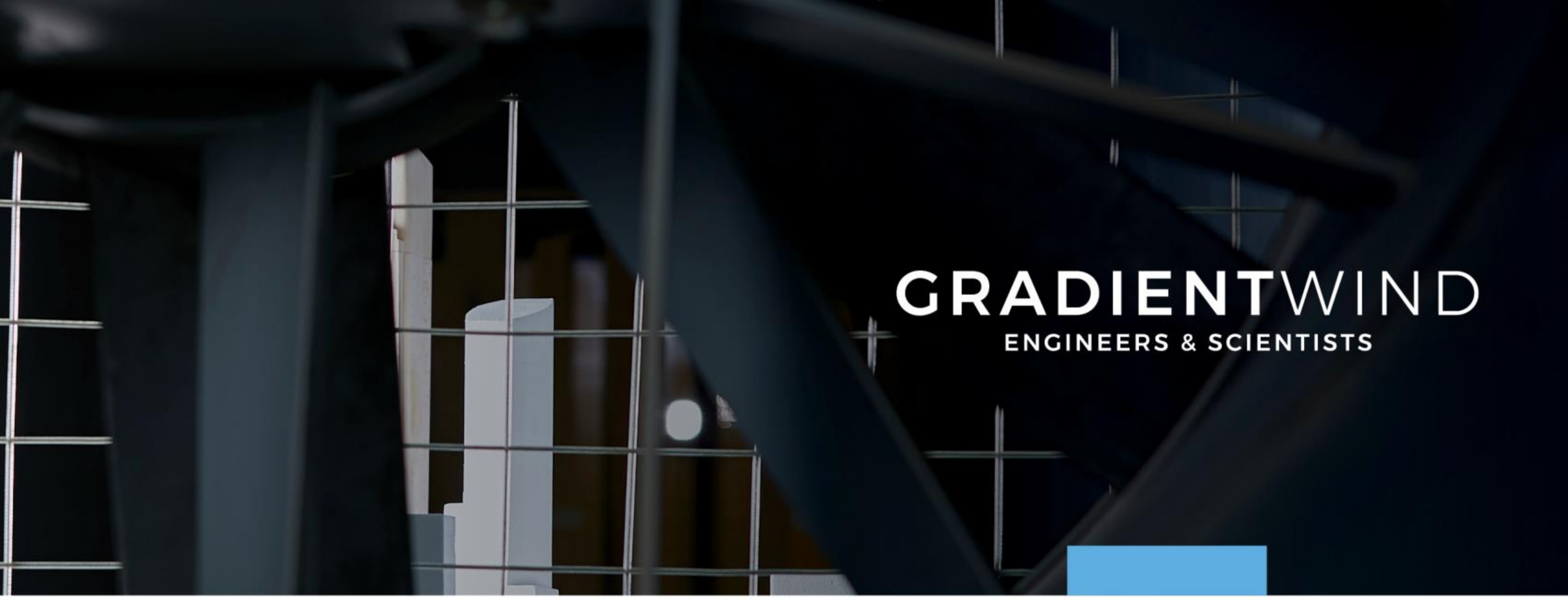
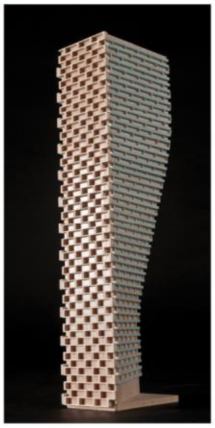
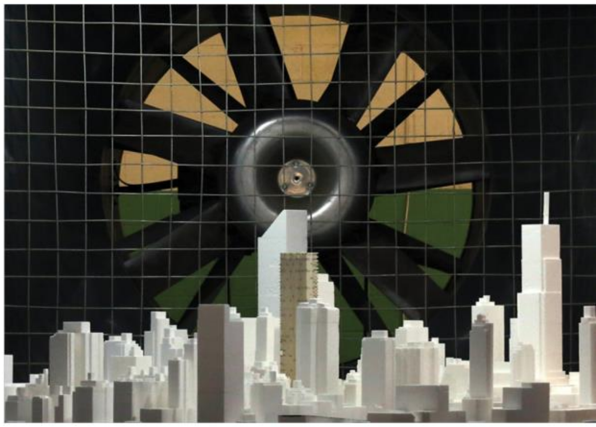


PEDESTRIAN LEVEL WIND STUDY

2026 Scott Street
Ottawa, Ontario

Report: 22-006-PLW-2023





April 28, 2023

PREPARED FOR
Morley Hoppner Inc.
1818 Bradley Side Road
Ottawa, ON K0A 1L0

PREPARED BY
Daniel Davalos, MESc, Junior Wind Scientist
Justin Ferraro, P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy concurrent Zoning By-law Amendment (ZBLA) and Site Plan Control application requirements for the proposed mixed-use residential development located at 2026 Scott Street in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). The proposed development also includes the properties at 314 and 318 Athlone Avenue, and 2006 and 2020 Scott Street. Our mandate within this study is to investigate pedestrian wind comfort and safety within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study involves simulation of wind speeds for selected wind directions in a three-dimensional (3D) computer model using the computational fluid dynamics (CFD) technique, combined with meteorological data integration, to assess pedestrian wind comfort and safety within and surrounding the subject site according to City of Ottawa wind comfort and safety criteria. The results and recommendations derived from these considerations are detailed in the main body of the report (Section 5), illustrated in Figures 3A-10, and summarized as follows:

1) Most grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered satisfactory for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, walkways, Lion's Park, and in the vicinity of building access points, are considered acceptable. Two windy areas are described as follows:

    a. **Grade-Level Outdoor Amenity Area.** Owing to the prominent westerly winds, and the channelling effect produced by the proximity of Buildings A and B, the outdoor amenity at grade is predicted to be windy. Specifically, wind comfort conditions are predicted to be suitable for a mix of standing and strolling during the typical use period. Notably, a central region within the outdoor amenity is predicted to experience uncomfortable conditions during the winter, as illustrated in Figure 6A.

        - Conditions may be improved within the area by introducing tall wind screens between Buildings A and B in addition to coniferous plantings in dense arrangements. The extent of wind mitigation is dependant on the programming of the area. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

b. **Building Access Along West Elevation of Building A:** Conditions in the vicinity of the secondary building access points along the west elevation of Building A are predicted to be suitable for standing during the summer and autumn, becoming suitable for walking during the winter and spring. While walking conditions are considered satisfactory for secondary building access points, strong wind speeds are expected to occur between Buildings A and B, as noted above. As such, it is recommended that the building access points be recessed into the façade by at least 2 m.

2) The common amenity terraces serving Building A at Level 8 and Building B at Level 10 were modelled with 1.8-m-tall wind screens along their full perimeters. Additionally, the common amenity terraces serving Buildings A and B at their respective MPH level, as well as the common amenity terrace serving the proposed development atop the building link at Level 11, were modelled with 2-m-tall wind screens along their full perimeters. Wind comfort conditions during the typical use period within the noted areas, as illustrated in Figure 10, and recommendation regarding further mitigation, where required, are described as follows:

   a. With the noted mitigation, wind conditions over the common amenity terraces serving Building A at Level 8 and at the MPH level, and over the common amenity terrace serving Building B at Level 10, are predicted to be suitable for sitting. The noted conditions are considered acceptable.

   b. With the noted mitigation, wind conditions within the common amenity terrace serving Building B at the MPH level are predicted to be suitable for sitting to the north and south, and suitable for standing throughout the remainder of the terrace.

   c. With the noted mitigation, wind comfort conditions within the common amenity terrace serving the proposed development atop the building link at Level 11 are predicted to be mostly suitable for standing.

d. To improve wind comfort conditions within the common amenity terraces serving Building B at the MPH level, it is recommended to include taller wind screens along the full perimeter of the terrace. Specifically, 2.4-m-tall wind screens, glazed and solid, are recommended. Additionally, mitigation inboard of the perimeter, which could take form of 1.8-m-tall wind screens and/or other landscape elements such as planters and dense clusters of coniferous plantings and/or trees located around the windiest areas, are recommended to further improved conditions within the terrace.

e. To improve wind comfort conditions within the common amenity terraces atop the building link connecting Buildings A and B, it is recommended that the terrace be served by 2.4-m-tall wind screens, glazed and solid. Additionally, mitigation inboard of the perimeter, which could take form of 1.8-m-tall wind screens and/or other landscape elements such as planters and dense clusters of coniferous plantings and/or trees located around designated sitting areas, are recommended to further improved conditions within the terrace. Additionally, canopies located above designated seating areas are also recommended to further improve conditions. The underside of the canopies should measure no greater than 4 m from the local walking surface of the terrace and extend at least 3 m outwards from the west and east elevations of Buildings A and B, respectively, to deflect downwash incident on the tall buildings.

f. The extent of mitigation measures is dependant on the programming of the terrace. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

3) **Wind Safety.** Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas at grade level are predicted to experience conditions that could be considered dangerous, per the definition in Section 4.4.

   Two areas within the common amenity terrace atop the proposed link connecting Buildings A and B are predicted to experience conditions that could be considered dangerous. The areas are located to the north and south of the terrace. Gust wind speeds greater than 90 km/h are estimated to occur for at least 0.22% of the time over the noted areas (that is, 19 hours annually), where the threshold is 0.1% of the time (that is, 9 hours annually). While the wind mitigation recommendations described in Section 5.2 are expected to reduce strong wind speeds to below the wind safety threshold, mitigation testing will be required to confirm the effectiveness of the preferred wind mitigation strategy.

GRADIENTWIND
ENGINEERS & SCIENTISTS

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Morley Hoppner Inc. to undertake a pedestrian level wind (PLW) study to satisfy concurrent Zoning By-law Amendment (ZBLA) and Site Plan Control application requirements for the proposed mixed-use development located at 2026 Scott Street in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). The proposed development also includes the properties at 314 and 318 Athlone Avenue, and 2006 and 2020 Scott Street. A PLW study was conducted in April 2022 for the previous design of the proposed development. Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Ottawa wind comfort and safety criteria, architectural drawings prepared by Hobin Architecture, in April 2023, surrounding street layouts and existing and approved future building massing information obtained from the City of Ottawa, as well as recent satellite imagery.

2. TERMS OF REFERENCE

The subject site is located at 2026 Scott Street in Ottawa; situated at the southwest intersection of Scott Street and Athlone Avenue. Throughout this report, Scott Street is considered as project north. The proposed development comprises two 40-storey towers with a nominally rectangular planform identified as Building A and Building B, to the east and west of the subject site, respectively, and includes a 4-storey building link to the north from Level 7 to 10. The buildings are served by four shared below-grade parking levels and include mechanical penthouse (MPH) levels.

Above below-grade parking, the ground floor of Building A includes a residential main entrance to the north, a central elevator core, retail space at the northeast and southwest corners, a mail room to the west, and bike storage at the southeast corner. Access to below-grade parking is provided by a ramp to the east from Athlone Avenue. Levels 2-40 are reserved for residential use. The building steps back from the south elevation from Levels 5 to 7, and at Level 8 to accommodate private terraces and a common amenity terrace, respectively. At Level 7 and 9, the building link to the north includes indoor amenity space. A common amenity terrace is located atop the building link at Level 11, and is shared by Building A and Building B. Also, the building steps back from the east elevation at the MPH level to accommodate a common amenity terrace.

Above below-grade parking, the ground floor of Building B includes a residential main entrance to the north, a central elevator core, retail space at the northeast corner and to the east, bike storge and mail room to the west, residential space to the south, and indoor amenity space to the east. Between Building A and Building B, the proposed development includes a large outdoor amenity, which extends from the north to the south of the subject site. Access to below-grade parking is provided by a ramp at the northwest corner of Building B from Scott Street. Levels 2-40 are reserved for residential use. The building steps back from the south elevation from Levels 5 to 9, and at Level 10 to accommodate private terraces and a common amenity terrace, respectively. Also, the building steps back from the east elevation at the MPH level to accommodate a common amenity terrace.

The near-field surroundings, defined as an area within 200 m of the subject site, include two mid-rise residential buildings to the northwest, a mid-rise residential building and low-rise commercial buildings to the northeast, low-rise residential buildings to the east and southeast, a community centre and Lion's Park to the south, low-rise residential buildings to the southwest, a mid-rise residential building and low-rise commercial buildings to the west, and low-rise residential buildings to the northwest. Notably, Westboro Station is situated approximately 50 m to the northeast of the subject site and the Confederation Line Light Rail Transit (LRT) extends from the northeast to the southwest. In addition, a 26-storey mixed-use development is under construction at 320 McRae Avenue, located approximately 170 m to the east, a 25-storey mixed-use building is under construction at 2070 Scott Street, located approximately 130 m to the west, and a 30-storey mixed-use apartment building is approved (Zoning By-law) at 2046-2050 Scott Street, located to the immediate west of the subject site.

The far-field surroundings, defined as an area beyond the near-field but within a 2-kilometre (km) radius of the subject site, are characterized primarily by low-rise buildings with isolated mid- and high-rise buildings to the north, northeast, southeast, and southwest. In addition, the Ottawa River flows from the southwest to the northeast, approximately 800 m to the northwest of the subject site.

Site plans for the proposed and existing massing scenarios are illustrated in Figures 1A and 1B, while Figures 2A-2H illustrate the computational models used to conduct the study. The existing massing scenario includes the existing massing and any changes which have been approved by the City of Ottawa.

3. OBJECTIVES

The principal objectives of this study are to (i) determine pedestrian level wind comfort and safety conditions at key areas within and surrounding the development site; (ii) identify areas where wind conditions may interfere with the intended uses of outdoor spaces; and (iii) recommend suitable mitigation measures, where required.

4. METHODOLOGY

The approach followed to quantify pedestrian wind conditions over the site is based on CFD simulations of wind speeds across the study site within a virtual environment, meteorological analysis of the Ottawa area wind climate, and synthesis of computational data with City of Ottawa wind comfort and safety criteria[1]. The following sections describe the analysis procedures, including a discussion of the noted pedestrian wind criteria.

[1] City of Ottawa Terms of References: Wind Analysis
https://documents.ottawa.ca/sites/default/files/torwindanalysis_en.pdf

4.1 Computer-Based Context Modelling

A computer based PLW study was performed to determine the influence of the wind environment on pedestrian comfort over the proposed development site. Pedestrian comfort predictions, based on the mechanical effects of wind, were determined by combining measured wind speed data from CFD simulations with statistical weather data obtained from Ottawa Macdonald-Cartier International Airport. The general concept and approach to CFD modelling is to represent building and topographic details in the immediate vicinity of the study site on the surrounding model, and to create suitable atmospheric wind profiles at the model boundary. The wind profiles are designed to have similar mean and turbulent wind properties consistent with actual site exposures.

An industry standard practice is to omit trees, vegetation, and other existing and planned landscape elements from the model due to the difficulty of providing accurate seasonal representation of vegetation. The omission of trees and other landscaping elements produces slightly stronger wind speeds.

4.2 Wind Speed Measurements

The PLW analysis was performed by simulating wind flows and gathering velocity data over a CFD model of the site for 12 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of 480 m. Wind simulations were performed for the two context scenarios described in Section 2.

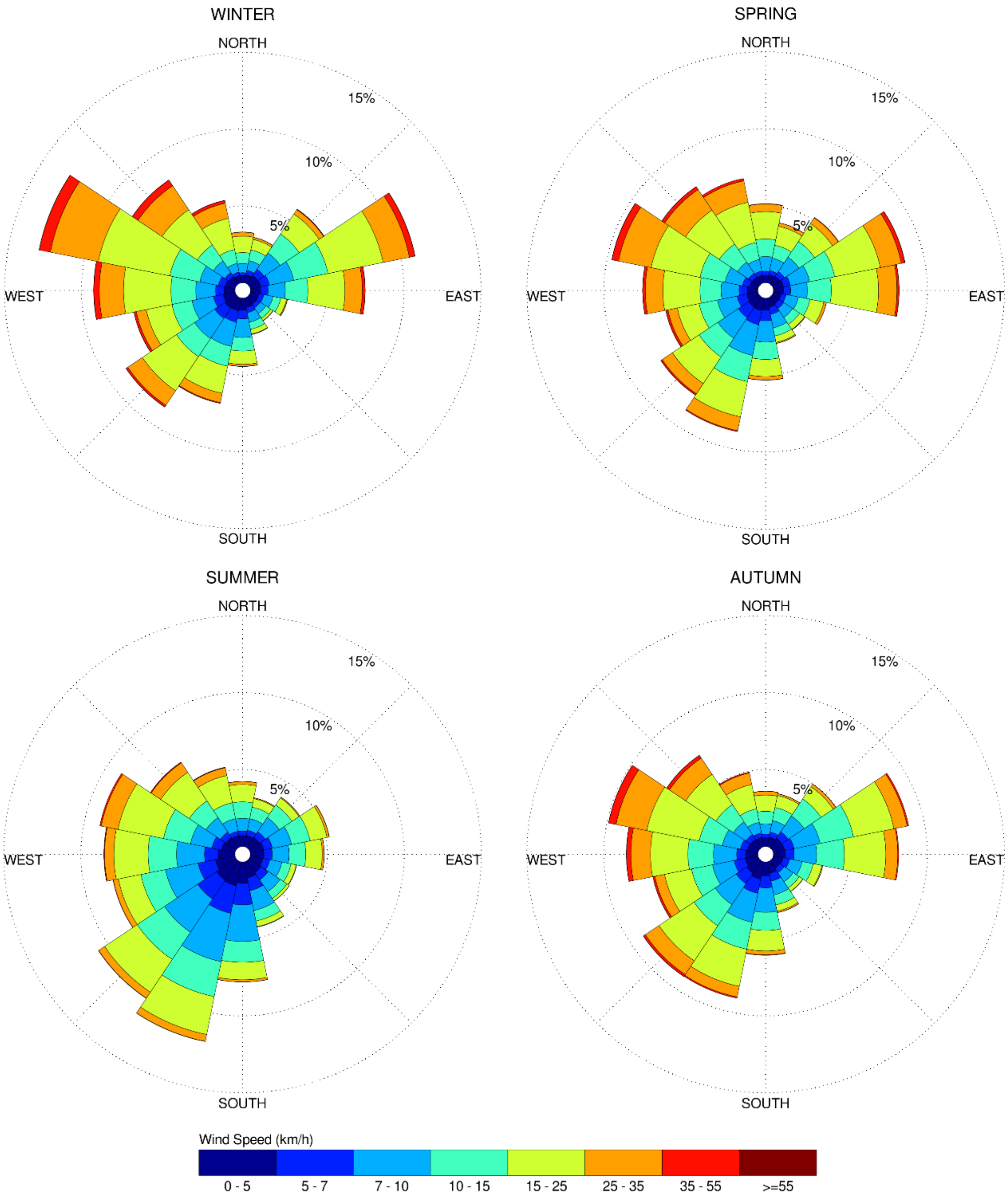
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the common amenity terraces were referenced to the wind speed at gradient height to generate mean and peak velocity ratios, which were used to calculate full-scale values. Gradient height represents the theoretical depth of the boundary layer of the earth’s atmosphere, above which the mean wind speed remains constant. Further details of the wind flow simulation technique are presented in Appendix A.

4.3 Historical Wind Speed and Direction Data

A statistical model for winds in Ottawa was developed from approximately 40 years of hourly meteorological wind data recorded at Ottawa Macdonald-Cartier International Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed for each month of the year to determine the statistically prominent wind directions and corresponding speeds, and to characterize similarities between monthly weather patterns.

The statistical model of the Ottawa area wind climate, which indicates the directional character of local winds on a seasonal basis, is illustrated on the following page. The plots illustrate seasonal distribution of measured wind speeds and directions in kilometers per hour (km/h). Probabilities of occurrence of different wind speeds are represented as stacked polar bars in sixteen azimuth divisions. The radial direction represents the percentage of time for various wind speed ranges per wind direction during the measurement period. The prominent wind speeds and directions can be identified by the longer length of the bars. For Ottawa, the most common winds occur for westerly wind directions, followed by those from the east, while the most common wind speeds are below 36 km/h. The directional prominence and relative magnitude of wind speed changes somewhat from season to season.

SEASONAL DISTRIBUTION OF WIND
OTTAWA MACDONALD-CARTIER INTERNATIONAL AIRPORT



Notes:

1. Radial distances indicate percentage of time of wind events.
2. Wind speeds are mean hourly in km/h, measured at 10 m above the ground.

4.4 Pedestrian Wind Comfort and Safety Criteria – City of Ottawa

Pedestrian comfort and safety criteria are based on the mechanical effects of wind without consideration of other meteorological conditions (that is, temperature, relative humidity). The comfort criteria assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Five pedestrian comfort classes are based on 20% non-exceedance mean wind speed ranges, which include (1) Sitting; (2) Standing; (3) Strolling; (4) Walking; and (5) Uncomfortable. More specifically, the comfort classes and associated mean wind speed ranges are summarized as follows:

1) **Sitting:** Mean wind speeds no greater than 10 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 16 km/h.

2) **Standing:** Mean wind speeds no greater than 14 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 22 km/h.

3) **Strolling:** Mean wind speeds no greater than 17 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 27 km/h.

4) **Walking:** Mean wind speeds no greater than 20 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 32 km/h.

5) **Uncomfortable:** Uncomfortable conditions are characterized by predicted values that fall below the 80% target for walking. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

The pedestrian safety wind speed criterion is based on the approximate threshold that would cause a vulnerable member of the population to fall. A 0.1% exceedance gust wind speed of 90 km/h is classified as dangerous. The gust speeds, and equivalent mean speeds, are selected based on 'The Beaufort Scale', presented on the following page, which describes the effects of forces produced by varying wind speed levels on objects. Gust speeds are included because pedestrians tend to be more sensitive to wind gusts than to steady winds for lower wind speed ranges. For strong winds approaching dangerous levels, this effect is less important because the mean wind can also create problems for pedestrians.

THE BEAUFORT SCALE

Number	Description	Gust Wind Speed (km/h)	Description
2	Light Breeze	9-17	Wind felt on faces
3	Gentle Breeze	18-29	Leaves and small twigs in constant motion; wind extends light flags
4	Moderate Breeze	30-42	Wind raises dust and loose paper; small branches are moved
5	Fresh Breeze	43-57	Small trees in leaf begin to sway
6	Strong Breeze	58-74	Large branches in motion; Whistling heard in electrical wires; umbrellas used with difficulty
7	Moderate Gale	75-92	Whole trees in motion; inconvenient walking against wind
8	Gale	93-111	Breaks twigs off trees; generally impedes progress

Experience and research on people's perception of mechanical wind effects has shown that if the wind speed levels are exceeded for more than 20% of the time, the activity level would be judged to be uncomfortable by most people. For instance, if a mean wind speed of 10 km/h (equivalent gust wind speed of approximately 16 km/h) were exceeded for more than 20% of the time most pedestrians would judge that location to be too windy for sitting. Similarly, if mean wind speed of 20 km/h (equivalent gust wind speed of approximately 30 km/h) at a location were exceeded for more than 20% of the time, walking or less vigorous activities would be considered uncomfortable. As these criteria are based on subjective reactions of a population to wind forces, their application is partly based on experience and judgment.

Once the pedestrian wind speed predictions have been established throughout the site, the assessment of pedestrian comfort involves determining the suitability of the predicted wind conditions for discrete regions within and surrounding the subject site. This step involves comparing the predicted comfort classes to the desired comfort classes, which are dictated by the location type for each region (that is, a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their typical windiest desired comfort classes are summarized on the following page. Depending on the programming of a space, the desired comfort class may differ from this table.

DESIRED PEDESTRIAN COMFORT CLASSES FOR VARIOUS LOCATION TYPES

Location Types	Desired Comfort Classes
Primary Building Entrance	Standing
Secondary Building Access	Walking
Public Sidewalk / Bicycle Path	Walking
Outdoor Amenity Space	Sitting / Standing
Café / Patio / Bench / Garden	Sitting / Standing
Transit Stop (Without Shelter)	Standing
Transit Stop (With Shelter)	Walking
Public Park / Plaza	Sitting / Standing
Garage / Service Entrance	Walking
Parking Lot	Walking
Vehicular Drop-Off Zone	Walking

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-6D, illustrating wind conditions at grade level within the subject site and over the Lion's Park for the proposed and existing massing scenarios, and Figures 9A-9D, illustrating wind conditions over the common amenity terraces serving the proposed development. Conditions are presented as continuous contours of wind comfort throughout the subject site and correspond to the comfort classes noted in Section 4.4. Wind conditions suitable for sitting are represented by the colour blue, standing by green, strolling by yellow, and walking by orange; uncomfortable conditions are represented by the colour magenta.

Wind conditions at grade and within the common amenity terraces serving Buildings A and B are also reported for the typical use period, which is defined as May to October, inclusive. Figure 7 illustrates wind comfort conditions at grade level within the subject site, while Figures 8A and 8B illustrates wind comfort conditions over Lion's Park for the proposed and existing massing scenarios, respectively. Figure 10 illustrates wind comfort conditions within the common amenity terraces. The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Ground Floor

Sidewalks and Building Access along Scott Street: Following the introduction of the proposed development, the nearby public sidewalks along Scott Street are predicted to be suitable for a mix of sitting and standing during the summer, suitable for a mix of standing and strolling during the autumn, becoming suitable for a mix of standing, strolling, and walking during the winter and spring. Conditions in the vicinity of building access points serving Buildings A and B fronting Scott Street are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, during the remaining three seasons. The noted conditions are considered acceptable.

Conditions over the sidewalks along Scott Street with the existing massing are predicted to be suitable for a mix of sitting and standing during the summer. During the spring and autumn, the sidewalks are predicted to be mostly suitable for standing with a region that is predicted to be suitable for strolling to the immediate east of 2046-2050 Scott Street. During the winter, conditions along the sidewalks are predicted to be suitable for a mix of standing and strolling with an isolated region predicted to be suitable for walking at the northeast corner of 2046-2050 Scott Street during the winter. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are considered acceptable.

Sidewalk and Building Access along Athlone Avenue: Following the introduction of the proposed development, the public sidewalk along Athlone Avenue is predicted to be suitable for a mix of sitting and standing during the summer, with an isolated region suitable for strolling. During the autumn, conditions are predicted to be suitable for strolling, or better, with an isolated region suitable for walking. During the winter and spring, conditions are predicted to be suitable for walking, or better.

Conditions in the vicinity of building access points serving Building A fronting Athlone Avenue are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable.

Conditions over the sidewalks along Athlone Avenue with the existing massing are predicted to be suitable for sitting during the summer and autumn, becoming suitable for a mix of sitting and standing during the winter and spring. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are considered acceptable.

Walkway and Building Access along West Elevation of Subject Site: Conditions during the summer over the walkway along the west elevation of Building B are predicted to be suitable for standing, or better, with an isolated region suitable for strolling. During the spring and autumn, conditions are predicted to be suitable for strolling, or better, with an isolated region suitable for walking. During the winter, conditions are predicted to be suitable for walking, or better.

Wind comfort conditions in the vicinity of the secondary building access points along the west elevation of Building B are predicted to be suitable for standing, or better, throughout the year. The only exceptions are the exits to the south of the ramp, where conditions are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the spring and autumn, and suitable for walking, or better, during the winter. The noted conditions are considered acceptable.

Walkways and Building Access along South Elevation of Subject Site: Wind conditions over the walkways along the south elevation of Buildings A and B are predicted to be suitable for standing, or better, throughout the year. Conditions in the vicinity of building access points serving Building A along the south elevation are predicted to be suitable for sitting throughout the year. Per the architectural drawings, Building B is not served by building access points along its south elevation. The noted conditions are considered acceptable.

Building Access Along West Elevation of Building A: Conditions in the vicinity of the secondary building access points along the west elevation of Building A are predicted to be suitable for standing during the summer and autumn, becoming suitable for walking during the winter and spring. While walking conditions are considered satisfactory for secondary building access points, strong wind speeds are expected to occur between Buildings A and B and may create uncomfortable conditions on account of prominent westerly winds that accelerate between the buildings. As such, it is recommended that the building access points be recessed into the façade by at least 2 m.

Building Access Along East Elevation of Building B: Conditions in the vicinity of the secondary building access points along the east elevation of Building B are predicted to be suitable for sitting during the summer, becoming suitable for standing during the remaining three seasons. The noted conditions are considered acceptable.

Parkland Area and Outdoor Amenity: The proposed development is served by a parkland area to the south of the subject site and an outdoor amenity between Buildings A and B. Wind comfort conditions during the typical use period are illustrated in Figure 7 and described as follows:

- **Parkland Area:** Wind conditions within the parkland area to the south of Building B are predicted to be suitable for sitting to the west, and suitable for standing near the northwest corner and to the east. The areas that are predicted to be suitable for standing are also predicted to be suitable for sitting for at least 73% of the time during the typical use period, where the target is 80% to achieve the sitting comfort class. Since most of the area is predicted to be suitable for sitting, the noted conditions are considered acceptable.

- **Outdoor Amenity:** Owing to the prominent westerly winds, and the channelling effect produced by the proximity of Buildings A and B, the outdoor amenity at grade is predicted to be windy. Specifically, wind comfort conditions are predicted to be suitable for a mix of standing and strolling during the typical use period. Notably, a central region within the outdoor amenity is predicted to experience uncomfortable conditions during the winter, as illustrated in Figure 6A. Conditions may be improved within the area by introducing tall wind screens between Buildings A and B in addition to coniferous plantings in dense arrangements. The extent of wind mitigation is dependant on the programming of the area. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

Lion's Park: Following the introduction of the proposed development, wind comfort conditions over Lion's Park to the immediate south of the proposed development are predicted to be mostly suitable for sitting during the typical use period, with standing conditions predicted to occur at the northwest and northeast corners of the park, as illustrated in Figure 8A. The areas that are predicted to be suitable for standing are also predicted to be suitable for sitting for at least 76% of the time during the same period, where the target is 80% to achieve the sitting comfort class.

Wind comfort conditions over Lion's Park with the existing massing are predicted to be suitable for sitting during the typical use period, with standing conditions at the northwest corner of the park, as illustrated in Figure 8B. The area that is predicted to be suitable for standing is also predicted to be suitable for sitting for at least 74% of the time during the same period, where the target is 80% to achieve the sitting comfort class. Since wind comfort conditions with the existing massing are predicted to be similar to those with the proposed development, and since the windiest areas are close to achieving the sitting comfort class, the noted conditions are considered acceptable.

5.2 Wind Comfort Conditions – Common Amenity Terraces

The proposed development is served by several amenity terraces. The common amenity terraces serving Building A at Level 8 and Building B at Level 10 were modelled with 1.8-m-tall wind screens along their full perimeters. Additionally, the common amenity terraces serving Buildings A and B at their respective MPH level, as well as the common amenity serving the proposed development atop the building link at Level 11, were modelled with 2-m-tall wind screens along their full perimeters. Wind comfort conditions during the typical use period within the noted areas, and recommendation regarding further mitigation, where required, are described as follows:

Building A, Level 8 and MPH level: With the noted mitigation, wind comfort conditions within the common amenity terraces serving Building A at Level 8 and at the MPH level are predicted to be suitable for sitting, as illustrated in Figure 10. The noted conditions are considered acceptable.

Building B, Level 10: With the noted mitigation, wind comfort conditions within the common amenity terrace serving Building B at Level 10 are predicted to be suitable for sitting, as illustrated in Figure 10. The noted conditions are considered acceptable.

Building B, MPH level: With the noted mitigation, wind comfort conditions within the common amenity terrace serving Building B at the MPH level are predicted to be suitable for sitting to the north and south, and suitable for standing throughout the remainder of the terrace, as illustrated in Figure 10. The area that is predicted to be suitable for standing is also predicted to be suitable for sitting for at least 73% of the time during the typical use period, where the target is 80% to achieve the sitting comfort class.

To improve wind comfort conditions within the terrace, it is recommended to include taller wind screens along the full perimeter of the terrace. Specifically, 2.4-m-tall wind screens, glazed and solid, are recommended. Additionally, mitigation inboard of the perimeter, which could take form of 1.8-m-tall wind screens and/or other landscape elements such as planters and dense clusters of coniferous plantings and/or trees located around the windiest areas, are recommended to further improved conditions within the terrace. The extent of mitigation measures is dependant on the programming of the terrace. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

Building Link, Level 11: Owing to the prominent westerly winds, and the channelling effect produced by the proximity of Buildings A and B, the common amenity terrace serving the proposed development atop the building link at Level 11 is predicted to be windy. Specifically, with the noted mitigation, wind comfort conditions are predicted to be mostly suitable for standing, as illustrated in Figure 10.

To improve wind comfort conditions within the terrace, it is recommended that the terrace be served by 2.4-m-tall wind screens, glazed and solid. Additionally, mitigation inboard of the perimeter, which could take form of 1.8-m-tall wind screens and/or other landscape elements such as planters and dense clusters of coniferous plantings and/or trees located around designated sitting areas, are recommended to further improved conditions within the terrace.

The extent of mitigation measures is dependant on the programming of the terrace. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

Canopies located above designated seating areas are also recommended to further improve conditions. The underside of the canopies should measure no greater than 4 m from the local walking surface of the terrace and extend at least 3 m outwards from the west and east elevations of Buildings A and B, respectively, to deflect downwash incident on the tall buildings.

The extent of mitigation measures is dependant on the programming of the terrace. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas at grade level are predicted to experience conditions that could be considered dangerous, per the definition in Section 4.4.

Two areas within the common amenity terrace atop the proposed link connecting Buildings A and B are predicted to experience conditions that could be considered dangerous. The areas are located to the north and south of the terrace. Gust wind speeds greater than 90 km/h are estimated to occur for at least 0.22% of the time over the noted areas (that is, 19 hours annually), where the threshold is 0.1% of the time (that is, 9 hours annually). While the wind mitigation recommendations described in Section 5.2 are expected to reduce strong wind speeds to below the wind safety threshold, mitigation testing will be required to confirm the effectiveness of the preferred wind mitigation strategy.

5.4 Applicability of Results

Pedestrian wind comfort and safety have been quantified for the specific configuration of existing and foreseeable construction around the subject site. Future changes (that is, construction or demolition) of these surroundings may cause changes to the wind effects in two ways, namely: (i) changes beyond the immediate vicinity of the subject site would alter the wind profile approaching the subject site; and (ii) development in proximity to the subject site would cause changes to local flow patterns.

Regarding primary and secondary building access points, wind conditions predicted in this study are only applicable to pedestrian comfort and safety. As such, the results should not be construed to indicate wind loading on doors and associated hardware.

6. CONCLUSIONS AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-10. Based on computer simulations using the CFD technique, meteorological data analysis of the Ottawa wind climate, City of Ottawa wind comfort and safety criteria, and experience with numerous similar developments, the study concludes the following:

1) Most grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered satisfactory for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, walkways, Lion's Park, and in the vicinity of building access points, are considered acceptable. Two windy areas are described as follows:

    a. **Grade-Level Outdoor Amenity Area.** Owing to the prominent westerly winds, and the channelling effect produced by the proximity of Buildings A and B, the outdoor amenity at grade is predicted to be windy. Specifically, wind comfort conditions are predicted to be suitable for a mix of standing and strolling during the typical use period. Notably, a central region within the outdoor amenity is predicted to experience uncomfortable conditions during the winter, as illustrated in Figure 6A.

        - Conditions may be improved within the area by introducing tall wind screens between Buildings A and B in addition to coniferous plantings in dense arrangements. The extent of wind mitigation is dependant on the programming of the area. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

    b. **Building Access Along West Elevation of Building A:** Conditions in the vicinity of the secondary building access points along the west elevation of Building A are predicted to be suitable for standing during the summer and autumn, becoming suitable for walking during the winter and spring. While walking conditions are considered satisfactory for secondary building access points, strong wind speeds are expected to occur between Buildings A and B, as noted above. As such, it is recommended that the building access points be recessed into the façade by at least 2 m.

2) The common amenity terraces serving Building A at Level 8 and Building B at Level 10 were modelled with 1.8-m-tall wind screens along their full perimeters. Additionally, the common amenity terraces serving Buildings A and B at their respective MPH level, as well as the common amenity terrace serving the proposed development atop the building link at Level 11, were modelled with 2-m-tall wind screens along their full perimeters. Wind comfort conditions during the typical use period within the noted areas, as illustrated in Figure 10, and recommendation regarding further mitigation, where required, are described as follows:

   a. With the noted mitigation, wind conditions over the common amenity terraces serving Building A at Level 8 and at the MPH level, and over the common amenity terrace serving Building B at Level 10, are predicted to be suitable for sitting. The noted conditions are considered acceptable.

   b. With the noted mitigation, wind conditions within the common amenity terrace serving Building B at the MPH level are predicted to be suitable for sitting to the north and south, and suitable for standing throughout the remainder of the terrace.

   c. With the noted mitigation, wind comfort conditions within the common amenity terrace serving the proposed development atop the building link at Level 11 are predicted to be mostly suitable for standing.

   d. To improve wind comfort conditions within the common amenity terraces serving Building B at the MPH level, it is recommended to include taller wind screens along the full perimeter of the terrace. Specifically, 2.4-m-tall wind screens, glazed and solid, are recommended. Additionally, mitigation inboard of the perimeter, which could take form of 1.8-m-tall wind screens and/or other landscape elements such as planters and dense clusters of coniferous plantings and/or trees located around the windiest areas, are recommended to further improved conditions within the terrace.

   e. To improve wind comfort conditions within the common amenity terraces atop the building link connecting Buildings A and B, it is recommended that the terrace be served by 2.4-m-tall wind screens, glazed and solid. Additionally, mitigation inboard of the perimeter, which could take form of 1.8-m-tall wind screens and/or other landscape elements such as planters and dense clusters of coniferous plantings and/or trees located around designated sitting areas, are recommended to further improved conditions within the terrace. Additionally, canopies located above designated seating areas are also recommended to further improve conditions. The underside of the canopies should measure no greater than 4 m from the local walking surface of the terrace and extend at least 3 m outwards from the west and east elevations of Buildings A and B, respectively, to deflect downwash incident on the tall buildings.

f. The extent of mitigation measures is dependant on the programming of the terrace. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

3) **Wind Safety.** Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas at grade level are predicted to experience conditions that could be considered dangerous, per the definition in Section 4.4.

Two areas within the common amenity terrace atop the proposed link connecting Buildings A and B are predicted to experience conditions that could be considered dangerous. The areas are located to the north and south of the terrace. Gust wind speeds greater than 90 km/h are estimated to occur for at least 0.22% of the time over the noted areas (that is, 19 hours annually), where the threshold is 0.1% of the time (that is, 9 hours annually). While the wind mitigation recommendations described in Section 5.2 are expected to reduce strong wind speeds to below the wind safety threshold, mitigation testing will be required to confirm the effectiveness of the preferred wind mitigation strategy.

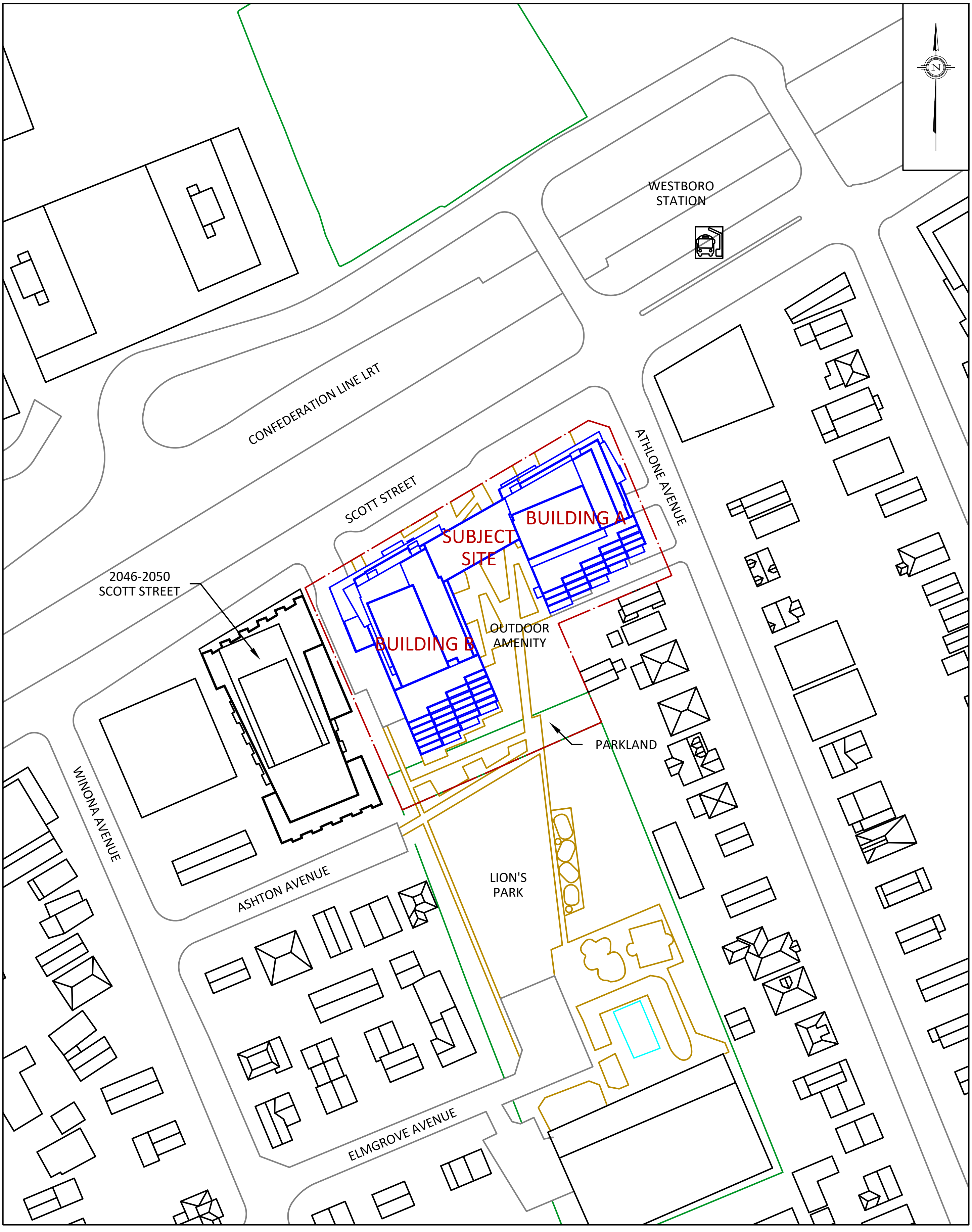
Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. D. FERRARO
100158495
Apr 28, 2023
PROVINCE OF ONTARIO

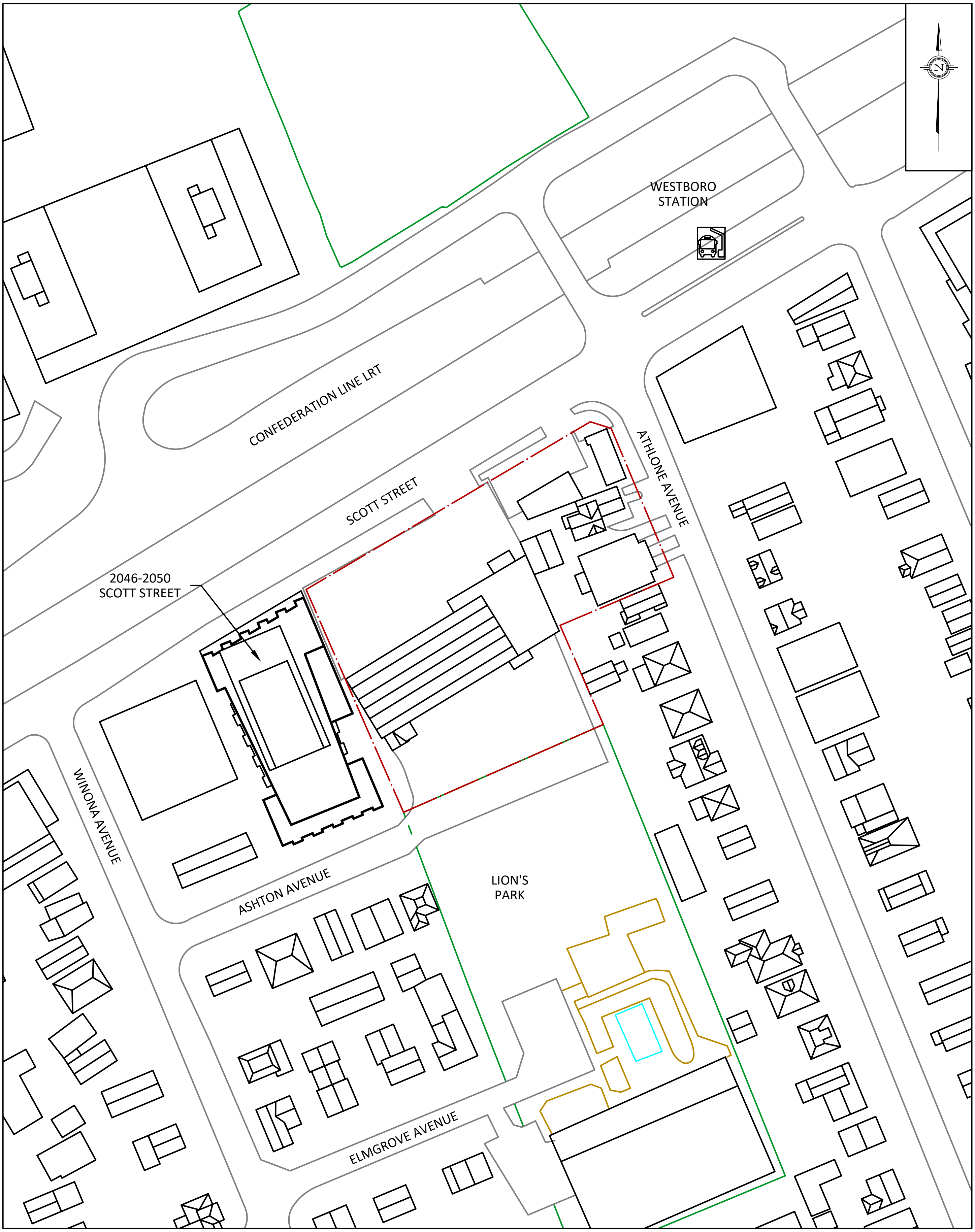
David Davalos, MESc
Junior Wind Scientist

Justin Ferraro, P.Eng.
Principal



GRADIENTWIND
ENGINEERS & SCIENTISTS
127 WALGREEN ROAD, OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT: 2026 SCOTT STREET, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:1500	DRAWING NO.: 22-006-PLW-2023-1A	
DATE: APRIL 28, 2023	DRAWN BY: T.K.	



GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD, OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	2026 SCOTT STREET, OTTAWA PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1500
DRAWING NO.	22-006-PLW-2023-1B
DATE	APRIL 28, 2023
DRAWN BY	T.K.
DESCRIPTION	FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT

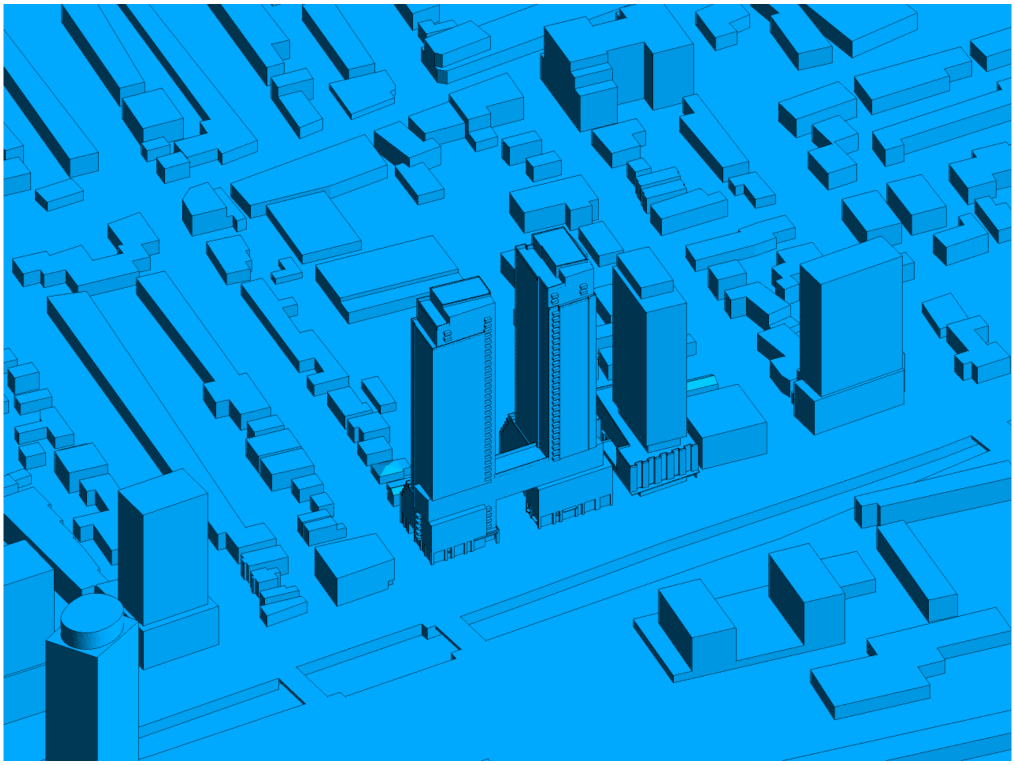


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

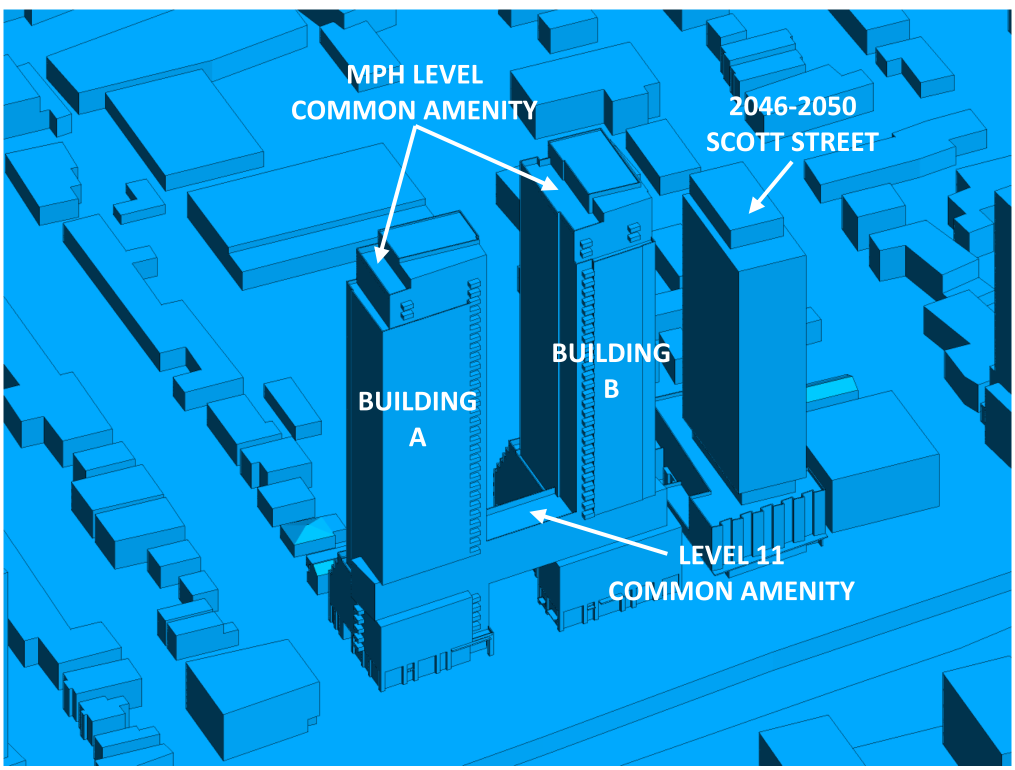


FIGURE 2B: CLOSE UP OF FIGURE 2A

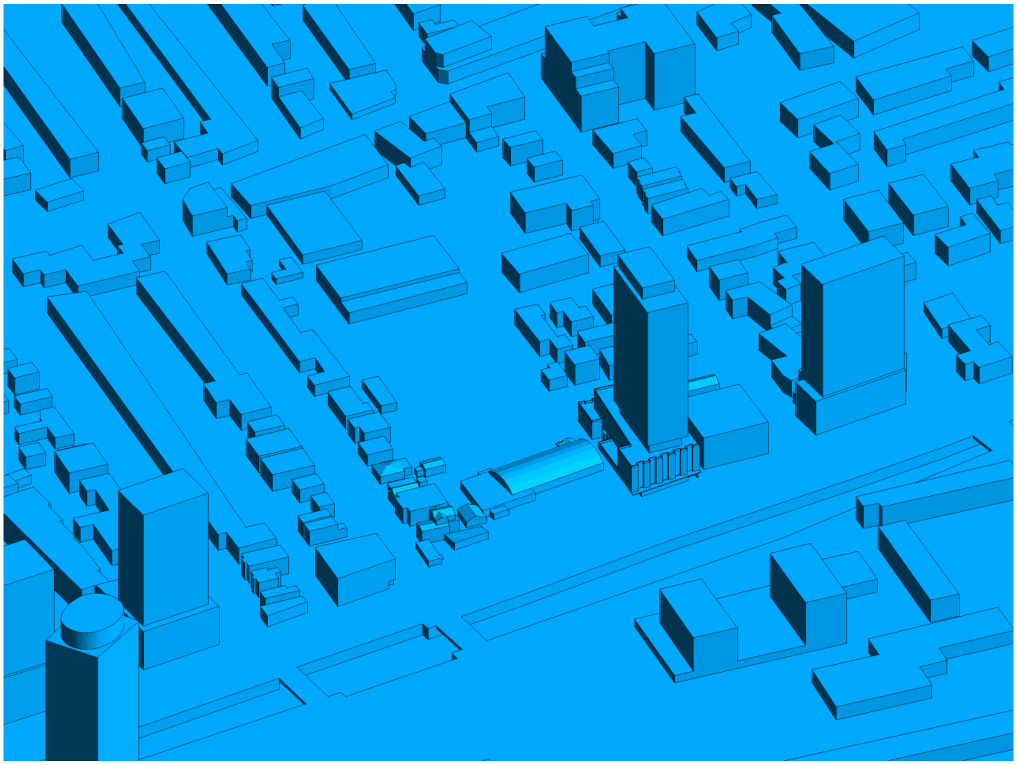


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

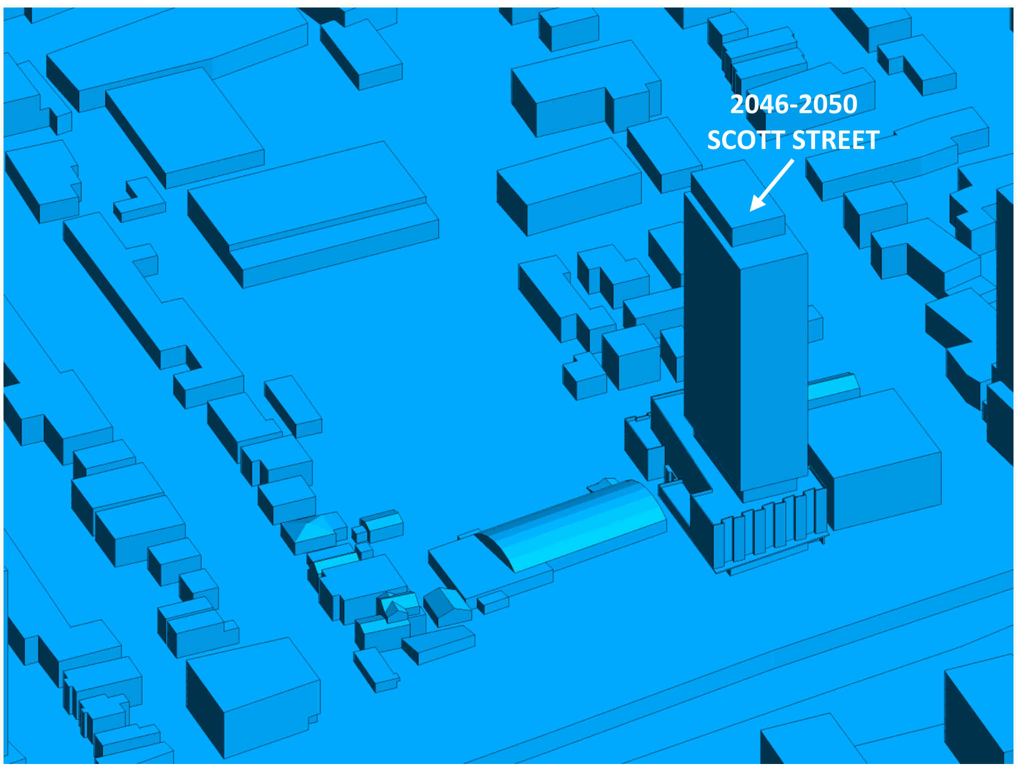


FIGURE 2D: CLOSE UP OF FIGURE 2C

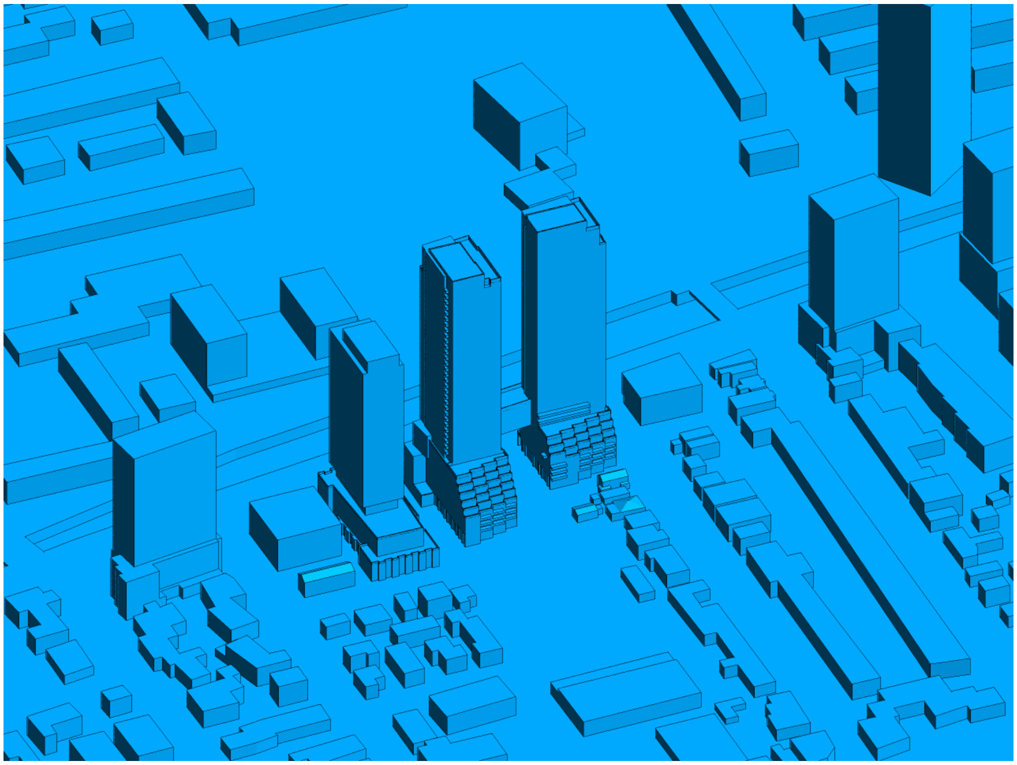


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

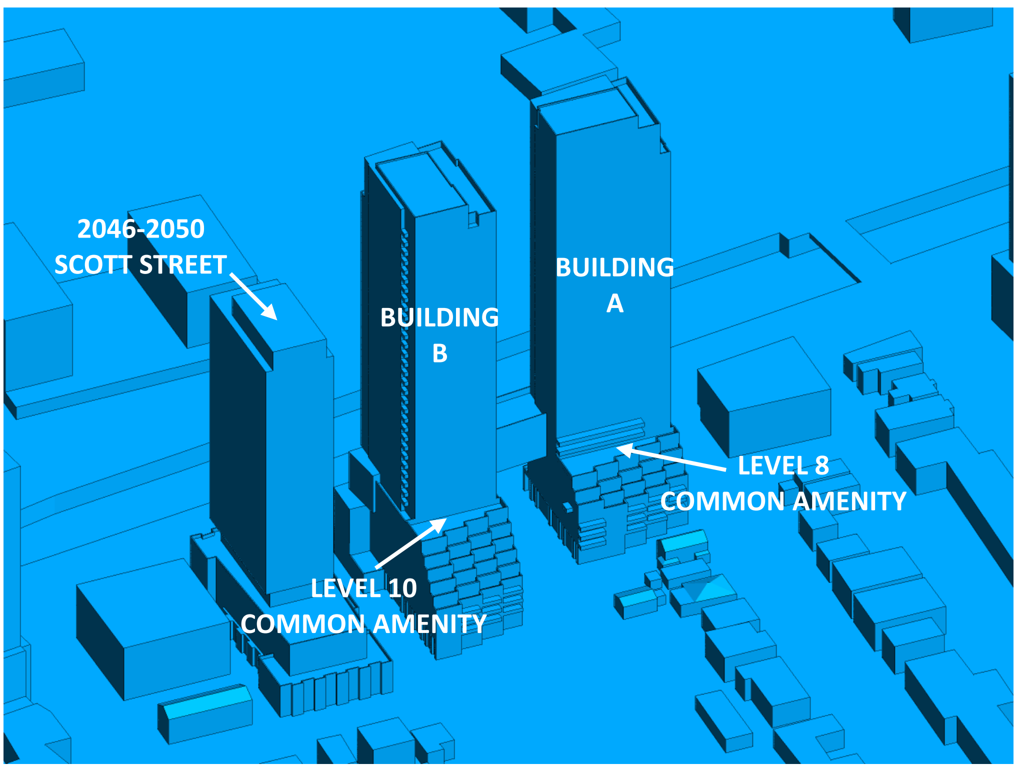


FIGURE 2F: CLOSE UP OF FIGURE 2E

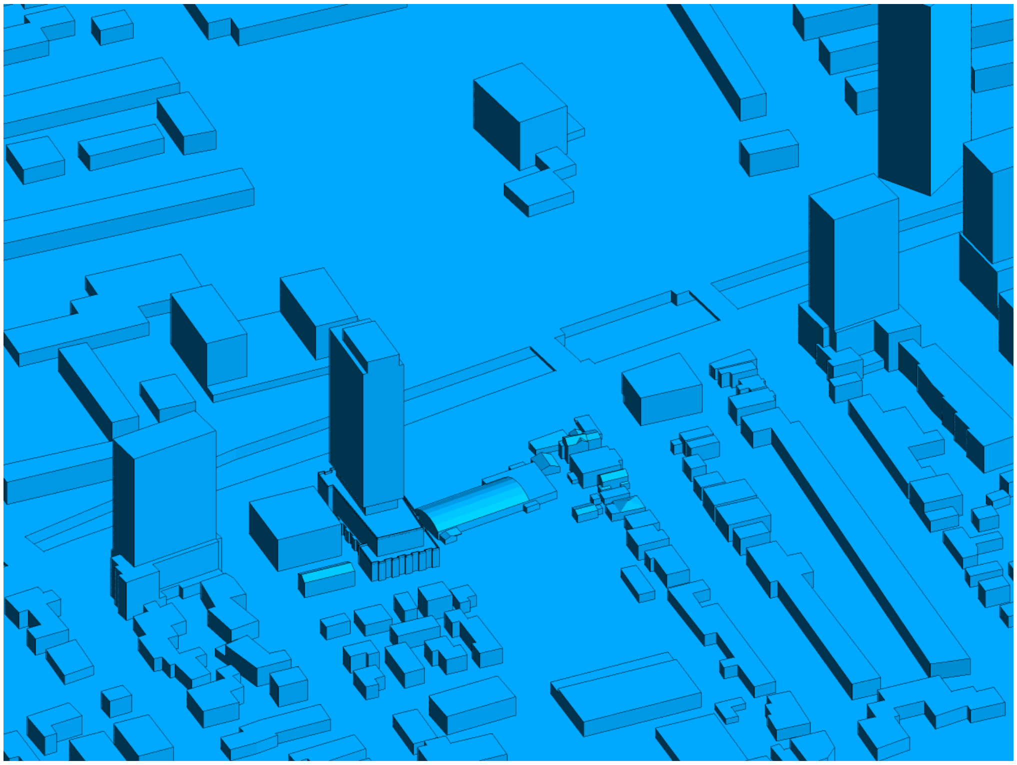


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

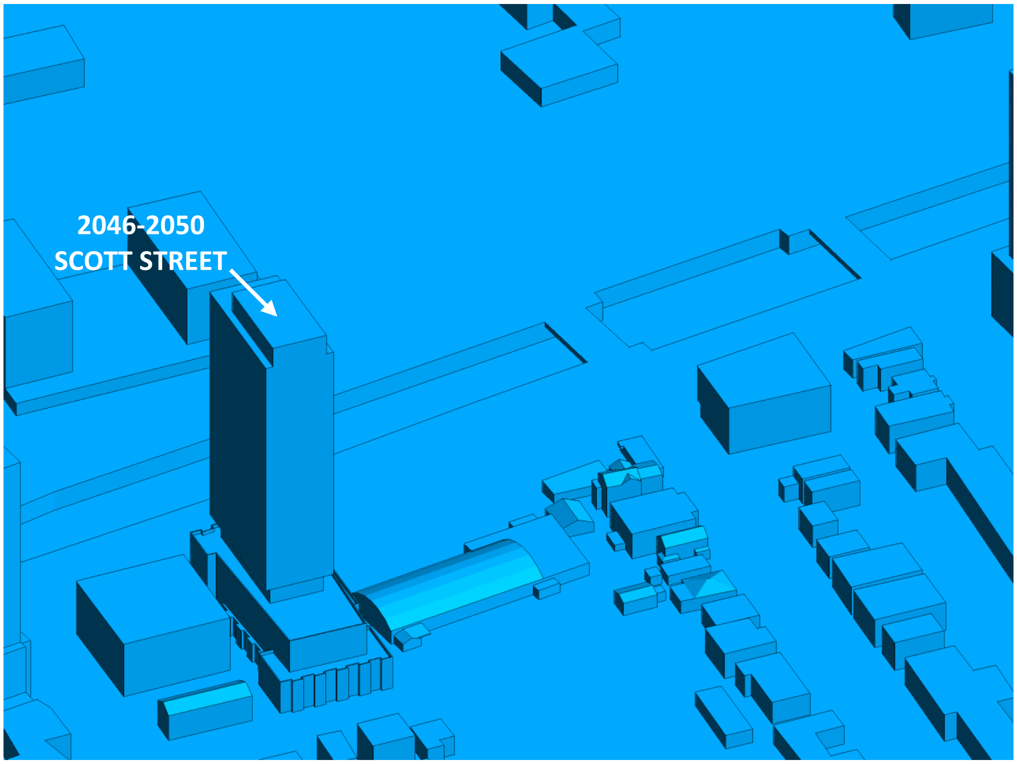


FIGURE 2H: CLOSE UP OF FIGURE 2G

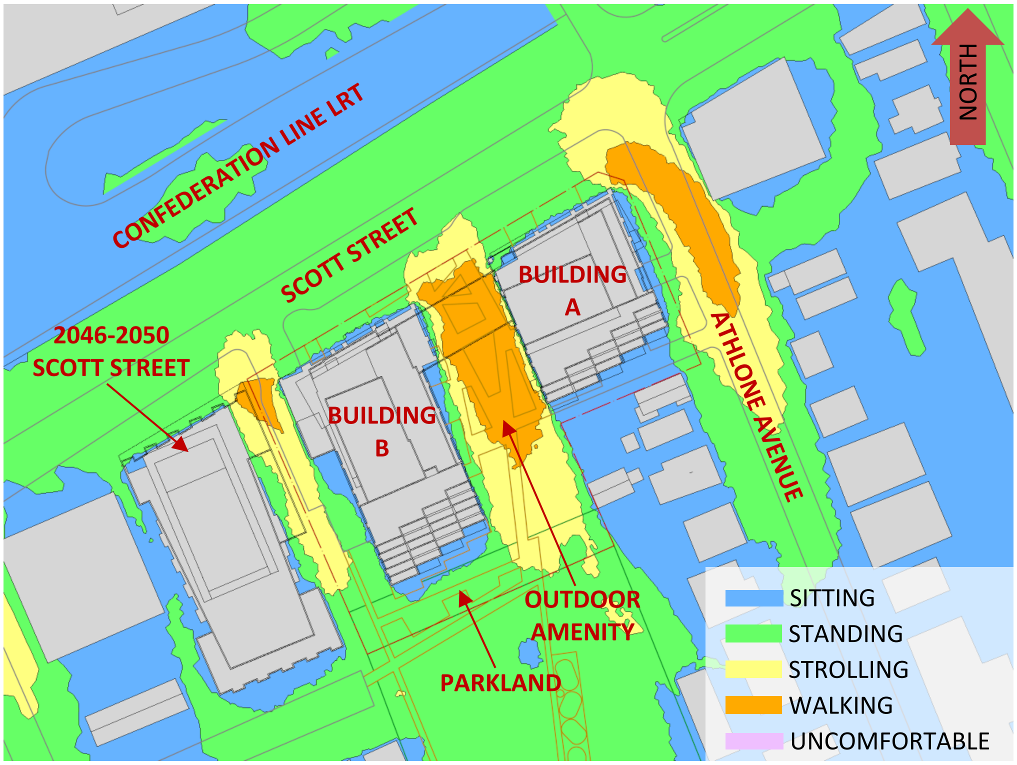


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

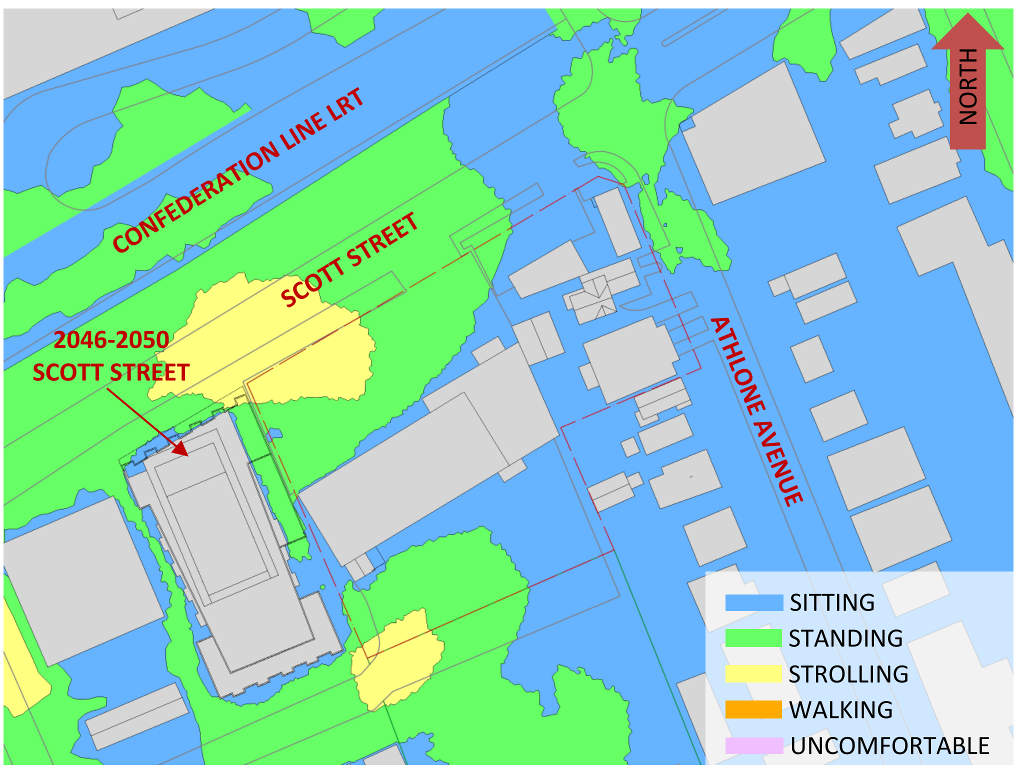


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

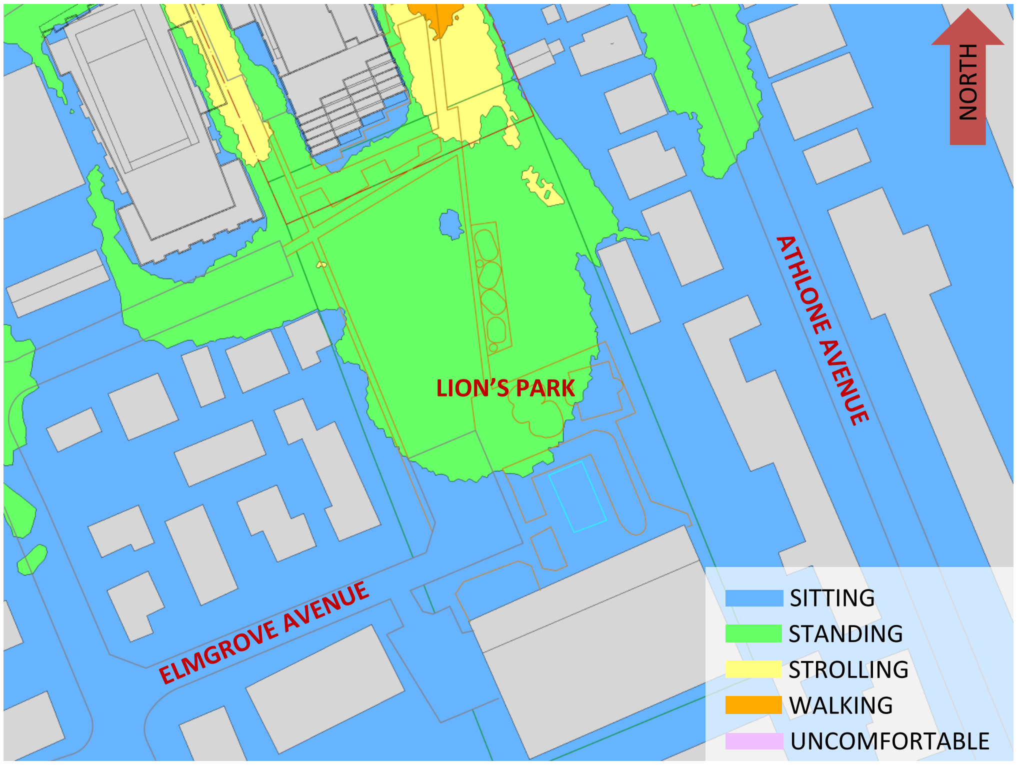


FIGURE 3C: SPRING – WIND COMFORT, LION'S PARK – PROPOSED MASSING

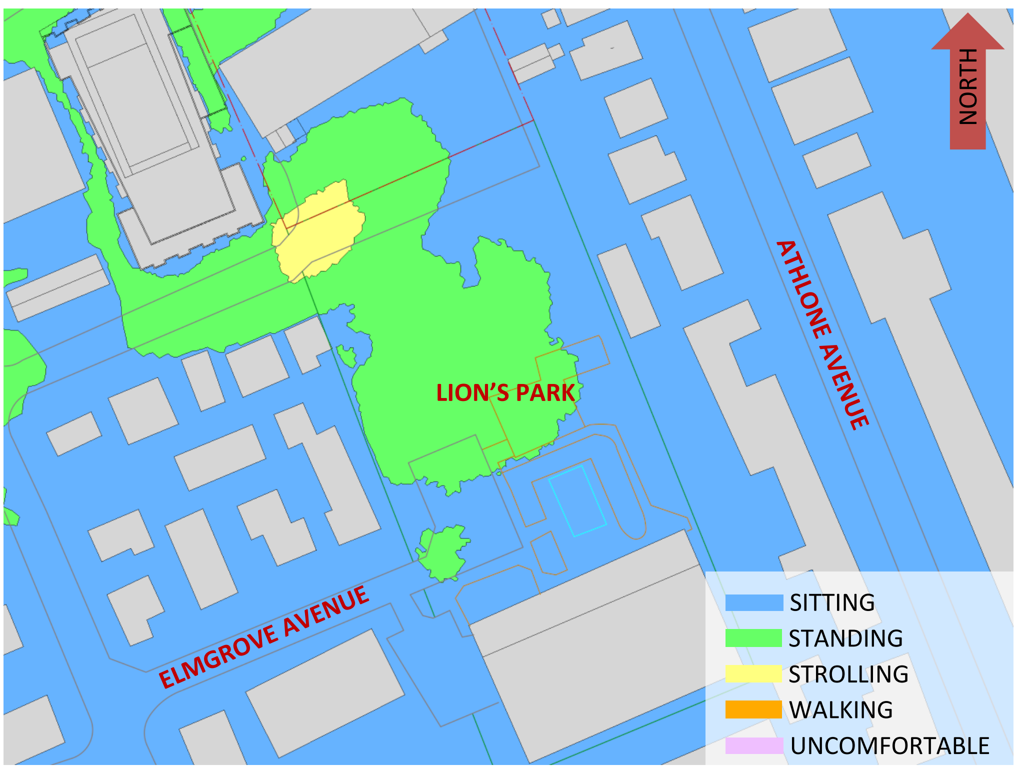


FIGURE 3D: SPRING – WIND COMFORT, LION'S PARK– EXISTING MASSING

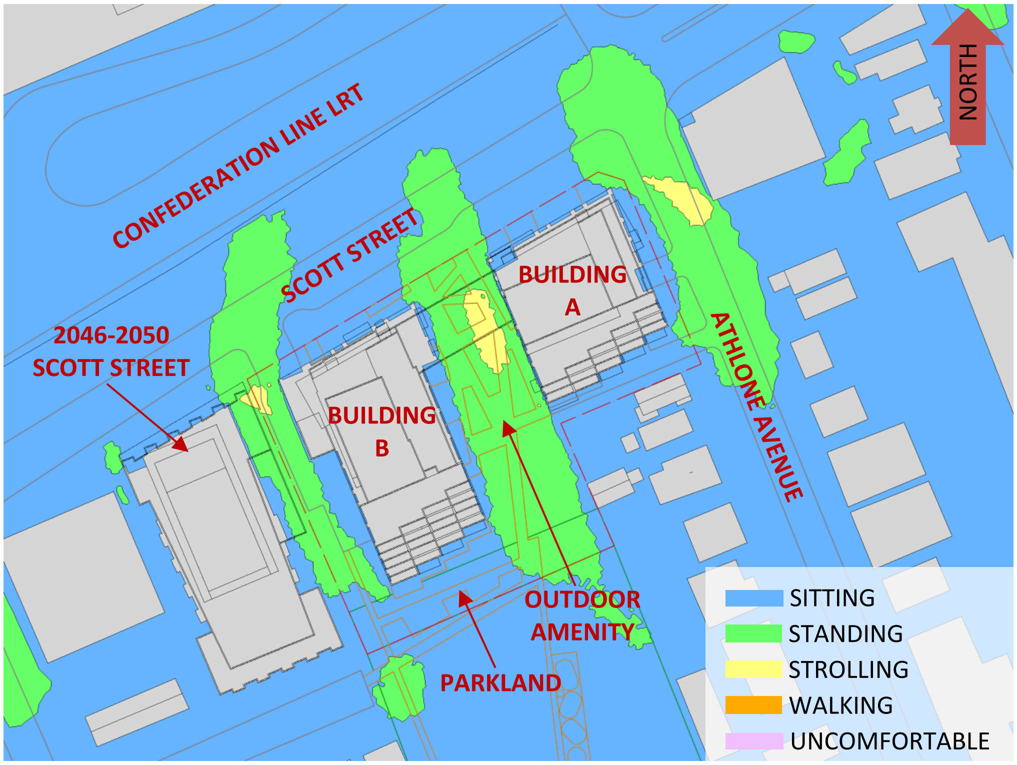


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

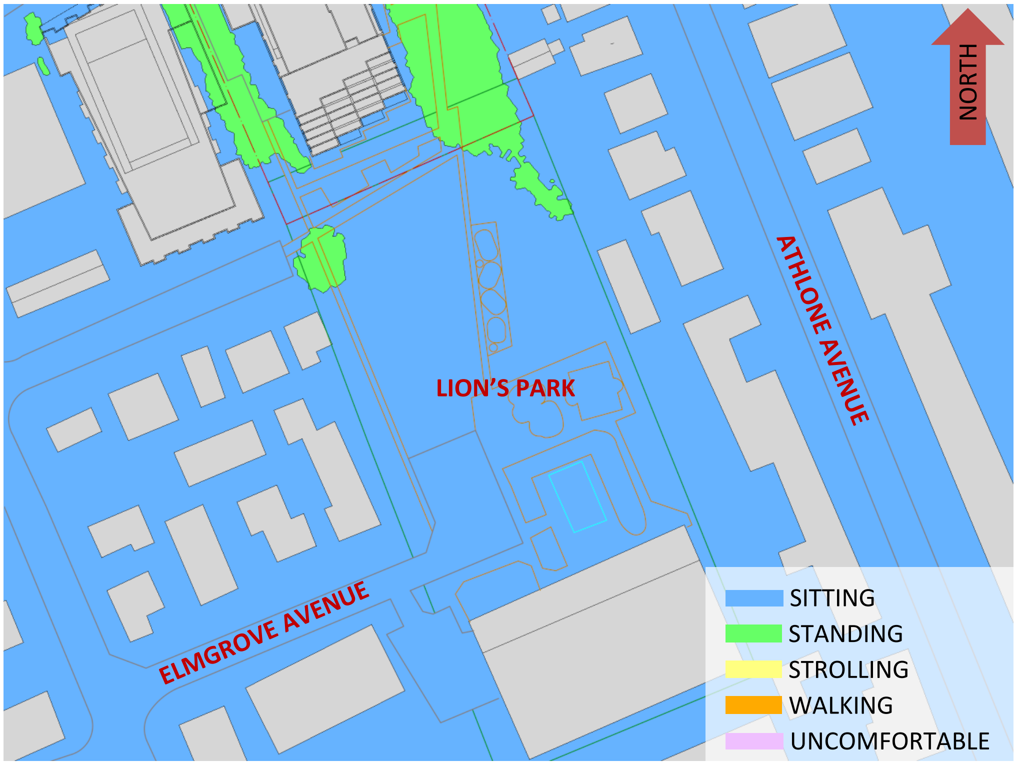


FIGURE 4C: SUMMER – WIND COMFORT, LION'S PARK – PROPOSED MASSING

FIGURE 4D: SUMMER – WIND COMFORT, LION'S PARK– EXISTING MASSING

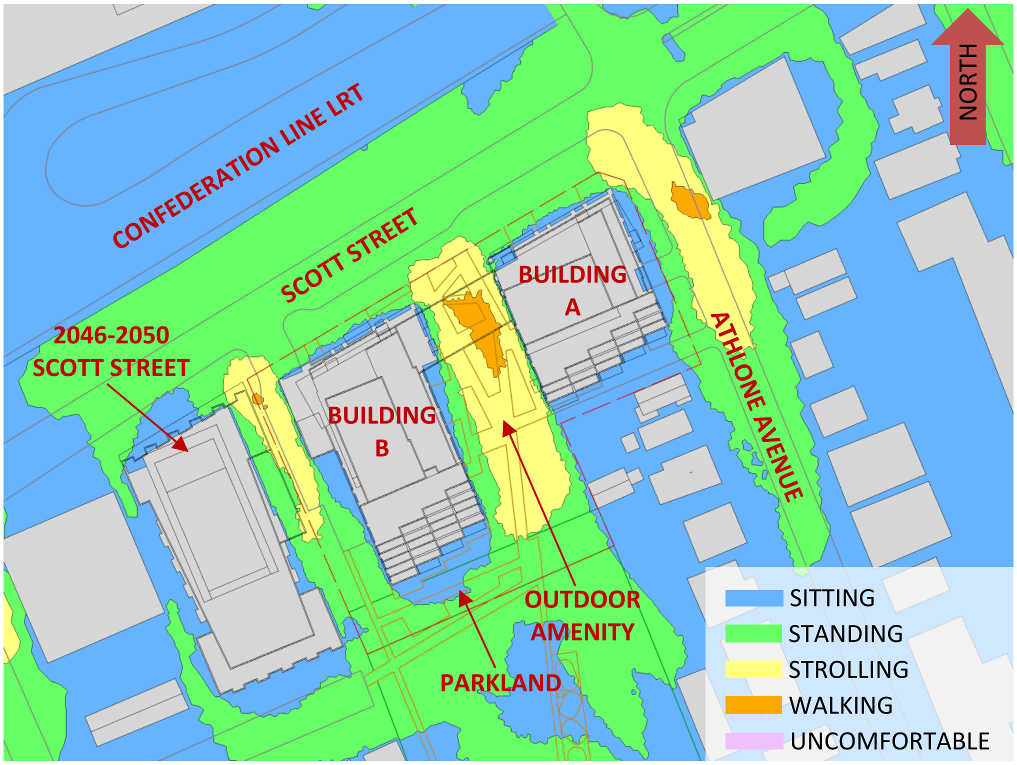


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

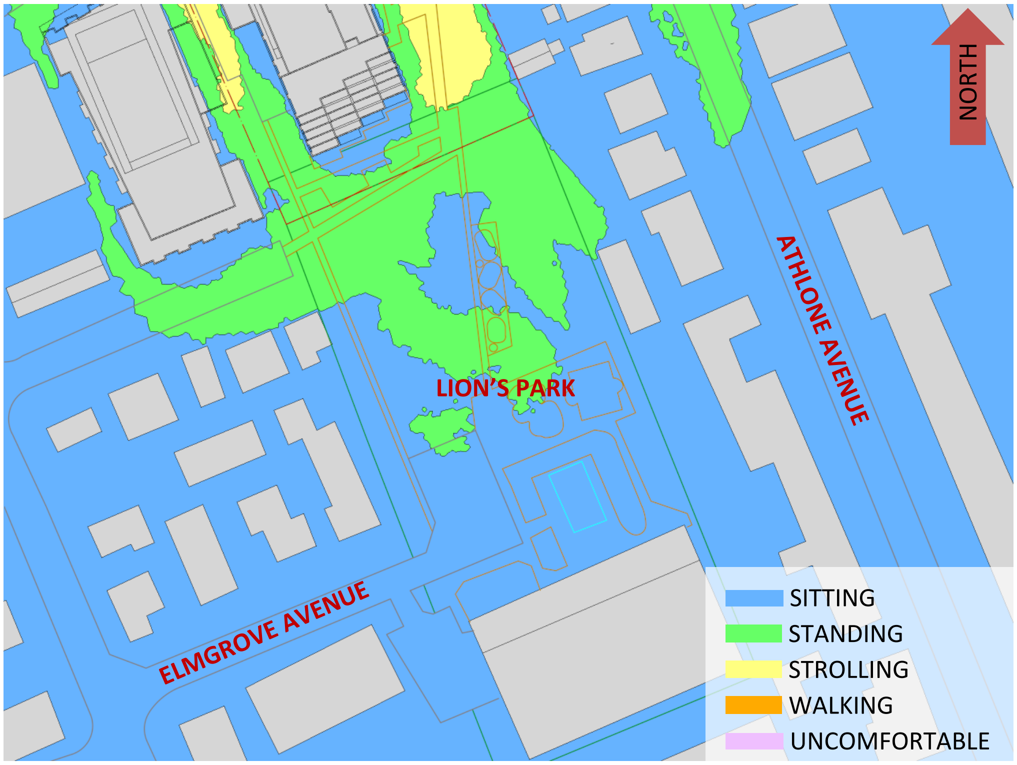


FIGURE 5C: AUTUMN – WIND COMFORT, LION'S PARK – PROPOSED MASSING

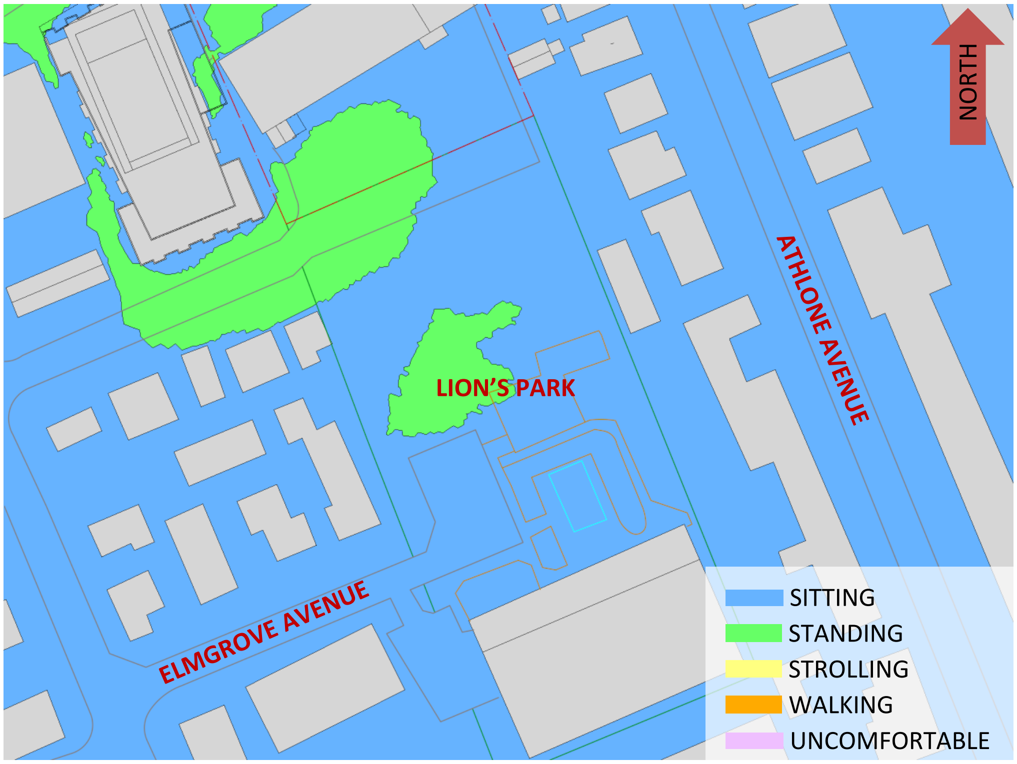


FIGURE 5D: AUTUMN – WIND COMFORT, LION'S PARK– EXISTING MASSING

FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

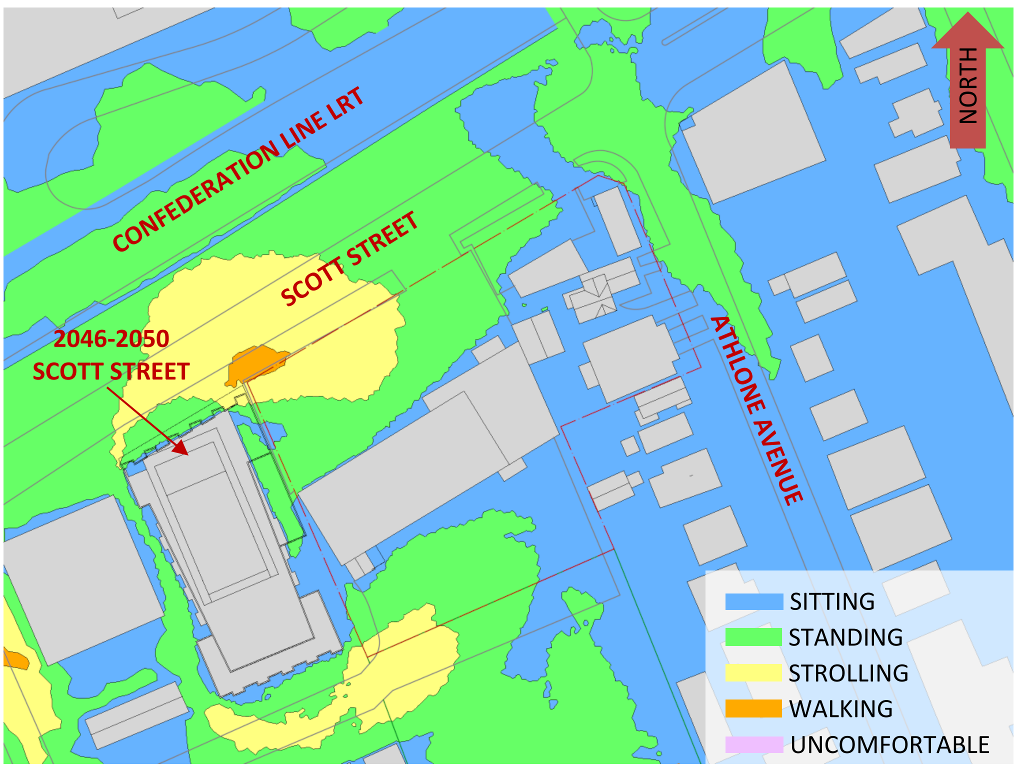


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

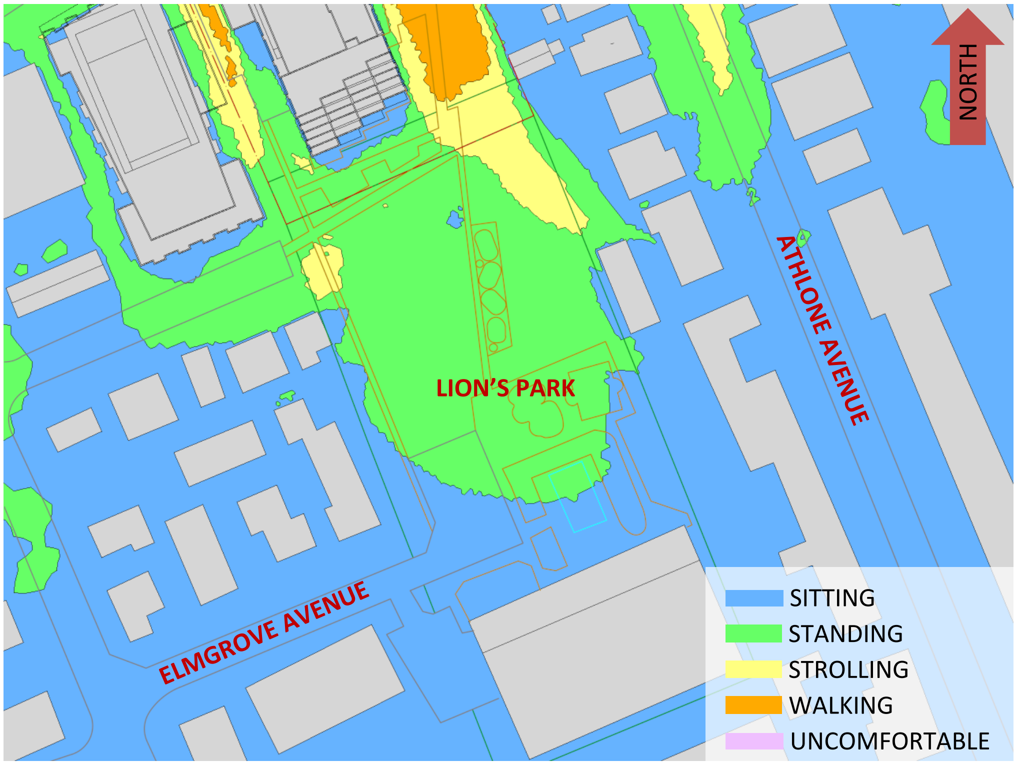


FIGURE 6C: WINTER – WIND COMFORT, LION'S PARK – PROPOSED MASSING

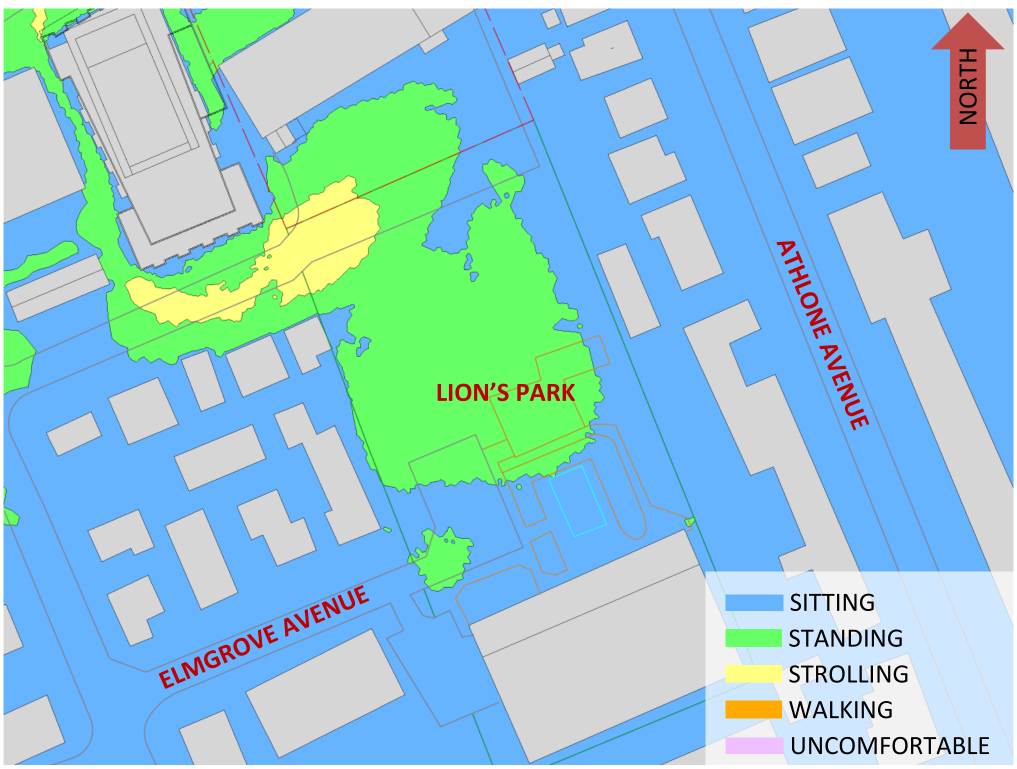


FIGURE 6D: WINTER – WIND COMFORT, LION'S PARK– EXISTING MASSING

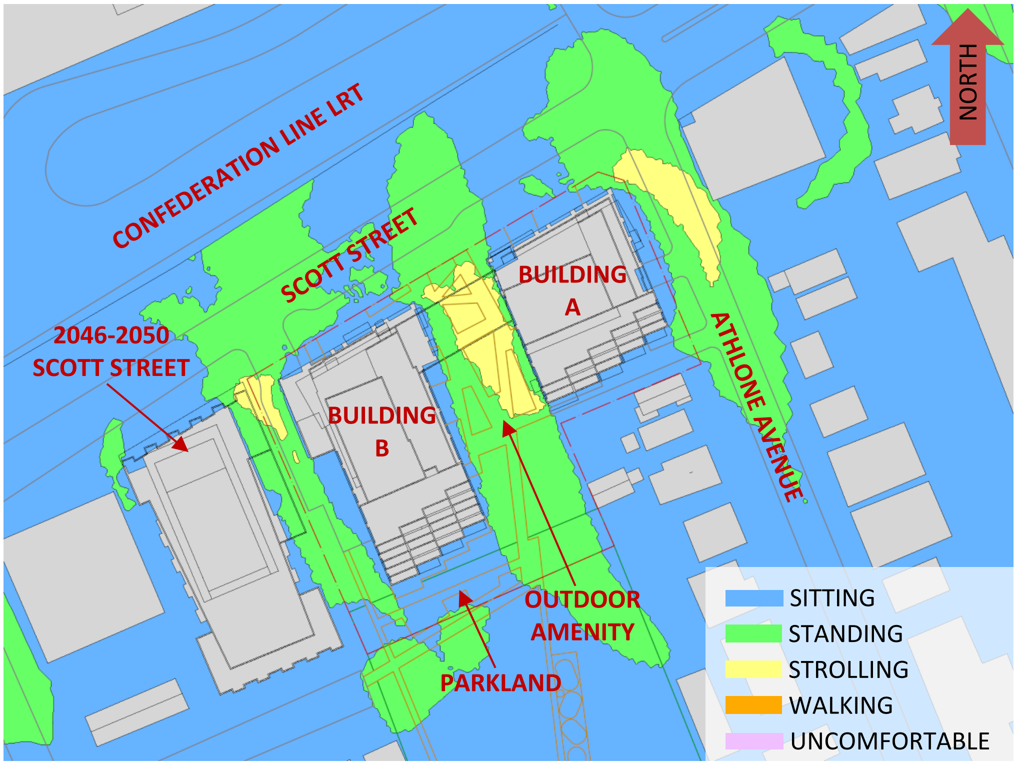


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

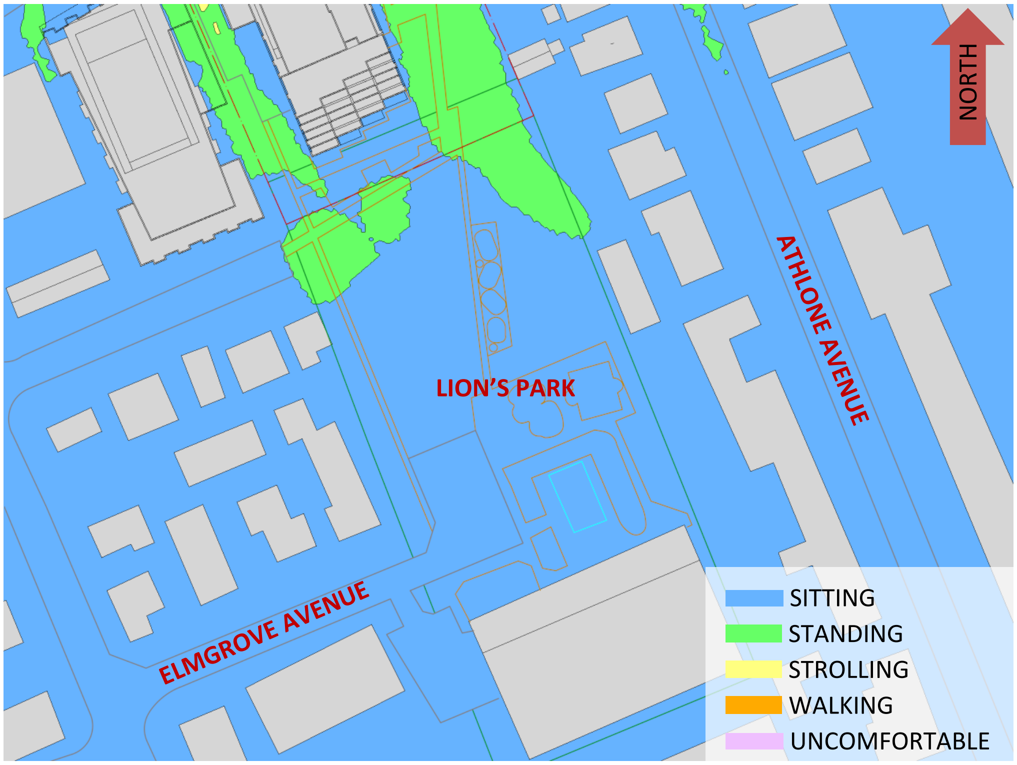


FIGURE 8A: TYPICAL USE PERIOD – WIND COMFORT, LION'S PARK – PROPOSED MASSING

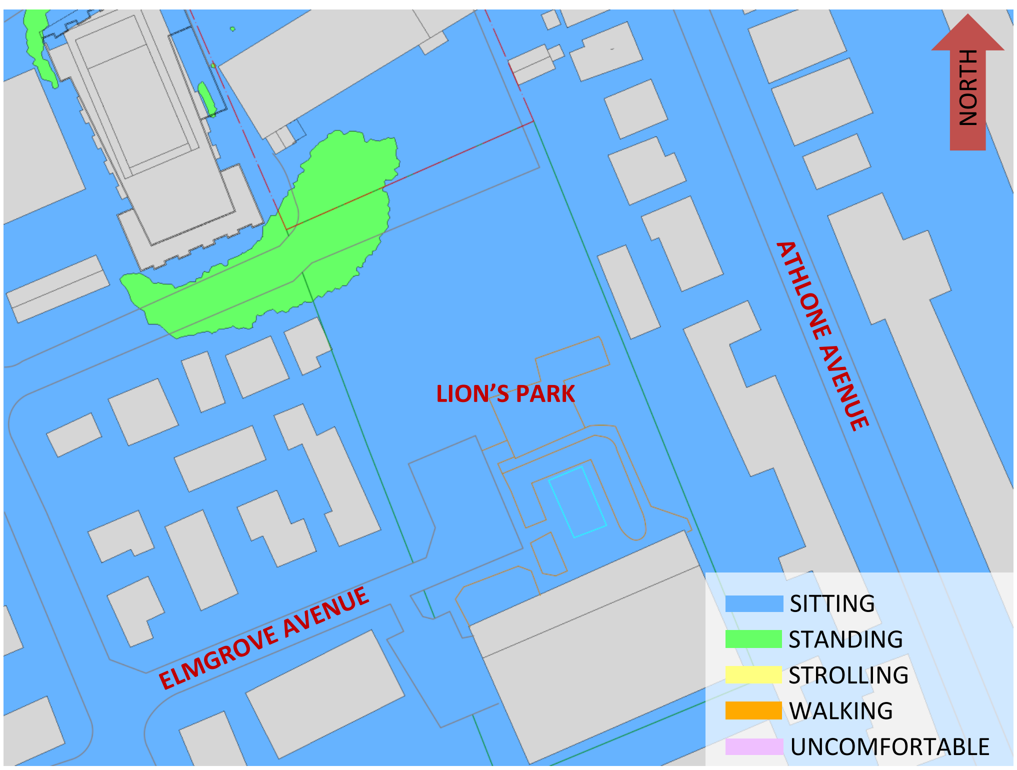


FIGURE 8B: TYPICAL USE PERIOD – WIND COMFORT, LION'S PARK – EXISTING MASSING

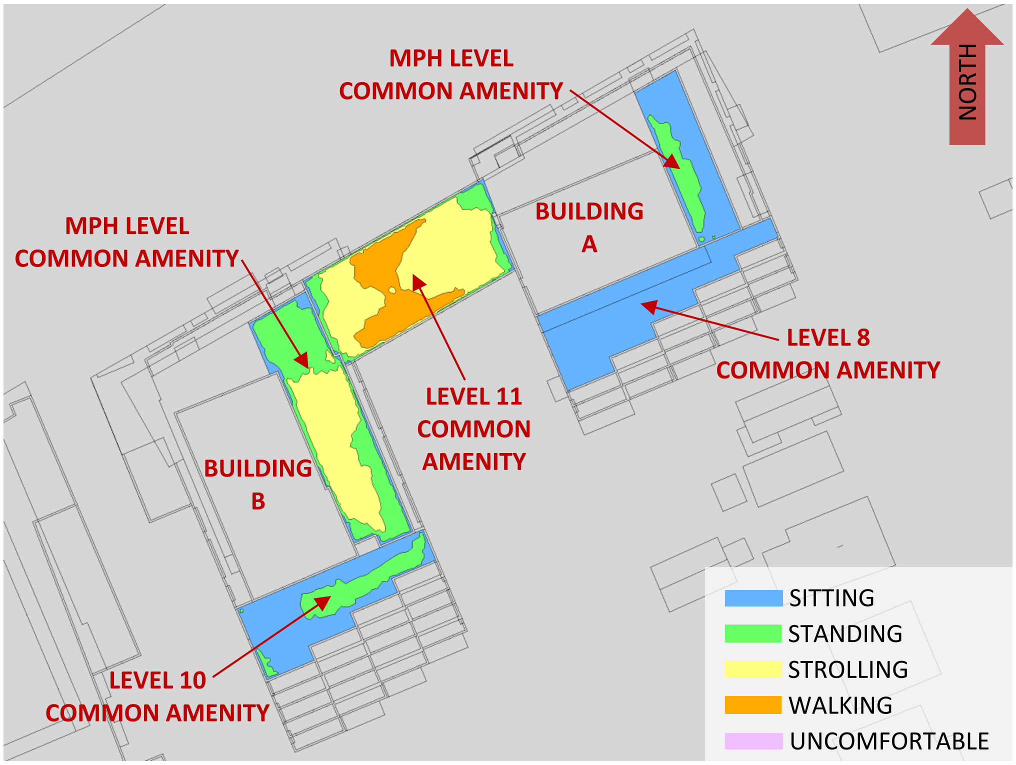


FIGURE 9A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

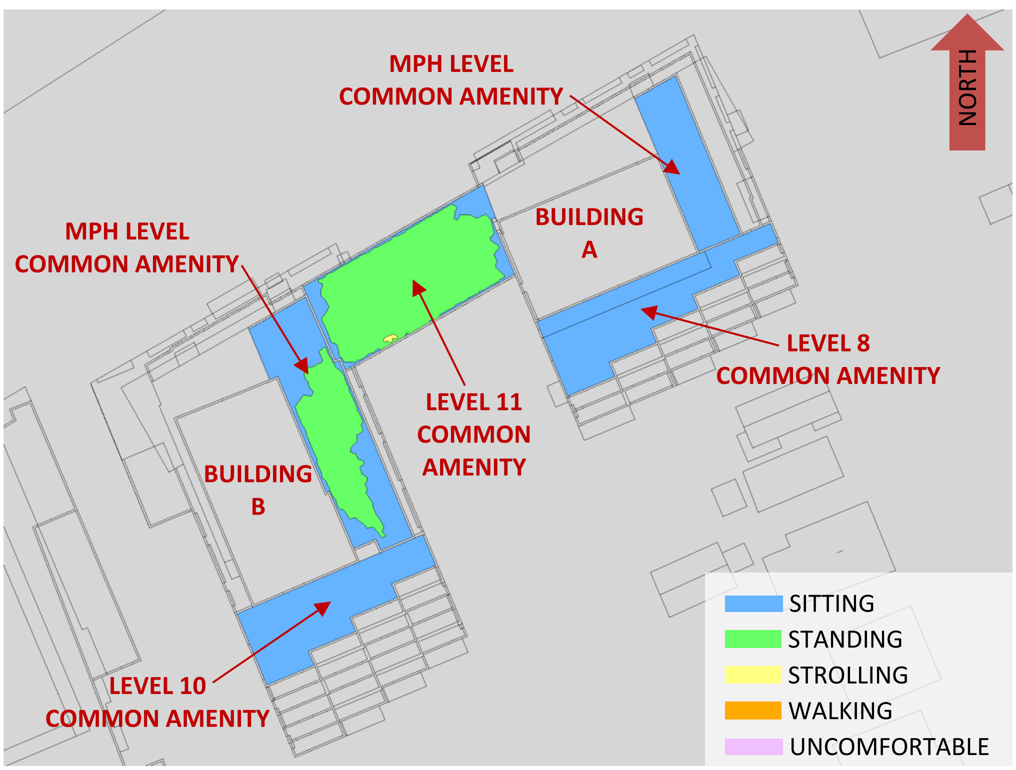


FIGURE 9B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACES

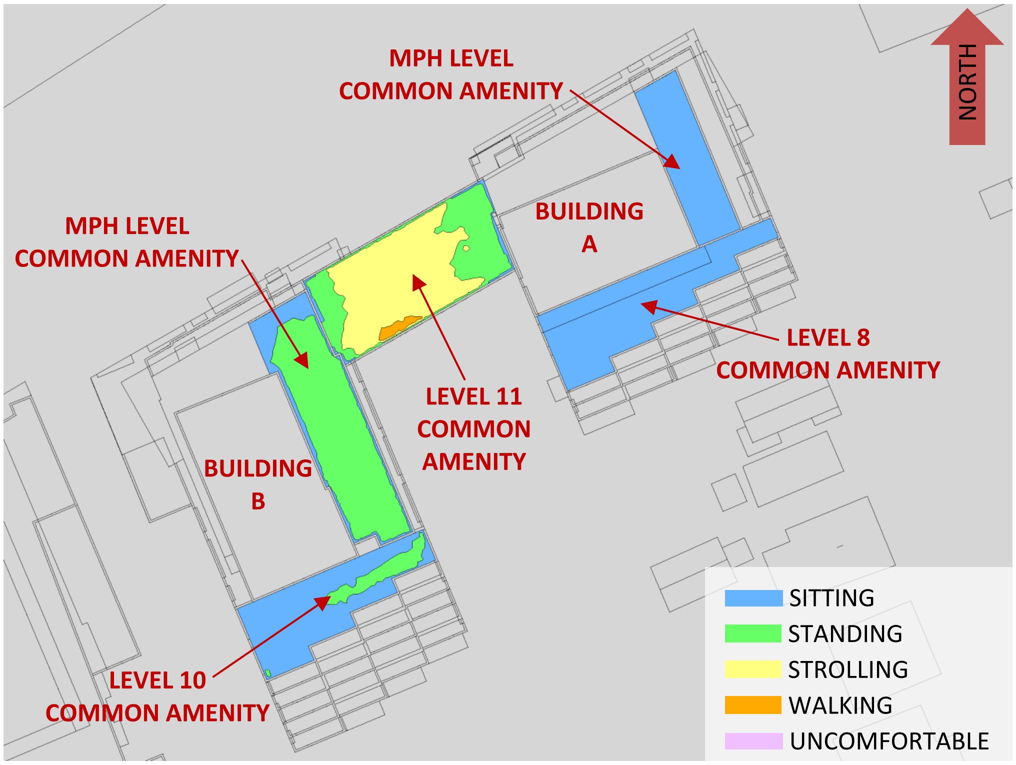


FIGURE 9C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACES

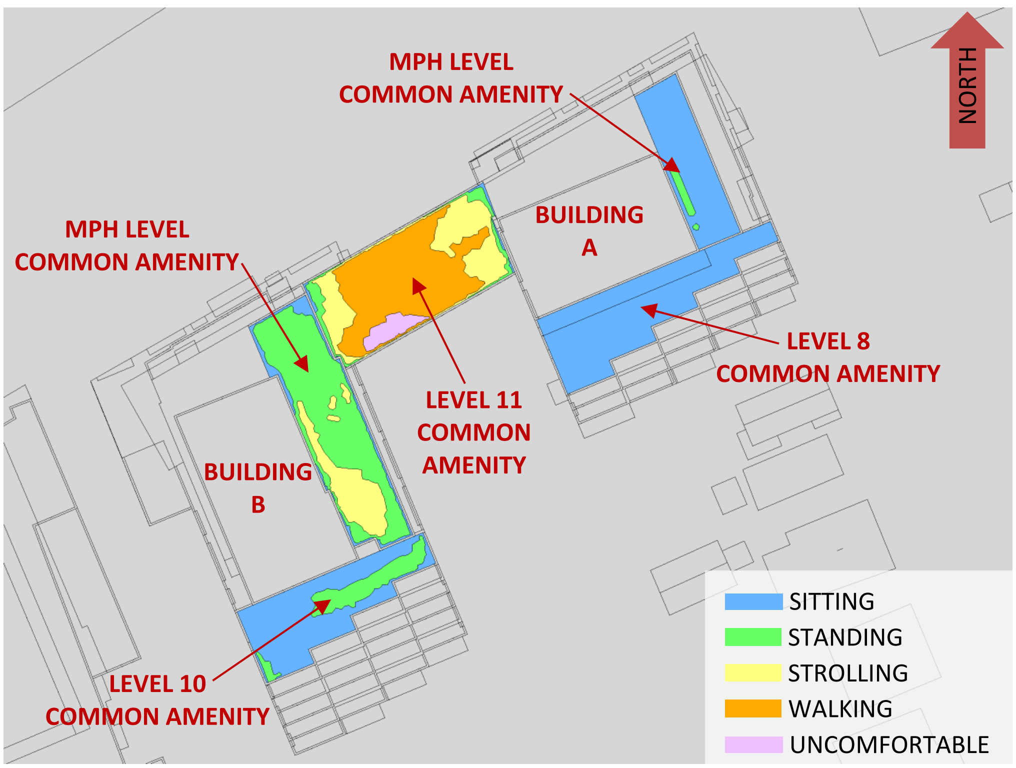


FIGURE 9D: WINTER – WIND COMFORT, COMMON AMENITY TERRACE

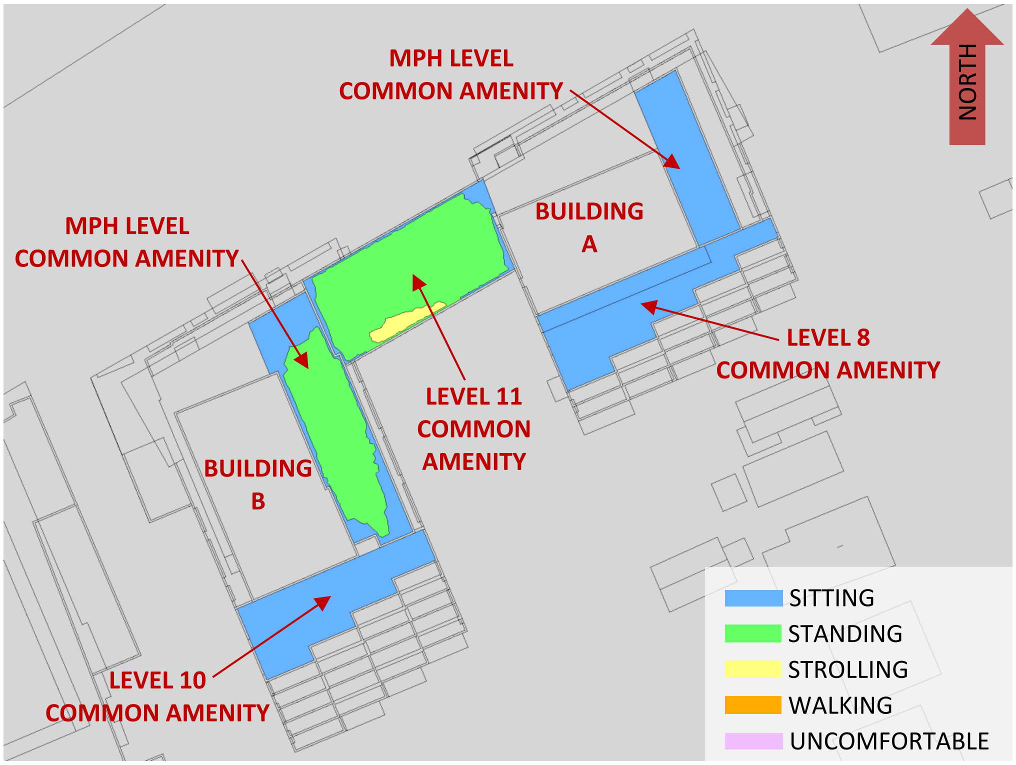
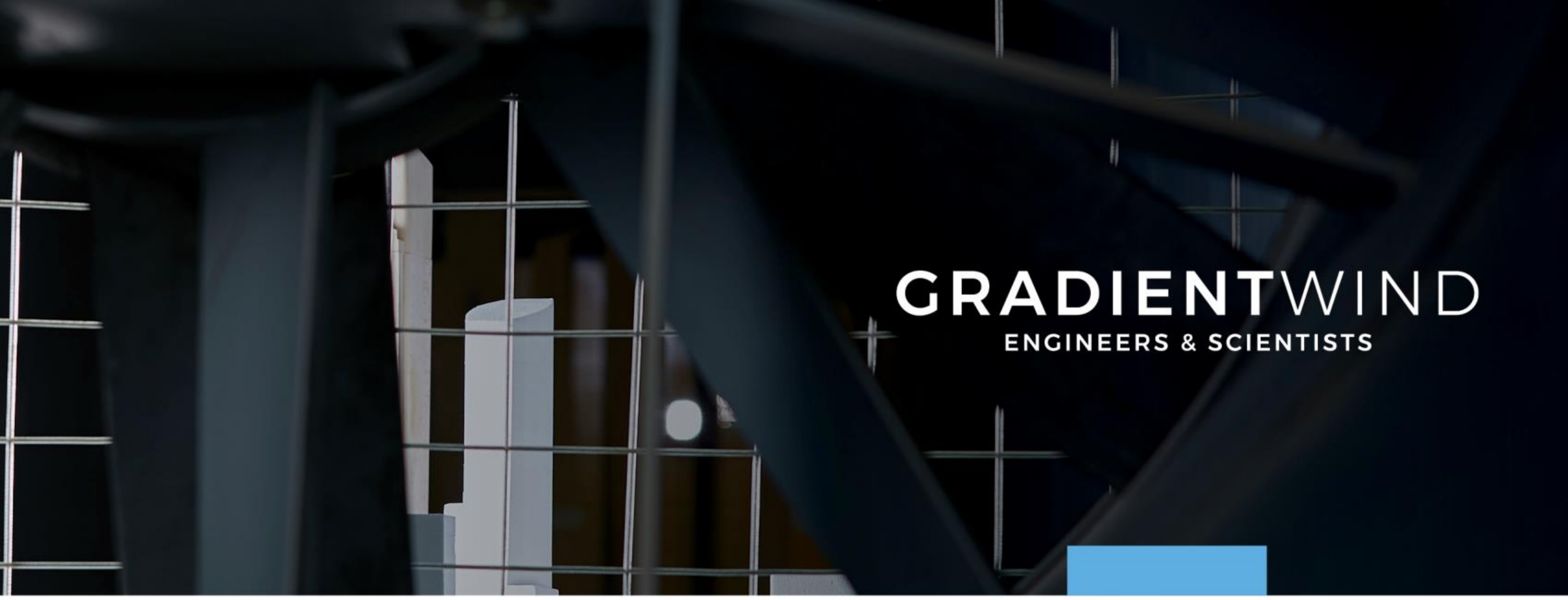
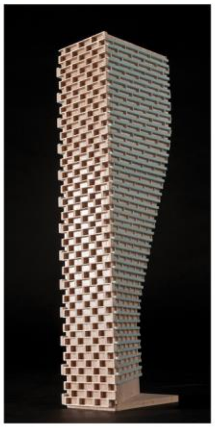
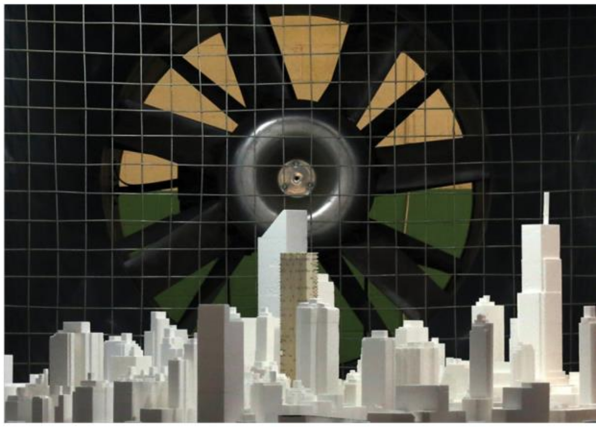


FIGURE 10: TYPICAL USE PERIOD – WIND COMFORT, COMMON AMENITY TERRACES







APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

The atmospheric boundary layer (ABL) is defined by the velocity and turbulence profiles according to industry standard practices. The mean wind profile can be represented, to a good approximation, by a power law relation, Equation (1), giving height above ground versus wind speed (1), (2).

$$U = U_g \left(\frac{Z}{Z_g}\right)^{\alpha} \qquad \text{Equation (1)}$$

where, $\boldsymbol{U}$ = mean wind speed, $\boldsymbol{U_g}$ = gradient wind speed, $\boldsymbol{Z}$ = height above ground, $\boldsymbol{Z_g}$ = depth of the boundary layer (gradient height), and α is the power law exponent.

For the model, U_g is set to 6.5 metres per second (m/s), which approximately corresponds to the 60% mean wind speed for Ottawa based on historical climate data and statistical analyses. When the results are normalized by this velocity, they are relatively insensitive to the selection of gradient wind speed.

Z_g is set to 540 m. The selection of gradient height is relatively unimportant, so long as it exceeds the building heights surrounding the subject site. The value has been selected to correspond to our physical wind tunnel reference value.

α is determined based on the upstream exposure of the far-field surroundings (that is, the area that it not captured within the simulation model).

Table 1 presents the values of α used in this study, while Table 2 presents several reference values of α. When the upstream exposure of the far-field surroundings is a mixture of multiple types of terrain, the α values are a weighted average with terrain that is closer to the subject site given greater weight.

TABLE 1: UPSTREAM EXPOSURE (ALPHA VALUE) VS TRUE WIND DIRECTION

Wind Direction (Degrees True)	Alpha Value (α)
0	0.21
49	0.24
74	0.25
103	0.23
167	0.25
197	0.25
217	0.25
237	0.20
262	0.17
282	0.18
301	0.19
324	0.19

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

Upstream Exposure Type	Alpha Value (α)
Open Water	0.14-0.15
Open Field	0.16-0.19
Light Suburban	0.21-0.24
Heavy Suburban	0.24-0.27
Light Urban	0.28-0.30
Heavy Urban	0.31-0.33

The turbulence model in the computational fluid dynamics (CFD) simulations is a two-equation shear-stress transport (SST) model, and thus the ABL turbulence profile requires that two parameters be defined at the inlet of the domain. The turbulence profile is defined following the recommendations of the Architectural Institute of Japan for flat terrain (3).

$$I(Z) = \begin{cases} 0.1\left(\frac{Z}{Z_g}\right)^{-\alpha-0.05}, & Z > 10\text{ m} \\ 0.1\left(\frac{10}{Z_g}\right)^{-\alpha-0.05}, & Z \leq 10\text{ m} \end{cases}$$ Equation (2)

$$L_t(Z) = \begin{cases} 100\text{ m}\sqrt{\frac{Z}{30}}, & Z > 30\text{ m} \\ 100\text{ m}, & Z \leq 30\text{ m} \end{cases}$$ Equation (3)

where, ***I*** = turbulence intensity, L_t = turbulence length scale, ***Z*** = height above ground, and α is the power law exponent used for the velocity profile in Equation (1).

Boundary conditions on all other domain boundaries are defined as follows: the ground is a no-slip surface; the side walls of the domain have a symmetry boundary condition; the top of the domain has a specified shear, which maintains a constant wind speed at gradient height; and the outlet has a static pressure boundary condition.

REFERENCES

[1] P. Arya, "Chapter 10: Near-neutral Boundary Layers," in *Introduction to Micrometeorology*, San Diego, California, Academic Press, 2001.

[2] S. A. Hsu, E. A. Meindl and D. B. Gilhousen, "Determining the Power-Law WInd Profile Exponent under Near-neutral Stability Conditions at Sea," vol. 33, no. 6, 1994.

[3] Y. Tamura, H. Kawai, Y. Uematsu, K. Kondo and T. Okhuma, "Revision of AIJ Recommendations for Wind Loads on Buildings," in *The International Wind Engieering Symposium, IWES 2003*, Taiwan, 2003.