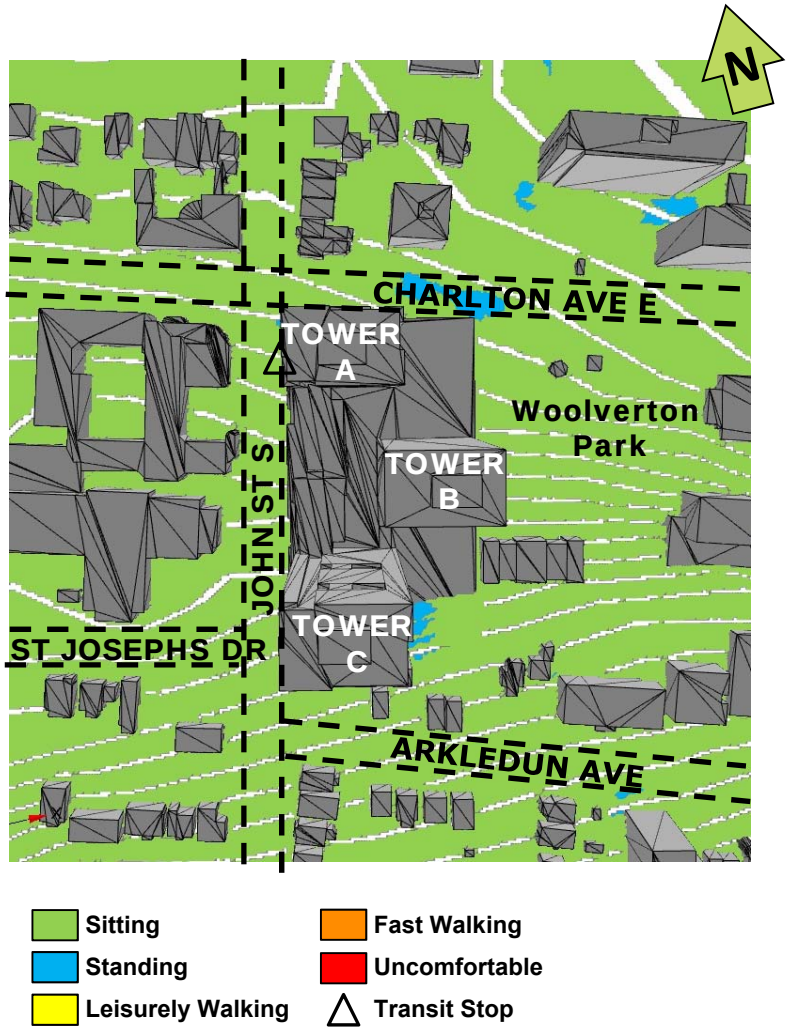

Figure 8b: Proposed Conditions – Grade Level – Winter

4.2 Building Entrances & Walkways

The main entrances to each of the towers are located on Tower Level 1, on top of the main podium. At each of these main entrances, wind conditions are comfortable for sitting throughout the year (**Figures 9a** and **9b**). The secondary entrance to Tower A, along Charlton Avenue East is located beneath the building overhang, and also has wind conditions comfortable for sitting throughout the year. Along John Street South, where multiple retail entrances are proposed, wind conditions are comfortable for sitting throughout the year as well (**Figures 7b** and **8b**). These wind conditions are considered ideal.

In the amenity space on Tower Level 1, east of Tower A, wind conditions are comfortable for sitting in the summer, while in the winter wind conditions are suitable for sitting or standing (**Figures 9a** and **9b**). These wind conditions are considered suitable for the intended usage.

Surrounding the proposed towers, wind conditions are generally suitable for sitting or standing throughout the year on Tower Level 1. At the southeast corner of Tower C, wind conditions are suitable for leisurely walking in the winter season.

Overall, wind conditions on the site are suitable for the intended usage.

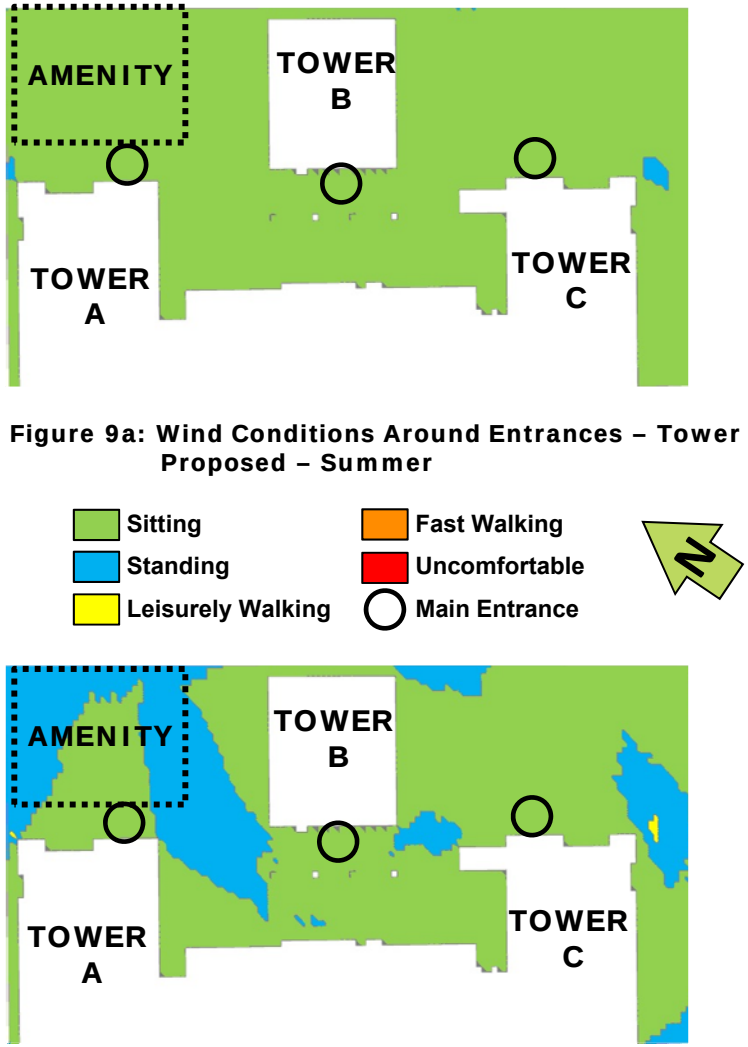

Figure 9a: Wind Conditions Around Entrances – Tower Level 1 Proposed – Summer

Figure 9b: Wind Conditions Around Entrances – Tower Level 1 Proposed – Winter

4.3 Amenity Terraces

Both the Tower Level 3 and Tower Level 5 amenity spaces are partially sheltered from the prevailing winds. On these terraces, wind conditions are comfortable for sitting in the summer, while in the winter wind conditions are conducive to sitting or standing (**Figures 10a** and **10b**). These wind conditions are considered suitable for the intended usage.

4.4 Surrounding Sidewalks

On the surrounding sidewalks, including John Street South, Charlton Street East, St Josephs Street and Arkledun Avenue, wind conditions are similar to the Existing Configuration and remain comfortable for sitting or standing throughout the year (**Figures 7b** and **8b**). At the transit stop on John Street South, wind conditions remain comfortable for sitting throughout the year. In Woolverton Park, wind conditions are also suitable for sitting throughout the year (**Figures 7b** and **8b**).

Wind conditions surrounding the site are considered suitable for the intended usage.

4.5 Wind Safety

The wind safety criterion is met in all areas in both the Existing and Proposed Configurations.

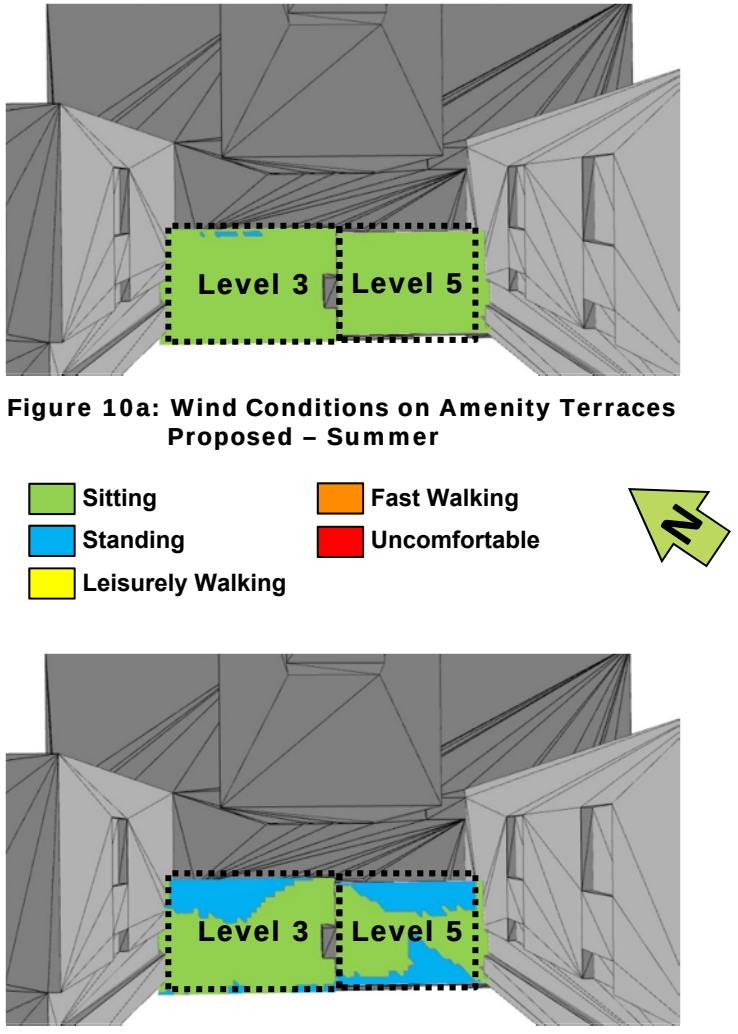

Figure 10a: Wind Conditions on Amenity Terraces Proposed – Summer

Figure 10b: Wind Conditions on Amenity Terraces Proposed – Winter

5.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 299-307 John Street South in Hamilton 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 in all areas in both the Existing and Proposed Configurations.
- Wind conditions at all entrances to the proposed development are considered suitable for the intended usage throughout the year.
- In the proposed amenity areas, wind conditions are considered suitable for the intended usage throughout the year.
- Wind conditions on the surrounding sidewalks are similar between the Existing and Proposed Configurations and suitable for the intended usage in both the summer and winter seasons.

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 Novus.

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

Sincerely,
Novus Environmental Inc.

Jenny Vesely, P. Eng.
Engineer – Microclimate

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

7.0 REFERENCES

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Appendix A

Pedestrian Wind Comfort Analysis

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

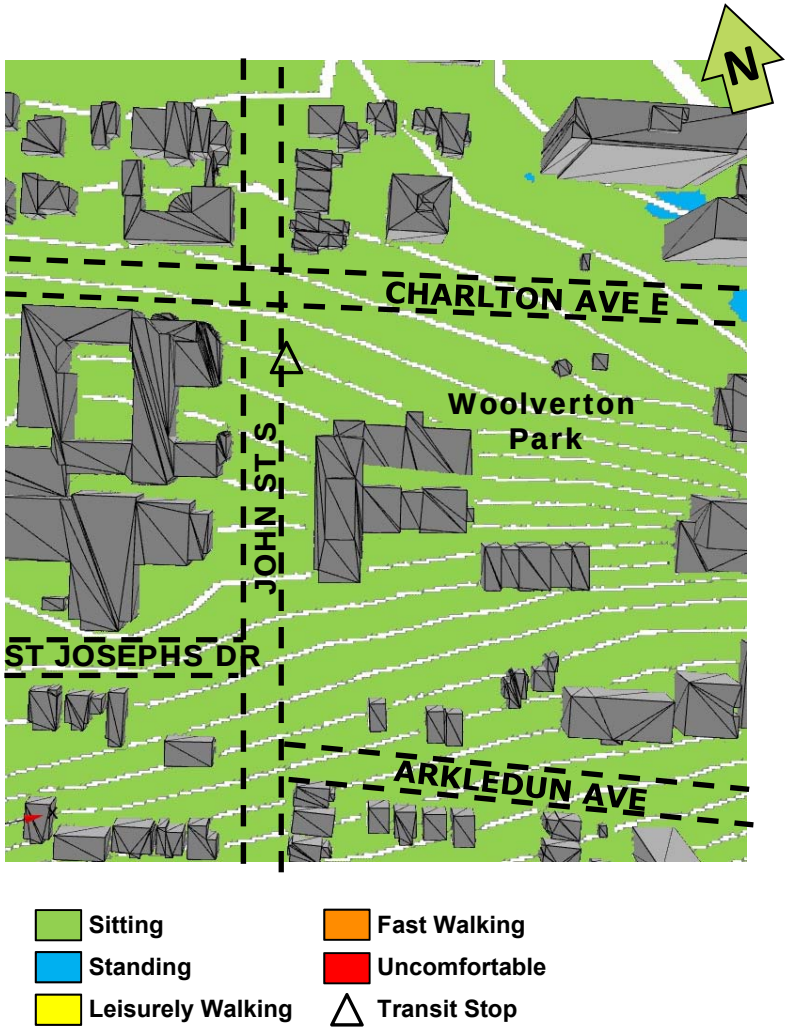

Figure A1a: Existing Configuration – Grade – Spring

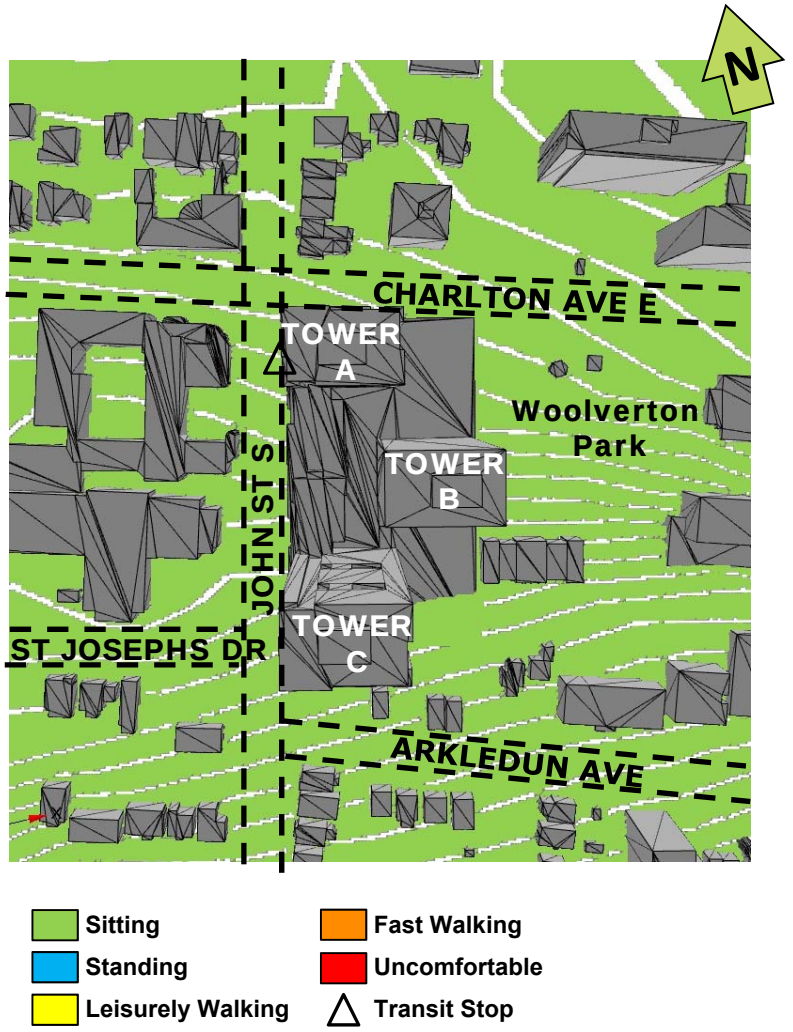

Figure A1b: Proposed Configuration – Grade – Spring

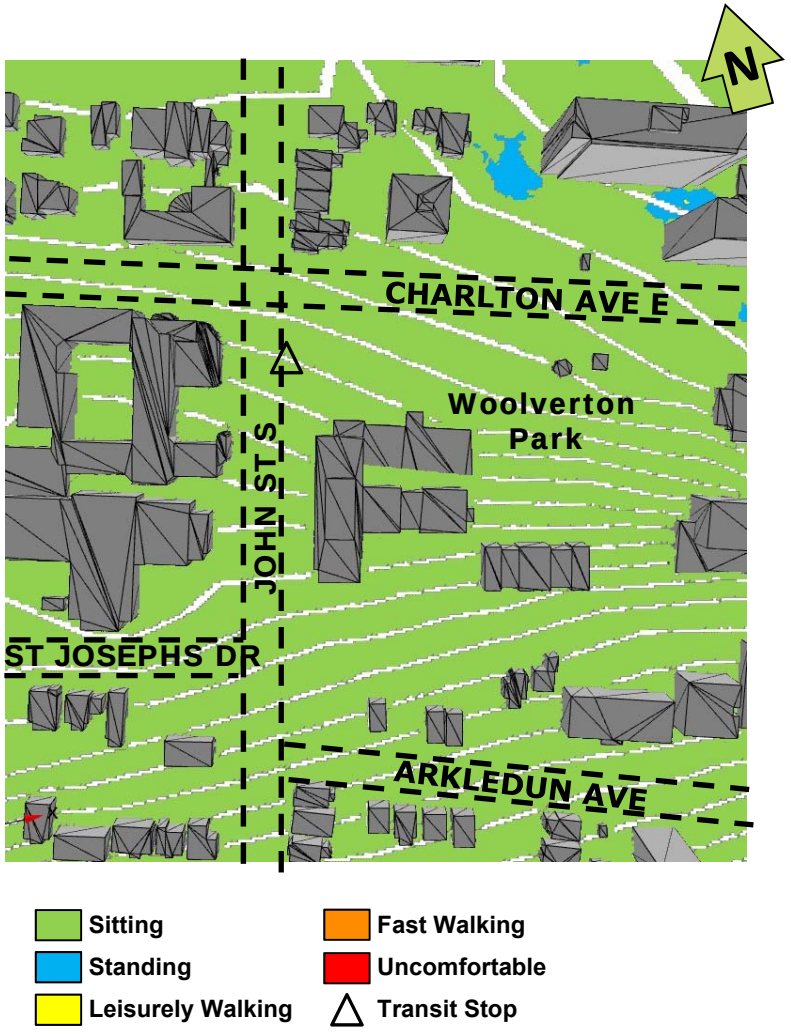

Figure A2a: Existing Configuration – Grade – Autumn

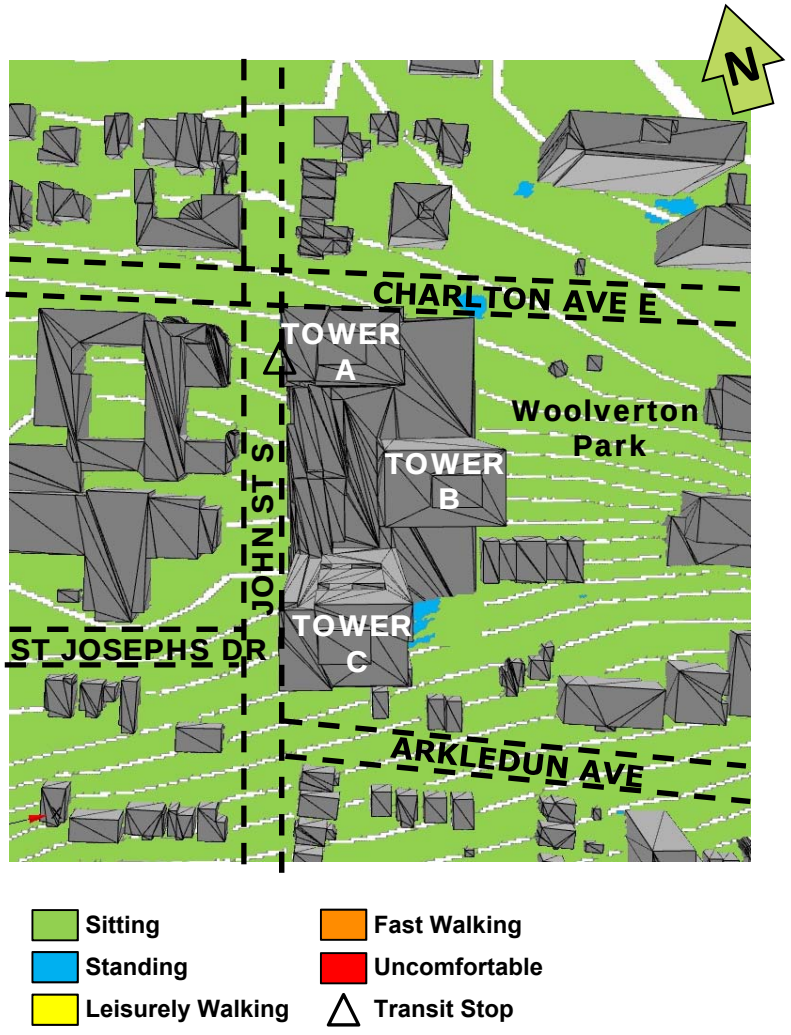

Figure A2b: Proposed Configuration – Grade – Autumn