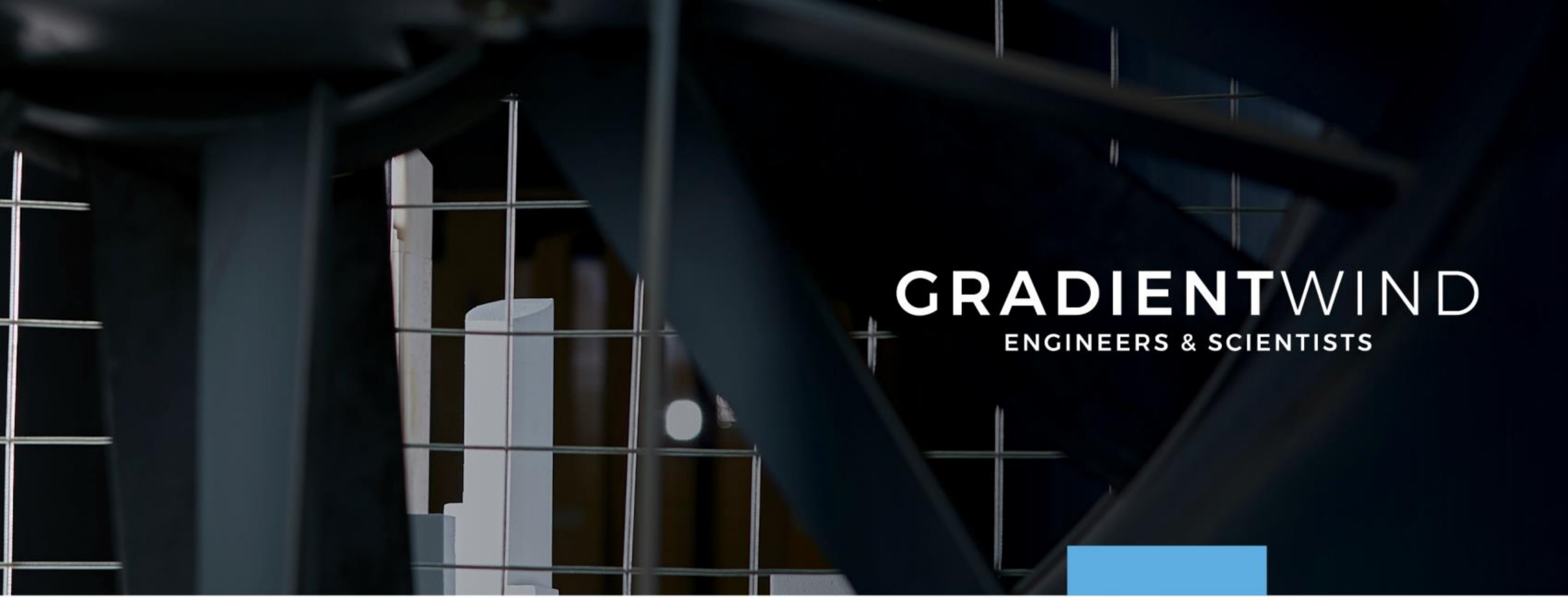
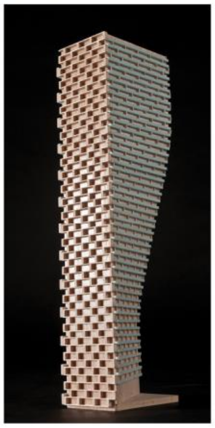
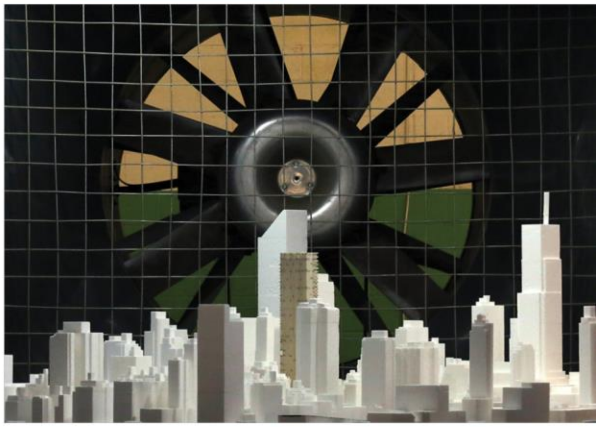


PEDESTRIAN LEVEL WIND STUDY

2026 Scott Street
Ottawa, Ontario

Report: 22-006-PLW





April 5, 2022

PREPARED FOR
Morley Hoppner Inc.
1818 Bradley Side Road
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PREPARED BY
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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Zoning By-law Amendment application requirements for the proposed mixed-use multi-building residential development located at 2026 Scott Street in Ottawa, Ontario (hereinafter referred to as “subject site” or “proposed development”). 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-8B, and summarized as follows:

1) All grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, laneways, and in the vicinity of building access points, are considered acceptable.

2) Following the introduction of the proposed development, wind conditions within Lion’s Park, situated to the south of the subject site, are expected to be similar to those that presently exist. Specifically, conditions for the proposed and existing massing scenarios are predicted to be suitable for sitting during the summer, for a mix of sitting and standing during the autumn, becoming mostly suitable for standing during the winter and spring.

3) The common amenity terraces serving each of three proposed buildings atop the individual podia and at higher levels are expected to experience strong wind speeds in the majority of areas during the typical use period. While each terrace will require tall perimeter wind screens, typically glazed and preferably solid, as described in Section 5.2, a canopy or series of canopies cantilevered from Building 2 above its podium may also be required.

a. Mitigation strategies will be discussed with the design team. Mitigation testing may be required to confirm the effectiveness of a preferred wind mitigation strategy.

4) Within the context of typical weather patterns, which exclude anomalous localized storm events, two areas within the subject site are predicted to receive dangerous wind conditions. Specifically, conditions within the amenity terraces serving Buildings 3 and 2 at the MPH Level are predicted to exceed the wind speed threshold of 90 km/h for more than 0.1% of the time on an annual basis; dangerous wind speeds are predicted to occur for 0.2% of the time (i.e., approximately 18 hours annually, where the threshold is approximately 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 strategies. Specifically, mitigation strategies will be explored and confirmed for the future Site Plan Control application through additional simulations.

   During extreme weather events (e.g., thunderstorms, tornadoes, and downbursts), pedestrian safety is paramount. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Morley Hoppner Inc. to undertake a pedestrian level wind (PLW) study to satisfy Zoning By-law Amendment application requirements for the proposed mixed-use multi-building residential development located at 2026 Scott Street in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). 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.

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 March 2022, 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 phases. Phase 1 includes two buildings identified as "Building 3" (or "Bldg 3") and "Building 2" (or "Bldg 2"), situated to the northeast and to the northwest of the subject site, respectively. Phase 2 includes a single building identified as "Building 1" (or "Bldg 1"), located to the southwest. All three buildings are served by six shared below-grade parking levels, rise above five-storey podia, and include mechanical penthouse (MPH) levels.

Building 3 comprises a near rectangular 40-storey mixed-use residential building. Above below-grade parking, the ground floor includes a residential main entrance to the west, commercial spaces fronting Scott Street to the north, building services to the east, a gym at the southwest corner, a central elevator core, and shared building support spaces throughout the remainder of the floor. Access to below-grade parking is provided by a ramp at the southeast corner of Building 3 via a laneway from Athlone Avenue.

Levels 2-40 are reserved for residential use. Outdoor amenity terraces are provided atop the podium, as well as at Level 36 and at the MPH Level.

Building 2 comprises a near rectangular 36-storey building. Above below-grade parking, the ground floor includes a residential main entrance to the east, a gym at the southeast corner, a bike room to the south, building services at the southwest corner, commercial spaces fronting Scott Street to the north, a central elevator core, and shared building support spaces throughout the remainder of the floor. Access to below-grade parking is provided by a ramp at the northwest corner of Building 2 via a laneway from Scott Street. Levels 2-36 are reserved for residential use, while Levels 6-36 overhang the floor below to the east. Outdoor amenity terraces are provided atop the podium and at the MPH Level.

Building 1 comprises a near rectangular 20-storey building. Above below-grade parking, the ground floor includes a residential main entrance within an inset at the northeast corner, commercial space from the northeast clockwise southwest, a bike room and building services at the northwest corner, a central elevator core, and shared building support spaces throughout the remainder of the floor. Levels 2-20 are reserved for residential use. Outdoor amenity terraces are provided atop the podium, as well as at the MPH Level.

The shortest distance between the podia serving Buildings 3 and 2 is approximately 21.8 metres (m), while the shortest distance between the two tall buildings above the podia is approximately 21.9 m. The shortest distance between the podia serving Buildings 2 and 1 is approximately 16.5 m, while the shortest distance between the two tall buildings above the podia is approximately 18.9 m.

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 30-storey mixed-use apartment building is proposed at 2046-2050 Scott Street, located to the immediate west of the subject site, and a 25-storey mixed-use building is proposed at 2070 Scott Street, located approximately 130 m to the west. 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. The proposed and existing massing scenarios also include the proposed development at 2046-2050 Scott Street as the Site Plan Control application was resubmitted in November 2021[1].

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[2]. The following sections describe the analysis procedures, including a discussion of the noted pedestrian wind criteria.

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[1] City of Ottawa, **'Application D07-12-21-0037'**
<*https://devapps.ottawa.ca/en/applications/D07-12-21-0037/details*> (accessed Apr 5, 2022)

[2] City of Ottawa Terms of References: Wind Analysis (accessed Apr 5, 2022)
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 study building, complete with surrounding massing within a radius of 480 m.

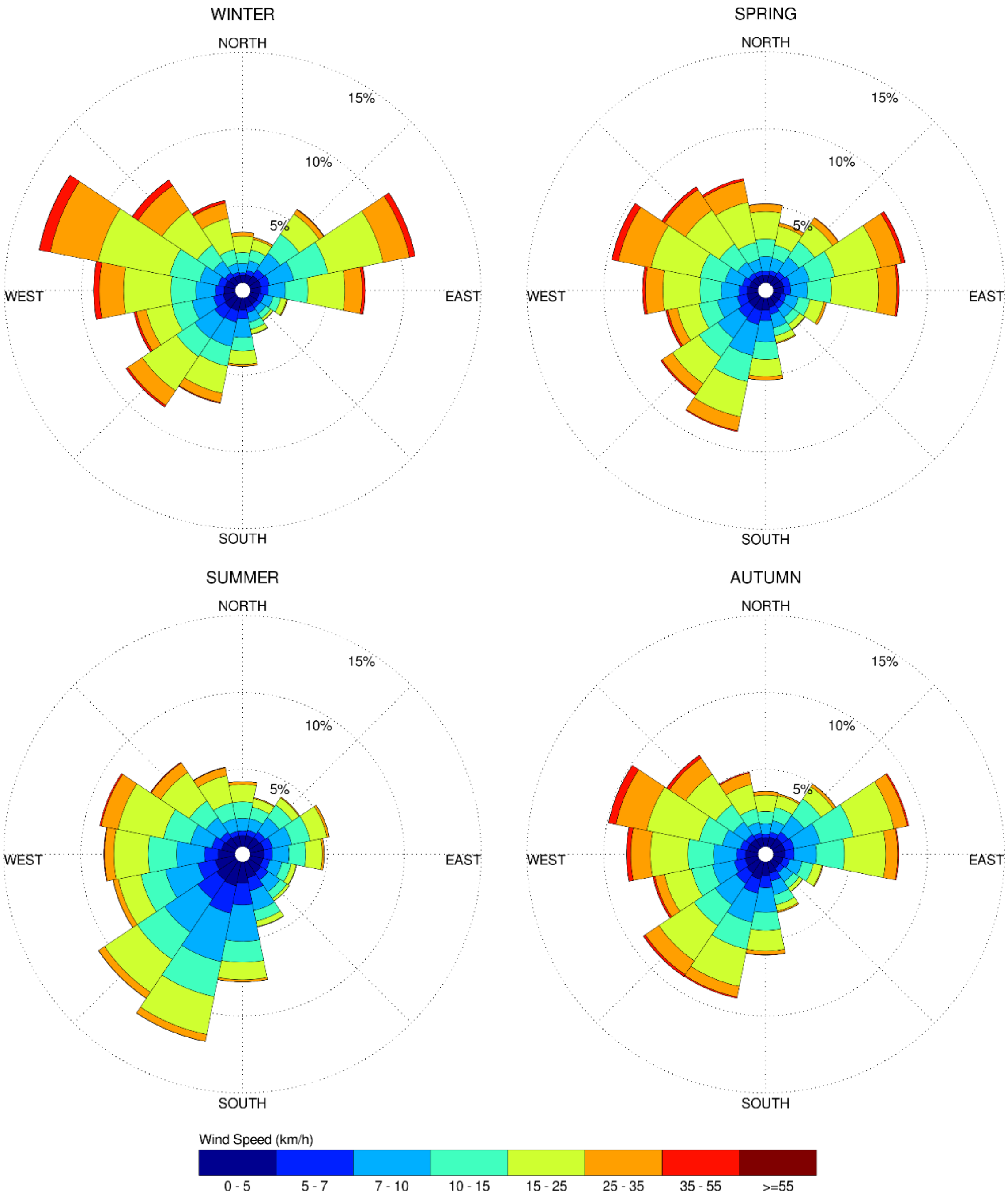
Mean and peak wind speed data obtained over the study site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the common amenity terraces were referenced to the wind speed 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 preferred 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 preference 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 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 (i.e., 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 (i.e., 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 Point	Walking
Public Sidewalk / Bicycle Path	Walking
Outdoor Amenity Space	Sitting
Café / Patio / Bench / Garden	Sitting (Summer)
Transit Stop (Without Shelter)	Standing
Transit Stop (With Shelter)	Walking
Public Park / Plaza	Sitting (Summer)
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-6B, illustrating wind conditions at grade level for the proposed and existing massing scenarios, and Figures 7A-7D, 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 within the common amenity terraces serving Buildings 3, 2, and 1 are also reported for the typical use period, which is defined as May to October, inclusive. Figure 8A illustrates wind comfort conditions consistent with the comfort classes in Section 4.4, while Figure 8B illustrates contours indicating the percentage of time conditions within the terraces are predicted to be suitable for sitting during the same period. 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 immediate vicinity of building access points serving Buildings 3 and 2 along Scott Street are predicted to be suitable for sitting during the summer, becoming suitable for standing during the autumn, winter, and spring. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria in Section 4.4.

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, becoming mostly suitable for standing during the spring and autumn; conditions to the immediate east of 2046-2050 Scott Street are predicted to be suitable for strolling during the two noted seasons. During the winter, conditions are predicted to be similar to those during spring except walking conditions are predicted to form at the northeast corner of 2046-2050 Scott Street, extending over the Scott Street sidewalk. While the introduction of the proposed development results in windier conditions in comparison to existing conditions, wind conditions with the proposed development are considered acceptable according to the City of Ottawa wind comfort criteria.

Sidewalks and Building Access along Athlone Avenue: Following the introduction of the proposed development, the nearby public sidewalks along Athlone Avenue are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a mix of sitting, standing, and strolling during the autumn. During the spring, conditions along the sidewalks are predicted to be suitable for a mix of standing, strolling, and walking, while conditions during the winter are predicted to be mostly suitable for a mix of strolling and walking. The strongest wind speeds are predicted to form at the northeast corner of Building 3 extending along the east and west sides of Athlone Avenue. Conditions in the immediate vicinity of building access points serving Building 3 along Athlone Avenue are predicted to be suitable for sitting during the summer and autumn, becoming suitable for standing during the winter and spring. The noted conditions are considered acceptable according to the City of Ottawa wind criteria.

Wind conditions over the existing neighbouring properties along Athlone Avenue are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing during the autumn, winter, and spring. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

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. Conditions over the existing neighbouring properties along Athlone Avenue are predicted to be suitable for sitting throughout the year. While the introduction of the proposed development results in windier conditions in comparison to existing conditions, conditions with the proposed development are considered acceptable. Specifically, the walking comfort class is considered appropriate for public sidewalks, while the sitting and standing comfort classes are considered appropriate for residential dwellings.

Area Between Buildings 3 and 2: Conditions between Buildings 3 and 2 are predicted to be suitable for standing during the summer, for strolling during the autumn, becoming suitable mostly for walking during the winter and spring. For walkways, the noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

The main residential entrance serving Building 3 is situated near the centre of the west podium elevation, while the main residential entrance serving Building 2 is situated near the centre of the east podium elevation. Wind conditions in the vicinity of both noted entrances are predicted to be suitable for sitting during the summer, becoming suitable for standing during the autumn, winter, and spring. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

Area Between Buildings 2 and 1: Conditions between Buildings 2 and 1 are predicted to be suitable for a mix of sitting standing during the summer, becoming suitable for a mix of standing and strolling during the autumn, winter, and spring. For walkways, the noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

The main residential entrance serving Building 1 is situated near the northeast corner of the north podium elevation, while building access points serve Building 2 along the south podium elevation. Wind conditions in the vicinity of the noted building access points are predicted to be suitable for sitting during the summer, becoming suitable for standing during the autumn, winter, and spring. The only exception is the main residential entrance serving Building 1 which may occasionally experience conditions suitable for strolling during the winter. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

Area Between Building 2 and 2046-2050 Scott Street: Conditions between Building 2 and 2046-2050 Scott Street to the immediate west of the proposed development are predicted to be suitable for standing during the summer, for a mix of standing and strolling during the autumn, becoming suitable for a mix of strolling and walking during the winter and spring. For walkways, the noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

Building access points (i.e., building services) serve Building 2 near the southwest corner of the west podium elevation. Based on the architectural drawings of 2046-2050 Scott Street, building access points are not provided along its east elevation. Wind conditions in the vicinity of the building access points serving the west elevation of Building 2 are predicted to be suitable for standing during the summer, becoming suitable for strolling during the autumn, winter, and spring. Wind conditions in the vicinity of the east elevation of 2046-2050 Scott Street are predicted to be suitable for standing during the summer and autumn, becoming suitable for strolling during the winter and spring. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

South Elevation of Building 3: Conditions along the south elevation of Building 3 are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

West Elevation of Building 1: Conditions along the west elevation of Building 1 are predicted to be suitable for standing during the summer and autumn, becoming suitable for a mix of standing and strolling during the winter and spring. Owing to the protection of the building façade, conditions in the vicinity of the building access points along the west elevation of Building 1 are predicted to be suitable for a mix of sitting standing during the summer, becoming suitable for standing during the autumn, winter, and spring. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

East Elevation of Building 1: Conditions along the east elevation of Building 1 are predicted to be suitable for standing during the summer, for a mix of standing and strolling during the autumn, for strolling during the spring, becoming suitable for a mix of strolling and walking during the winter. Owing to the protection of the building façade, conditions in the vicinity of the building façade are predicted to be suitable for sitting during the summer, becoming suitable for standing during the autumn, winter, and spring. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

South Elevation of Building 1: Conditions along the south elevation of Building 1 are predicted to be suitable for sitting during the summer, becoming suitable for standing during the autumn, winter, and spring. Owing to the protection of the building façade, conditions in the vicinity of the building façade are predicted to be suitable for sitting during the spring, summer, and autumn, becoming mostly suitable for sitting during the winter. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

Lion's Park: Following the introduction of the proposed development, wind conditions within Lion's Park are predicted to be suitable for sitting during the summer, for a mix of sitting and standing during the autumn, becoming mostly suitable for standing during the winter and spring. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria. Wind conditions within Lion's Park with the existing massing are predicted to be similar to those with the proposed development.

5.2 Wind Comfort Conditions – Common Amenity Terraces

Building 3, Podium Roof Level: During the typical use period, wind conditions within the common amenity terrace serving Building 3 atop its podium are predicted to be suitable for sitting to the east and south and suitable for standing to the west, as illustrated in Figure 8A.

Within the noted area that is predicted to be suitable for standing, conditions are also predicted to be suitable for sitting for at least 60% of the time during the same period, as illustrated in Figure 8B, where the target is 80%. Depending on the programming of the space, the noted wind conditions may be considered acceptable. Specifically, if the area to the west will not accommodate seating or lounging activities, the noted wind conditions would be considered acceptable. Otherwise, if sitting conditions consistent with the sitting criterion in Section 4.4 are required along the west side of the podium roof, mitigation in the form of a wind screen would be required. Specifically, the wind screen, typically glazed and preferably solid, would be required along the west perimeter extending at least 1.8 m above the local walking surface (i.e., top of paver to top of wind screen).

Building 3, Level 36 and MPH Level: During the typical use period, conditions within the common amenity terraces serving Building 3 at Level 36 and at the MPH Level are predicted to be suitable for a mix of standing and strolling, as illustrated in Figure 8A.

To achieve the sitting comfort class in all areas during the typical use period, we recommend implementing a full perimeter wind screen, typically glazed and preferably solid, extending 2.4 m above the local walking surface.

Building 2, Podium Roof Level: During the typical use period, conditions within the common amenity terraces serving Building 2 atop its podium are predicted to be suitable for a mix of standing and strolling, as illustrated in Figure 8A. The terrace at the southeast corner is predicted to be suitable for sitting.

To achieve the sitting comfort class in all areas during the typical use period, we recommend implementing a full perimeter wind screen, typically glazed and preferably solid, extending 1.8 m above the local walking surface. The noted wind screen would apply to the area at the northeast corner and the area along the west side of the roof. A canopy or series of canopies, typically cantilevered from the building, may also be required to deflect downwash winds away from the terraces. Mitigation strategies will be discussed with the design team. Mitigation testing may be required to confirm the effectiveness of a preferred wind mitigation strategy.

Building 2, MPH Level: During the typical use period, conditions within the common amenity terrace serving Building 2 at the MPH Level are predicted to be suitable for a mix of standing and strolling, as illustrated in Figure 8A.

To achieve the sitting comfort class within all area of the terrace during the typical use period, we recommend implementing a full perimeter wind screen, typically glazed and preferably solid, extending 2.4 m above the local walking surface.

Building 1, Podium Roof Level: During the typical use period, wind conditions within the common amenity terrace serving Building 1 atop its podium are predicted to be suitable for sitting within the northeast corner, while conditions within the remaining roof area are predicted to be to be suitable for standing, as illustrated in Figure 8A.

Within the noted area that is predicted to be suitable for standing, conditions are also predicted to be suitable for sitting for at least 70% of the time during the same period, as illustrated in Figure 8B, where the target is 80%. To achieve the sitting comfort class in all areas during the typical use period, we recommend implementing a full perimeter wind screen, typically glazed and preferably solid, extending at least 1.8 m above the local walking surface.

Building 1, MPH Level: During the typical use period, wind conditions within the common amenity terrace serving Building 1 at the MPH Level are predicted to be suitable for a mix of sitting and standing, as illustrated in Figure 8A.

Within the noted area that is predicted to be suitable for standing, conditions are also predicted to be suitable for sitting for at least 70% of the time during the same period, as illustrated in Figure 8B, where the target is 80%. To achieve the sitting comfort class in all areas during the typical use period, we recommend implementing a full perimeter wind screen, typically glazed and preferably solid, extending at least 2.0 m above the local walking surface.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events, two areas within the subject site are predicted to receive dangerous wind conditions. Specifically, conditions within the amenity terraces serving Buildings 3 and 2 at the MPH Level are predicted to exceed the wind speed threshold of 90 km/h for more than 0.1% of the time on an annual basis; dangerous wind speeds are predicted to occur for 0.2% of the time (i.e., approximately 18 hours annually, where the threshold is approximately 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 strategies. Specifically, mitigation strategies will be explored and confirmed for the future Site Plan Control application through additional simulations.

During extreme weather events (e.g., thunderstorms, tornadoes, and downbursts), pedestrian safety is paramount. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

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 (i.e., 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-8B. 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) All grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, laneways, and in the vicinity of building access points, are considered acceptable.

2) Following the introduction of the proposed development, wind conditions within Lion's Park, situated to the south of the subject site, are expected to be similar to those that presently exist. Specifically, conditions for the proposed and existing massing scenarios are predicted to be suitable for sitting during the summer, for a mix of sitting and standing during the autumn, becoming mostly suitable for standing during the winter and spring.

3) The common amenity terraces serving each of three proposed buildings atop the individual podia and at higher levels are expected to experience strong wind speeds in the majority of areas during the typical use period. While each terrace will require tall perimeter wind screens, typically glazed and preferably solid, as described in Section 5.2, a canopy or series of canopies cantilevered from Building 2 above its podium may also be required.

    a. Mitigation strategies will be discussed with the design team. Mitigation testing may be required to confirm the effectiveness of a preferred wind mitigation strategy.

4) Within the context of typical weather patterns, which exclude anomalous localized storm events, two areas within the subject site are predicted to receive dangerous wind conditions. Specifically, conditions within the amenity terraces serving Buildings 3 and 2 at the MPH Level are predicted to exceed the wind speed threshold of 90 km/h for more than 0.1% of the time on an annual basis; dangerous wind speeds are predicted to occur for 0.2% of the time (i.e., approximately 18 hours annually, where the threshold is approximately 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 strategies. Specifically, mitigation strategies will be explored and confirmed for the future Site Plan Control application through additional simulations.

    During extreme weather events (e.g., thunderstorms, tornadoes, and downbursts), pedestrian safety is paramount. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

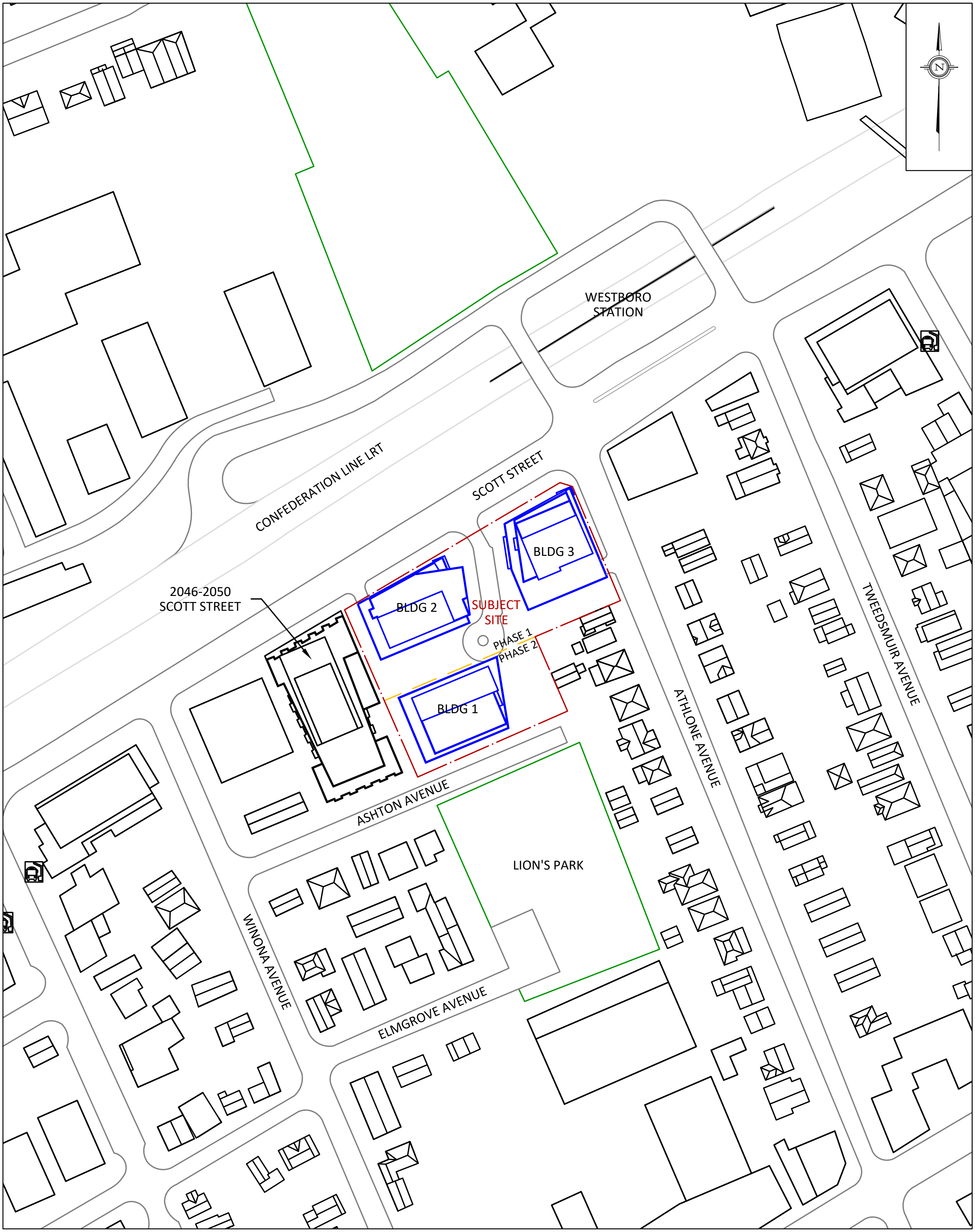
Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. D. FERRARO
100158495
Apr 5, 2022
PROVINCE OF ONTARIO

David Davalos, MEsc.
Junior Wind Scientist

Justin Ferraro, P.Eng.
Principal



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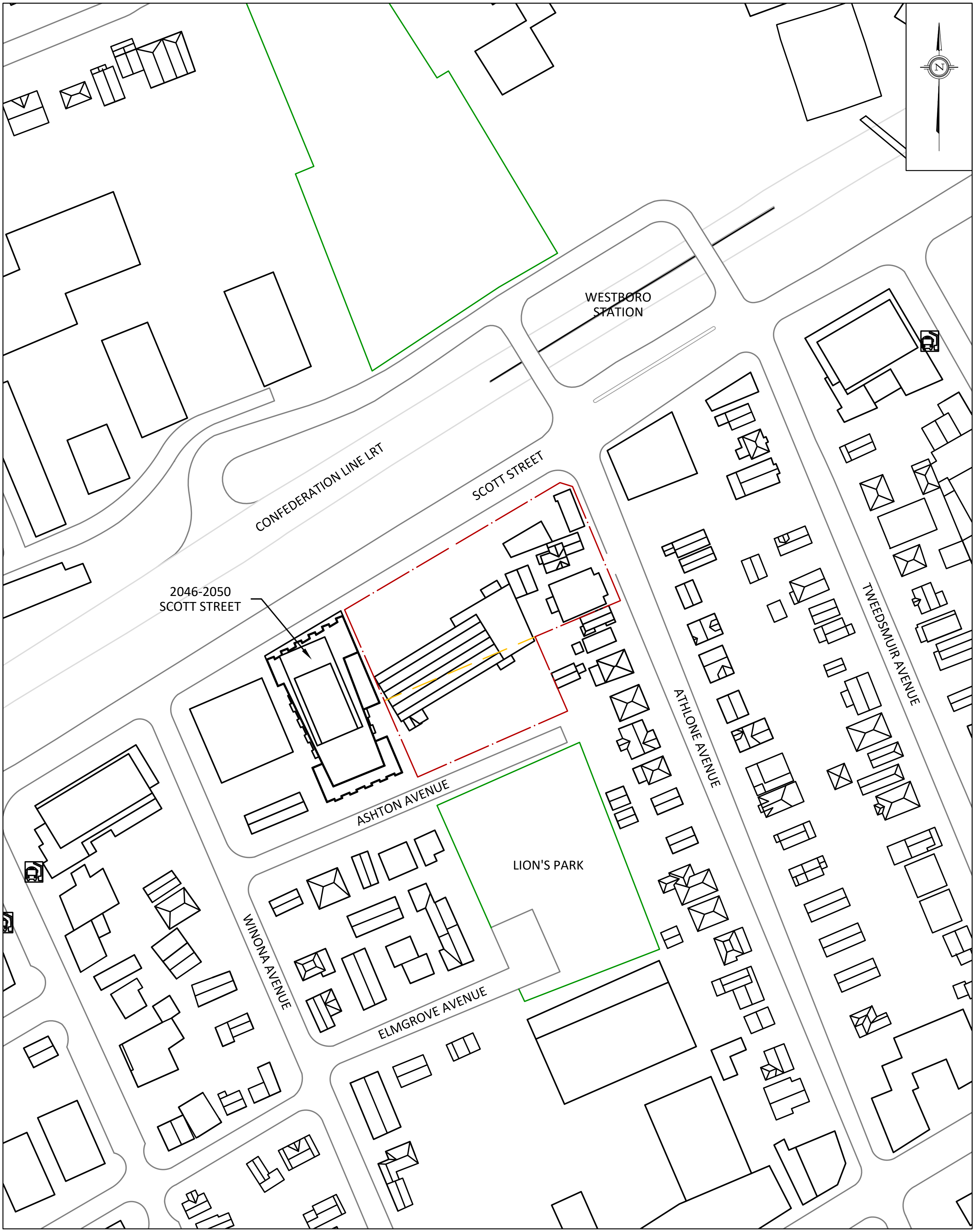
PROJECT	2026 SCOTT STREET, OTTAWA PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:2000	DRAWING NO.	22-006-PLW-1A
DATE	APRIL 5, 2022	DRAWN BY	S.K.

DESCRIPTION

FIGURE 1A:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT



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PROJECT		DESCRIPTION
2026 SCOTT STREET, OTTAWA PEDESTRIAN LEVEL WIND STUDY		FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2000	DRAWING NO.: 22-006-PLW-1B	
DATE: APRIL 5, 2022	DRAWN BY: S.K.	

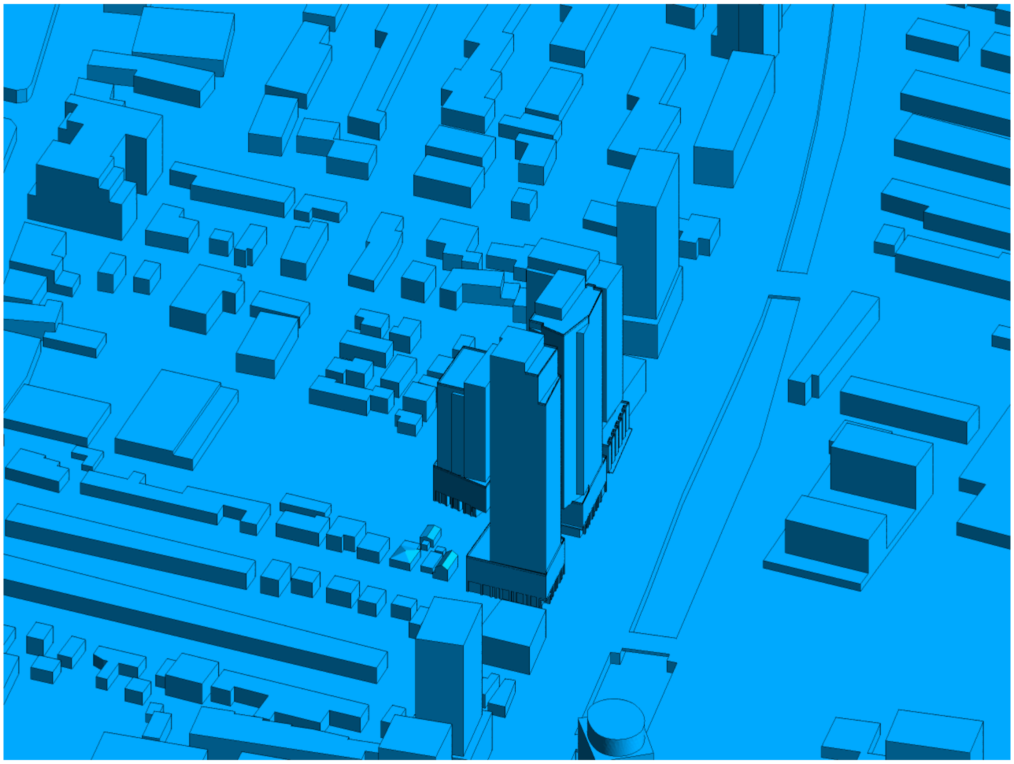


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, EAST PERSPECTIVE

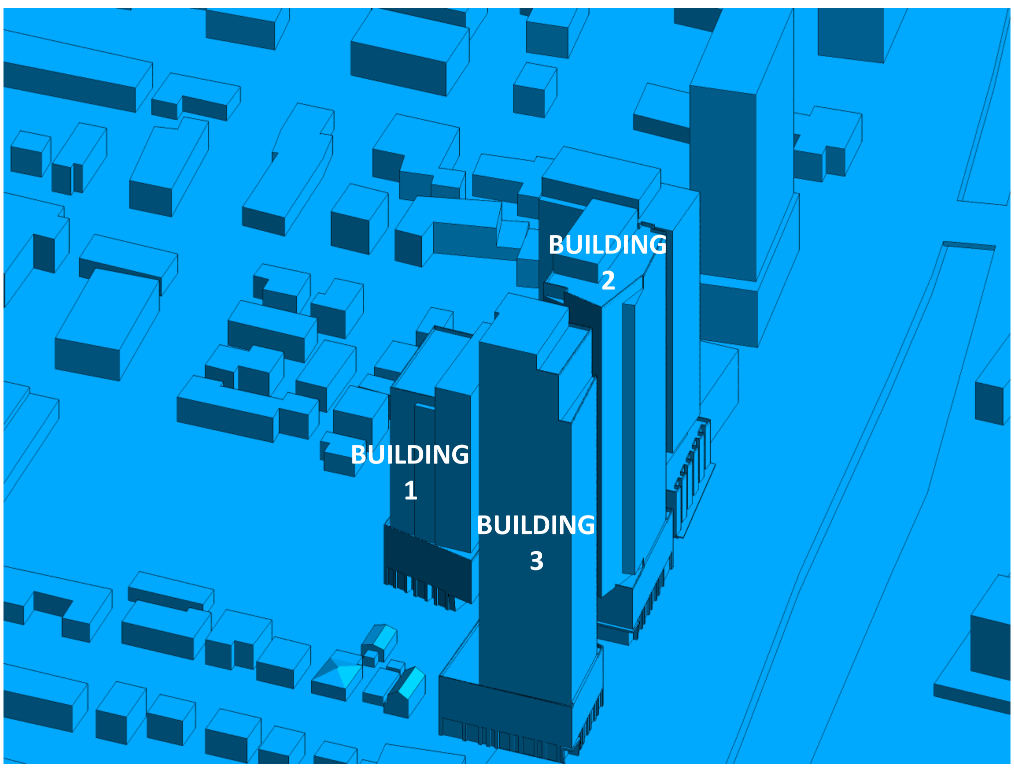


FIGURE 2B: CLOSE UP OF FIGURE 2A

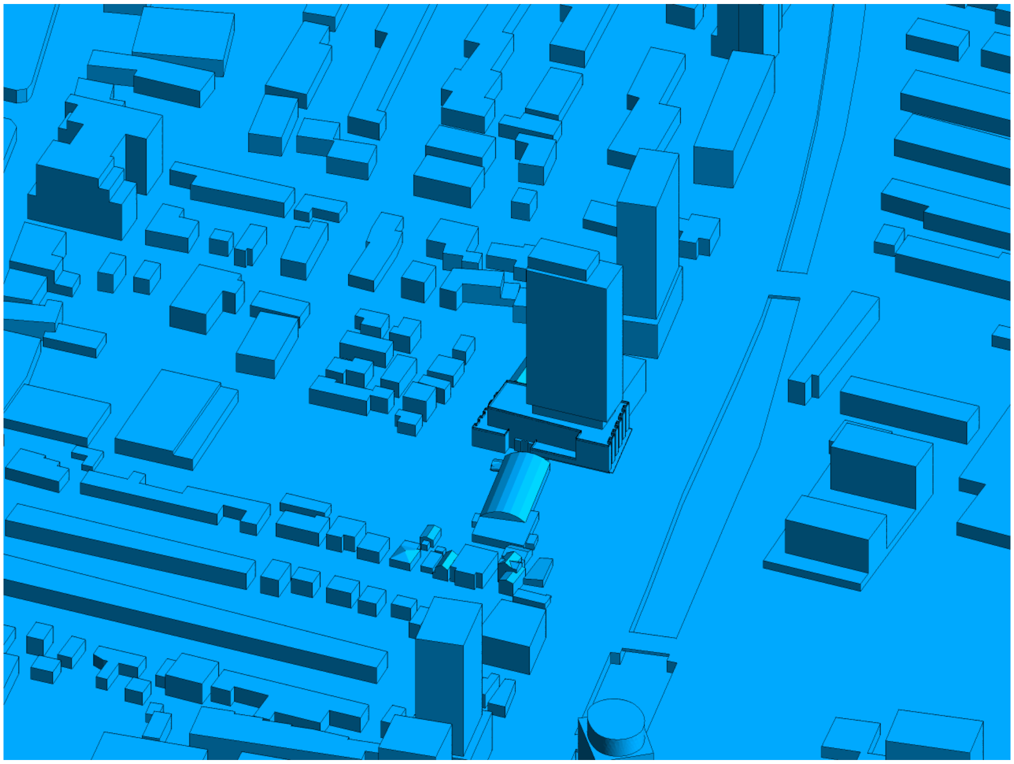


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, EAST PERSPECTIVE

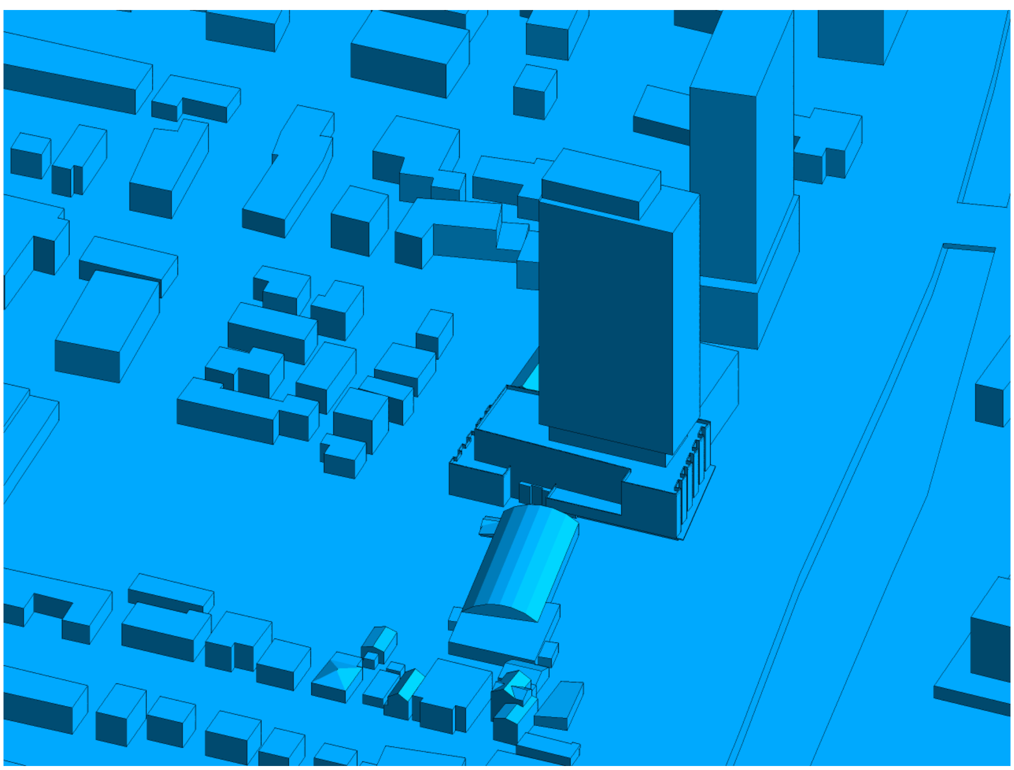


FIGURE 2D: CLOSE UP OF FIGURE 2C

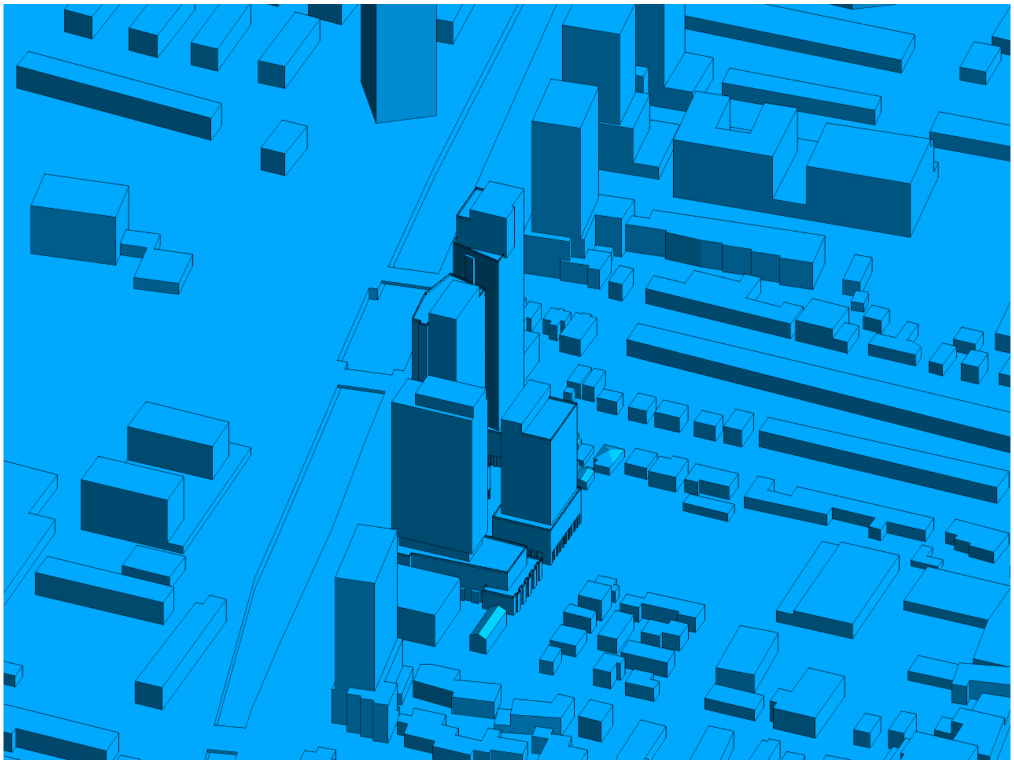


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, WEST PERSPECTIVE

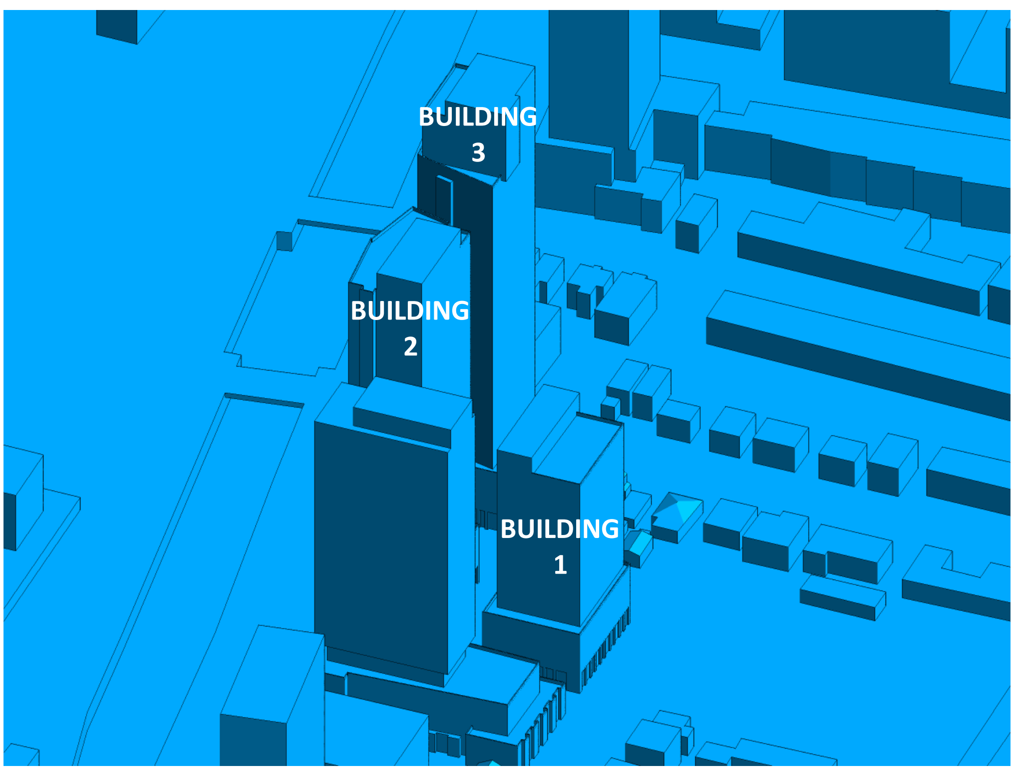


FIGURE 2F: CLOSE UP OF FIGURE 2E

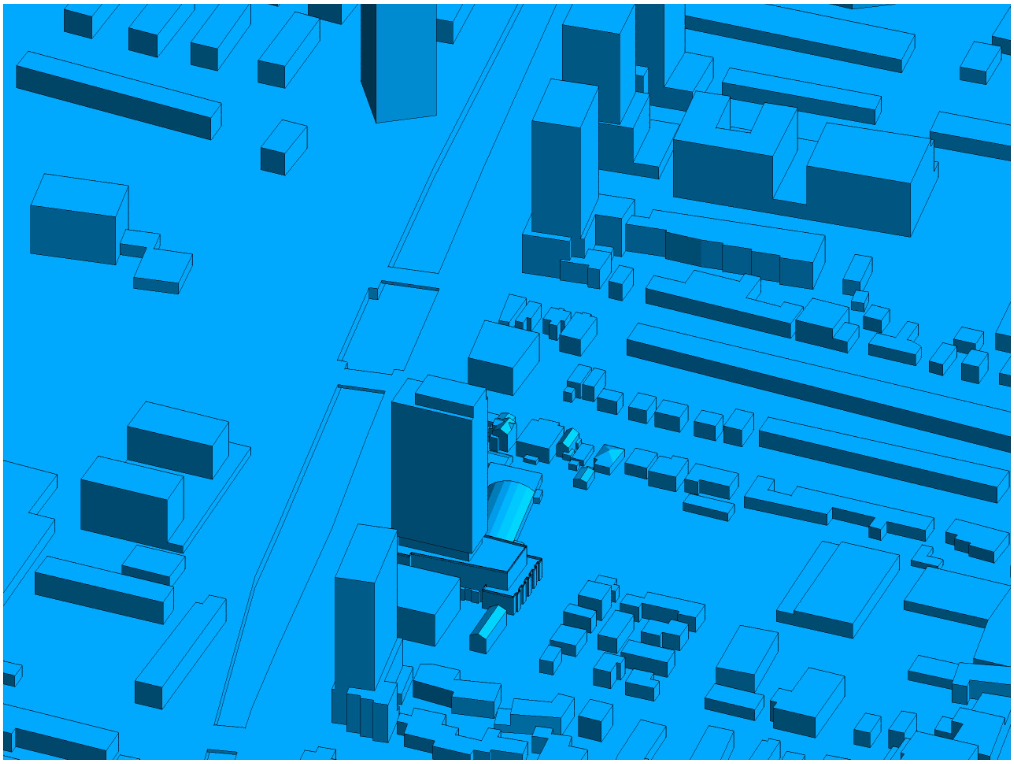


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, WEST PERSPECTIVE

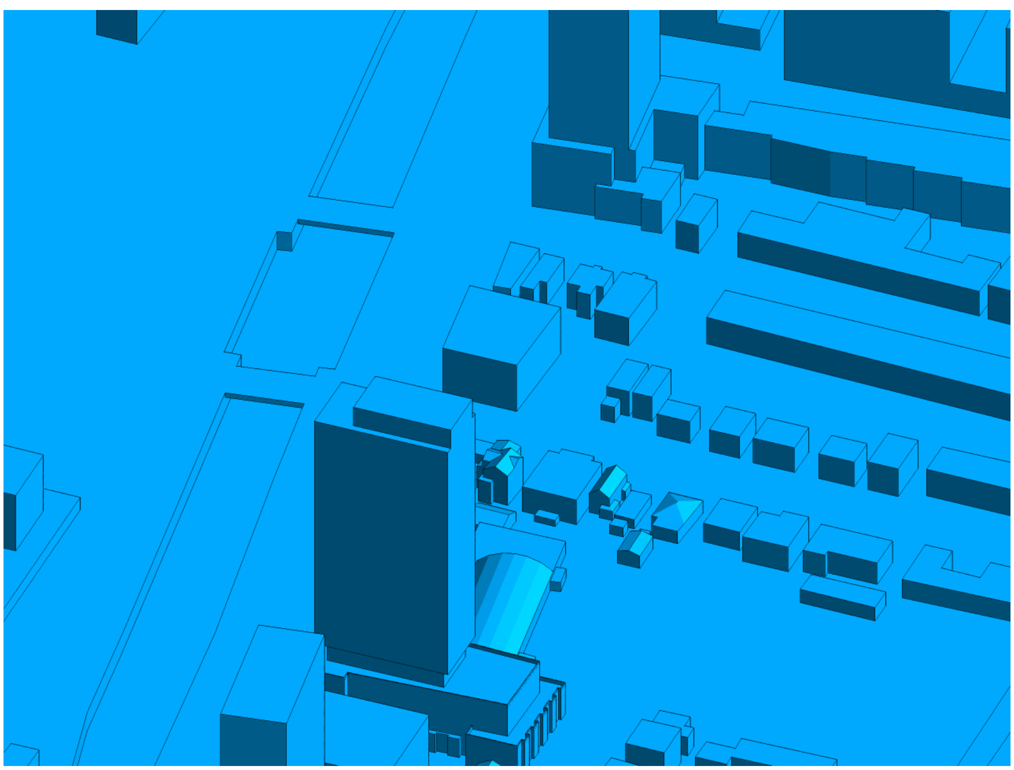


FIGURE 2H: CLOSE UP OF FIGURE 2G

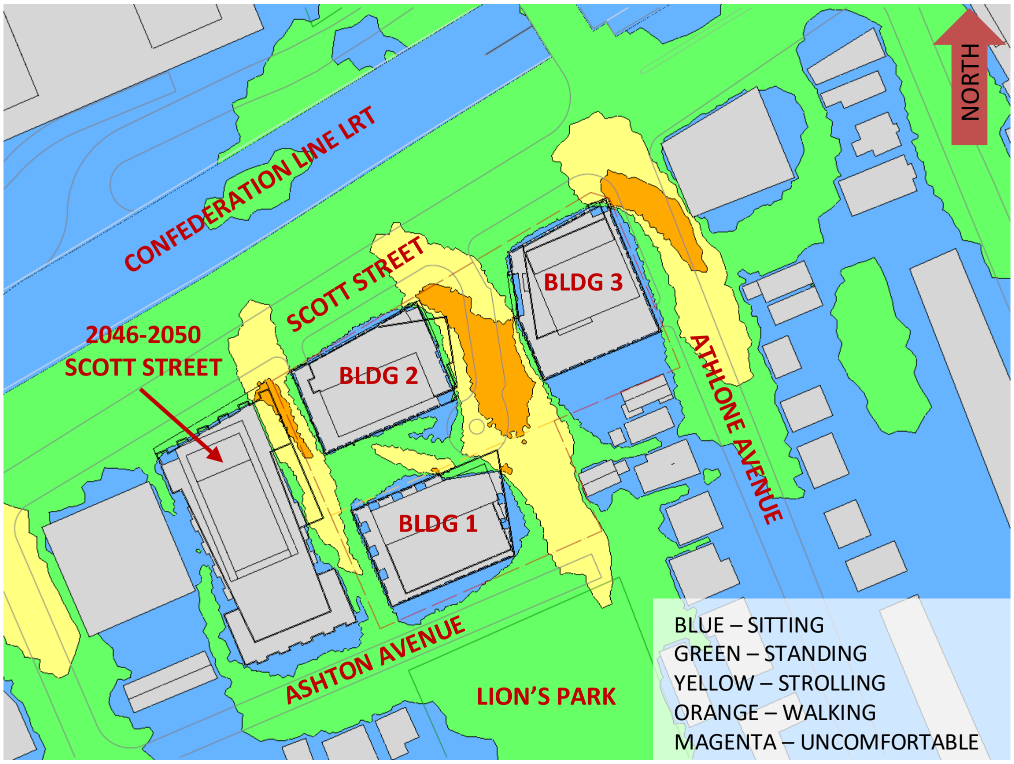


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

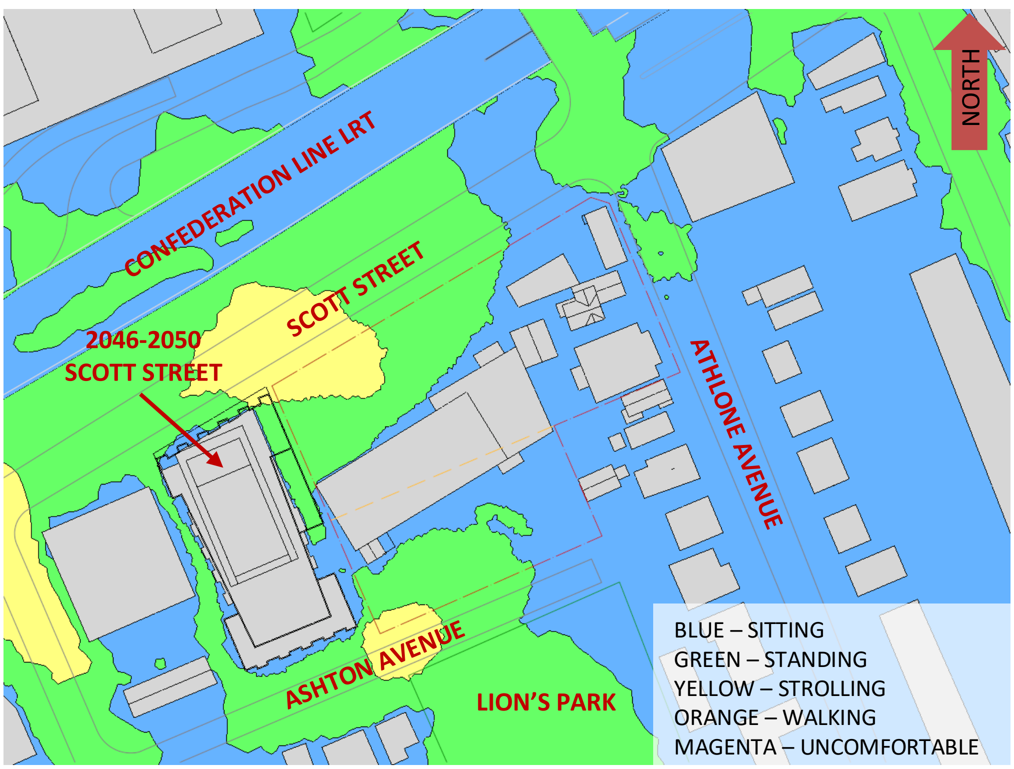


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

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

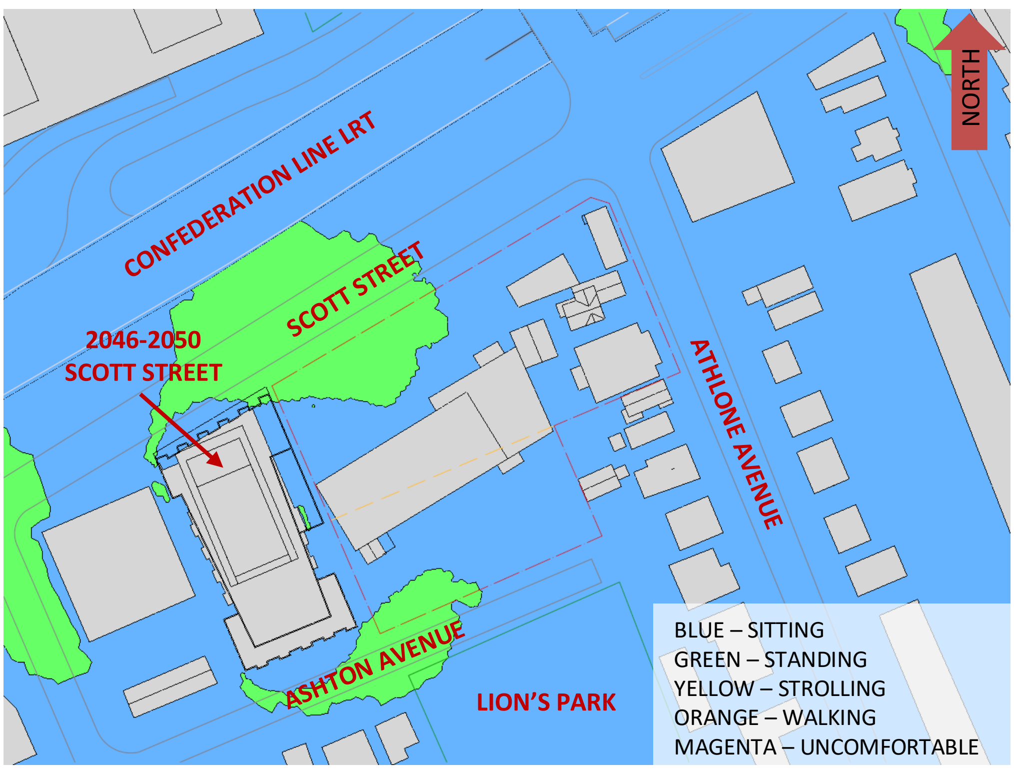


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

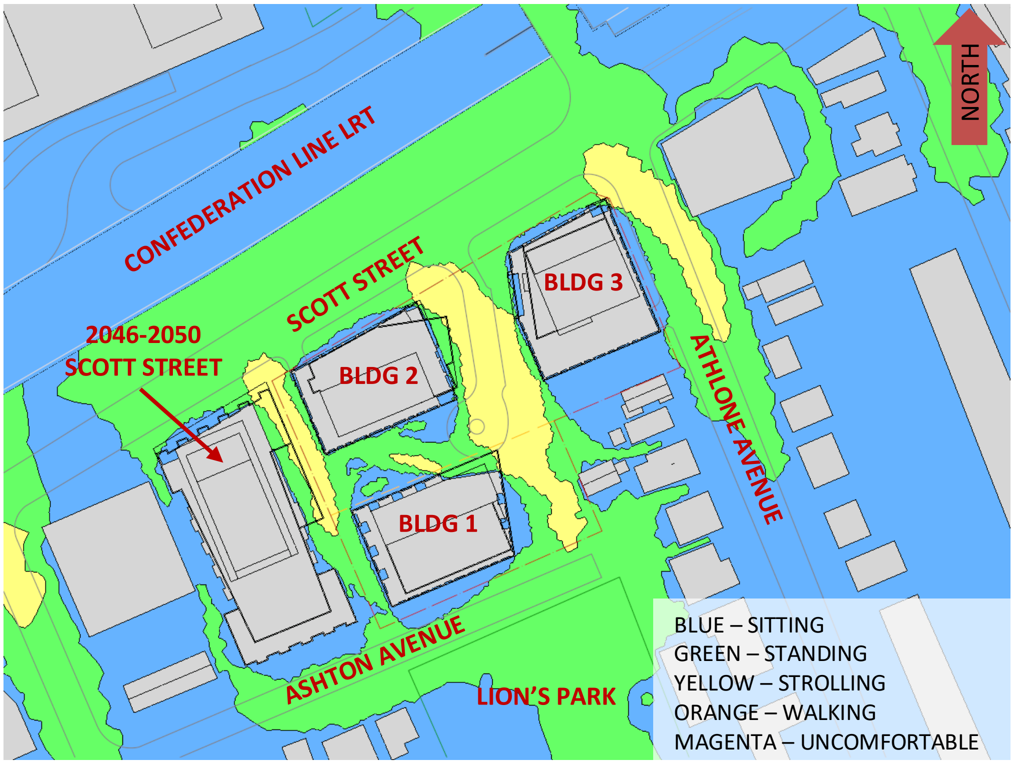


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

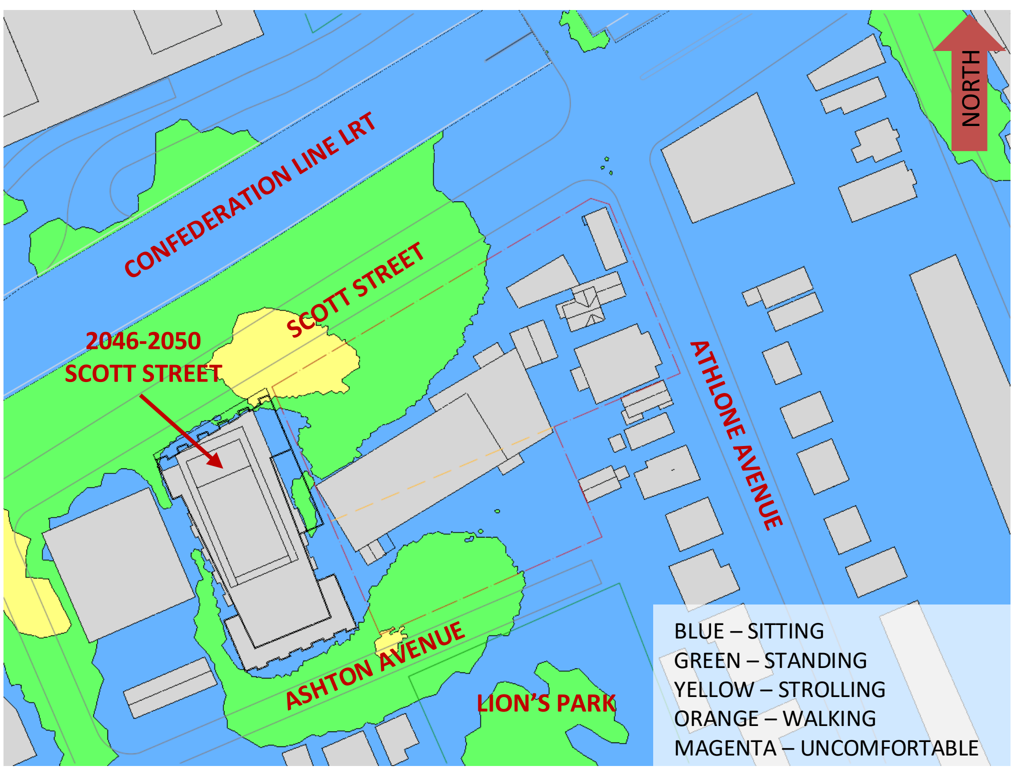


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

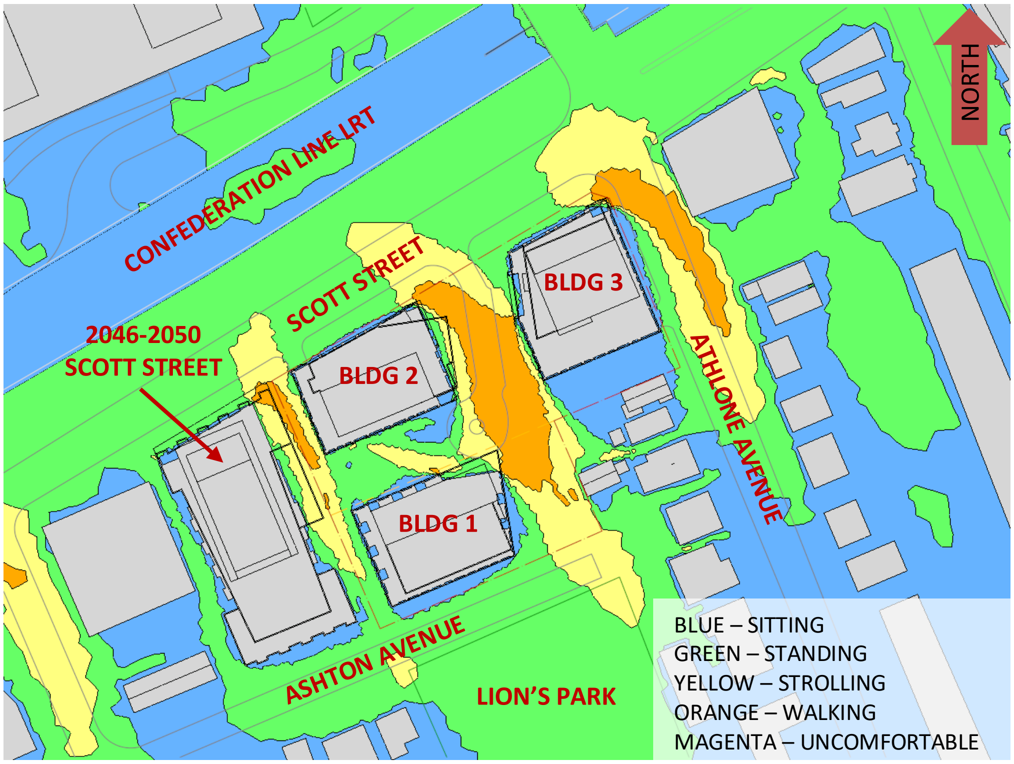


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

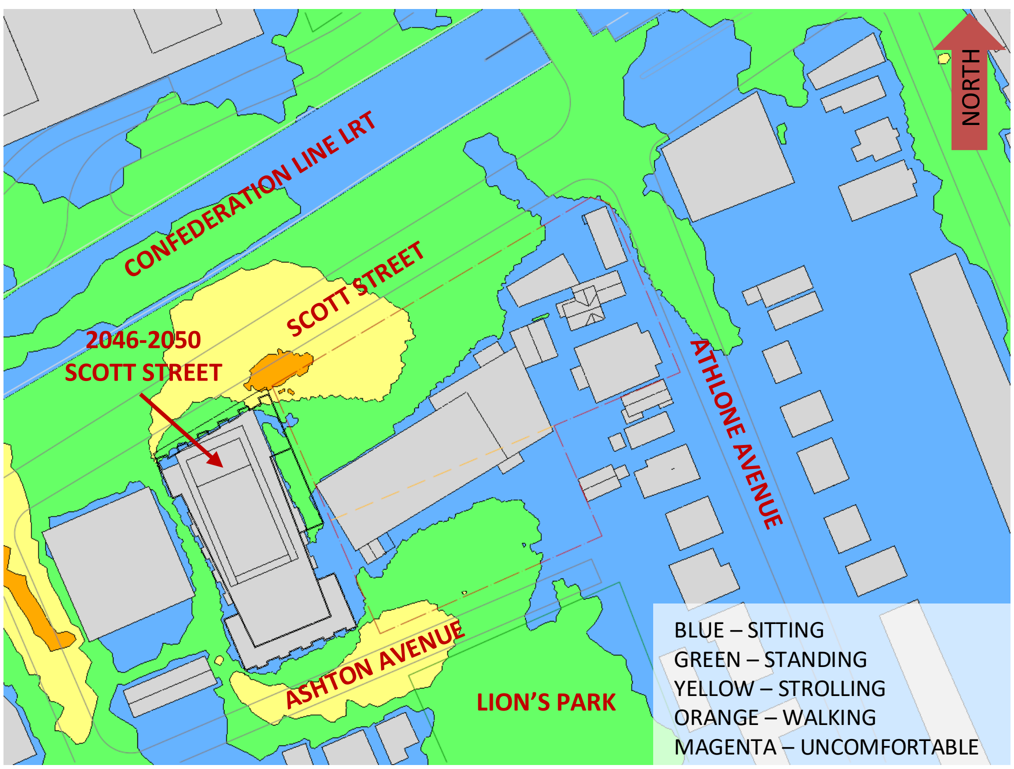


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

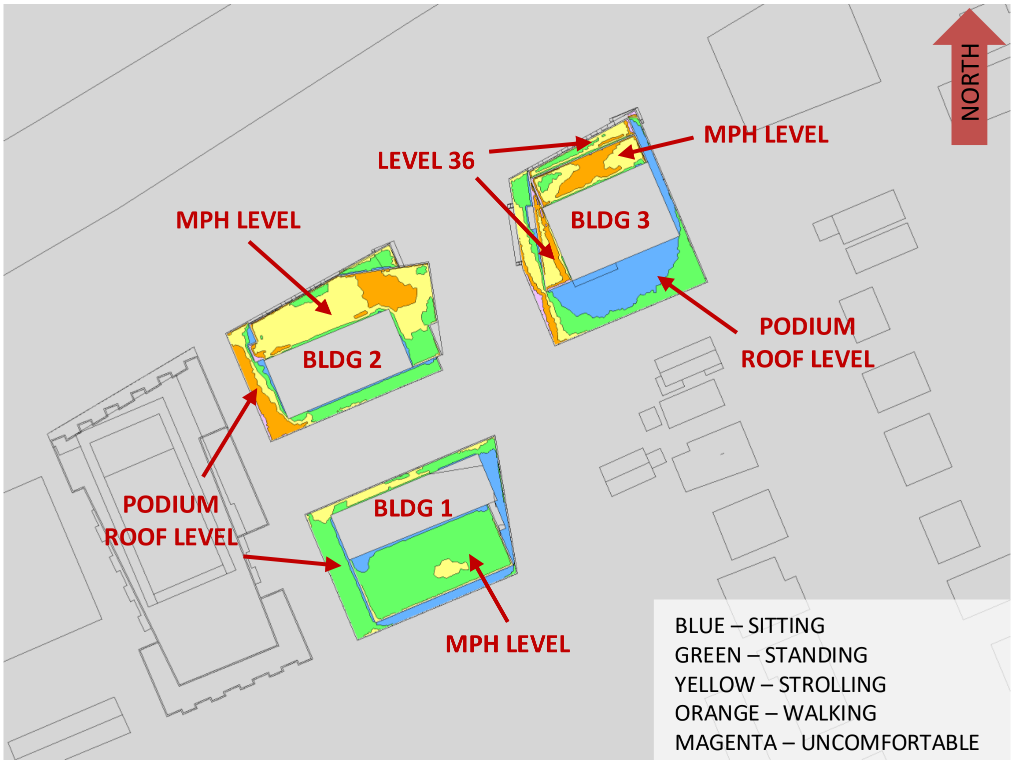


FIGURE 7A: SPRING – WIND COMFORT, COMMON AMENITY TERRACE

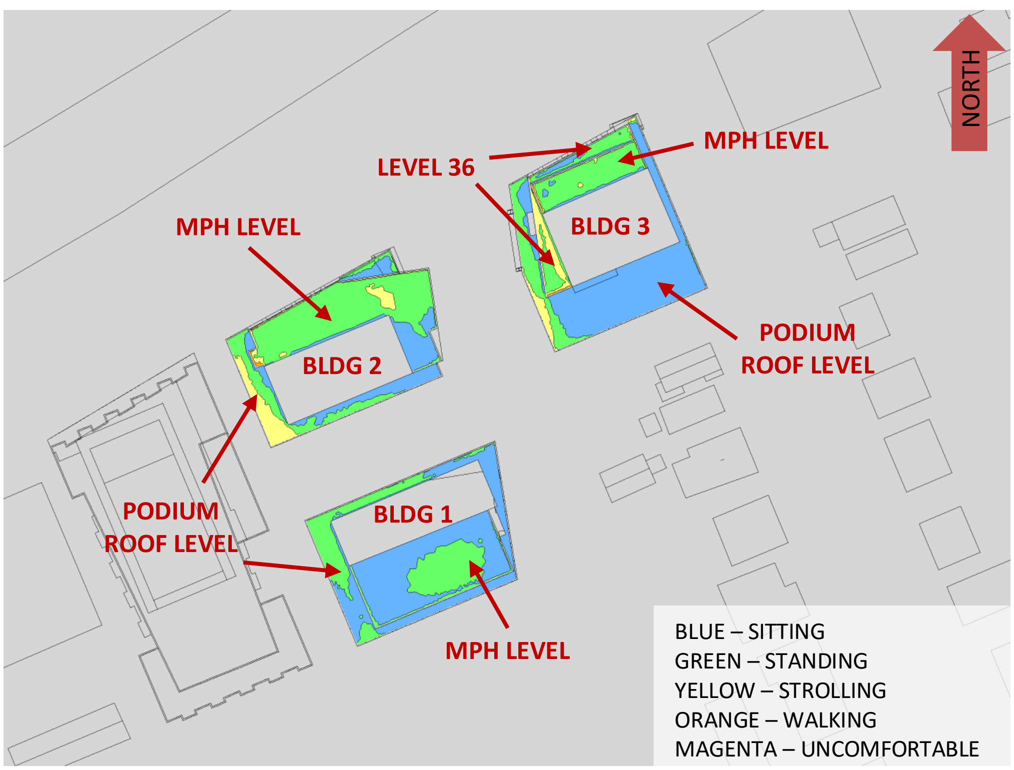


FIGURE 7B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACE

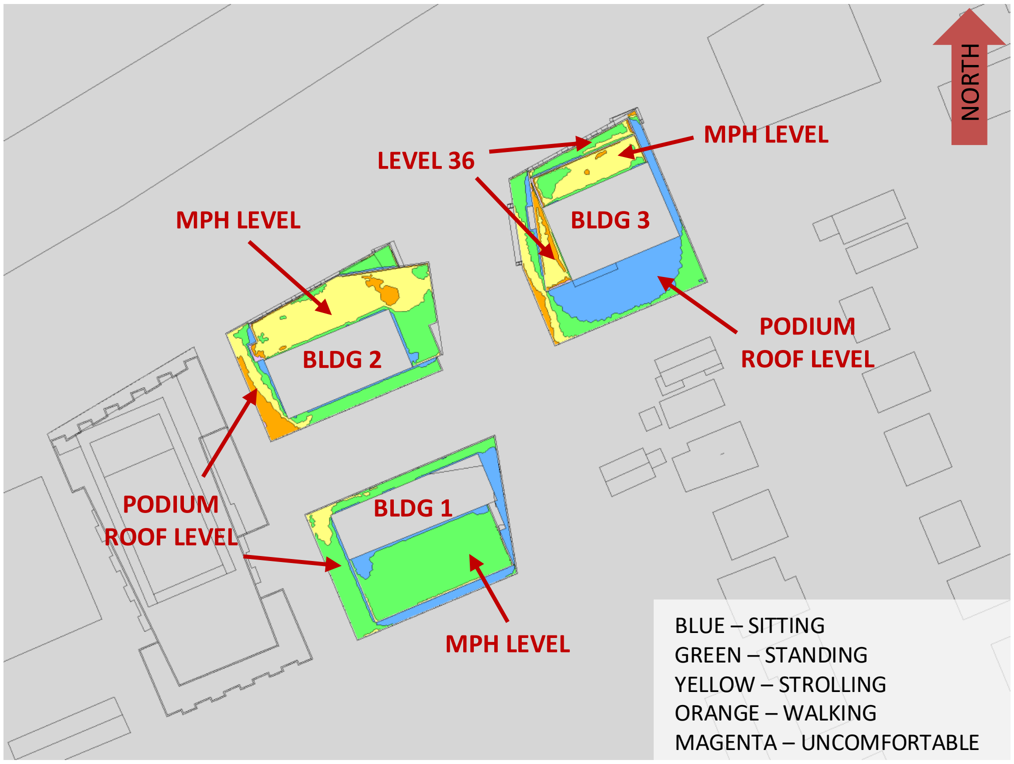


FIGURE 7C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACE

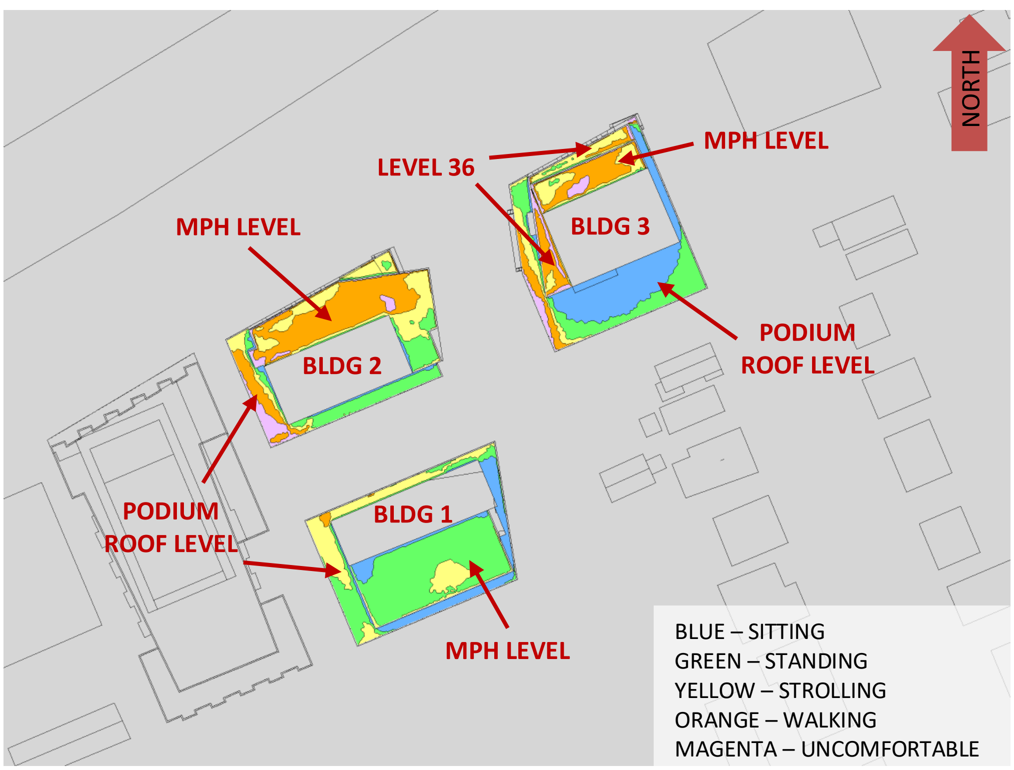


FIGURE 7D: WINTER – WIND COMFORT, COMMON AMENITY TERRACE

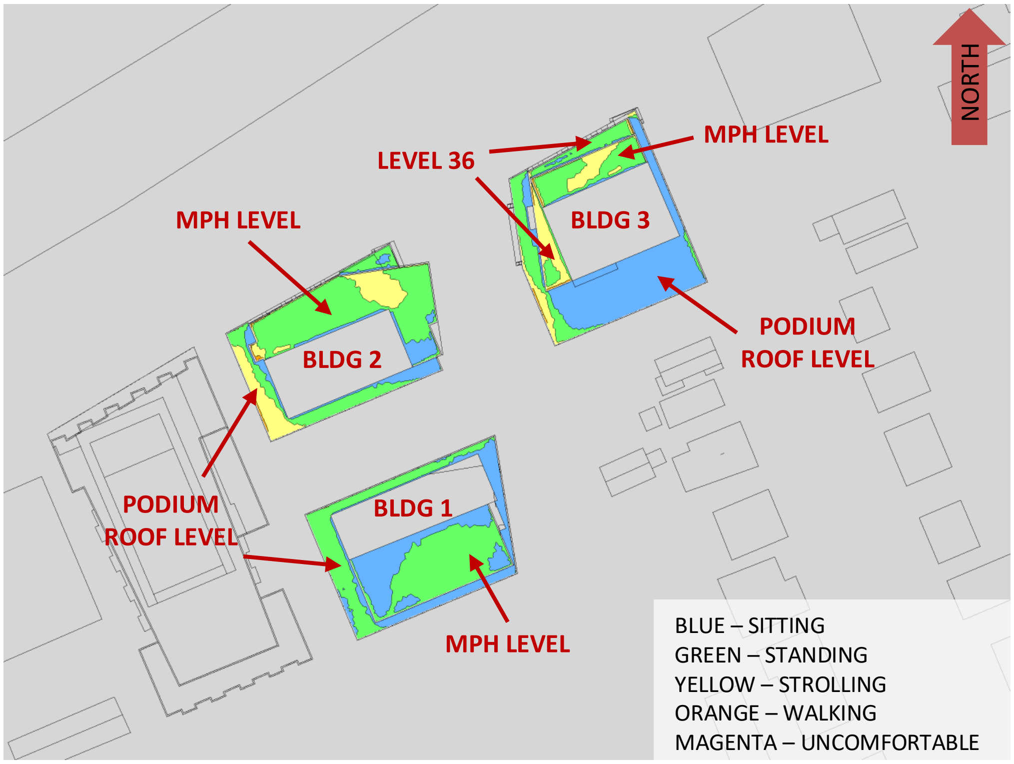


FIGURE 8A: TYPICAL USE PERIOD – WIND COMFORT, COMMON AMENITY TERRACES

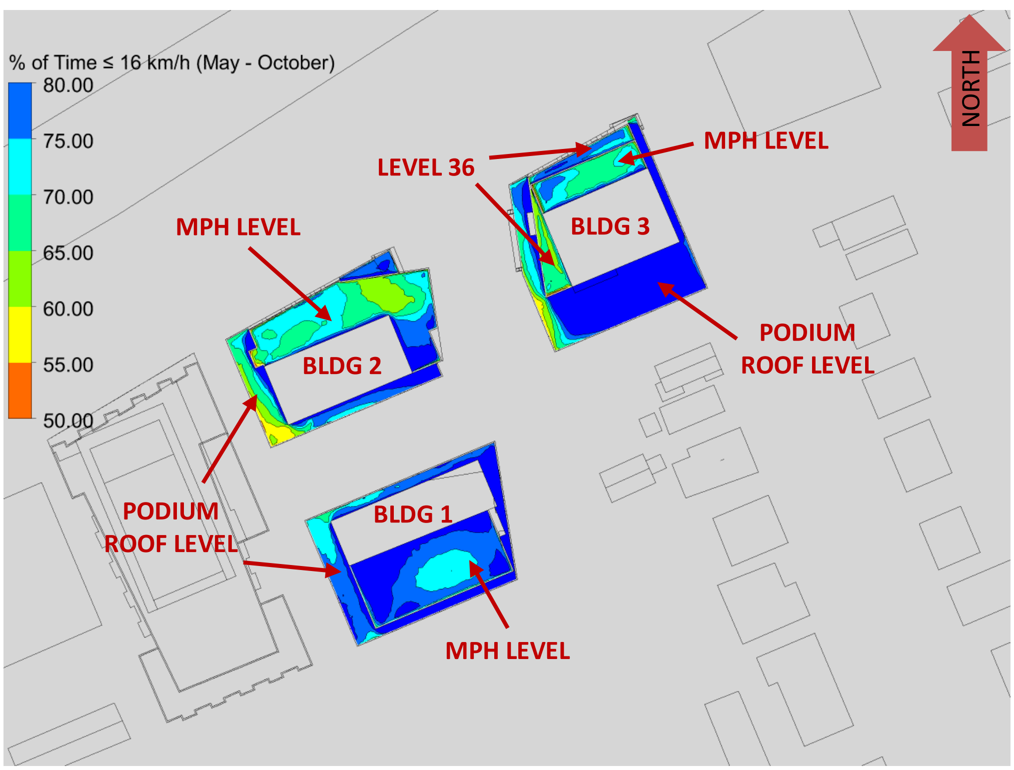
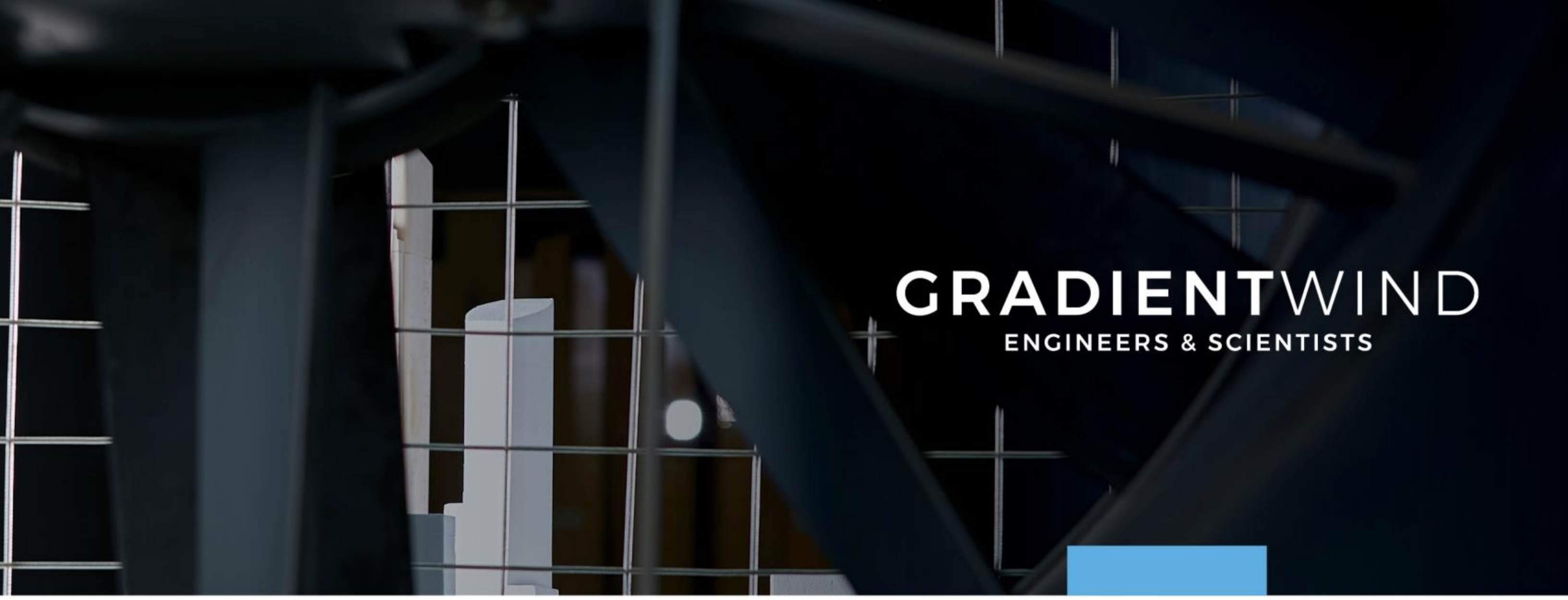
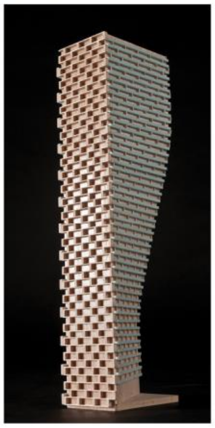
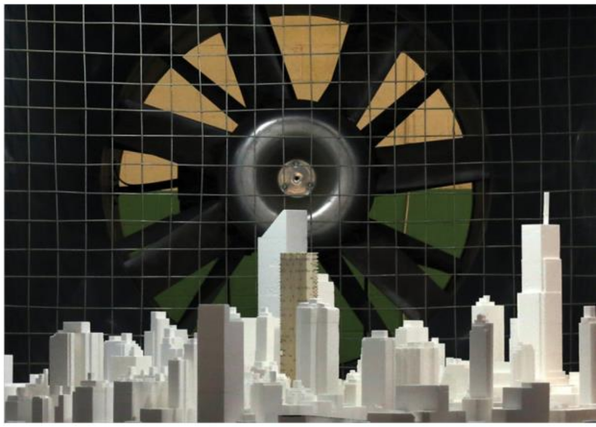


FIGURE 8B: TYPICAL USE PERIOD – % OF TIME SUITABLE FOR SITTING IN FIGURE 8A







APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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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 (i.e., 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).

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

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

where, $\boldsymbol{I}$ = turbulence intensity, $\boldsymbol{L_t}$ = turbulence length scale, $\boldsymbol{Z}$ = 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.

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[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.