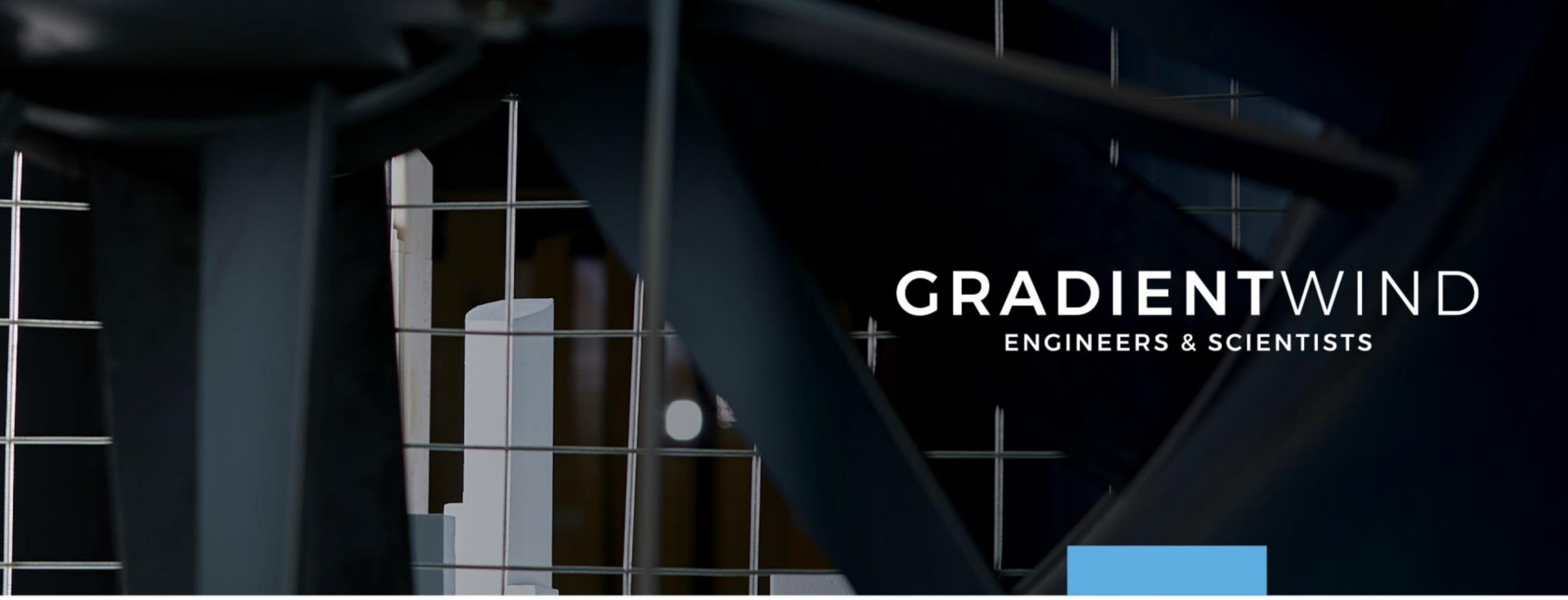
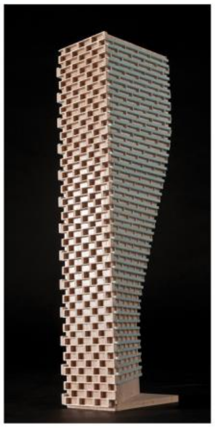
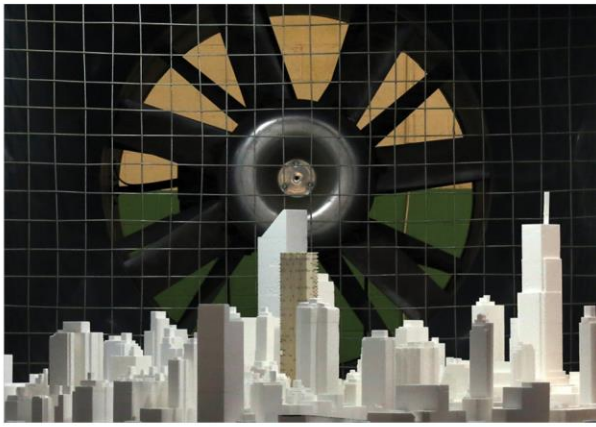


PEDESTRIAN LEVEL WIND STUDY

1887 St. Joseph Boulevard
Ottawa, Ontario

Report: 23-117-PLW





July 10, 2023

PREPARED FOR
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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Zoning By-law Amendment application submission requirements for the proposed multi-building development located at 1887 St. Joseph Boulevard in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where 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-9, 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, nearby transit stop to the southeast, existing parking lots, potential public and private streets, proposed walkways, outdoor amenities southeast, southwest, and north of Buildings C1, C2, and D, respectively, and in the vicinity of building access points, are considered acceptable. Exceptions are as follows:

    a. Conditions in the vicinity of the building access point serving the indoor amenity situated at the southeast corner of Building D are predicted to be suitable for standing during the summer, becoming suitable for strolling throughout the remainder of the year. It is recommended that this building entrance be recessed into the building façade by at least 2 m on account of windy conditions that are predicted to occur during the colder months of the year.

    b. The nearby transit stops to the south of St. Joseph Boulevard and near the southwest corner of the subject site are predicted to experience wind comfort conditions suitable for strolling during the winter.

c. Regarding the outdoor amenities to the northwest of Building A2 and to the southwest of Building B2, wind comfort conditions are predicted to be suitable for mostly for sitting with some regions predicted to be suitable for standing during the typical use period.

- Depending on programming of the noted spaces, the noted conditions may be considered acceptable. Specifically, if the windier areas of the noted spaces will not accommodate seating or more sedentary activities, the noted conditions would be considered acceptable.
- If required by programming, sitting conditions may be extended with targeted wind barriers installed around sensitive areas. Wind barriers could take the form of wind screens, clusters of coniferous trees in dense arrangements, or a combination of both options.

2) The proposed development is served by several common amenity terraces. Wind comfort conditions within the common amenity terraces and recommendations regarding mitigation, where required, are described as follows:

a. **Building A1, MPH Level Common Amenity Terrace**. Conditions during the typical use period are predicted to be suitable for sitting over most of the area, with a small, isolated region predicted to be suitable for standing to the east of the terrace. The noted conditions are considered acceptable.

b. **Building A2, Level 7 Common Amenity Terrace.** Conditions during the typical use period are predicted to be suitable for sitting, with a region predicted to be suitable standing to the east of the terrace.

c. **Buildings A2, B1, C1, and C2 Common Amenity Terraces:** Wind comfort conditions within the common amenity terrace serving Building C1 at Level 7, the common amenity terrace serving Building C2 at Level 5, and the common amenity terraces serving Buildings A2, B1, C1, and C2 at their respective MPH Levels are predicted to be suitable for sitting during the typical use period. The noted conditions are considered acceptable.

d. **Building B2, Level 6 and MPH Level Common Amenity Terraces.** Conditions are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable.

e. **Building D, Level 7 Common Amenity Terrace.** Conditions during the typical use period are predicted to be suitable for sitting, with a region predicted to be suitable for standing to the east of the terrace.

f. **Building D, MPH Level Common Amenity Terrace.** Conditions during the typical use period are predicted to be suitable for sitting at the northeast corner and to the west and suitable for standing elsewhere throughout the terrace.

g. Sitting conditions may be extended within the Level 7 amenity terraces serving Buildings A2 and D, and within the MPH Level amenity terrace serving Building D by implementing wind screens, typically glazed and solid, along the full perimeters of the noted common amenity terraces, in combination with targeted mitigation inboard of the terrace perimeters. This inboard mitigation could take the form of wind screens or clusters of coniferous plantings in dense arrangements located around sensitive areas, and canopies located above designated seating areas.

h. The extent of the mitigation measures is dependent on the programming of the terraces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to be resolved in the future Site Plan Control application submission.

3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events (for example, thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Sobeys Capital Limited to undertake a pedestrian level wind (PLW) study to satisfy Zoning By-law Amendment application submission requirements for the proposed multi-building development located at 1887 St. Joseph Boulevard in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where 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 Figurr Architects Collective in June 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 1887 St. Joseph Boulevard in Ottawa, situated approximately 90 metres (m) to the northwest of the intersection of St. Joseph Boulevard and Marenger Street, on a parcel of land bounded by St. Joseph Boulevard to the south, low-rise buildings with parking lots from the west clockwise to the east, and a mid-rise building to the southeast.

The proposed development comprises seven buildings: Building A1 (18 storeys), Building A2 (16 storeys), Building B1 (nine storeys), Building B2 (seven storeys), Building C1 (nine storeys), Building C2 (nine storeys), and Building D (18 storeys). Buildings A1 and A2 are situated at the southwest and southeast corners of the subject site, respectively, Buildings B1 and C1 are to the west, Buildings B2 and C2 are to the east, and Building D is to the north. A potential public street extends along the west elevation, a potential private street extends east-west to the south of Building D, and a potential private street extends along the east elevation of the subject site. All buildings are topped with a mechanical penthouse (MPH). Buildings A1, A2, B1, B2, C1, and C2 share a below-grade parking level which is accessed by parking ramps situated to the north of Buildings A2, B2, and C2 from the potential private street along the east elevation of the subject site. Building D includes its own below-grade parking level which is accessed by a parking ramp at the northeast corner from the potential private street to the south of Building D.

The ground floor of Building A1 comprises a near rectangular planform and includes a residential main entrance at the southeast corner, retail spaces at the southwest corner, an indoor amenity to the west, residential units to the north, and an indoor bike storage and mail/parcel space to the east. Levels 2-18 are reserved for residential use. The building steps back from the west elevation at Level 2 and from all elevations at Level 7. The MPH level includes an indoor amenity to the south and a mechanical space to the north. This level is served by an amenity terrace to the south.

The ground floor of Building A2 comprises a nominally 'L'-shaped planform, with its long axis-oriented along St. Joseph Boulevard, and includes a residential main entrance at the southeast corner, retail spaces to the south, an indoor amenity to the west, residential units to the north, and a commercial garbage space and mail/parcel space to the east. An outdoor amenity is provided to the northwest. Levels 2-16 are reserved for residential use. The building steps back from all elevations and includes an amenity terrace to the north at Level 7. The MPH level includes an indoor amenity to the south and a mechanical space to the north. This level is served by an amenity terrace to the south.

The ground floor of Building B1 comprises a nominally rectangular planform and includes a residential main entrance, a bike room, and shared building support spaces at the southwest corner, an indoor amenity at the southeast corner, and residential units throughout the remainder of the level. Levels 2-9 are reserved for residential use. The MPH level includes an indoor amenity along the west and north elevations and a mechanical space throughout the remainder of the level. This level is served by an amenity terrace extending along the west and north elevations.

The ground floor of Building B2 comprises a nominally 'L'-shaped planform, with its long axis-oriented along the eastern potential private street, and includes a residential main entrance at the southeast corner, shared building support spaces at the southeast corner and central to the building, and residential units throughout the remainder of the level. An outdoor amenity is provided to the southwest. Levels 2-7 are reserved for residential use. The building steps back from the east and west elevations and extends from the north elevation at Level 6. This level is served by an amenity terrace to the west. The MPH level includes an indoor amenity to the south and mechanical space to the north. This level is served by an amenity terrace to the south.

The ground floor of Building C1 comprises a nominally ‘L’-shaped planform, with its short axis-oriented along the western potential public street, and includes a residential main entrance and shared building support spaces at the southwest corner, a bike room at the inner southeast corner, and residential units throughout the remainder of the level. An outdoor amenity is provided to the southeast. Levels 2-9 are reserved for residential use. The building steps back from all elevations and includes an amenity terrace to the south at Level 7. The MPH level includes an indoor amenity along the south and west elevations and a mechanical space throughout the remainder of the level. This level is served by an amenity terrace along the south and east perimeters.

The ground floor of Building C2 comprises a nominally rectangular planform and includes a residential main entrance and shared building support spaces at the southeast corner, a bike room at the southwest corner, and residential units throughout the remainder of the level. An outdoor amenity is provided to the southwest. Levels 2-9 are reserved for residential use. The building extends from the west elevation at Levels 3 and 4 to link to Building C1. The building steps back from the east and west elevations and includes an amenity terrace to the west at Level 5. The MPH level includes an indoor amenity to the east and a mechanical space along the south and west elevations. This level is served by an amenity terrace extending along the north and east elevations.

The ground floor of Building D comprises a nominally rectangular planform with an inset at the southeast corner and includes a residential main entrance and a bike storage space to the south, an indoor amenity at the southeast corner, and residential units throughout the remainder of the level. An outdoor amenity is provided to the north. Levels 2-18 are reserved for residential use. The building steps back from the southeast corner at Level 2 and from all elevations at Level 7. An amenity terrace is provided to the east at Level 7. The MPH level includes a mechanical space at the southeast corner and an indoor amenity throughout the remainder of the level. This level is served by an amenity terrace extending along the west and north elevations.

The near-field surroundings, defined as an area within 200 m of the subject site, include low-rise massing in all compass directions with a mid-rise building to the southeast, a mid-rise building to the south, and a church to the southwest. 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 by low-rise suburban massing in all compass directions with open exposures of green spaces and fields to the southeast and from the south clockwise to the north. The Ottawa River flows from west to east approximately 2.3 km to the north 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 future developments approved by the City of Ottawa.

3. OBJECTIVES

The principal objectives of this study are to (i) determine pedestrian level wind 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 subject 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 subject 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 530 m. The process was performed for two context massing scenarios, as noted in Section 2.

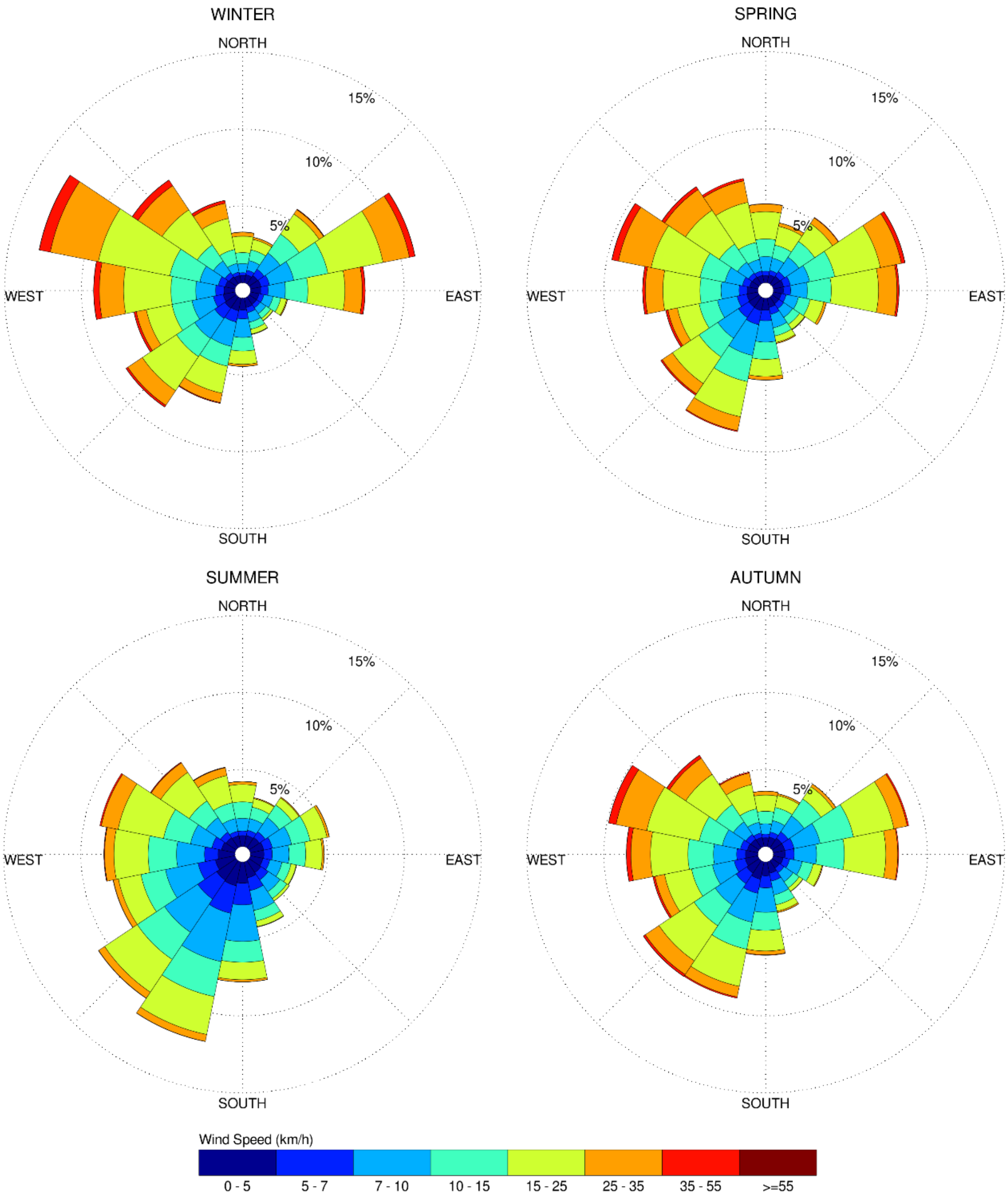
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the common amenity terraces serving the proposed development 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 32 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 Point	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-6B, illustrating wind conditions at grade level for the proposed and existing massing scenarios, and by Figures 8A-8D, illustrating wind conditions over the common amenity terrace serving Building C2 at Level 5, the common amenity terrace serving Building B2 at Level 6, the common amenity terraces serving Buildings A2, C1, and D at Level 7, and the common amenity terraces serving each building at their respective MPH Levels. Conditions are presented as continuous contours of wind comfort throughout the subject site and correspond to the comfort classes presented in Section 4.4. 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 comfort conditions are also reported for the typical use period, which is defined as May to October, inclusive. Figures 7 and 9 illustrate comfort conditions at grade level and over the noted amenity terraces serving the proposed development, respectively, consistent with the comfort classes in Section 4.4. The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Grade Level

Sidewalks St. Joseph Boulevard: Following the introduction of the proposed development, wind comfort conditions over the public sidewalks along St. Joseph Boulevard are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming suitable for strolling, or better, during the winter and spring. The noted conditions are considered acceptable.

Wind comfort conditions over the sidewalks along St. Joseph Boulevard with the existing massing are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions with the proposed development are nevertheless considered acceptable.

Transit Stops along St. Joseph Boulevard: Prior to the introduction of the proposed development, wind comfort conditions in the vicinity of the nearby transit stops to the south of St. Joseph Boulevard and near the southwest corner of the subject site are predicted to be suitable for sitting during the summer, becoming suitable for standing throughout the remainder of the year.

Following the introduction of the proposed development, wind comfort conditions in the vicinity of the nearby transit stop to the south of St. Joseph Boulevard are predicted to be suitable for standing during the spring, summer, and autumn, becoming suitable for strolling during the winter. Conditions in the vicinity of the nearby transit stop along St. Joseph Boulevard near the southwest corner of the subject site are predicted to be suitable for standing during the spring, summer, and autumn, becoming suitable for a mix of standing and strolling during the winter.

For both massing scenarios, wind conditions in the vicinity of the nearby transit stop along St. Joseph Boulevard near the southeast corner of the subject site are predicted to be suitable for sitting during the summer, becoming suitable for standing throughout the remainder of the year. The noted conditions are considered acceptable.

Existing Parking Lots Southwest and Northwest of Subject Site: Following the introduction of the proposed development, wind comfort conditions over the existing parking lot situated to the southwest of the subject site are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing throughout the remainder of the year. Conditions over the existing parking lot situated to the northwest of the subject site are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing during the spring and autumn, with isolated regions suitable for strolling during the spring, and suitable for a mix of standing and strolling during the winter. The noted conditions are considered acceptable.

Wind comfort conditions over the parking lot to the southwest with the existing massing are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year. Conditions over the existing parking lot situated to the northwest are predicted to be suitable for standing, or better, during the summer, becoming suitable for standing during the autumn, and suitable for a mix of standing and strolling during the winter and spring. Notably, the introduction of the proposed development is predicted to improve comfort levels over the noted parking lots, in comparison to existing conditions, and wind conditions with the proposed development are considered acceptable.

Existing Parking Lots North and East of Subject Site: Following the introduction of the proposed development, wind comfort conditions over the existing parking lot situated to the north of the subject site are predicted to be suitable mostly for sitting during the summer, becoming suitable for standing during the spring and autumn, with an isolated region suitable for strolling during the spring, and suitable for a mix of standing and strolling during the winter. Conditions over the existing parking lot situated to the northeast of the subject site are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a strolling, or better, throughout the remainder of the year. Conditions over the existing parking lot situated to the southeast of the subject site are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable.

Wind comfort conditions over the parking lot to the north with the existing massing are predicted to be suitable mostly for sitting during the summer, becoming suitable for standing throughout the remainder of the year, with an isolated region suitable for strolling during the winter. Conditions over the existing parking lot situated to the northeast are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing throughout the remainder of the year. Conditions over the existing parking lot situated to the southeast are predicted to be suitable mostly for sitting during the summer, becoming suitable for standing throughout the remainder of the year. While the introduction of the proposed development produces windier conditions over the existing parking lots to the north and northeast, conditions over the existing parking lot to the southeast are predicted to improve in comparison to existing conditions. The noted conditions are considered acceptable.

Sidewalks along Potential Public Street and Potential Private Streets: Wind comfort conditions over the public sidewalks along the potential public street extending along the west elevation of the subject site are predicted to be suitable for a mix of sitting and standing throughout the year, with isolated regions predicted to be suitable for strolling during the spring, autumn, and winter. Conditions over the sidewalks along the east-west potential private street situated to the south of Building D are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a mix of standing and strolling throughout the remainder of the year. Conditions over the sidewalks along the potential private street extending along the east elevation of the subject site are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing with isolated regions suitable for strolling throughout the remainder of the year. The noted conditions are considered acceptable.

Proposed Walkways Within Subject Site: Wind comfort conditions over the walkways within the subject site are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for strolling, or better, throughout the remainder of the year. The noted conditions are considered acceptable.

Outdoor Amenities Within Subject Site: The proposed development is served by multiple outdoor amenities within the subject site. Wind comfort conditions within the noted areas and recommendations regarding mitigation, where required, are described as follows:

- **Outdoor Amenity Northwest of Building A2**: Wind comfort conditions over the outdoor amenity situated to the northwest of Building A2 are predicted to be suitable for sitting over most of the area with standing conditions along the north and west elevations during the typical use period, as illustrated in Figure 7. Where conditions are suitable for standing, they are also suitable for sitting for at least 75% and 73% of the time along the north and west elevations, respectively, during the same period, where the target is 80% to achieve the sitting comfort class.

- **Outdoor Amenity Southwest of Building B2**: Wind comfort conditions over the outdoor amenity situated to the southwest of Building B2 are predicted to be suitable for sitting over most of the area with standing conditions along the south elevation during the typical use period, as illustrated in Figure 7. Where conditions are suitable for standing, they are also suitable for sitting for at least 77% of the time during the same period, where the target is 80% to achieve the sitting comfort class.

- **Outdoor Amenity Southeast of Building C1:** Wind comfort conditions over the outdoor amenity situated to the southeast of Building C1 are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable.

- **Outdoor Amenity Southwest of Building C2**: Wind comfort conditions over the outdoor amenity situated to the southwest of Building C2 are predicted to be suitable for sitting during the typical use period, as illustrated in Figure 7. The noted conditions are considered acceptable.

- **Outdoor Amenity North of Building D**: Wind comfort conditions over the outdoor amenity situated to the north of Building D are predicted to be suitable for sitting over most of the area with standing conditions at the northeast corner during the typical use period, as illustrated in Figure 7. As conditions are predicted to be suitable for sitting over the majority of the outdoor amenity, and since the noted area predicted to be suitable for standing is just below the sitting comfort criteria threshold, the noted conditions are considered acceptable.

- Depending on programming of the outdoor amenities situated to the northwest of Building A2 and to the southwest of Building B2, the noted conditions may be considered acceptable. Specifically, if the windier areas of the noted spaces will not accommodate seating or more sedentary activities, the noted conditions would be considered acceptable. If required by programming, sitting conditions may be extended with targeted wind barriers installed around sensitive areas. Wind barriers could take the form of wind screens, clusters of coniferous trees in dense arrangements, or a combination of both options.

Building Access Points: Wind conditions in the vicinity of the building access point serving the indoor amenity situated at the southeast corner of Building D are predicted to be suitable for standing during the summer, becoming suitable for strolling throughout the remainder of the year. It is recommended that this building entrance be recessed into the building façade by at least 2 m on account of windy conditions that are predicted to occur during the colder months of the year.

The remaining building access points serving the proposed development are predicted to be suitable for standing, or better, throughout the year. The noted conditions are considered acceptable.

5.2 Wind Comfort Conditions – Common Amenity Terraces

The proposed development is served by several common amenity terraces. Wind comfort conditions within the common amenity terraces and recommendations regarding mitigation, where required, are described as follows:

Building A1, MPH Level Common Amenity Terrace: Wind comfort conditions within the common amenity terrace serving Building A1 at the MPH Level are predicted to be suitable for sitting over most of the area, with an isolated region predicted to be suitable for standing to the east of the terrace during the typical use period, as illustrated in Figure 9. Where conditions are suitable for standing, they are also predicted to be suitable for sitting for at least 77% of the time during the same period, where the target is 80% to achieve the sitting comfort class. Since the noted windiest area is small and close to achieve the sitting comfort class, the noted conditions are considered acceptable.

Building A2, Level 7 Common Amenity Terrace: Wind comfort conditions within the common amenity terrace serving Building A2 at Level 7 are predicted to be suitable for sitting, with conditions predicted to be suitable for standing to the east of the terrace during the typical use period, as illustrated in Figure 9. Where conditions are suitable for standing, they 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.

Buildings A2, B1, C1, and C2 Common Amenity Terraces: Wind comfort conditions within the common amenity terrace serving Building C1 at Level 7, the common amenity terrace serving Building C2 at Level 5, and the common amenity terraces serving Buildings A2, B1, C1, and C2 at their respective MPH Levels are predicted to be suitable for sitting during the typical use period, as illustrated in Figure 9. The noted conditions are considered acceptable.

Building B2, Level 6 and MPH Level Common Amenity Terraces: Wind comfort conditions within the common amenity terraces serving Building B2 at Level 6 and at the MPH level are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable.

Building D, Level 7 Common Amenity Terrace: Wind comfort conditions within the common amenity terrace serving Building D at Level 7 are predicted to be suitable for sitting, with conditions predicted to be suitable for standing to the east of the terrace during the typical use period, as illustrated in Figure 9. Where conditions are suitable for standing, they are also predicted to be suitable for sitting for at least 75% of the time during the same period, where the target is 80% to achieve the sitting comfort class.

Building D, MPH Level Common Amenity Terrace: Wind comfort conditions within the common amenity terrace serving Building D at the MPH Level are predicted to be suitable for sitting at the northeast corner and to the west and suitable for standing elsewhere throughout the terrace during the typical use period, as illustrated in Figure 9. Where conditions are suitable for standing, they are also predicted to be suitable for sitting for at least 75% and 65% of the time to the north and west, and at the northwest and southwest corners of MPH Level, respectively, during the same period, where the target is 80% to achieve the sitting comfort class.

Sitting conditions may be extended within the Level 7 amenity terraces serving Buildings A2 and D, and within the MPH Level amenity terrace serving Building D by implementing wind screens, typically glazed and solid, along the full perimeters of the noted common amenity terraces, in combination with targeted mitigation inboard of the terrace perimeters. This inboard mitigation could take the form of wind screens or clusters of coniferous plantings in dense arrangements located around sensitive areas, and canopies located above designated seating areas.

The extent of the mitigation measures is dependent on the programming of the terraces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to be resolved in the future Site Plan Control application submission.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no pedestrian areas within or surrounding the subject site are expected to experience conditions that could be considered dangerous, as defined in Section 4.4.

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.

6. CONCLUSIONS AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-9. 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, nearby transit stop to the southeast, existing parking lots, potential public and private streets, proposed walkways, outdoor amenities southeast, southwest, and north of Buildings C1, C2, and D, respectively, and in the vicinity of building access points, are considered acceptable. Exceptions are as follows:

    a. Conditions in the vicinity of the building access point serving the indoor amenity situated at the southeast corner of Building D are predicted to be suitable for standing during the summer, becoming suitable for strolling throughout the remainder of the year. It is recommended that this building entrance be recessed into the building façade by at least 2 m on account of windy conditions that are predicted to occur during the colder months of the year.

    b. The nearby transit stops to the south of St. Joseph Boulevard and near the southwest corner of the subject site are predicted to experience wind comfort conditions suitable for strolling during the winter.

    c. Regarding the outdoor amenities to the northwest of Building A2 and to the southwest of Building B2, wind comfort conditions are predicted to be suitable for mostly for sitting with some regions predicted to be suitable for standing during the typical use period.

        - Depending on programming of the noted spaces, the noted conditions may be considered acceptable. Specifically, if the windier areas of the noted spaces will not accommodate seating or more sedentary activities, the noted conditions would be considered acceptable.

- If required by programming, sitting conditions may be extended with targeted wind barriers installed around sensitive areas. Wind barriers could take the form of wind screens, clusters of coniferous trees in dense arrangements, or a combination of both options.

2) The proposed development is served by several common amenity terraces. Wind comfort conditions within the common amenity terraces and recommendations regarding mitigation, where required, are described as follows:

   a. **Building A1, MPH Level Common Amenity Terrace**. Conditions during the typical use period are predicted to be suitable for sitting over most of the area, with a small, isolated region predicted to be suitable for standing to the east of the terrace. The noted conditions are considered acceptable.

   b. **Building A2, Level 7 Common Amenity Terrace.** Conditions during the typical use period are predicted to be suitable for sitting, with a region predicted to be suitable standing to the east of the terrace.

   c. **Buildings A2, B1, C1, and C2 Common Amenity Terraces:** Wind comfort conditions within the common amenity terrace serving Building C1 at Level 7, the common amenity terrace serving Building C2 at Level 5, and the common amenity terraces serving Buildings A2, B1, C1, and C2 at their respective MPH Levels are predicted to be suitable for sitting during the typical use period. The noted conditions are considered acceptable.

   d. **Building B2, Level 6 and MPH Level Common Amenity Terraces.** Conditions are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable.

   e. **Building D, Level 7 Common Amenity Terrace.** Conditions during the typical use period are predicted to be suitable for sitting, with a region predicted to be suitable for standing to the east of the terrace.

   f. **Building D, MPH Level Common Amenity Terrace.** Conditions during the typical use period are predicted to be suitable for sitting at the northeast corner and to the west and suitable for standing elsewhere throughout the terrace.

g. Sitting conditions may be extended within the Level 7 amenity terraces serving Buildings A2 and D, and within the MPH Level amenity terrace serving Building D by implementing wind screens, typically glazed and solid, along the full perimeters of the noted common amenity terraces, in combination with targeted mitigation inboard of the terrace perimeters. This inboard mitigation could take the form of wind screens or clusters of coniferous plantings in dense arrangements located around sensitive areas, and canopies located above designated seating areas.

h. The extent of the mitigation measures is dependent on the programming of the terraces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to be resolved in the future Site Plan Control application submission.

3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events (for example, thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. 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
July 10, 2023
PROVINCE OF ONTARIO

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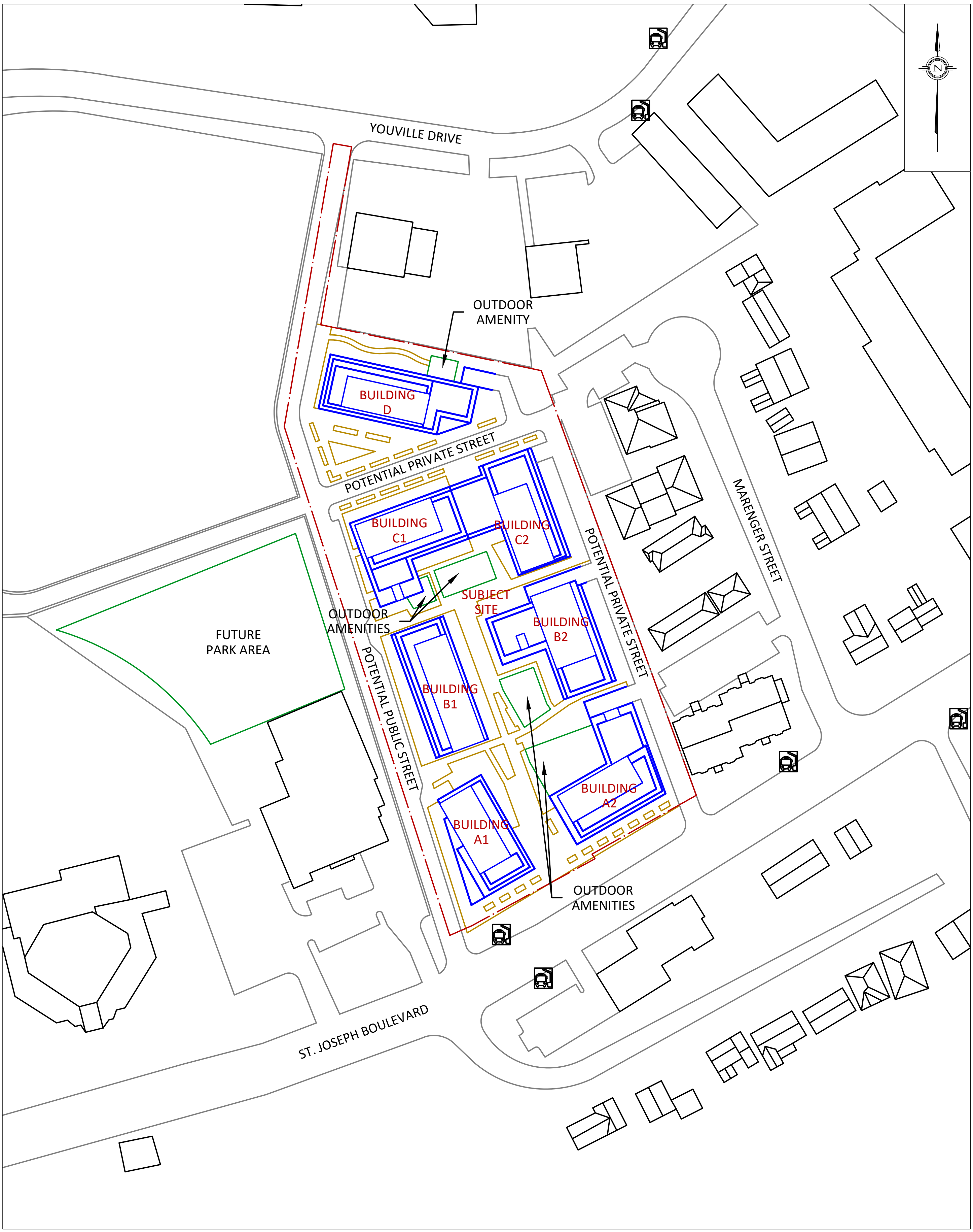
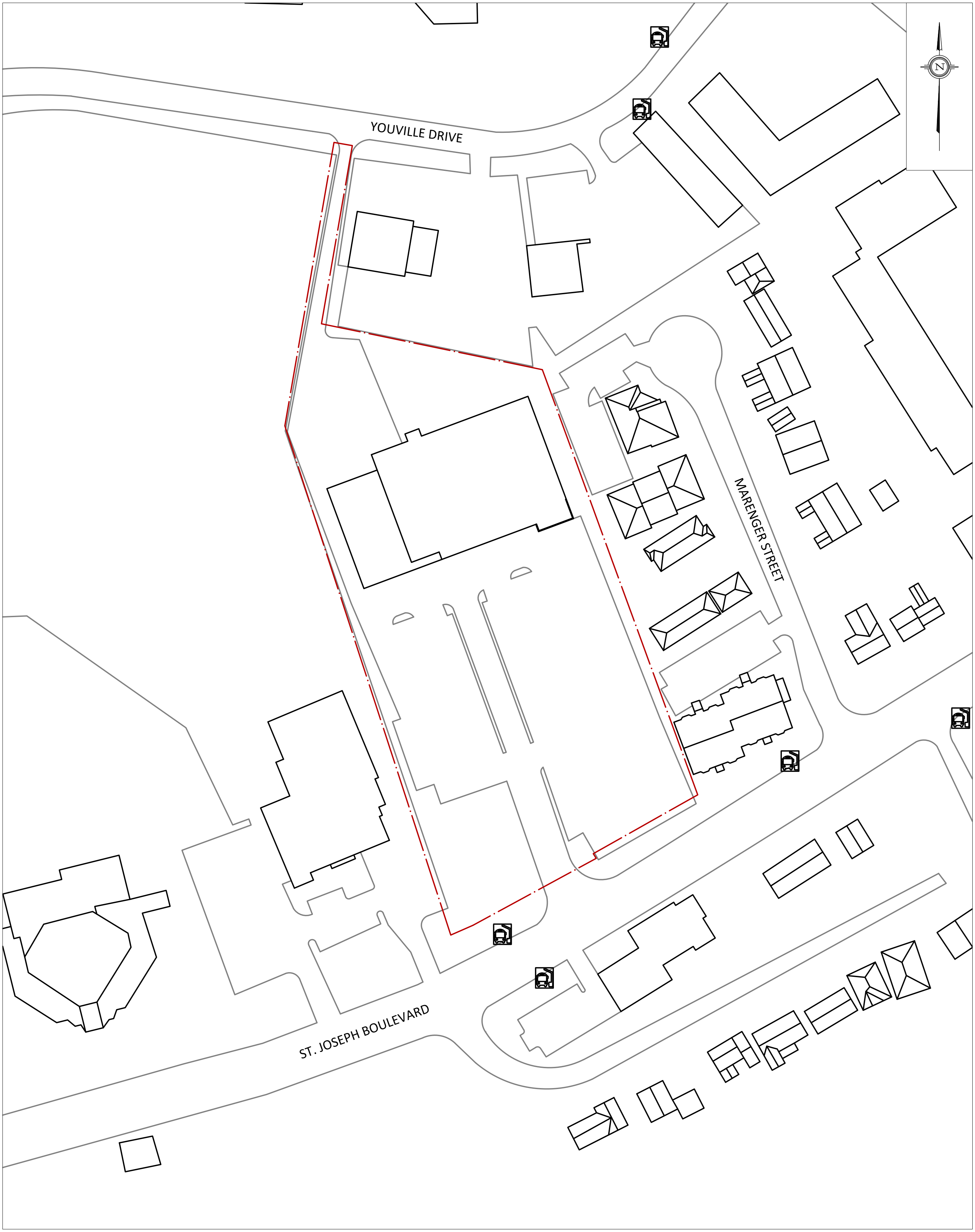


GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 1887 ST. JOSEPH BOULEVARD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
	SCALE 1:2000	DRAWING NO. 23-117-PLW-1A	
	DATE JUNE 16, 2023	DRAWN BY S.K.	



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PROJECT: 1887 ST. JOSEPH BOULEVARD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2000	DRAWING NO.: 23-117-PLW-1B	
DATE: JUNE 16, 2023	DRAWN BY: S.K.	

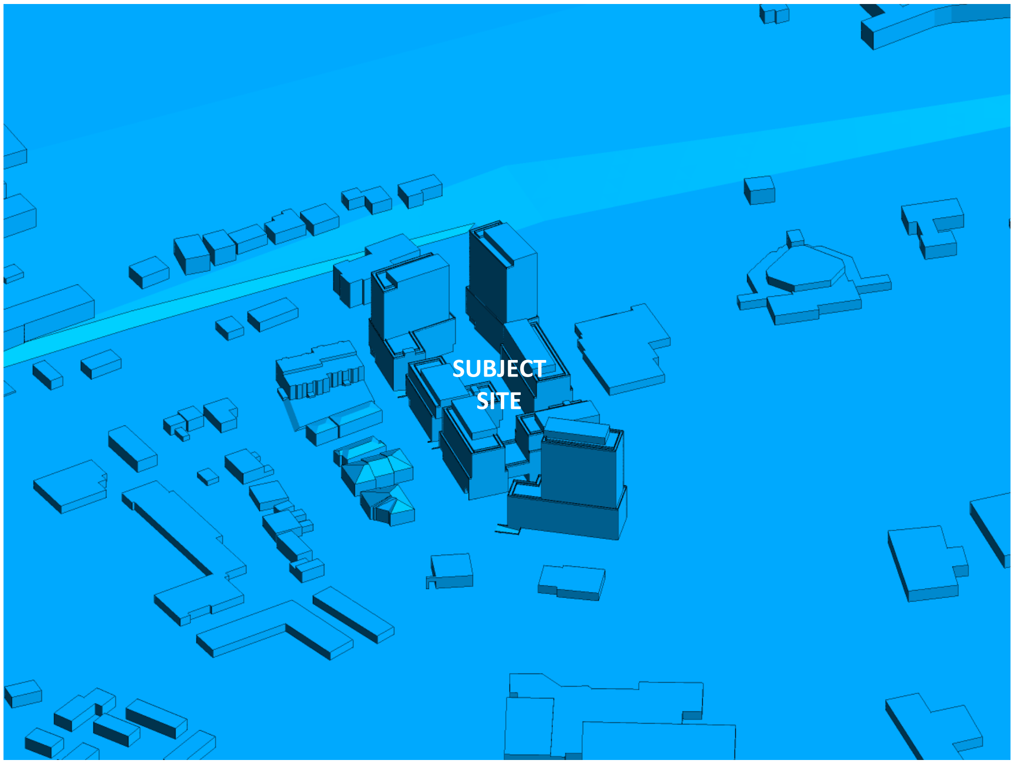


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

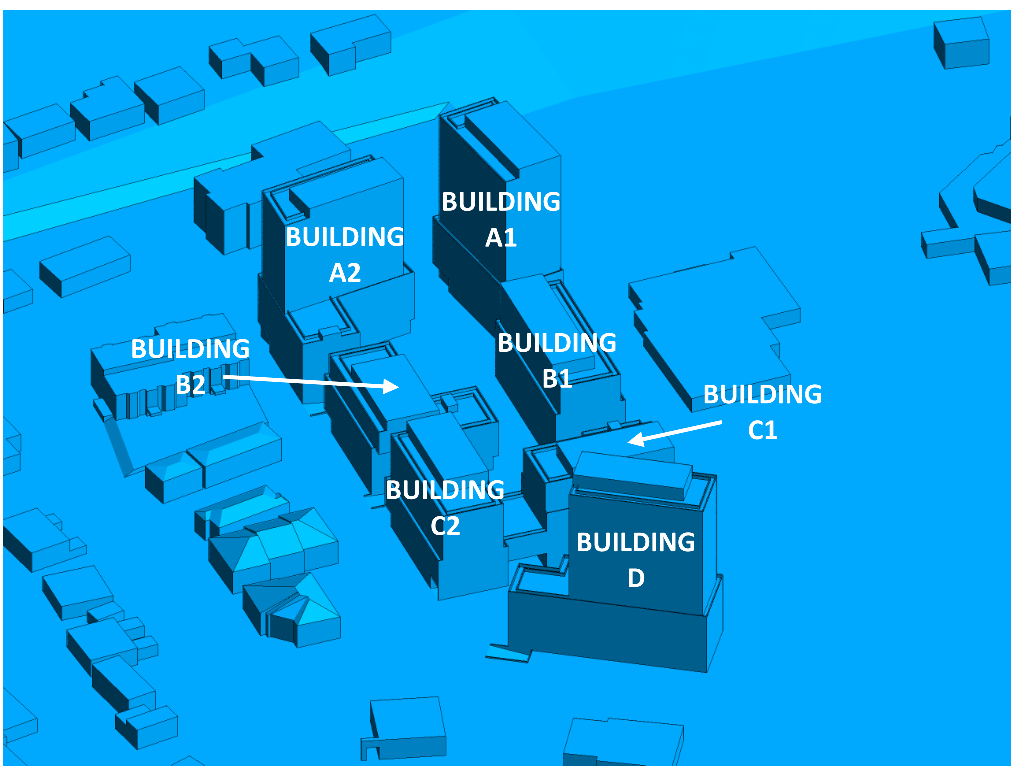


FIGURE 2B: CLOSE UP OF FIGURE 2A

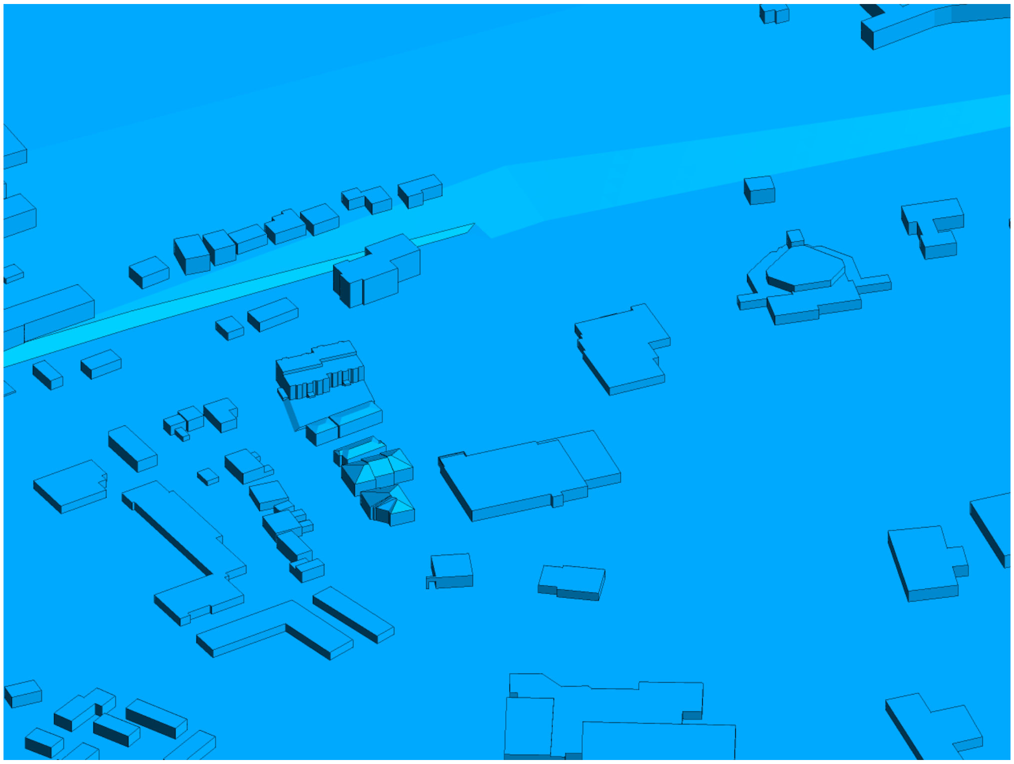


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

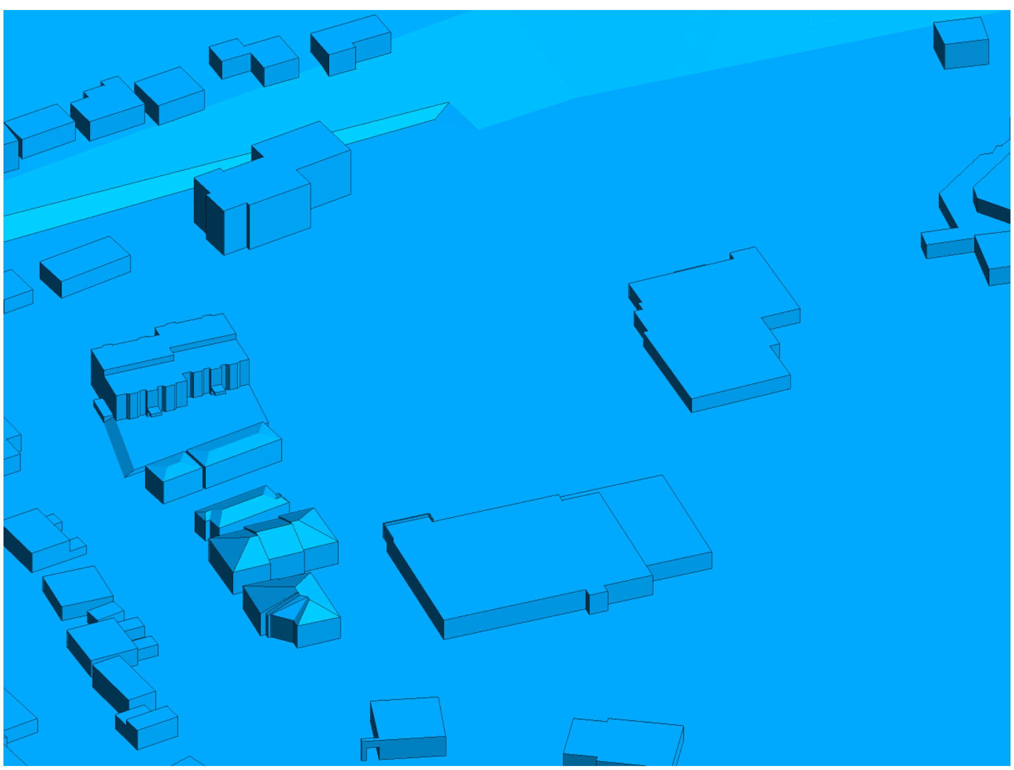


FIGURE 2D: CLOSE UP OF FIGURE 2C

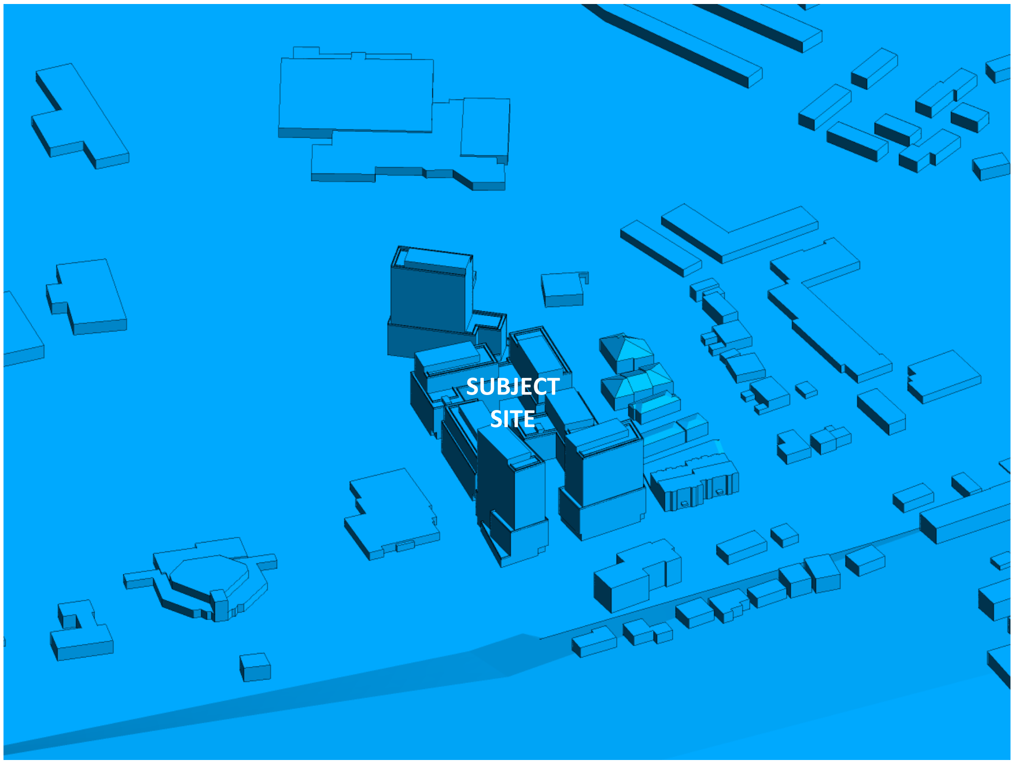


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

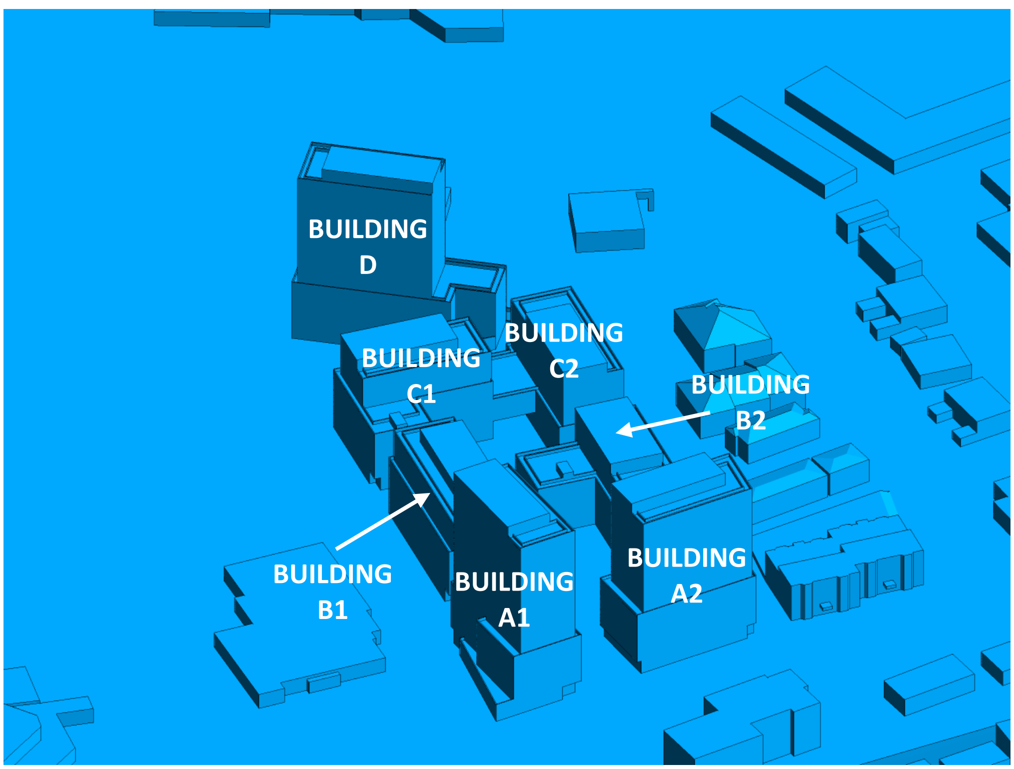


FIGURE 2F: CLOSE UP OF FIGURE 2E

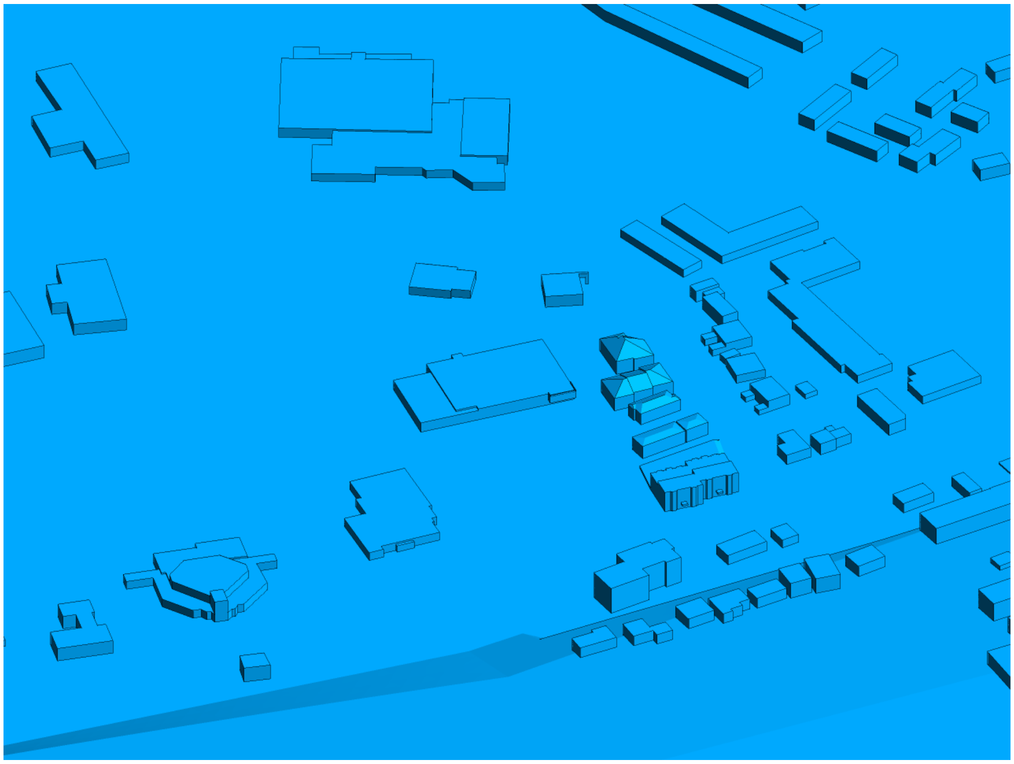


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

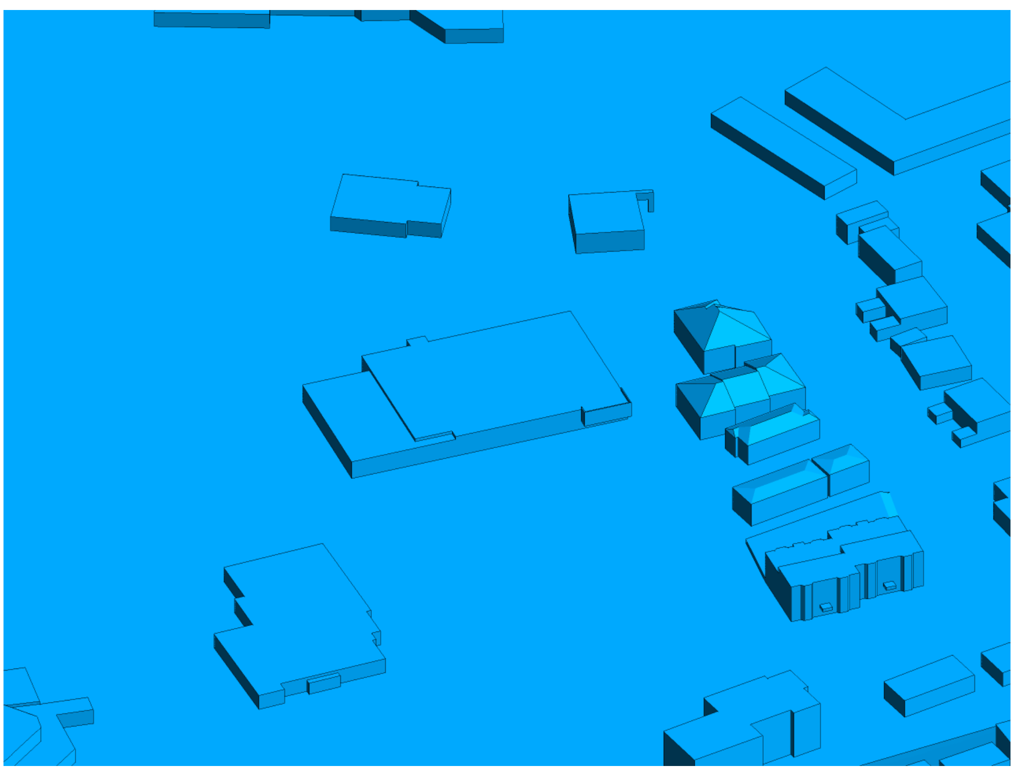


FIGURE 2H: CLOSE UP OF FIGURE 2G

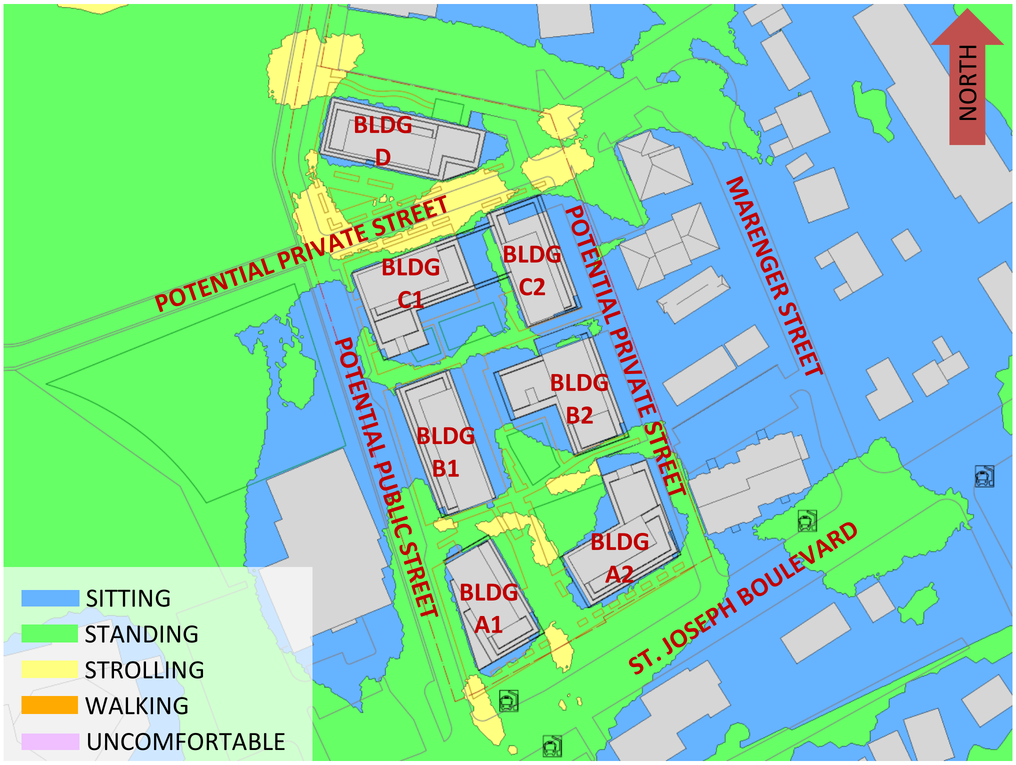


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

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

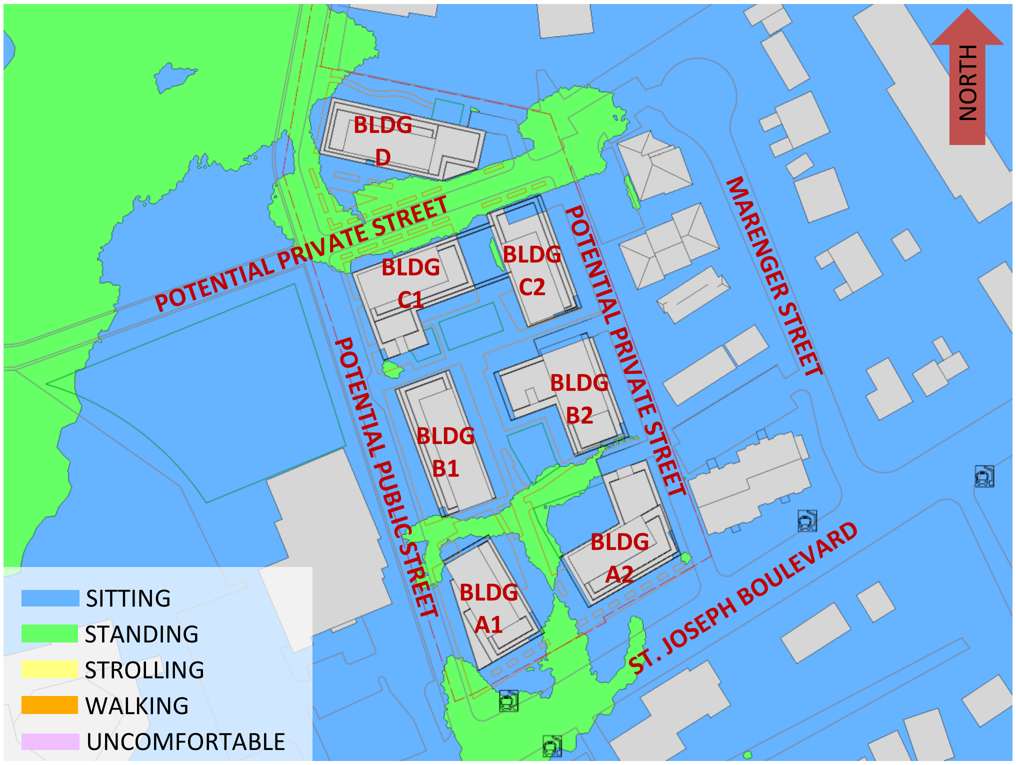


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

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

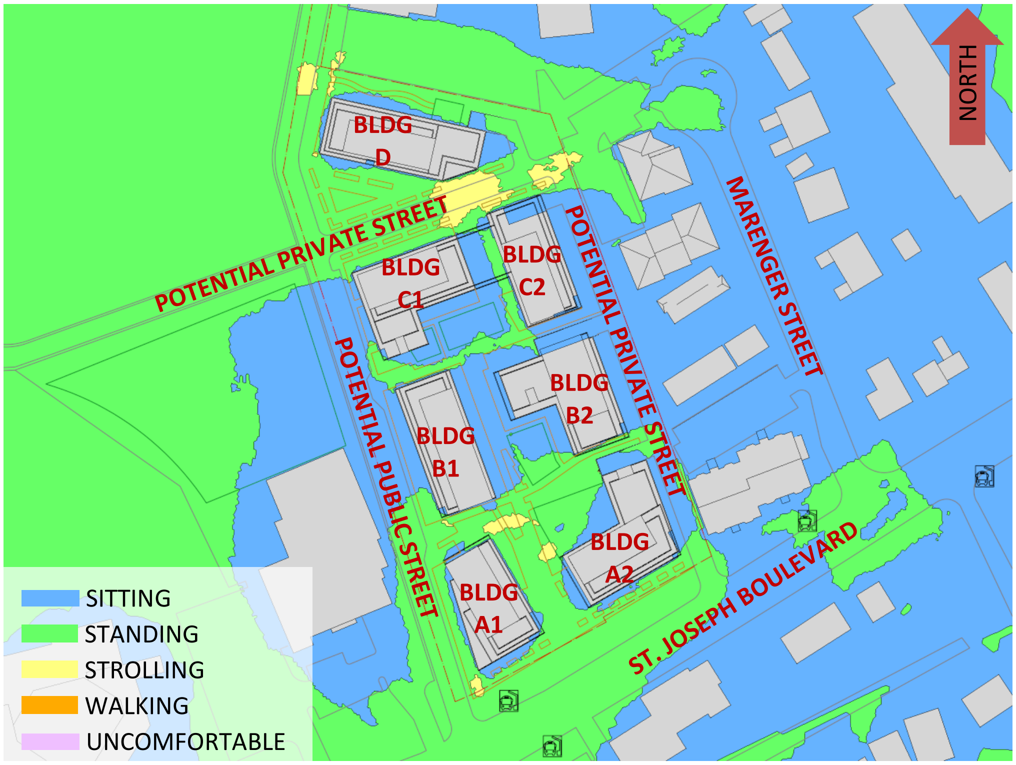


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

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

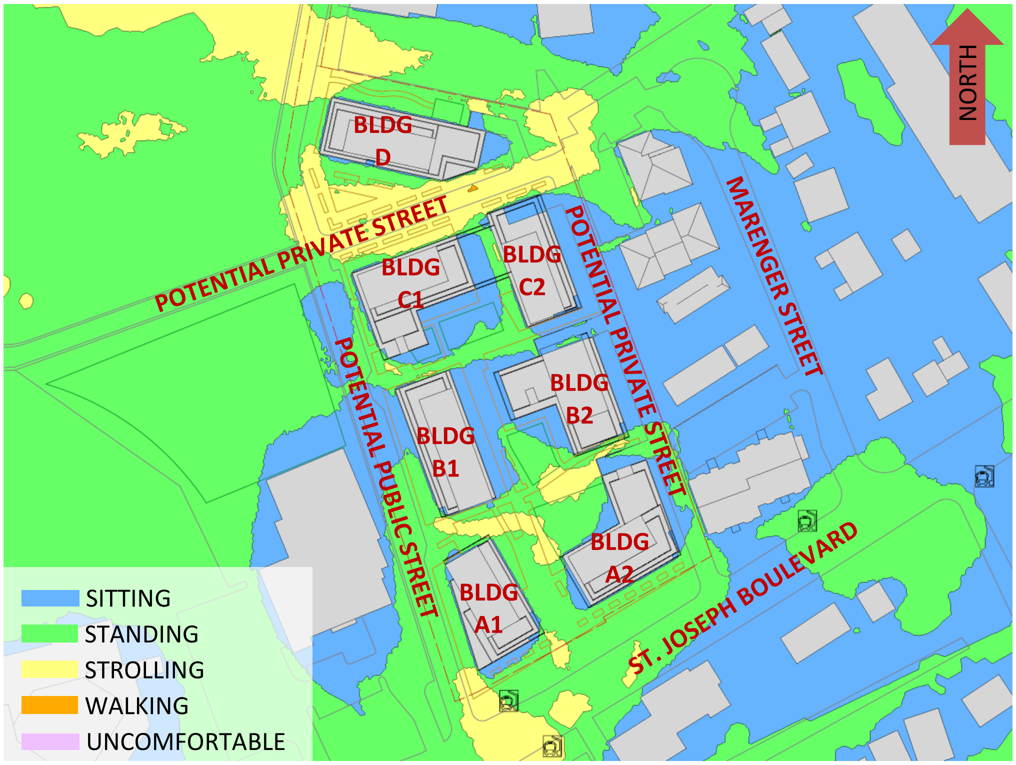


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

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

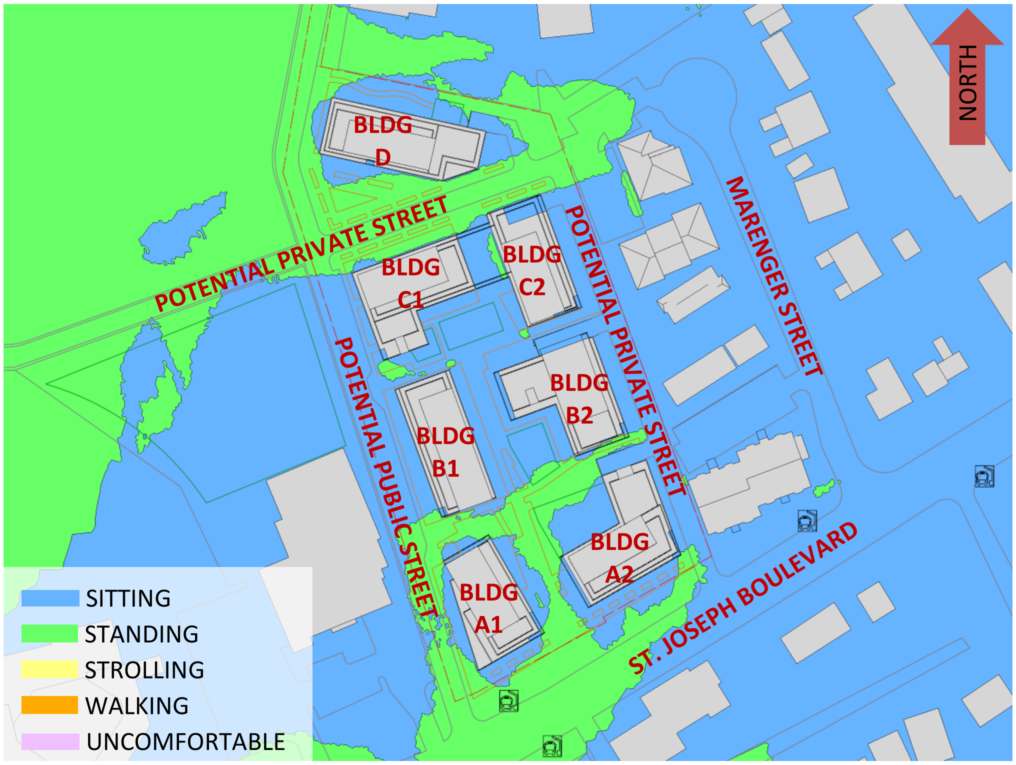


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

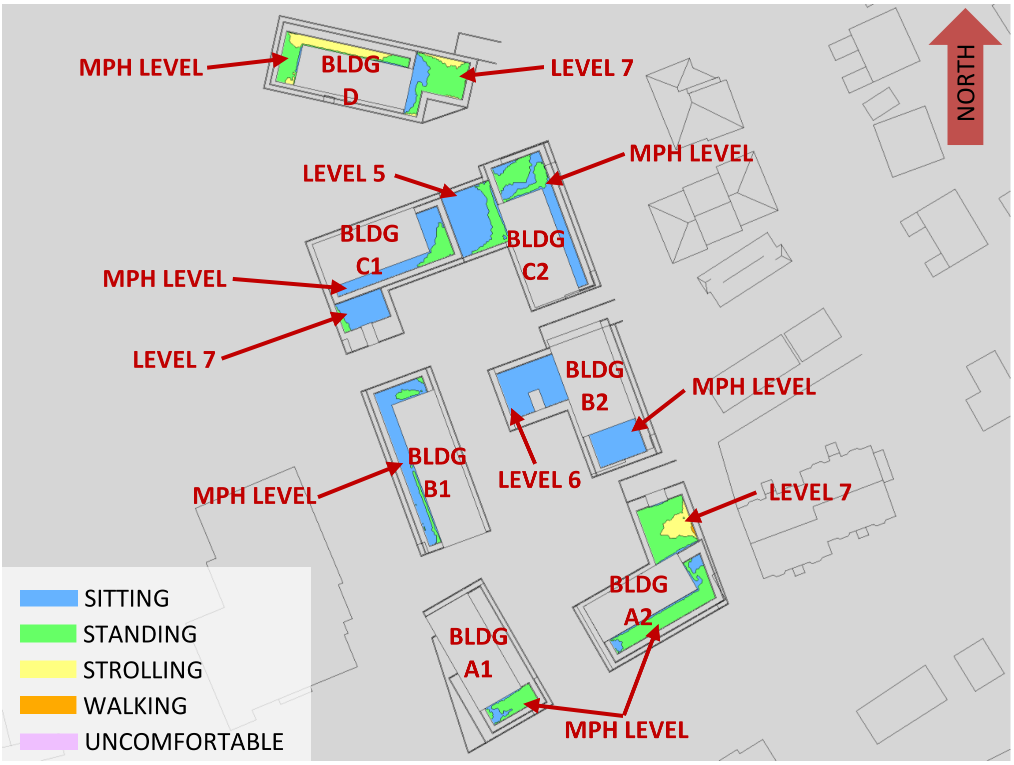


FIGURE 8A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

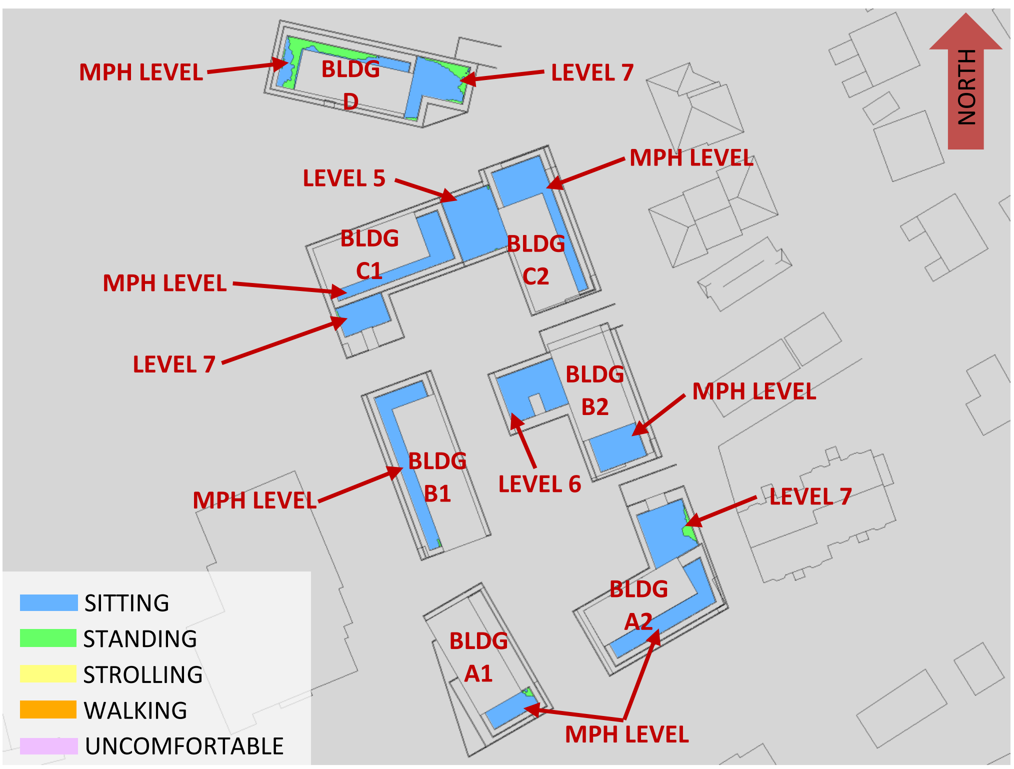


FIGURE 8B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACES

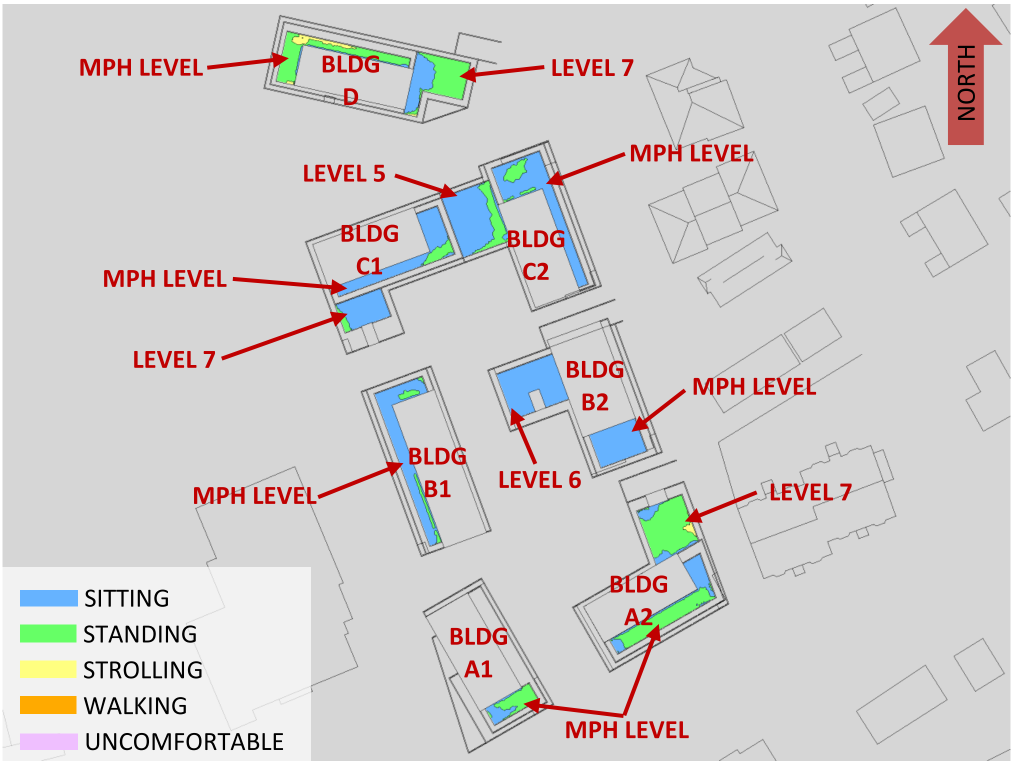


FIGURE 8C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACES

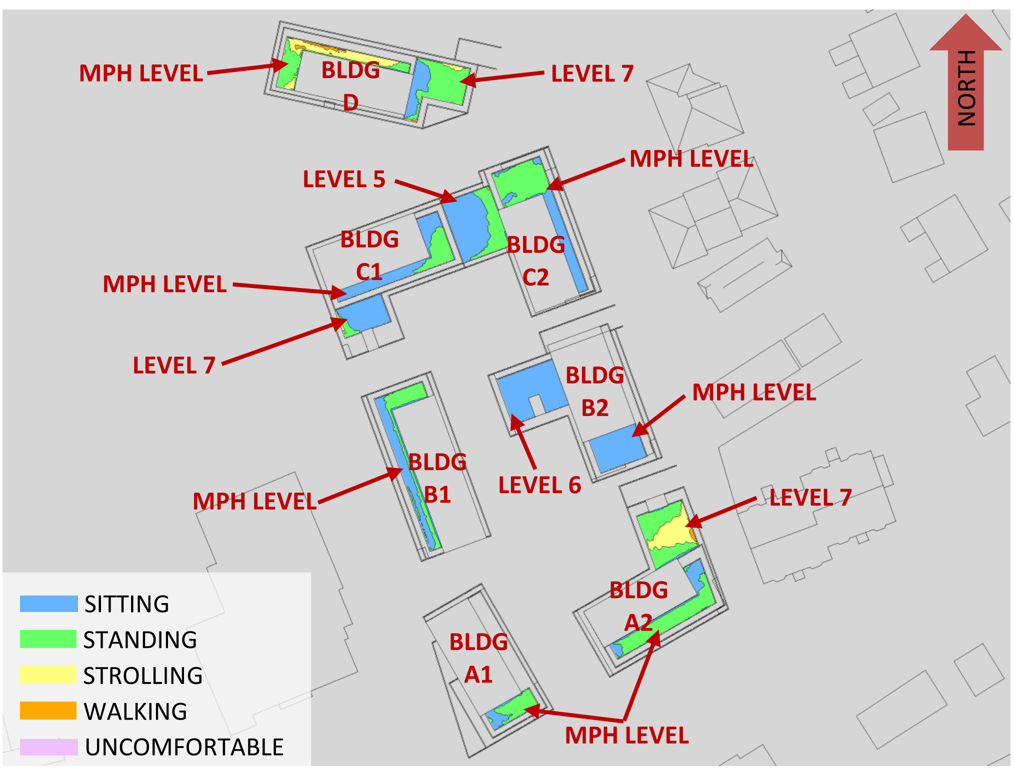


FIGURE 8D: WINTER – WIND COMFORT, COMMON AMENITY TERRACES

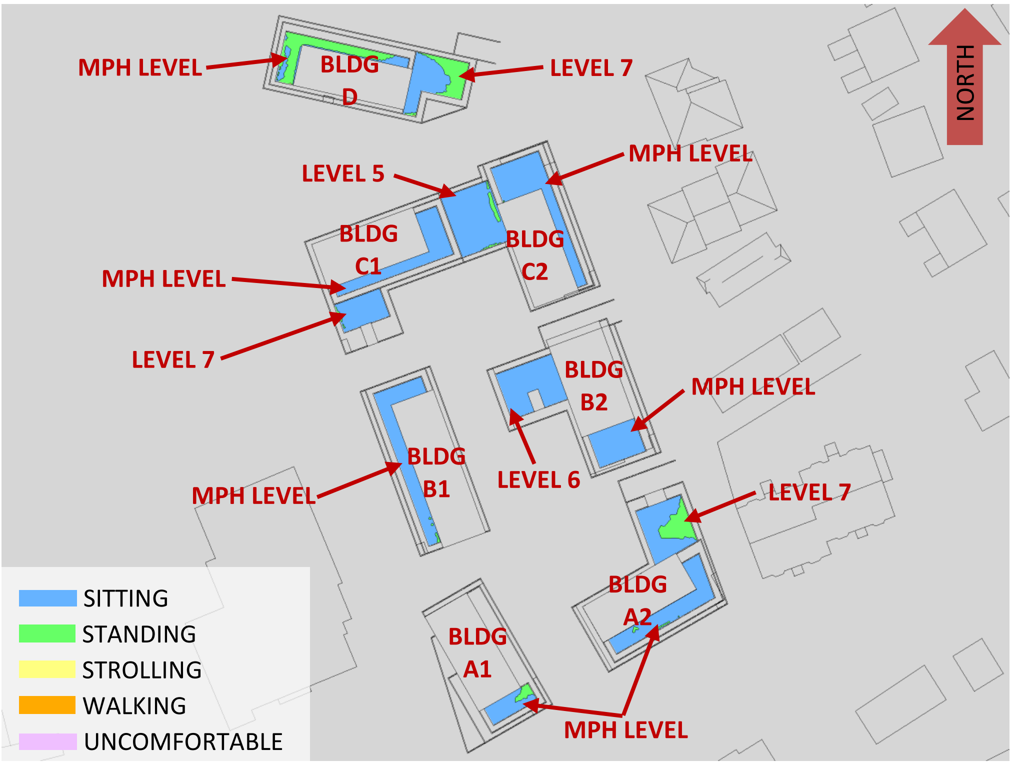
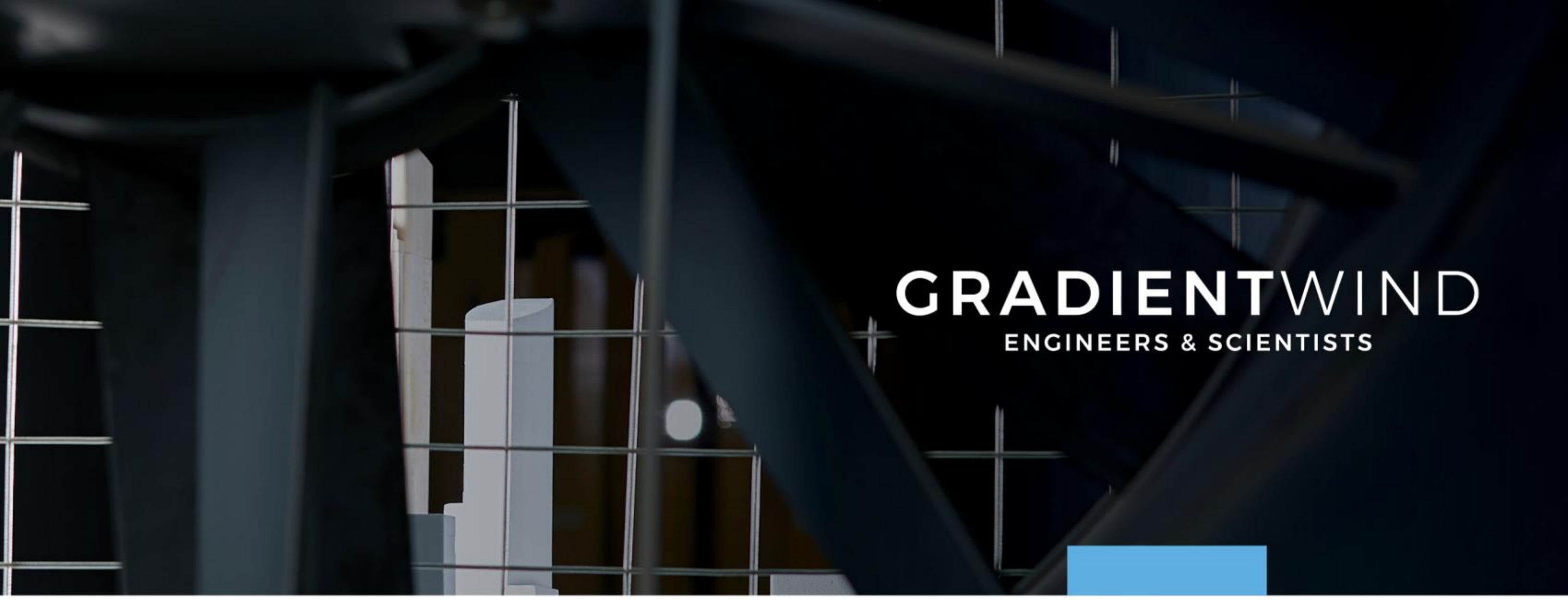
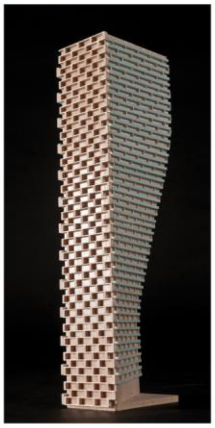
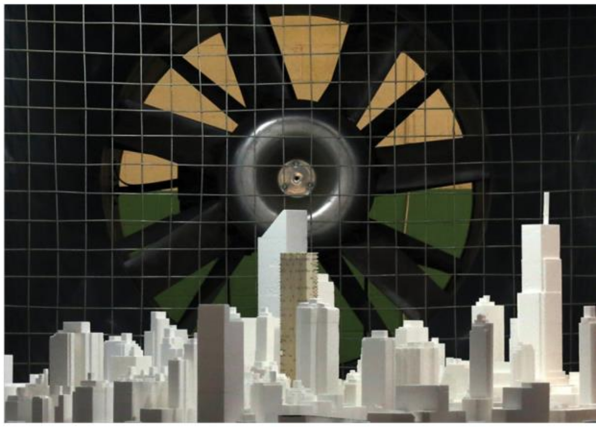


FIGURE 9: TYPICAL USE PERIOD – WIND COMFORT, COMMON AMENITY TERRACES





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, 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	0.23
49	0.24
74	0.24
103	0.24
167	0.23
197	0.23
217	0.20
237	0.19
262	0.19
282	0.19
301	0.20
324	0.23

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, ***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.

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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 Engineering Symposium, IWES 2003*, Taiwan, 2003.