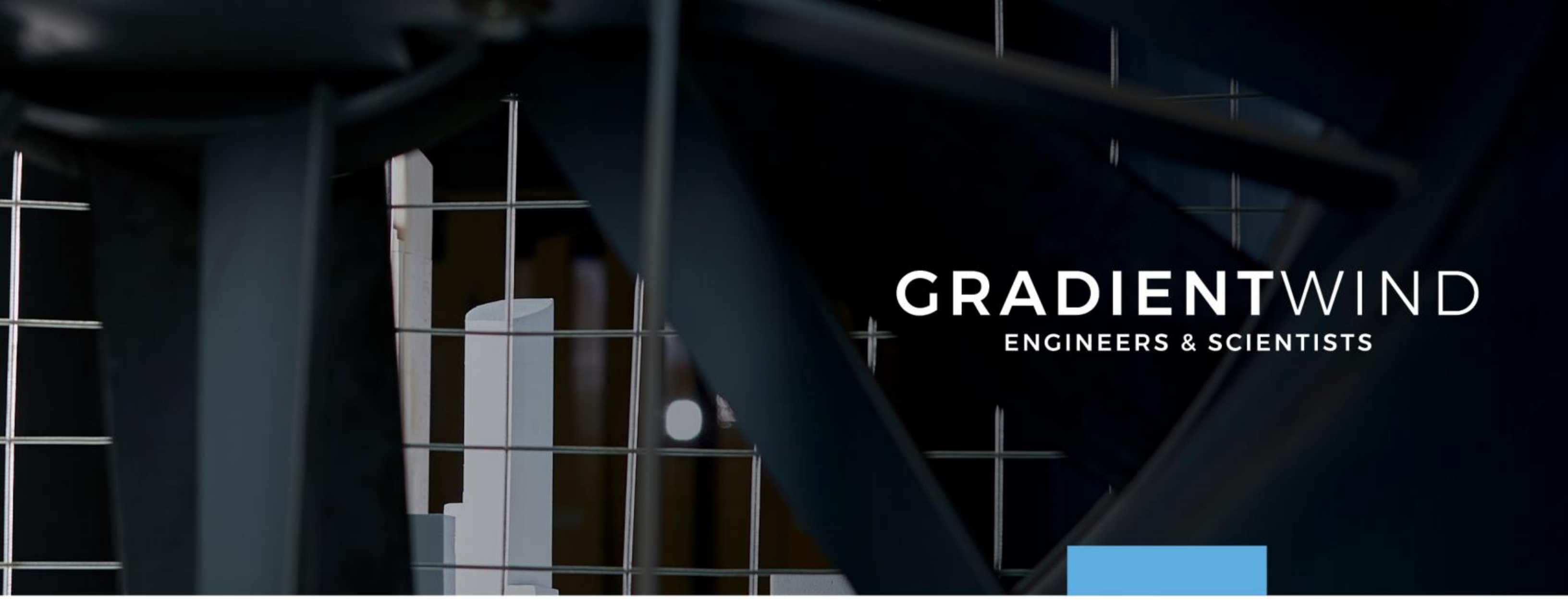
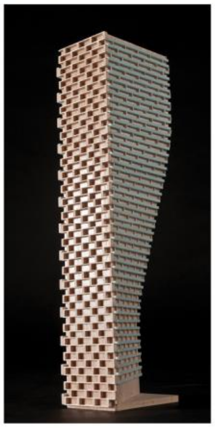
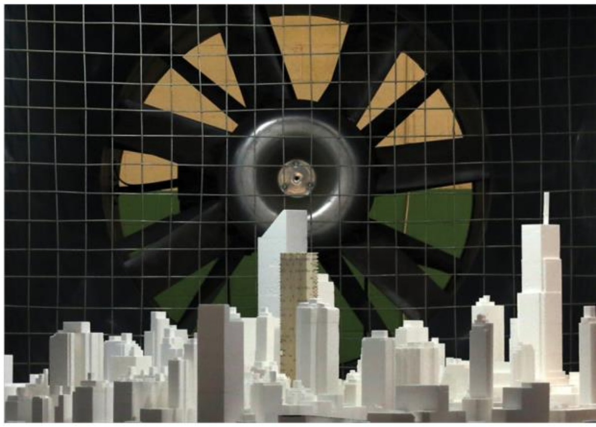


PEDESTRIAN LEVEL WIND STUDY

112 Montréal Road
Ottawa, Ontario

Report: 22-018-PLW-2022





September 8, 2022

PREPARED FOR
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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Site Plan Control application requirements for the proposed Phase 1 multi-building development located at 112 Montréal Road 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-11B, and summarized as follows:

1) While the introduction of the proposed development is anticipated to increase the winds at grade around the subject site, most 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, walkways, surface parking, transit stops, and in the vicinity of building access points, are considered acceptable. Exceptions are as follows:

    a. Conditions over the event space / plaza at the southwest corner of Tower B1 are predicted to be suitable for standing, or better, during the typical use period. In order to improve conditions, it is recommended that landscaping features such as tall wind screens, topographical berms, or coniferous plantings in dense arrangements be installed to the north and east of sensitive areas.

b. Depending on the programming of the landscaped space to the south of Tower B1, mitigation may be required. If necessary, this mitigation is expected to include landscaping features such as tall wind screens, topographical berms, and coniferous plantings in dense arrangements installed around sensitive areas.

c. It is recommended that a standard transit shelter be installed at the nearby transit stop along Vanier Parkway, to ensure conditions are acceptable for the intended use.

2) In order to extend sitting conditions over the common amenity terrace serving Tower B1 at Level 7, it is recommended that tall wind screens, rising at least 2.0-m above the terrace, are recommended along the full perimeter of the amenity.

3) In order to extend sitting conditions over the common amenity terrace serving Tower B1 at Level 35, it is recommended that tall wind screens, rising at least 2.0-m above the terrace, are recommended along the full perimeter of the amenity.

4) 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, (e.g., 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 2705460 Ontario Inc. to undertake a pedestrian level wind (PLW) study to satisfy Site Plan Control application requirements for Phase 1 of the proposed multi-building development located at 112 Montréal Road 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.

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 Roderick Lahey Architect Inc, in August 2022, surrounding street layouts and existing and approved future building massing information obtained from the City of Ottawa, as well as recent satellite imagery. Gradient Wind previously performed a PLW study for the proposed development with the combined Phase 1 and Phase 2 massing to satisfy Zoning By-law Amendment application requirements[1].

2. TERMS OF REFERENCE

The subject site is located at 112 Montréal Road in Ottawa; situated on a parcel of land bordered by Montreal Road and an existing gas station to the north, Vanier Parkway to the east, and existing developments to the south and west. Throughout this report, the Montreal Road elevation is referred to as the north elevation.

Architectural Rendering, South Perspective (Courtesy of Roderick Lahey Architect Inc)

Phase 1 comprises a nominally rectangular eight-storey mixed-use residential building (Building A) and a near rectangular 37-storey residential building (Tower B1), inclusive of a six-storey podium. Building A is situated at the northwest corner of the subject site and

[1] Gradient Wind Engineering Inc. ‘Pedestrian Level Wind Study, 112 Montreal Road, Ottawa, Ontario’, Report 20-018-PLW-R1 [April 21, 2021]

Tower B1 is situated at the northeast corner of the subject site. The Phase 1 buildings share four below-grade parking levels and are topped with a mechanical penthouse level (MPH).

The future Phase 2 comprises a 28-storey residential building (Tower B2) with a six-storey podium, and a 16-storey residential building (Tower B3) with a four-storey podium. Towers B2 and B3 are situated at the southeast corner and at the southwest corner of the subject site, respectively. A parkland is situated to the south of Tower B2, and laneways extend along the south and west sides of the subject site. The present study is focused on the influence of Phase 1. The massing details of Phase 2 are not final and are subject to change.

Above below-grade parking, the ground floor of Building A includes a residential main entrance to the south, a mail and parcel room at the southwest corner, an indoor amenity to the west, commercial space to the north, an elevator core to the east, and garbage and move-in spaces at the southeast corner. An outdoor multi-purpose space is provided along the west elevation, and surface parking spaces are situated to the south of Building A. Levels 2-8 are reserved for residential use. On Levels 2 to 4, inset balconies are provided along the west elevation and at the northeast and southeast corners. At Level 5, the building sets back from the south, west, and north elevations. Balconies are provided on the south, west, and north elevations at Levels 5 to 8.

Above below-grade parking, ground floor of Tower B1 includes a visitor lobby and admin space to the south, a main entrance at the southwest corner, a mail and parcel room to the west, garbage space at the northwest corner, townhouse units to the north and at the northeast corner, indoor amenity space at the southeast corner, and central elevator cores. An outdoor event space/plaza is situated to the southwest and surface parking spaces are situated to the west of Tower B1. Access to below-grade parking is provided by a ramp at the northwest corner of Tower B1 via a laneway from Palace Street. Floorplate setbacks are situated to the east and west at Level 7 and to the west and north at Level 35. Level 7 includes indoor amenity space to the south and residential units throughout the remainder of the level. This level is also served by an amenity terrace to the south. An additional amenity terrace is provided at Level 35 on the west elevation. The remaining space from Levels 2 through 37 is reserved for residential occupancy. Inset balconies are provided along the north and south elevations at Levels 2 through 6. Balconies are situated in all compass directions at Levels 8 through 34.

The near-field surroundings (defined as an area within 200 metres (m) of the subject site) include low-rise residential buildings from the west clockwise to the east, as well as to the south, and a mix of low-rise residential buildings and mid- and high-rise developments to the southeast and the southwest. Notably, a 20-storey residential building is proposed (awaiting ZBA approval) at 337-345 Montgomery Street, approximately 180 m to the south of the subject site, and the first phase of a three-phased development, comprising a 22-storey residential building, is proposed (awaiting Site Plan Control approval) at 3 Selkirk Street and 2 Montreal Road, approximately 185 m to the southwest of the subject site. The far-field surroundings (defined as an area beyond the near-field but within a 2-kilometre (km) radius of the subject site) contribute primarily suburban wind exposures, with isolated taller buildings from all directions, although southwesterly winds are affected by the Ottawa downtown core and westerly and northerly winds are affected by the Ottawa River.

Figure 1A illustrates the subject site and surrounding context, representing the proposed future massing scenario including both Phase 1 and Phase 2 of the proposed development. Figure 1B illustrates the subject site and surrounding context, representing the proposed future massing scenario including Phase 1 of the proposed development but not Phase 2. Finally, Figure 1C illustrates the subject site and surrounding context, representing the existing massing scenario. These scenarios are hereinafter referred to as the “Proposed Buildout”, “Phase 1”, and “Existing Massing” scenarios, respectively. Figures 2A-2L 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 Phase 1 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.

While the current study is focused on Phase 1, it is important to identify wind conditions that are caused by the interaction of winds with both Phase 1 and the future Phase 2. For this reason, the Proposed Buildout scenario was included to identify areas where the combination of Phases 1 and 2 may cause wind conditions which may interfere with the intended uses of outdoor spaces.

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.

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 500 m. The process was performed for three context massing scenarios, as noted in Section 2.

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

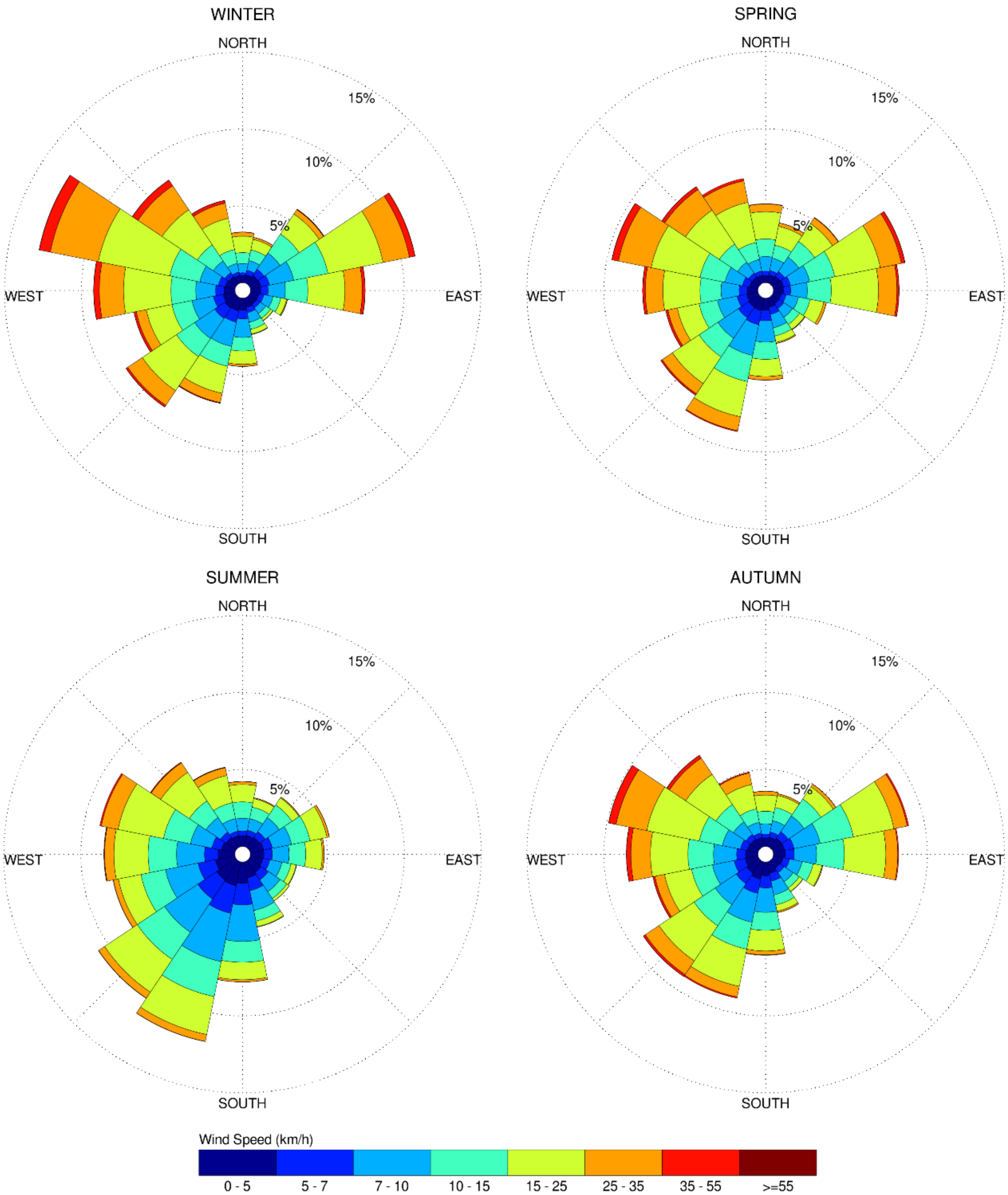
Mean and peak wind speed data obtained over the study site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the Level 7 and 35 common amenity terraces serving Tower B1 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 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 (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 (Typical Use Period)
Café / Patio / Bench / Garden	Sitting (Typical Use Period)
Transit Stop (Without Shelter)	Standing
Transit Stop (With Shelter)	Walking
Public Park / Plaza	Sitting (Typical Use Period)
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-6C, illustrating wind conditions at grade level for the Proposed Buildout, Phase 1, and Existing Massing scenarios, and by Figures 7A-10B, illustrating wind conditions over the Level 7 and 35 common amenity terraces serving Tower B1 for the Proposed Buildout and Phase 1 scenarios. 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 within the noted common amenity terraces serving Tower B1 are also reported for the typical use period, which is defined as May to October, inclusive. Figures 11A and 11B illustrate wind comfort conditions consistent with the comfort classes in Section 4.4 for the Proposed Buildout and Phase 1 scenarios, respectively. The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Ground Floor

Sidewalks along Montréal Road: For both the Proposed Buildout and Phase 1 scenarios, conditions over the sidewalks along Montréal Road 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 in the vicinity of the nearby transit stops 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.

Conditions over the sidewalks along Montréal Road with the existing massing are predicted to be suitable for sitting throughout the year. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable.

Walkways and Building Entrances around Building A: For both the Proposed Buildout and Phase 1 scenarios, conditions over the walkways around Building A are predicted to be suitable for mostly sitting during the summer, becoming mostly suitable for a mix of sitting and standing throughout the remainder of the year. The exception is near the southeast corner of Building A, where conditions are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the autumn, and suitable for walking, or better, during the spring and winter. Owing to the protection of the building façade, conditions in the vicinity of building entrances are predicted to be suitable for sitting during the summer and autumn, becoming suitable for standing, or better, during the spring and winter. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

Outdoor Multi-Purpose Space along West Elevation of Building A: For both the Proposed Buildout and Phase 1 scenarios, conditions over the outdoor multi-purpose space along the west elevation of Building A are predicted to be suitable for sitting during the typical use period. These conditions are considered acceptable based on the City of Ottawa wind criteria.

Sidewalks along Vanier Parkway: For both the Proposed Buildout and Phase 1 scenarios, conditions over the sidewalks along Vanier Parkway are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for strolling or better during the autumn, and suitable for walking or better during the spring and winter. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

Conditions over the sidewalks along Vanier Parkway 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 spring and winter. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable.

Transit Stop along Vanier Parkway: In the vicinity of the nearby transit stop along Vanier Parkway, conditions for both the Proposed Buildout and Phase 1 scenarios are predicted to be suitable for standing during the summer, becoming suitable for strolling during the autumn, and suitable for walking during the spring and winter. It is recommended that a standard transit shelter be installed at this transit stop to ensure conditions are acceptable.

Walkways and Building Entrances around Tower B1: For the Phase 1 scenario, conditions over the walkways around Tower B1 are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a mix of mostly standing and strolling during the spring, winter, and autumn. During the spring, conditions near the east elevation and the northwest corner are predicted to be suitable for walking, and during the winter, conditions near the east elevation, northwest corner, and southwest corner are predicted to be suitable for walking. In the vicinity of building entrances, conditions are predicted to be suitable for sitting during the summer and autumn, becoming suitable for standing, or better, during the spring and winter. The noted conditions are considered acceptable according to the City of Ottawa wind comfort criteria.

For the Proposed Buildout scenario, conditions along the south elevation are predicted to become somewhat windier, as compared to the Phase 1 scenario. Specifically, conditions along the south elevation of Tower B1 are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the autumn, and suitable for a mix of strolling and walking during the spring and winter. While the noted conditions are windier in comparison to the Phase 1 scenario, the noted conditions are considered acceptable for walkways.

Landscaped Area along South Elevation of Tower B1: For the Phase 1 scenario, conditions to the south of Tower B1 are predicted to be suitable for a mix of sitting and standing during the typical use period. For the Proposed Buildout scenario, conditions along the south elevation are predicted to become somewhat windier, as compared to the Phase 1 scenario. Specifically, conditions to the south of Tower B1 are predicted to be suitable for mostly standing during the typical use period. Depending on the programming of the space, mitigation may be required. If necessary, this mitigation is expected to include landscaping features such as tall wind screens, topographical berms, and coniferous plantings in dense arrangements installed around sensitive areas.

Surface Parking to South of Building A: For both the Proposed Buildout and Phase 1 scenarios, conditions over the surface parking to the south of Building A are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the autumn, and suitable for a mix of strolling and walking during the spring and winter. The noted conditions are considered acceptable.

Event Space / Plaza at Southwest Corner of Phase 1: For the Phase 1 scenario, conditions over the event space / plaza at the southwest corner of Phase 1 are predicted to be suitable for standing during the typical use period. For the Proposed Buildout scenario, conditions are predicted to be slightly calmer, being suitable for a mix of sitting and standing during the typical use period. In order to improve conditions, it is recommended that landscaping features such as tall wind screens, topographical berms, or coniferous plantings in dense arrangements be installed to the north and east of sensitive areas.

5.2 Wind Comfort Conditions – Common Amenity Terraces

Level 7 Amenity Terrace, Tower B1: The level 7 terrace serving Tower B1 is predicted to be suitable for a mix of sitting and standing during the typical use period for both the Proposed Buildout and Phase 1 scenarios. To extend sitting conditions over the full terrace, tall wind screens, rising at least 2.0-m above the terrace, are recommended along the full perimeter of the amenity.

Level 35 Amenity Terrace, Tower B1: The level 35 terrace serving Tower B1 is predicted to be suitable for mostly standing during the typical use period for both the Proposed Buildout and Phase 1 scenarios. To ensure conditions are suitable for sitting, tall wind screens, rising at least 2.0-m above the terrace, are recommended along the full perimeter of the amenity.

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 (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-11B. 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) While the introduction of the proposed development is anticipated to increase the winds at grade around the subject site, most 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, walkways, surface parking, transit stops, and in the vicinity of building access points, are considered acceptable. Exceptions are as follows:

    a. Conditions over the event space / plaza at the southwest corner of Tower B1 are predicted to be suitable for standing, or better, during the typical use period. In order to improve conditions, it is recommended that landscaping features such as tall wind screens, topographical berms, or coniferous plantings in dense arrangements be installed to the north and east of sensitive areas.

b. Depending on the programming of the landscaped space to the south of Tower B1, mitigation may be required. If necessary, this mitigation is expected to include landscaping features such as tall wind screens, topographical berms, and coniferous plantings in dense arrangements installed around sensitive areas.

c. It is recommended that a standard transit shelter be installed at the nearby transit stop along Vanier Parkway, to ensure conditions are acceptable for the intended use.

2) In order to extend sitting conditions over the common amenity terrace serving Tower B1 at Level 7, it is recommended that tall wind screens, rising at least 2.0-m above the terrace, are recommended along the full perimeter of the amenity.

3) In order to extend sitting conditions over the common amenity terrace serving Tower B1 at Level 35, it is recommended that tall wind screens, rising at least 2.0-m above the terrace, are recommended along the full perimeter of the amenity.

4) 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, (e.g., 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
S. R. HALL
100197168
Sept. 8, 2022
PROVINCE OF ONTARIO

Daniel Davalos, MESc.
Junior Wind Scientist

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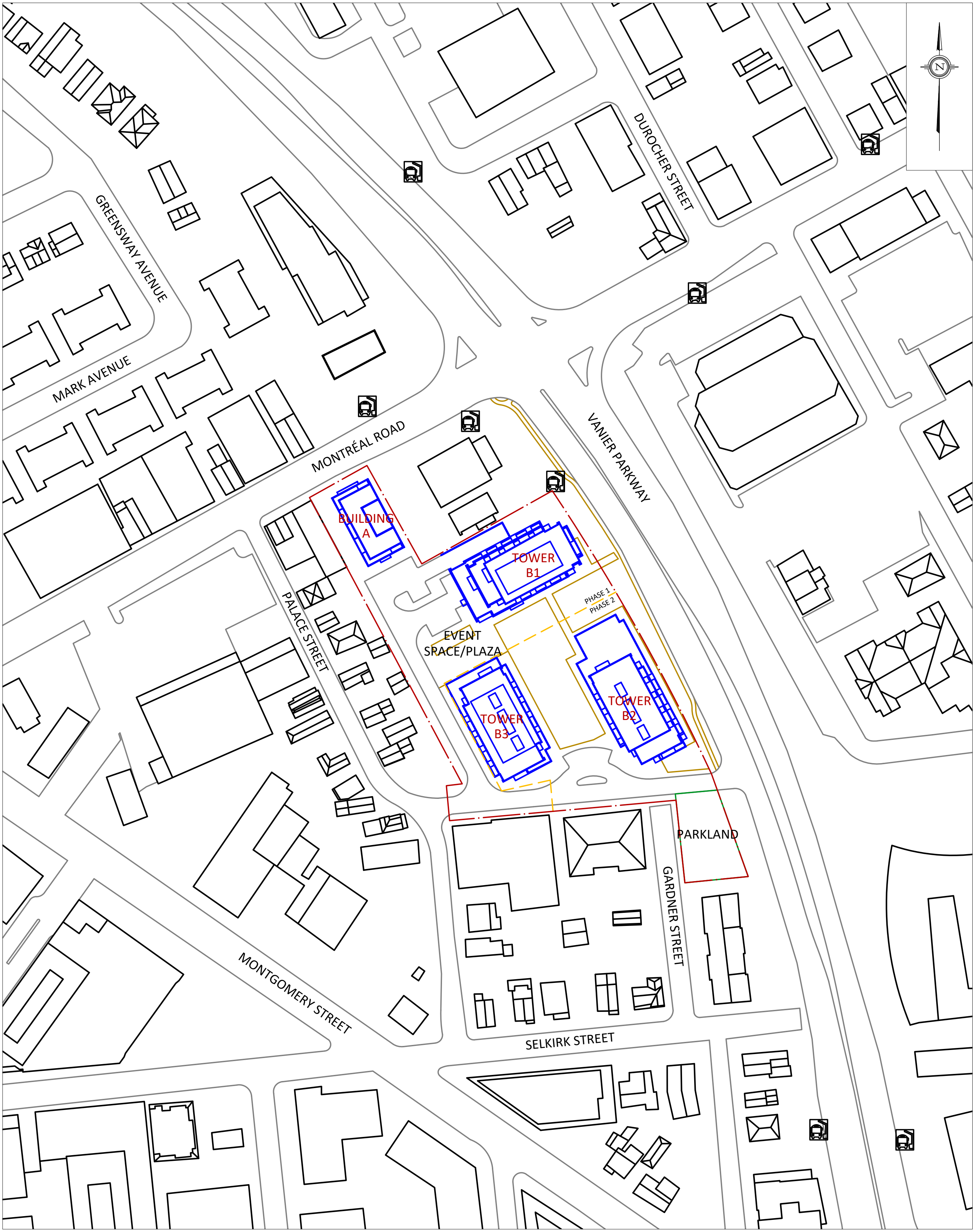

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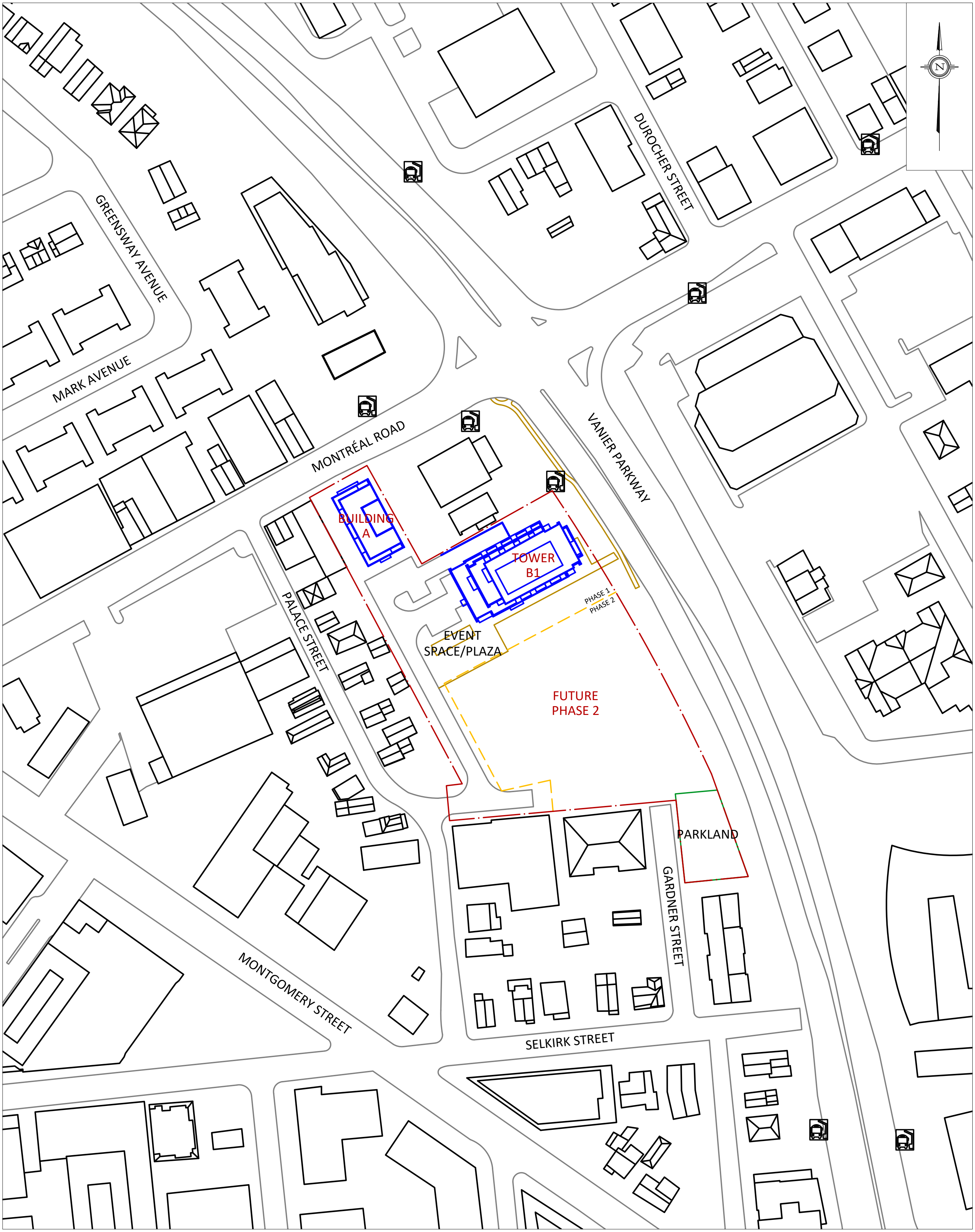
PROJECT: 112 MONTRÉAL ROAD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1A: PROPOSED BUILDOUT SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2000	DRAWING NO.: 20-018-PLW-2022-1A	
DATE: SEPTEMBER 7, 2022	DRAWN BY: S.K.	



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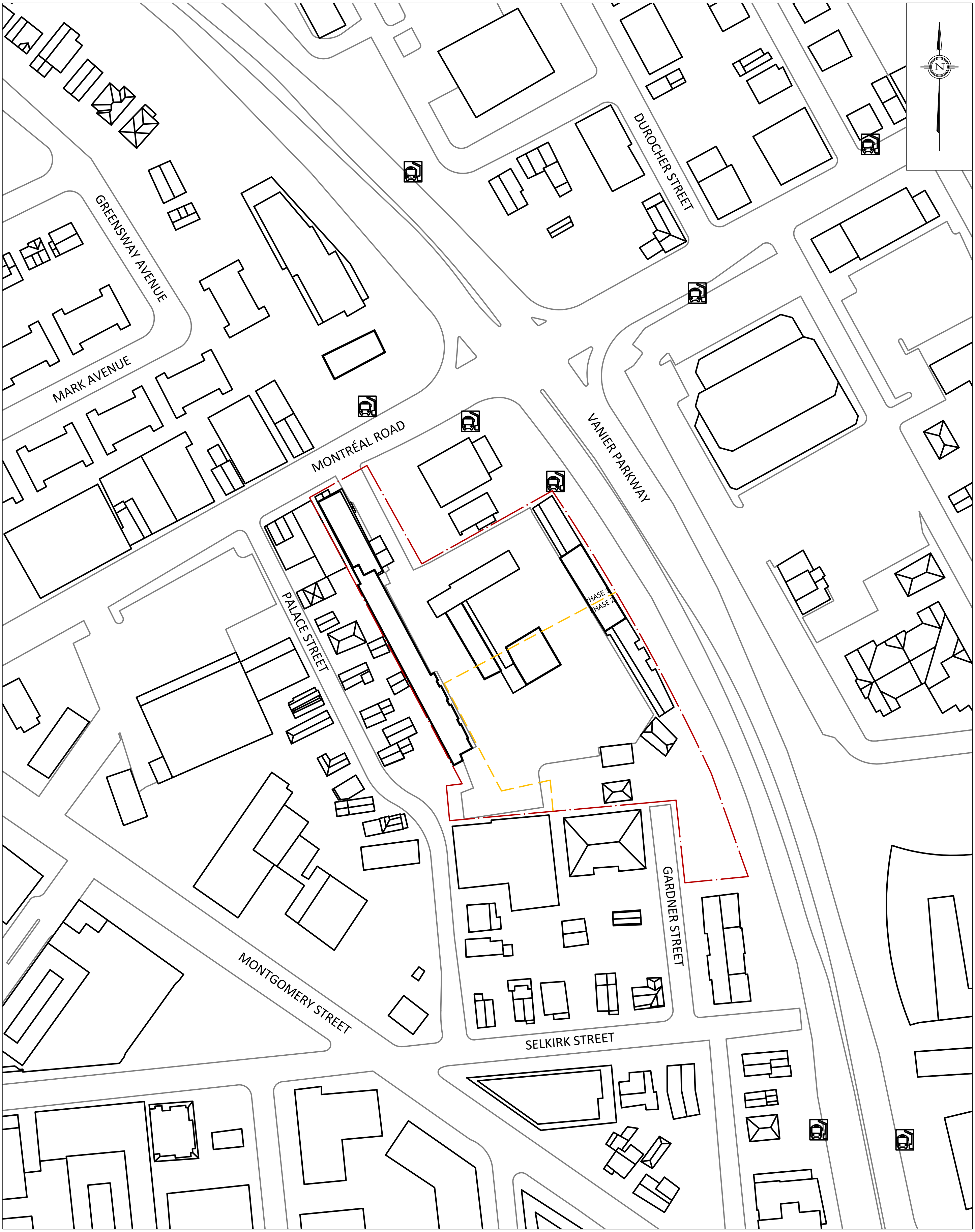
PROJECT	112 MONTRÉAL ROAD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:2000	DRAWING NO.	20-018-PLW-2022-1B
DATE	SEPTEMBER 7, 2022	DRAWN BY	S.K.

DESCRIPTION

FIGURE 1B:
PHASE 1 SITE PLAN AND SURROUNDING CONTEXT



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PROJECT	112 MONTRÉAL ROAD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:2000	DRAWING NO.	20-018-PLW-2022-1C
DATE	SEPTEMBER 7, 2022	DRAWN BY	S.K.

DESCRIPTION

FIGURE 1C:
EXISTING SITE PLAN AND SURROUNDING CONTEXT

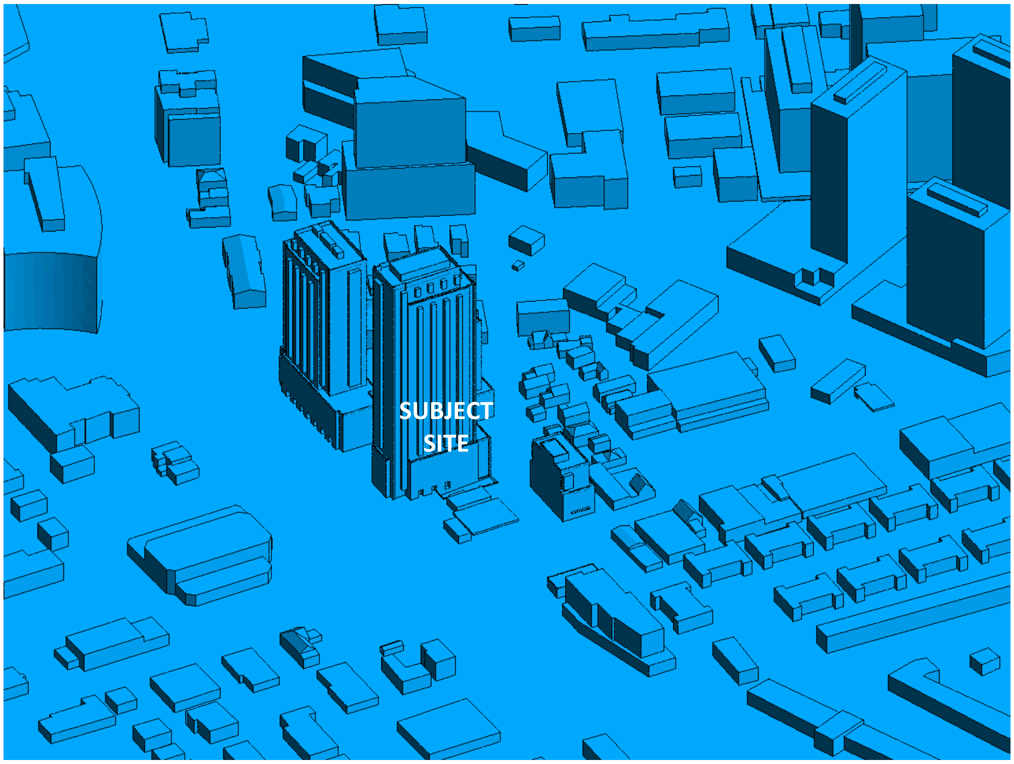

FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

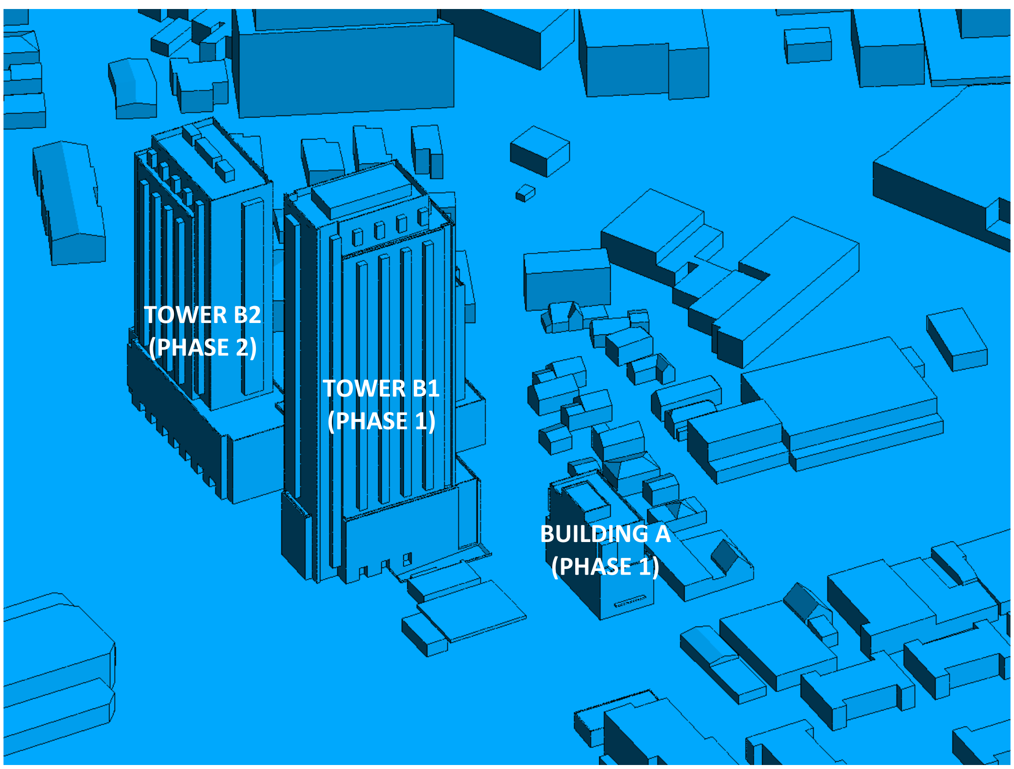

FIGURE 2B: CLOSE UP OF FIGURE 2A

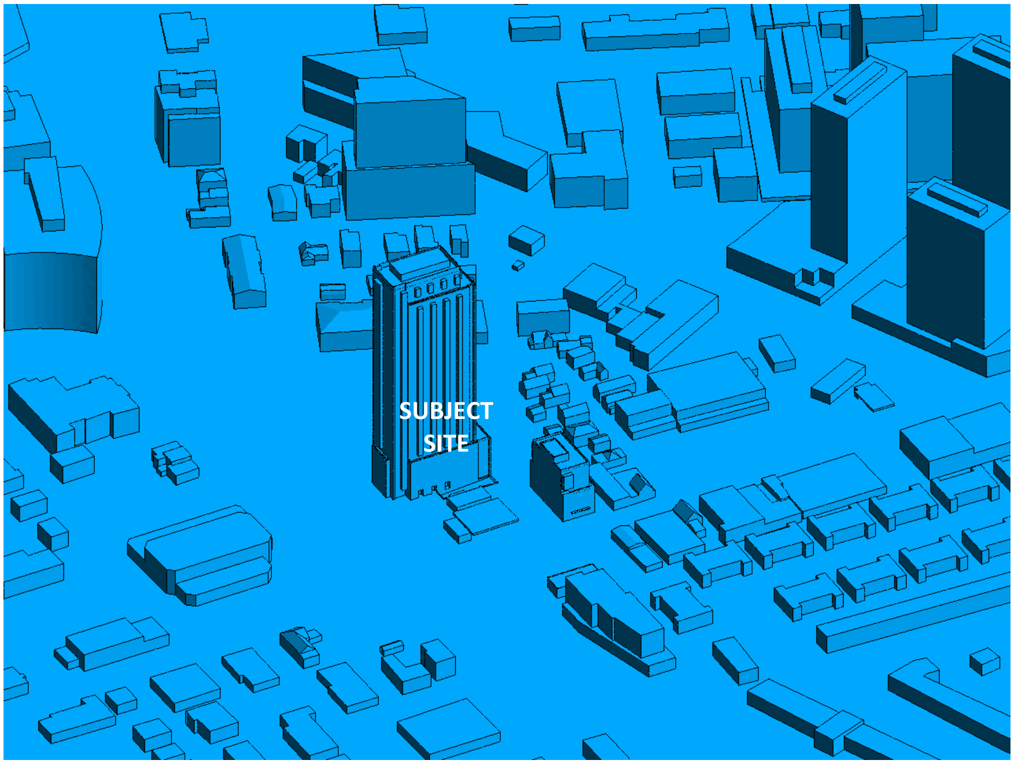

FIGURE 2C: COMPUTATIONAL MODEL, PHASE 1, NORTH PERSPECTIVE

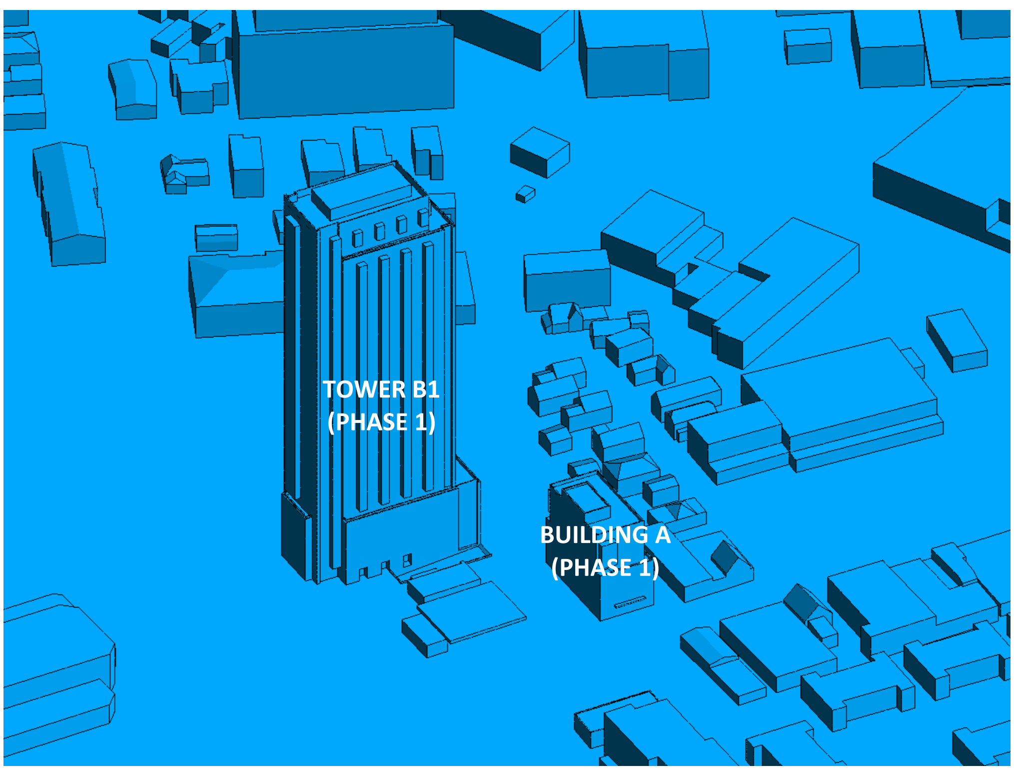

FIGURE 2D: CLOSE UP OF FIGURE 2C

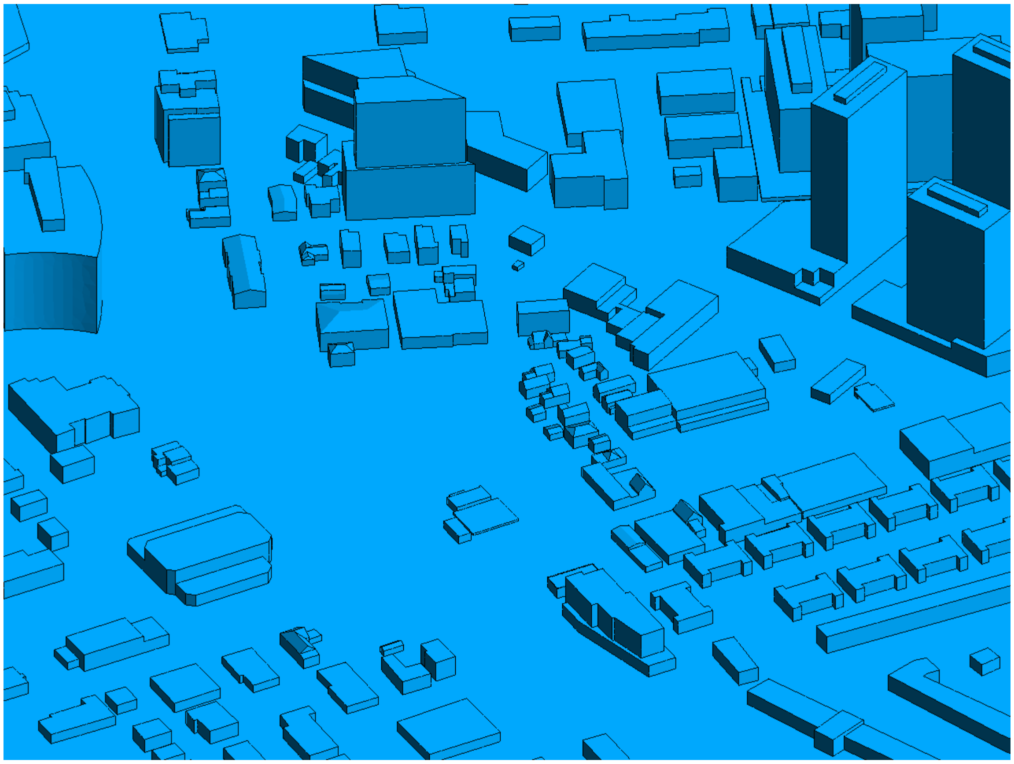

FIGURE 2E: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

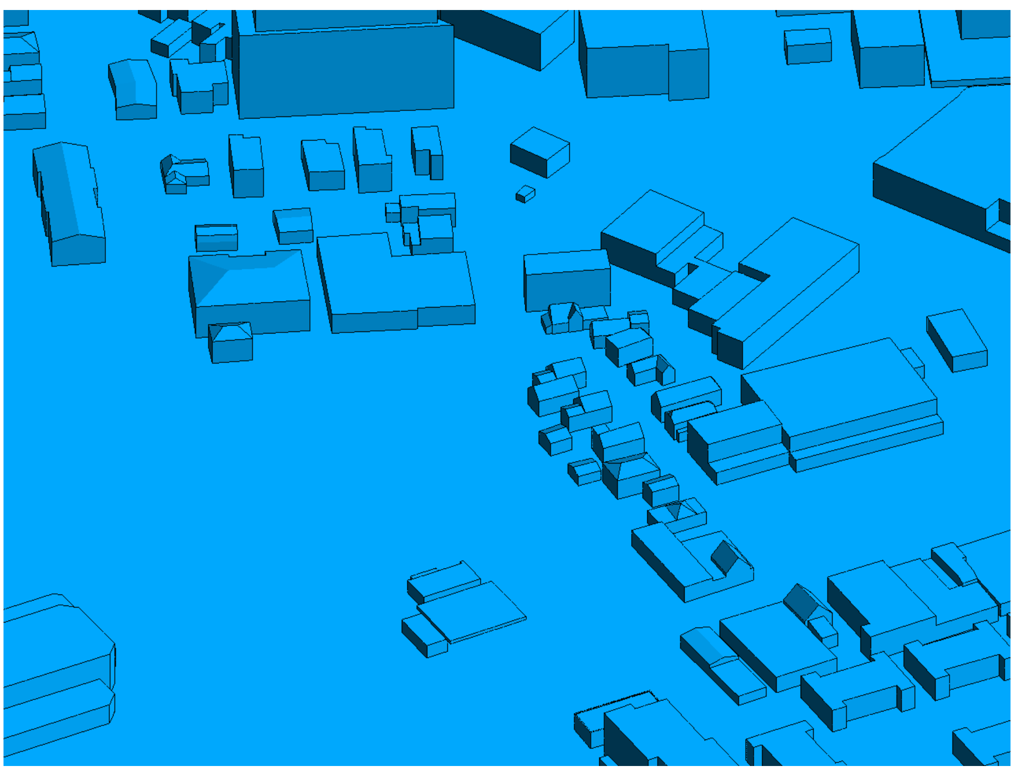

FIGURE 2F: CLOSE UP OF FIGURE 2E

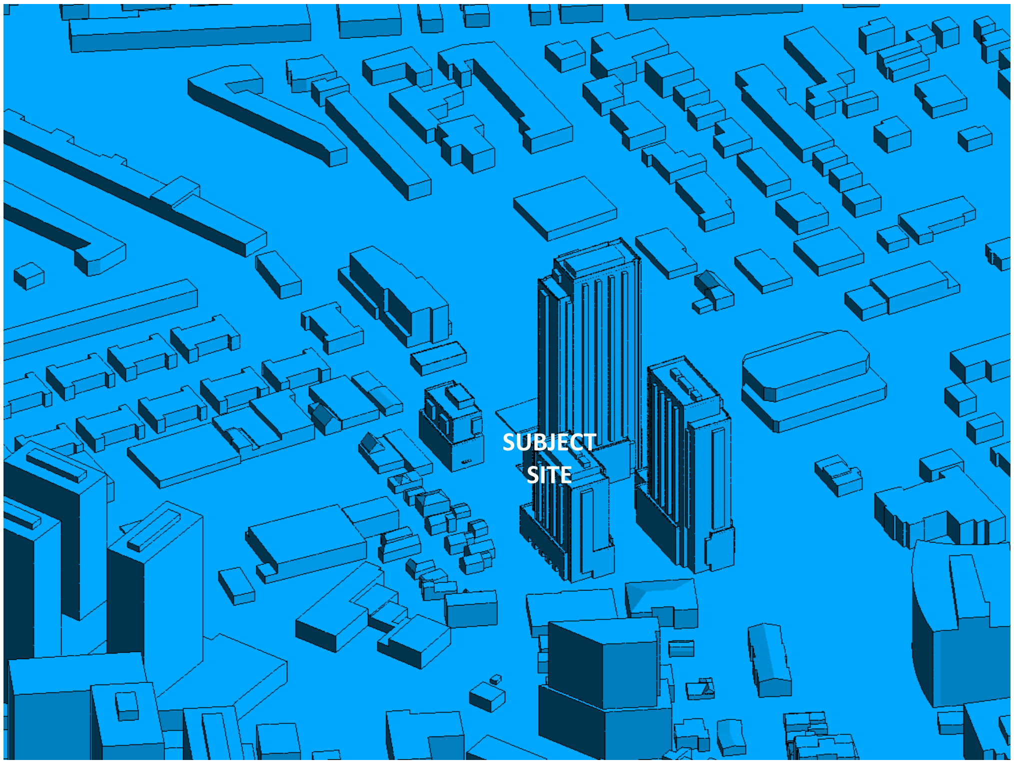

FIGURE 2G: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

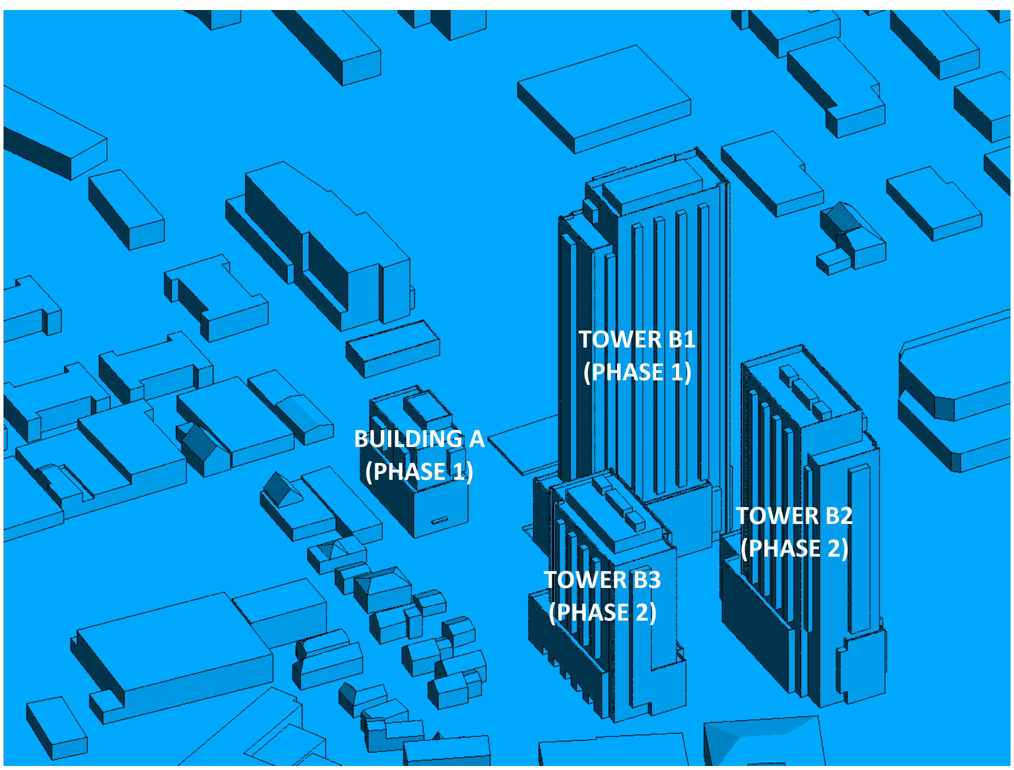

FIGURE 2H: CLOSE UP OF FIGURE 2G

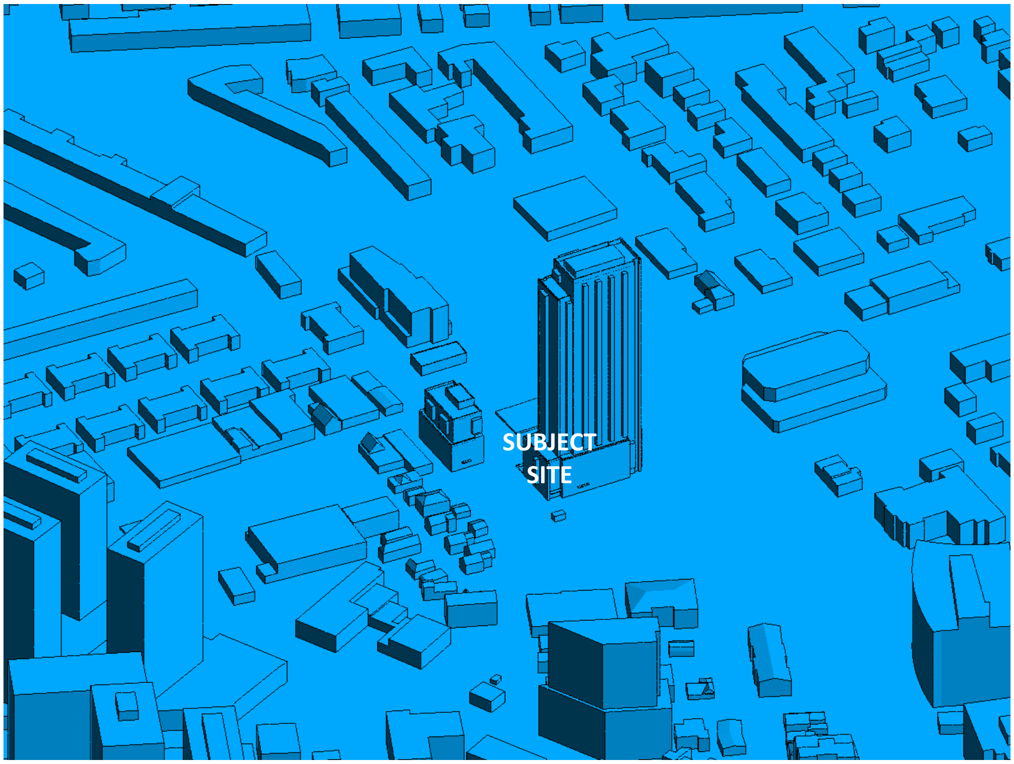

FIGURE 2I: COMPUTATIONAL MODEL, PHASE 1, SOUTH PERSPECTIVE

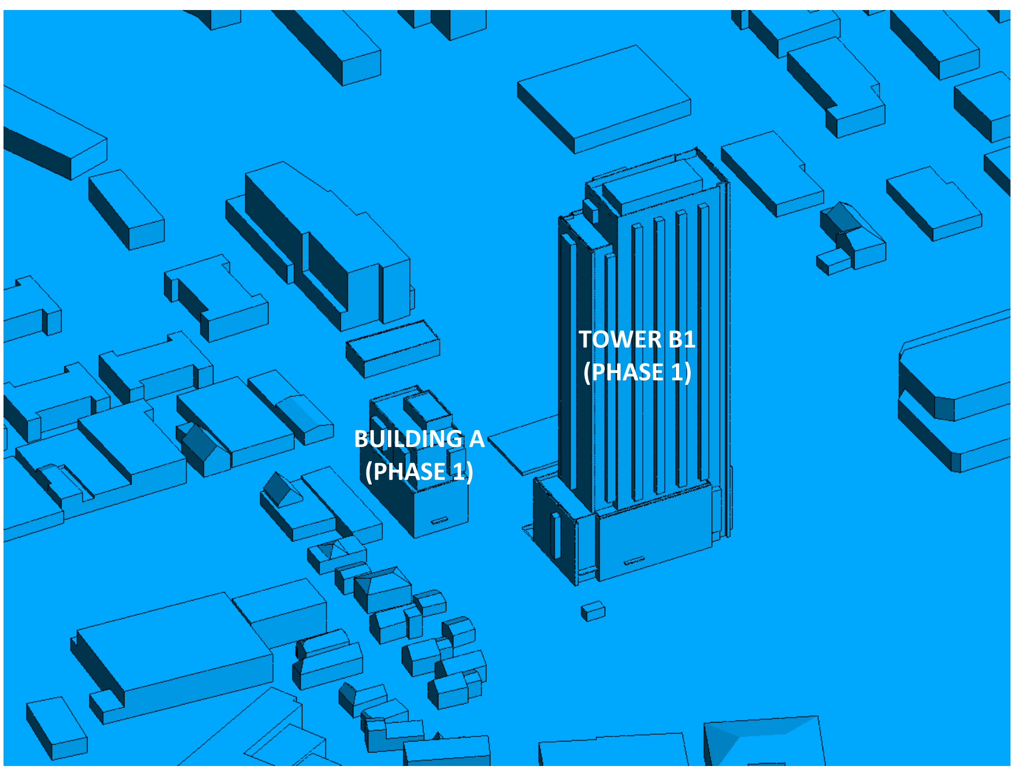

FIGURE 2J: CLOSE UP OF FIGURE 2I

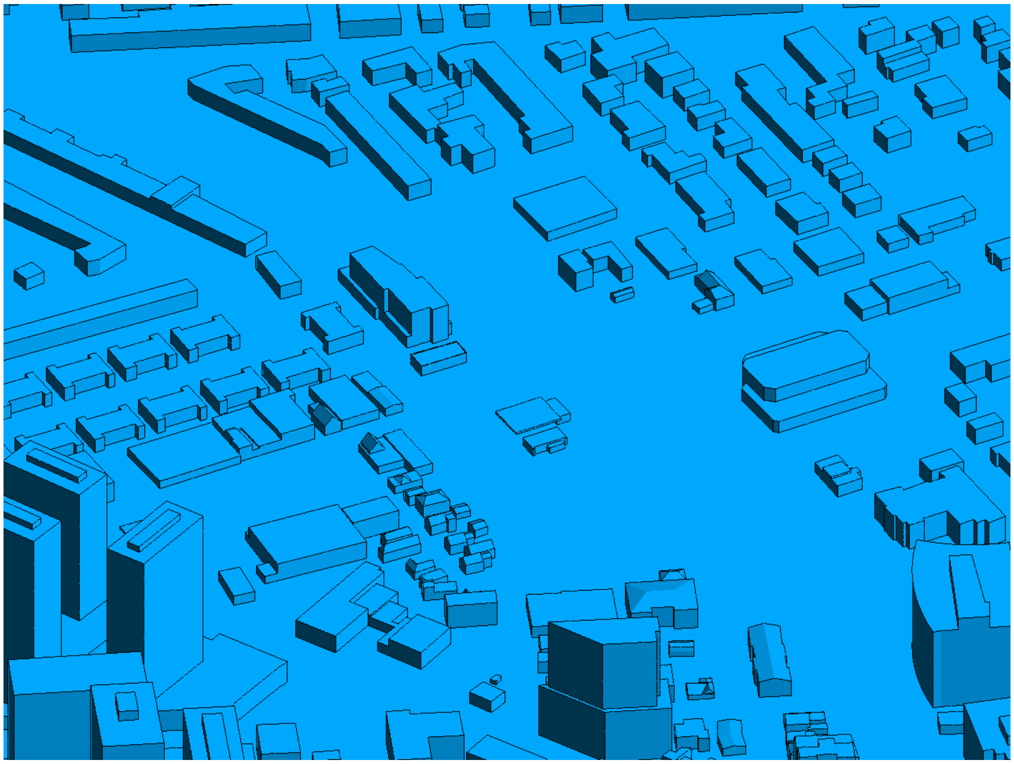

FIGURE 2K: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

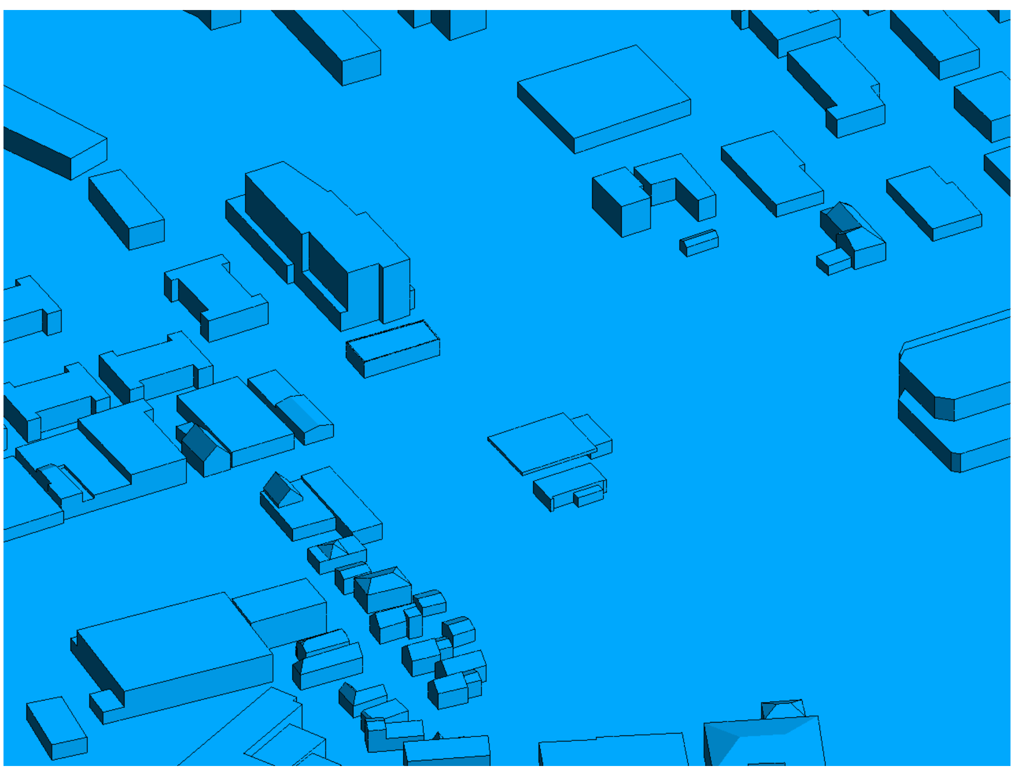

FIGURE 2L: CLOSE UP OF FIGURE 2K

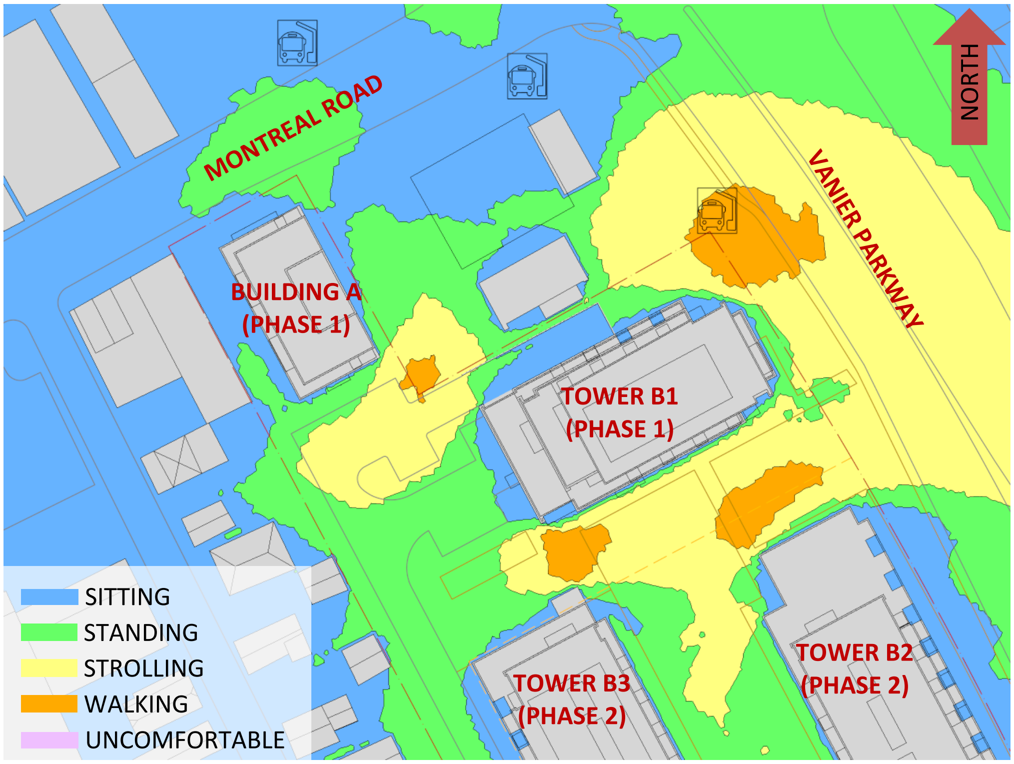

FIGURE 3A: SPRING – PROPOSED BUILDOUT – WIND COMFORT, GRADE LEVEL

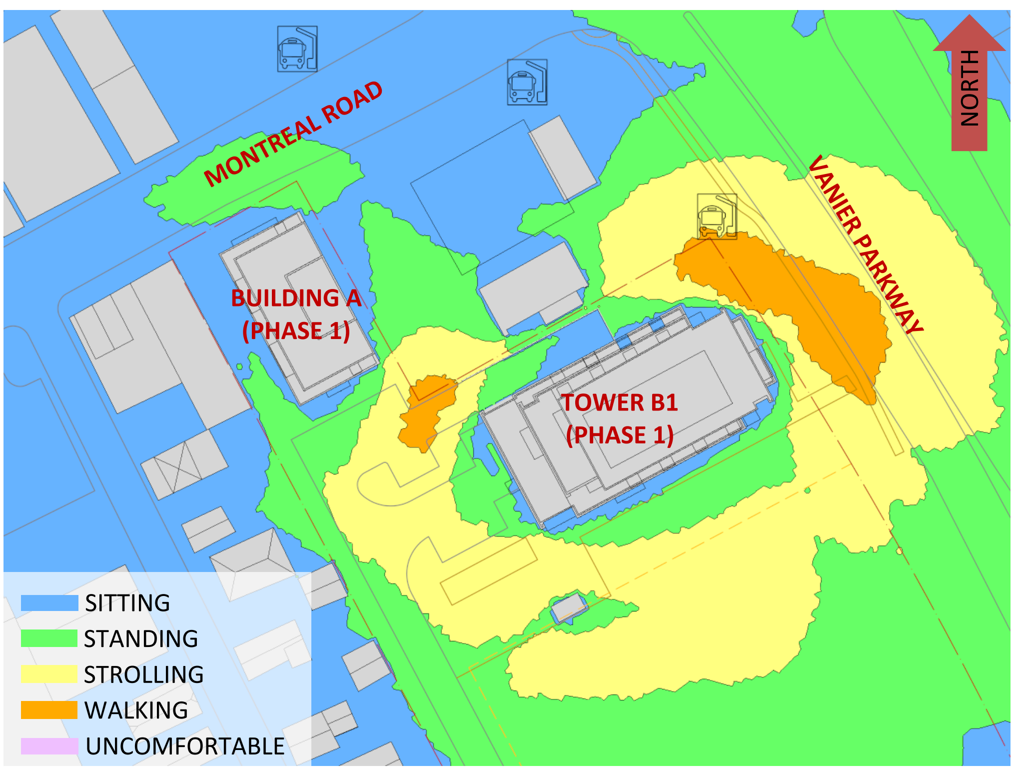

FIGURE 3B: SPRING – PHASE 1 – WIND COMFORT, GRADE LEVEL

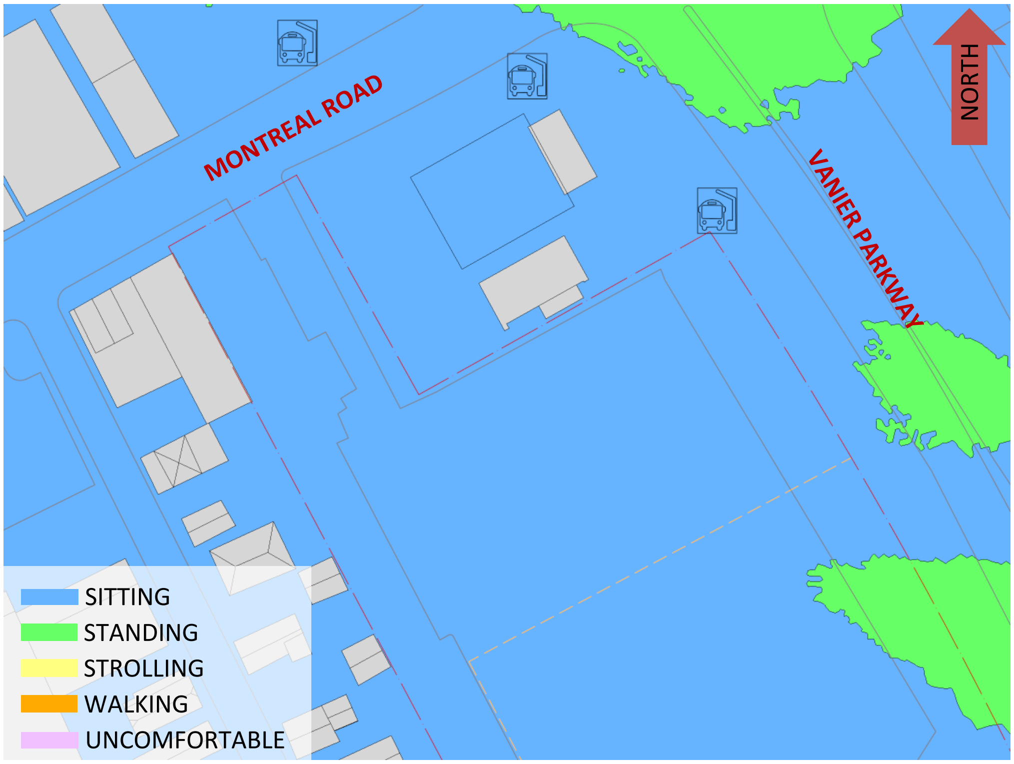

FIGURE 3C: SPRING – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

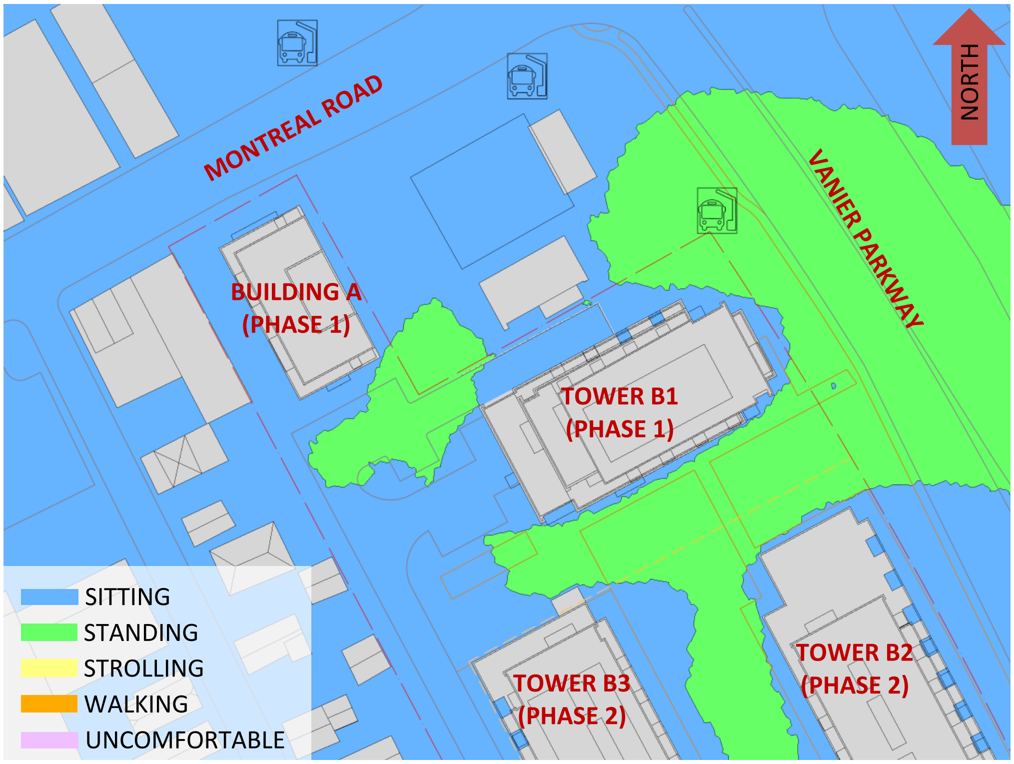

FIGURE 4A: SUMMER – PROPOSED BUILDOUT – WIND COMFORT, GRADE LEVEL

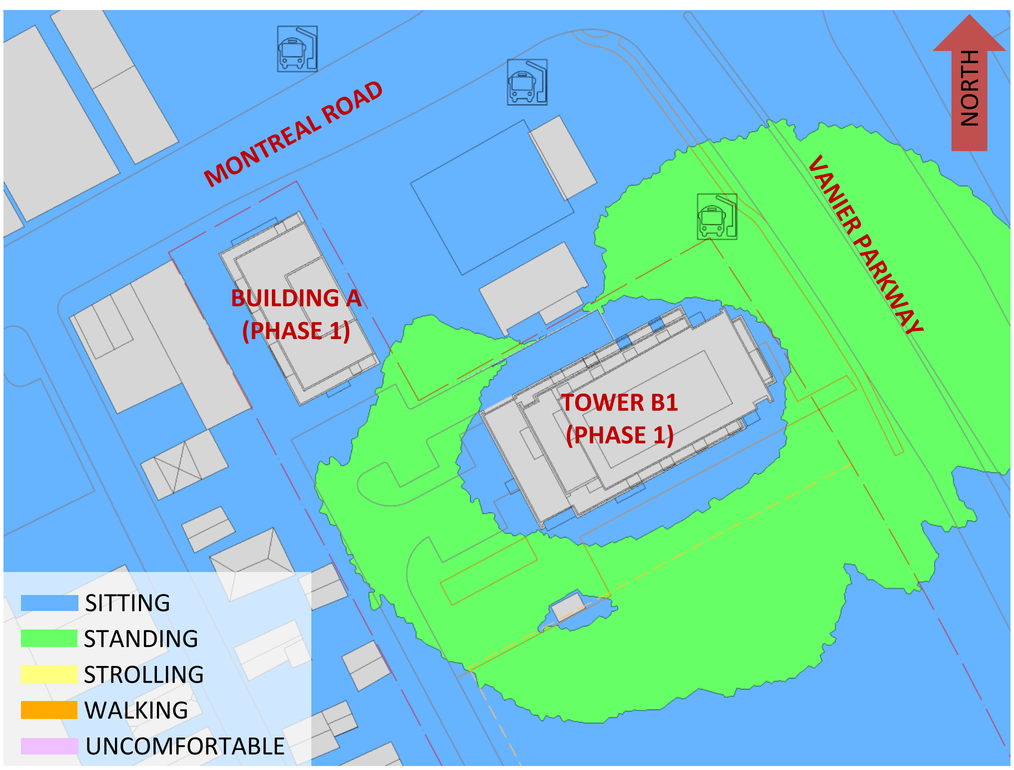

FIGURE 4B: SUMMER – PHASE 1 – WIND COMFORT, GRADE LEVEL

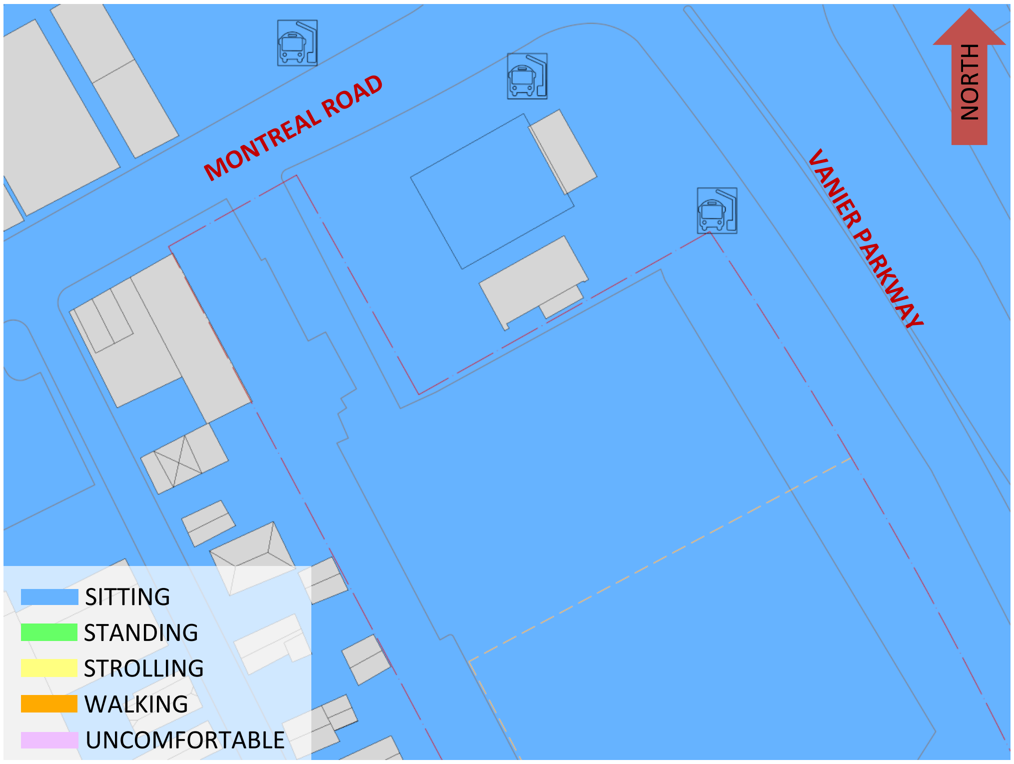

FIGURE 4C: SUMMER – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

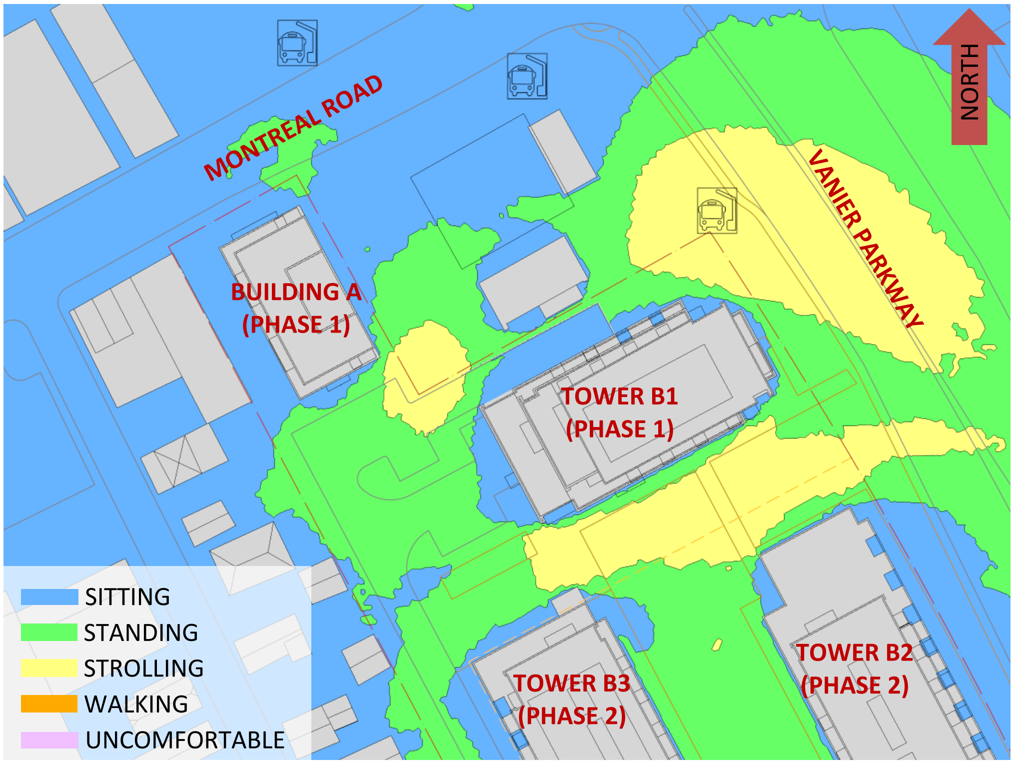

FIGURE 5A: AUTUMN – PROPOSED BUILDOUT – WIND COMFORT, GRADE LEVEL

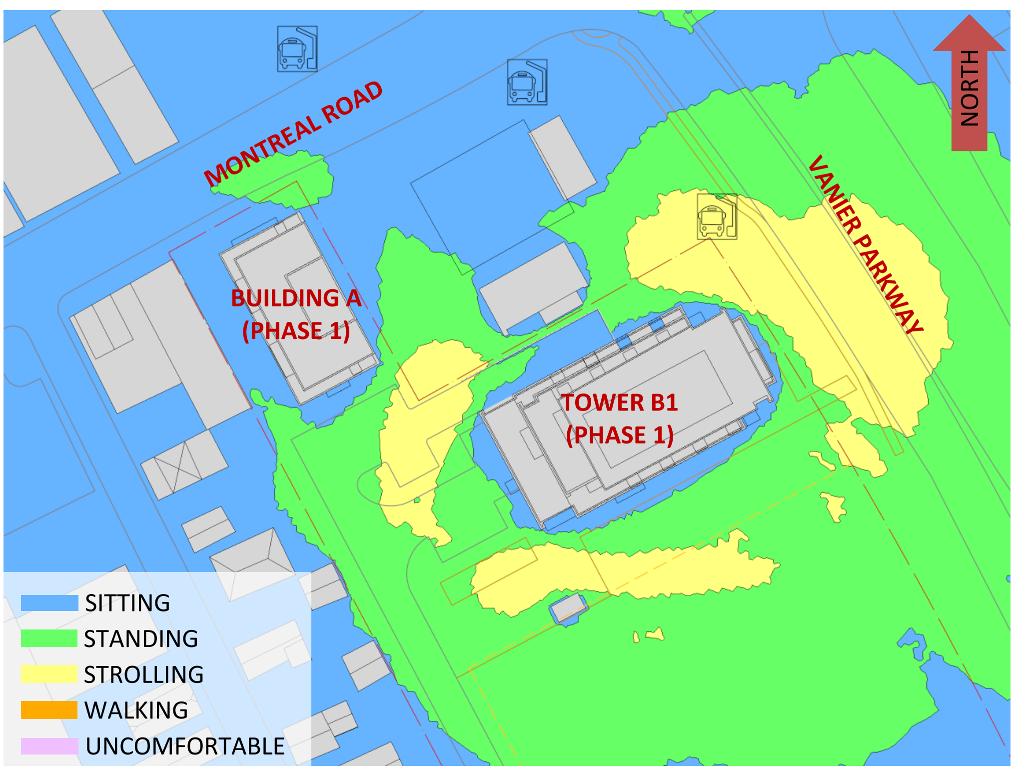

FIGURE 5B: AUTUMN – PHASE 1 – WIND COMFORT, GRADE LEVEL

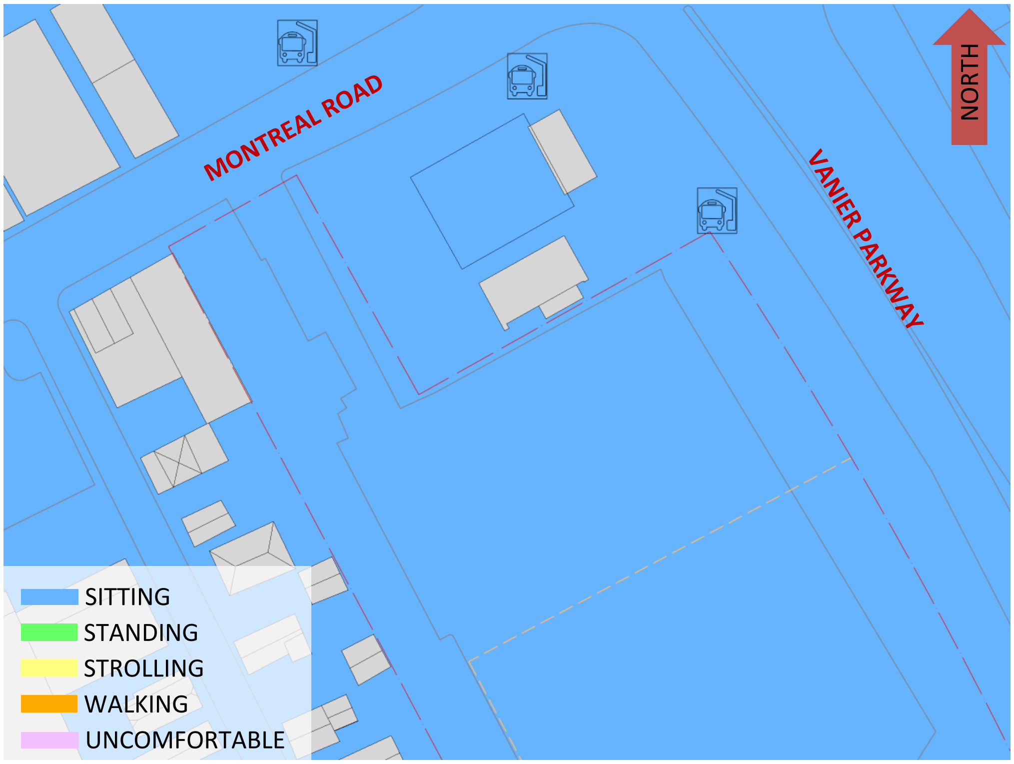

FIGURE 5C: AUTUMN – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

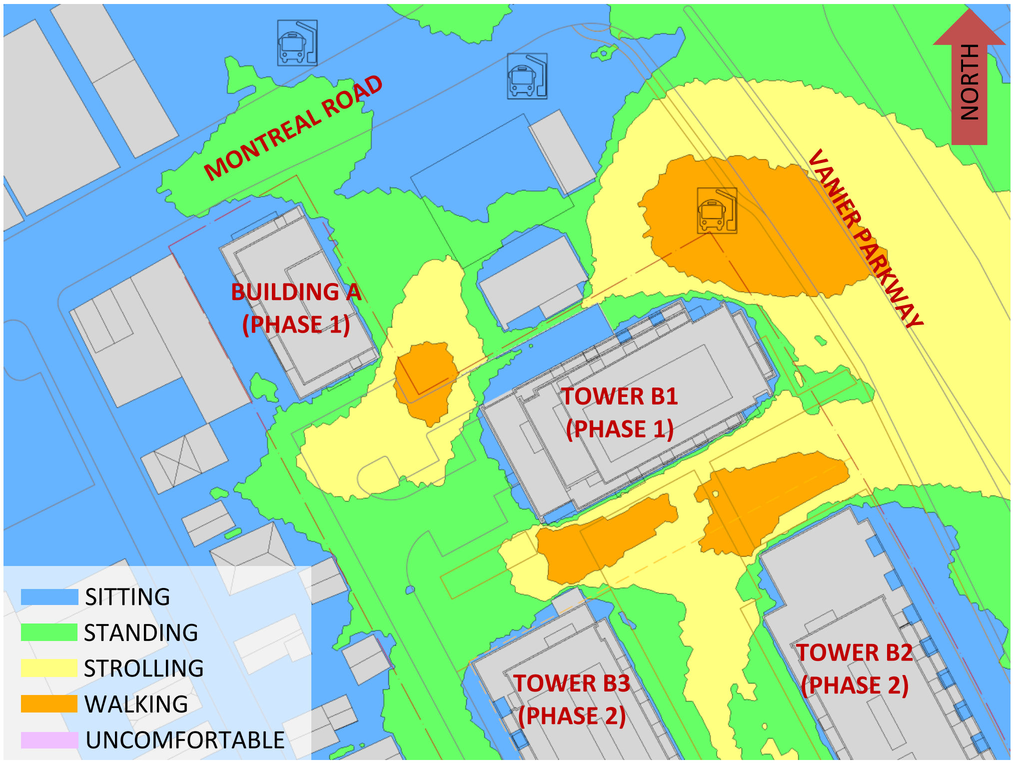

FIGURE 6A: WINTER – PROPOSED BUILDOUT – WIND COMFORT, GRADE LEVEL

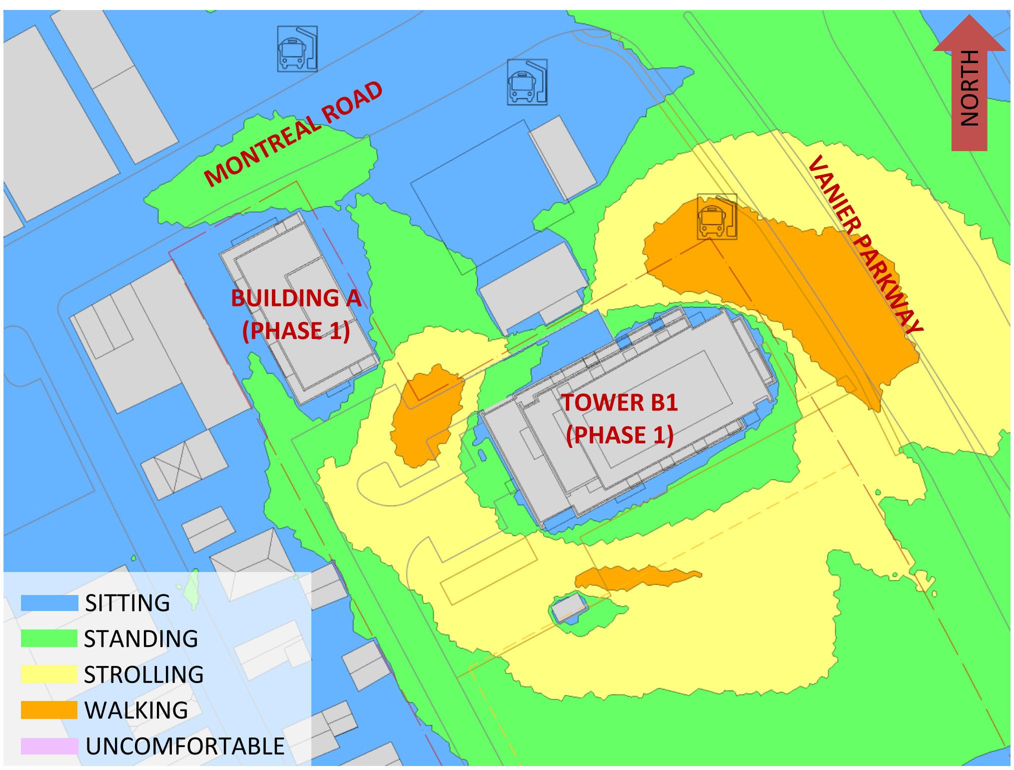

FIGURE 6B: WINTER – PHASE 1 – WIND COMFORT, GRADE LEVEL

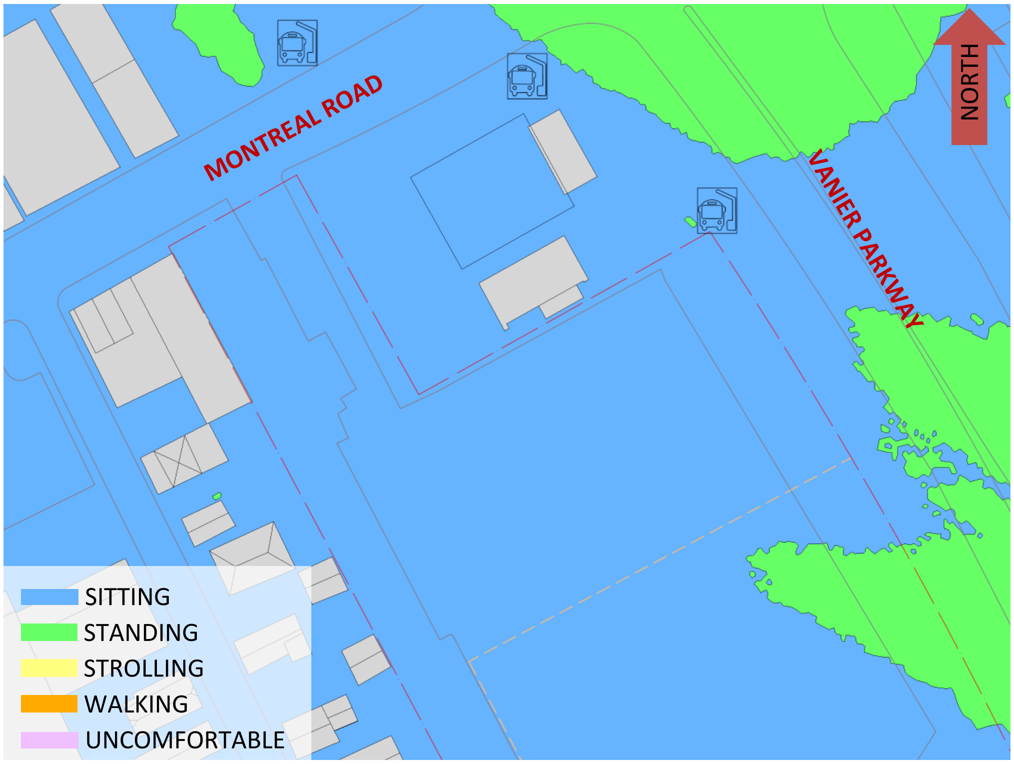

FIGURE 6C: WINTER – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

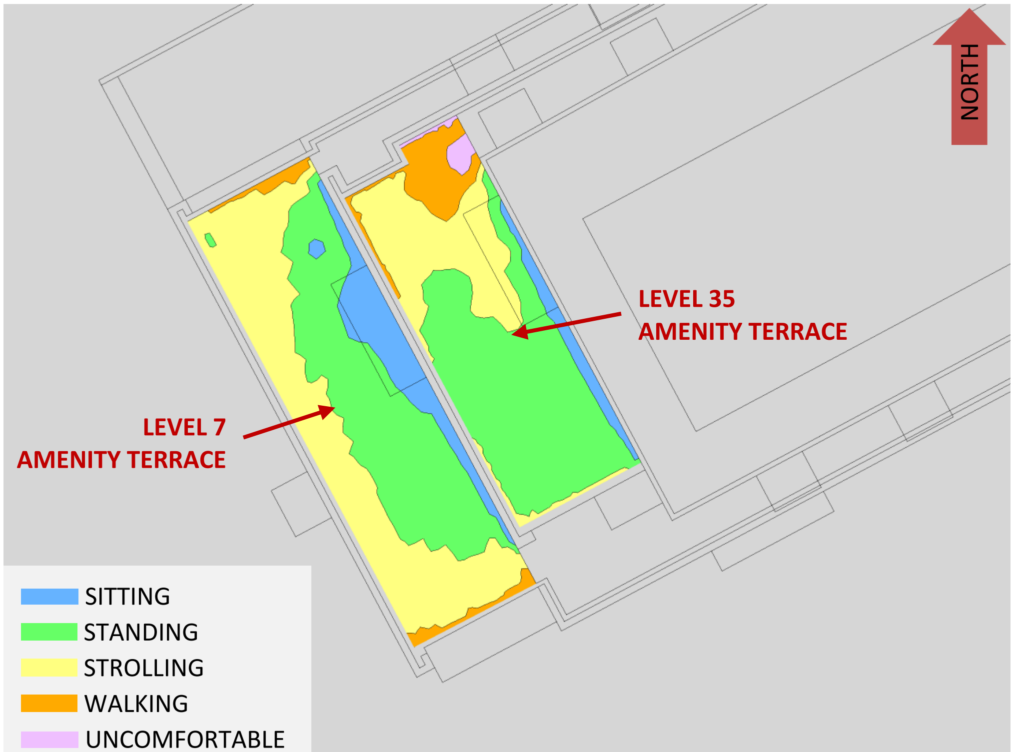

FIGURE 7A: SPRING – PROPOSED BUILDOUT – AMENITY TERRACES

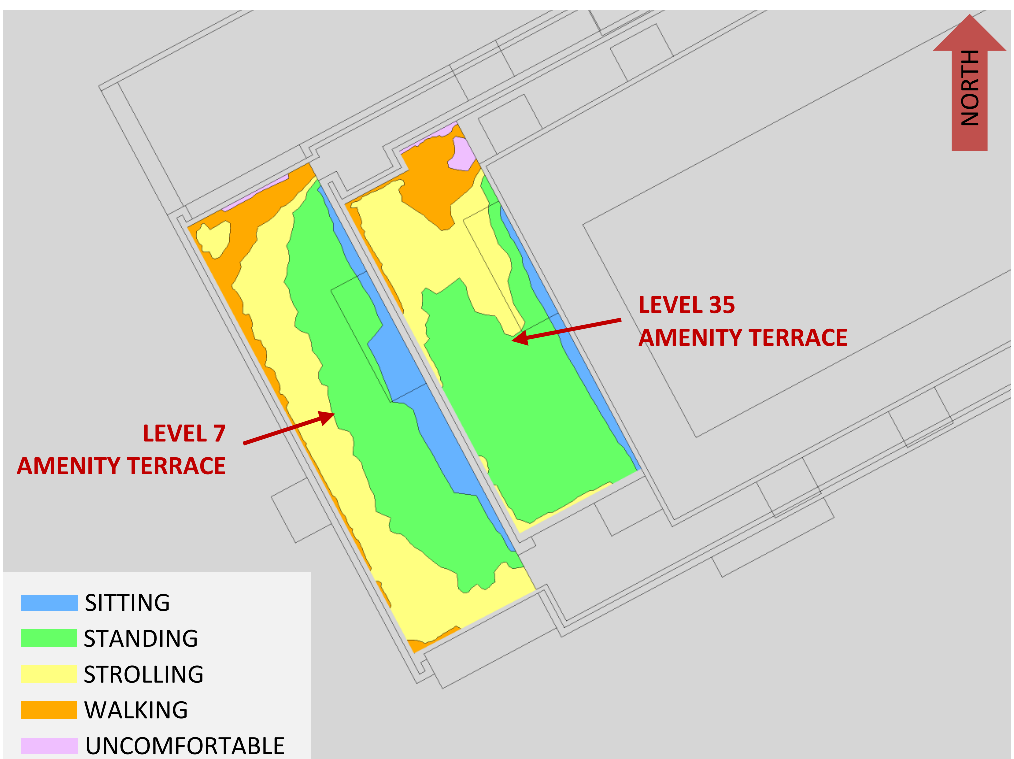

FIGURE 7B: SPRING – PHASE 1 – AMENITY TERRACES

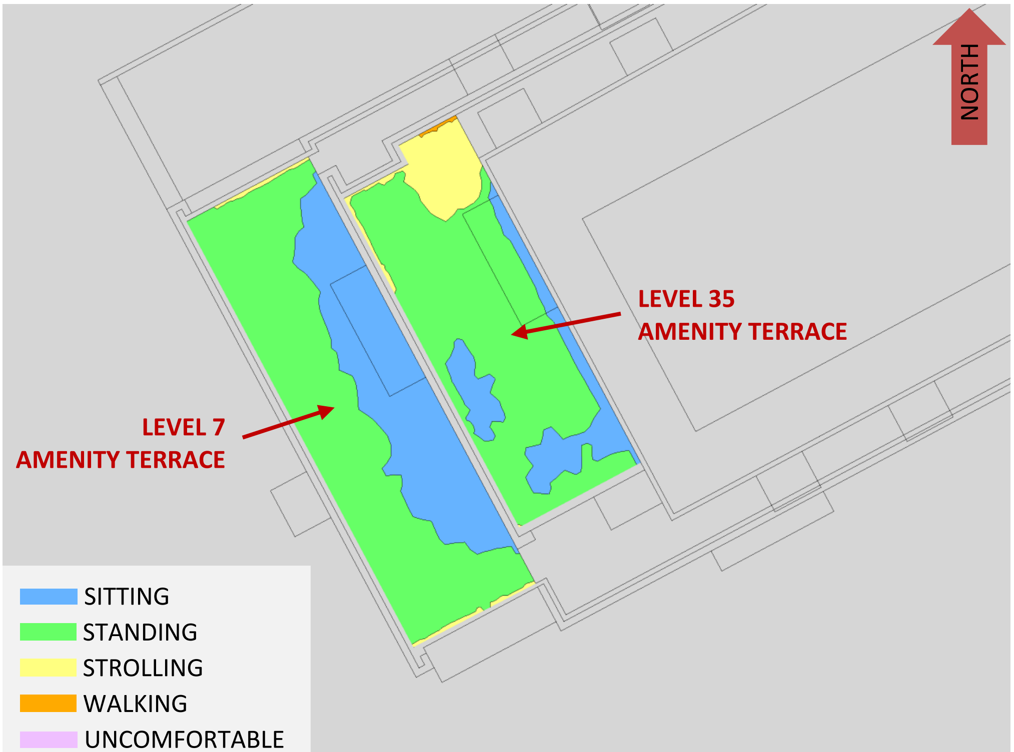

FIGURE 8A: SUMMER – PROPOSED BUILDOUT – AMENITY TERRACES

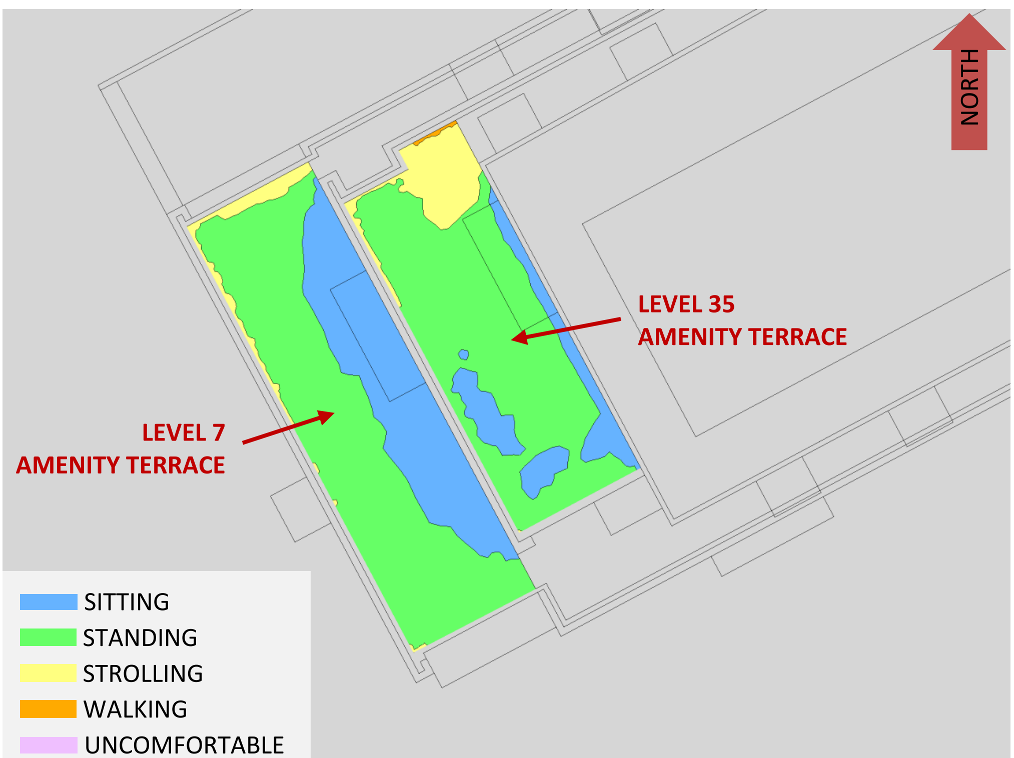

FIGURE 8B: SUMMER – PHASE 1 – AMENITY TERRACES

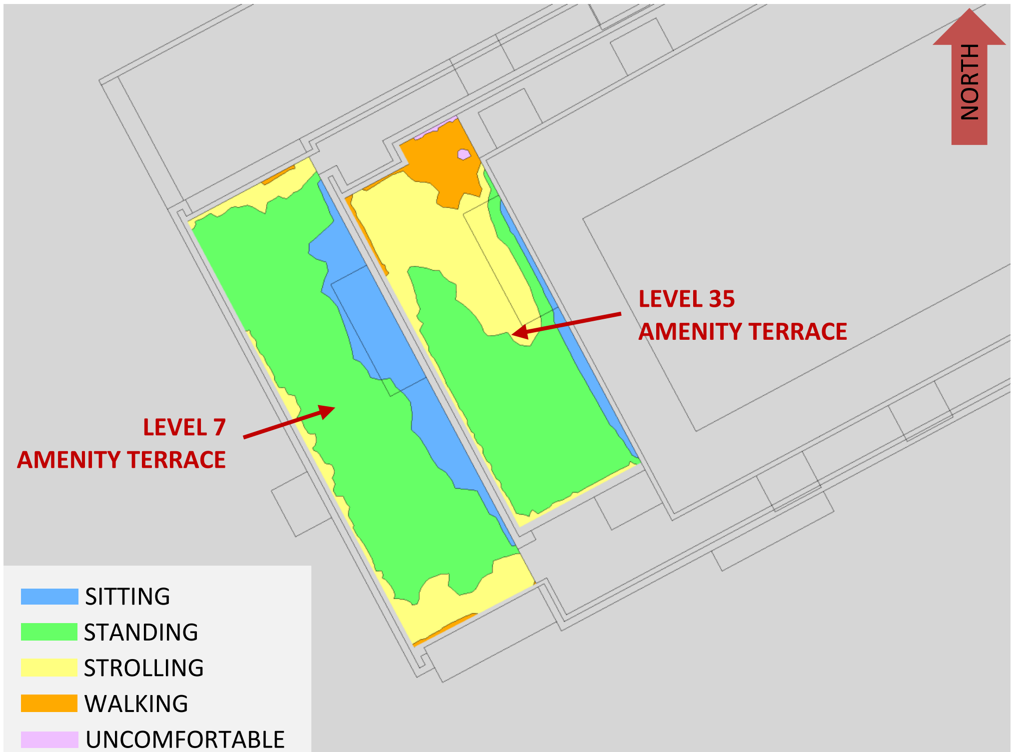

FIGURE 9A: AUTUMN – PROPOSED BUILDOUT – AMENITY TERRACES

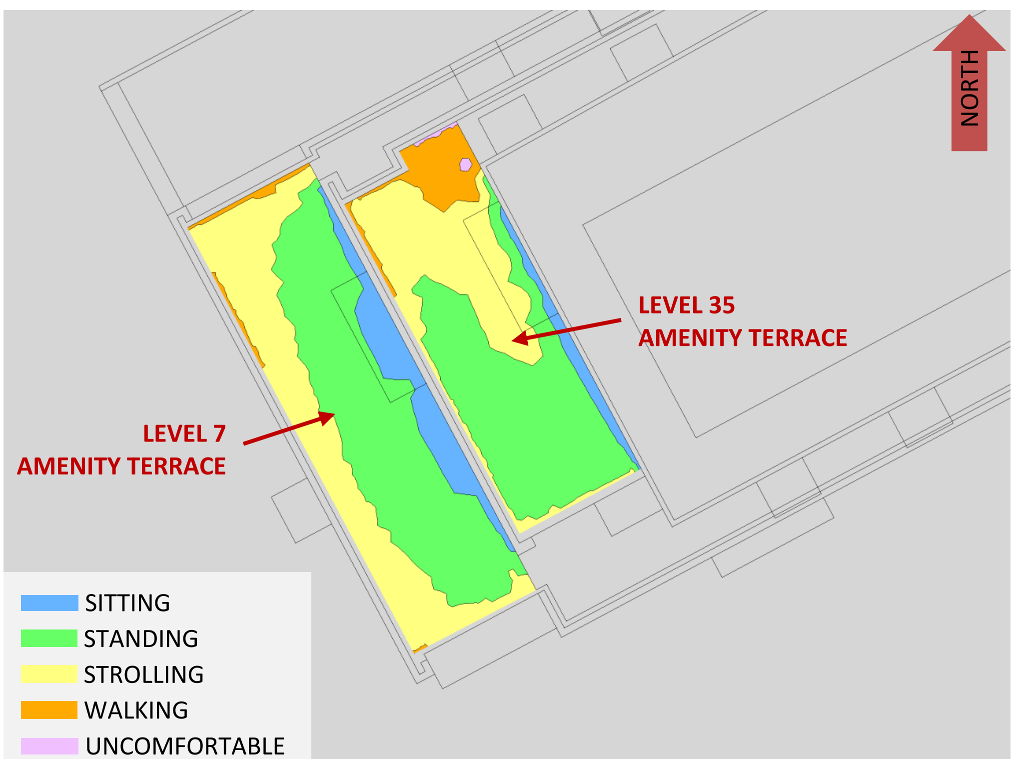

FIGURE 9B: AUTUMN – PHASE 1 – AMENITY TERRACES

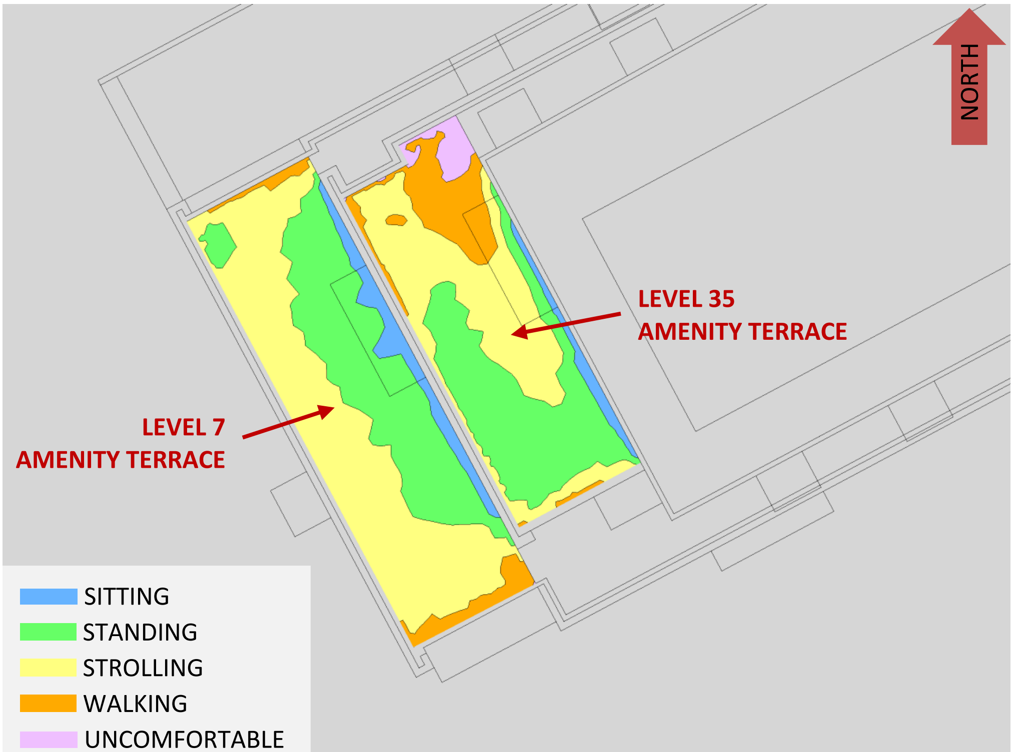

FIGURE 10A: WINTER – PROPOSED BUILDOUT – AMENITY TERRACES

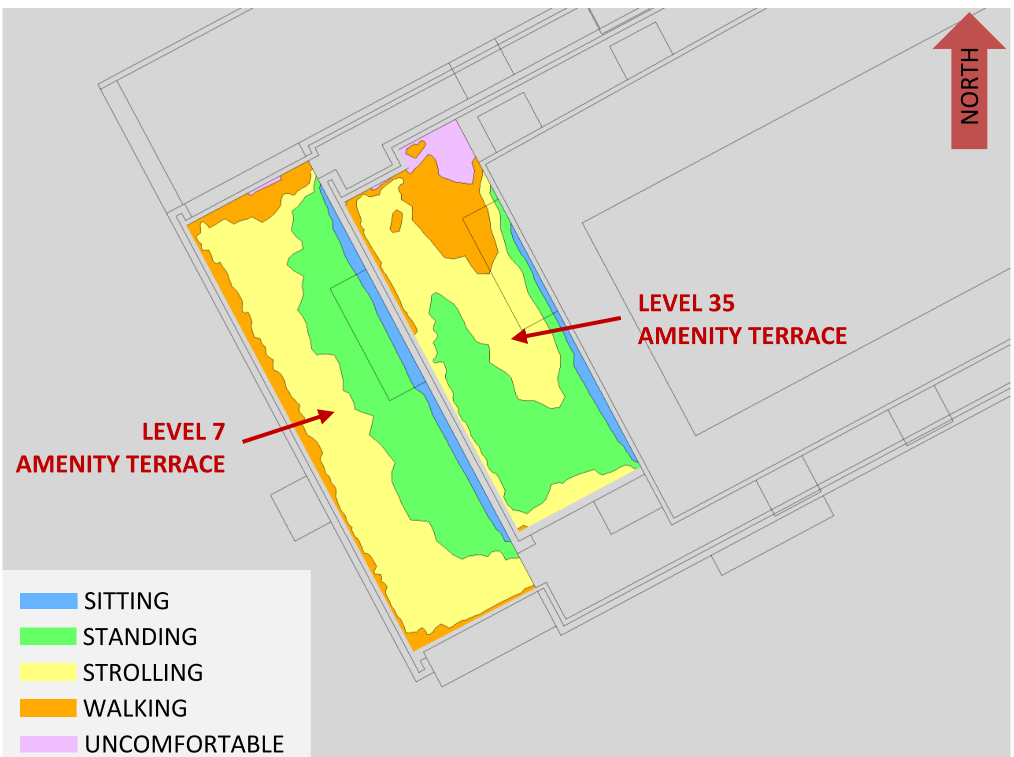

FIGURE 10B: WINTER – PHASE 1 – AMENITY TERRACES

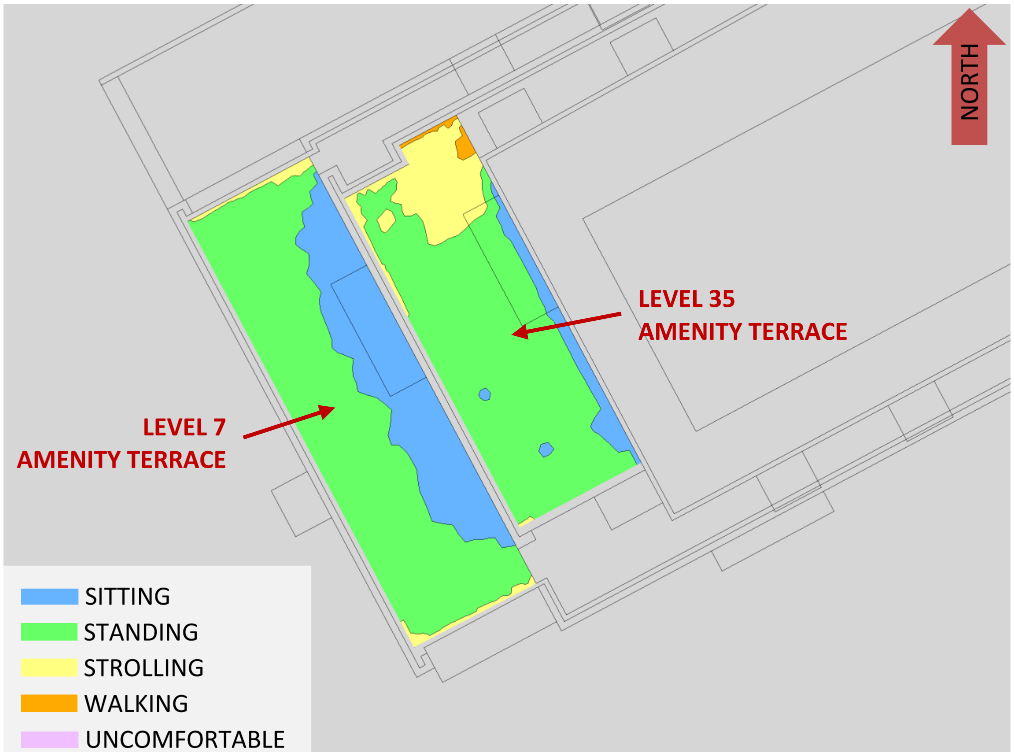

FIGURE 11A: TYPICAL USE PERIOD – PROPOSED BUILDOUT – AMENITY TERRACES

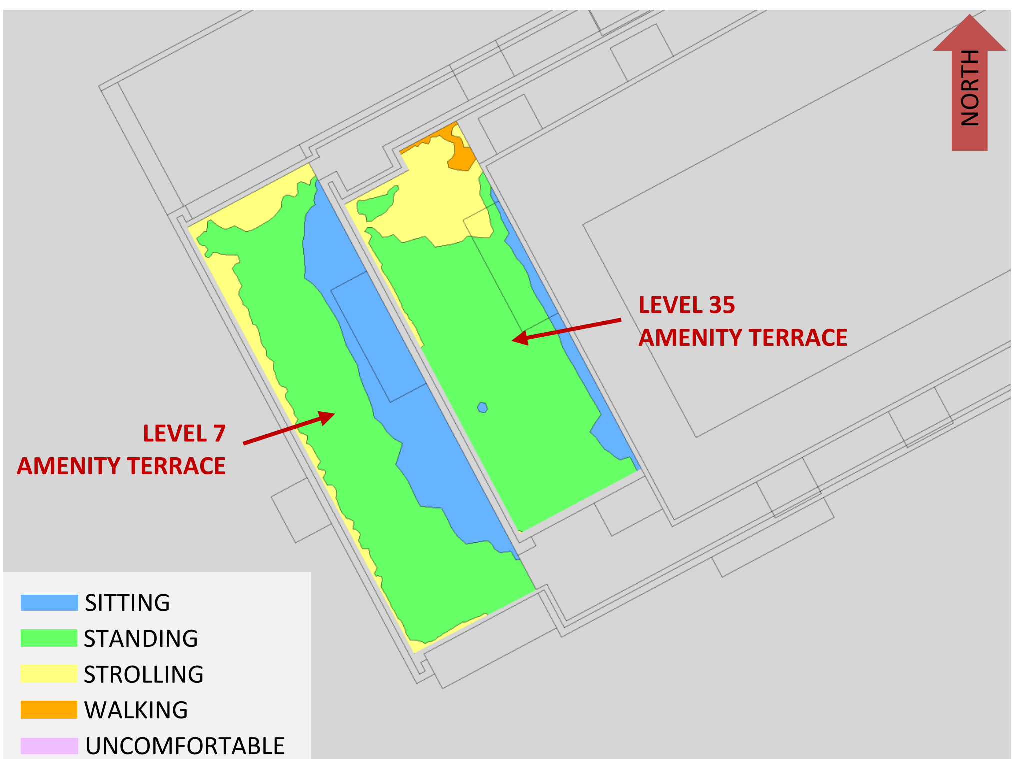

FIGURE 11B: TYPICAL USE PERIOD – PHASE 1 – AMENITY TERRACES

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, 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	0.22
49	0.23
74	0.24
103	0.24
167	0.24
197	0.24
217	0.25
237	0.26
262	0.26
282	0.24
301	0.24
324	0.24

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.

REFERENCES

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

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

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