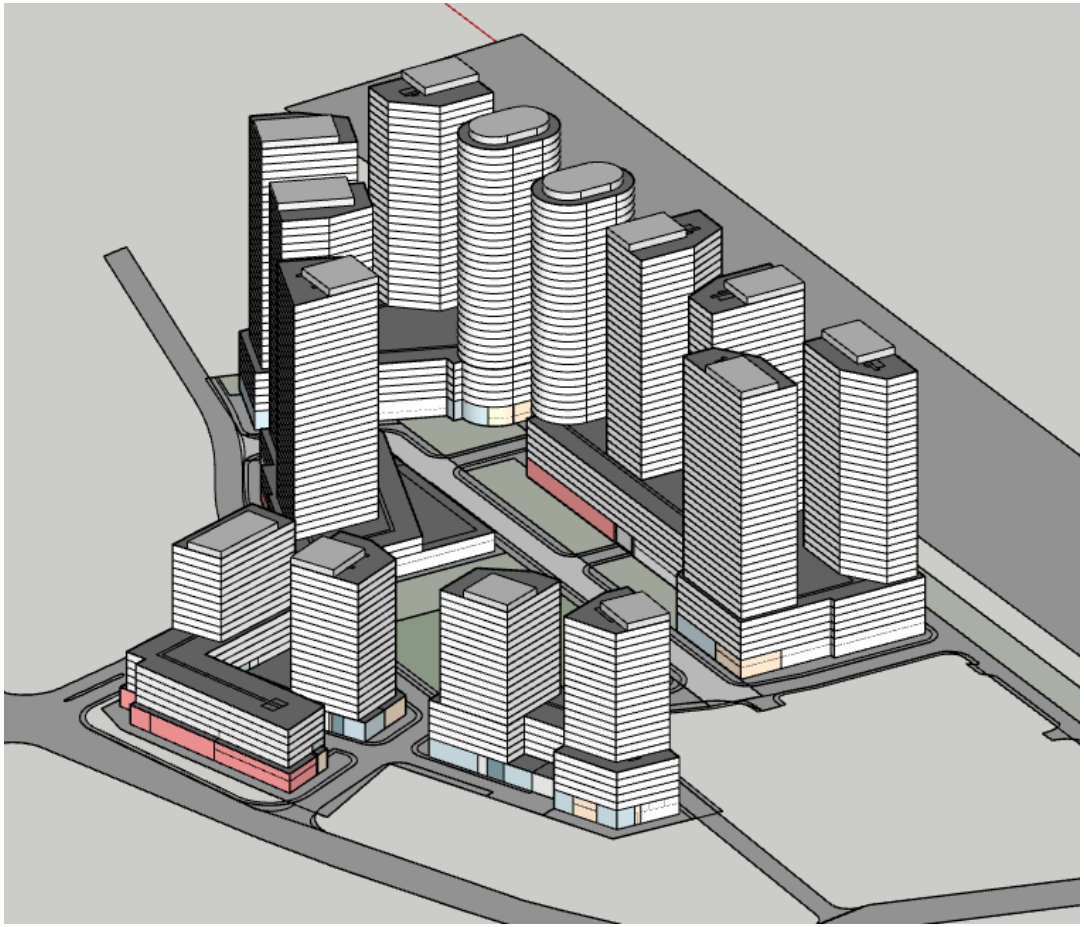
100 Stone Road West, Suite 201
Guelph, Ontario, N1G 5L3
226.706.8080 | SLRCONSULTING.COM

Date: December 16, 2024

Re: Pedestrian Wind Assessment
Brookdale (1101, 1105, & 1163 Kingston Road)
Pickering, Ontario
SLR Project #241.013026.00001



Credit: Turner Fleischer Architects Inc.

Prepared by:

SLR Consulting (Canada) Ltd.
100 Stone Road West – Suite 201
Guelph, ON N1G 5L3

For:

Tribute (Brookdale) Ltd.
1815 Ironside Manor, Unit 1
Pickering, Ontario, L1W 3W9

Mu'taz Suleiman, M.Sc., EIT
Microclimate Coordinator

Tahrana Lovlin, MAES, P.Eng.
Principal, Microclimate

Revision	Date	Prepared by	Checked by	Approved by
0	December 16, 2024	Mu'taz Suleiman	Tahrana Lovlin	Tahrana Lovlin

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1.0 Introduction

SLR Consulting (Canada) Ltd. (SLR) was retained by Tribute (Brookdale) Ltd. to conduct a pedestrian wind assessment for the proposed development at 1101, 1105, & 1163 Kingston Road in Pickering, Ontario. This report is in support of the upcoming Zoning By-Law Amendment (ZBA) resubmission for the development. SLR previously completed a qualitative pedestrian wind assessment for the initial submission in late 2023.

1.1 Existing Development

The proposed development is located between Kingston Road and Highway 401, just east of Dixie Road. The site is currently occupied by parking lots and low-rise commercial buildings. Figure 1 provides an aerial view of the immediate study area.

Immediately surrounding the site there are lightly forested fields to the east; Highway 401 to the southeast through south; low-rise commercial buildings to the southwest and northeast; and low-rise residential developments to the west through north. Beyond the immediate surroundings, Frenchman's Bay lies to the south and there are low-rise residential and commercial buildings in all other directions.

Typically, developments with Site Plan Control (SPC) approval within a 500 m radius are included as existing surroundings. For this assessment, the in-construction Walnut Lane development (blue in Figures 4a and 4b) to the east was included.

Figure 1: Aerial view of existing site & surroundings
Credit: Esri, Maxar, Earthstar Geographics, and the GIS User Community (Image Date May 5, 2022)

1.2 Proposed Development

The proposed master plan development (Figure 2) consists of Blocks A1, A2, B, C1, C2, and D, including multiple towers ranging from 17 to 35 storeys in height, with multiple shared six-storey podiums. The site is located between Kingston Road and Highway 401, just east of Dixie Road.

1.3 Areas of Interest

Areas of interest for pedestrian wind conditions include those areas which pedestrians are expected to use on a frequent basis. Typically, these include sidewalks, main entrances, transit stops, plazas and parks.

As shown in Figure 3a, the main entrances are situated around the perimeter the podiums of each individual blocks. In addition, there are numerous outdoor amenity areas, parks, and POPS at grade level. There are also transit stops located at the west and south intersections of Kingston Road and Walnut Lane.

Above grade, there are outdoor amenity terraces at Level 2 of Blocks A and D, Level 4 of Block D, and Level 7 of Blocks B, C, and E, as shown in Figure 3b.

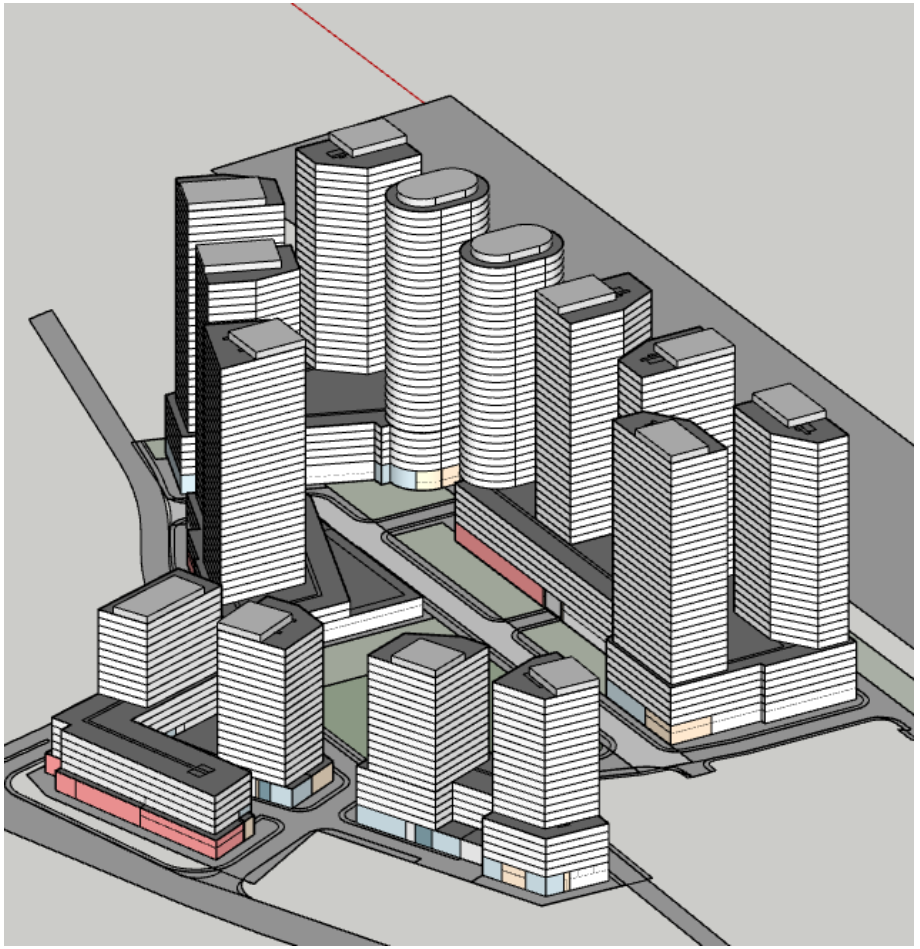

Figure 2: Rendering of proposed development
Credit: Turner Fleischer Architects Inc.

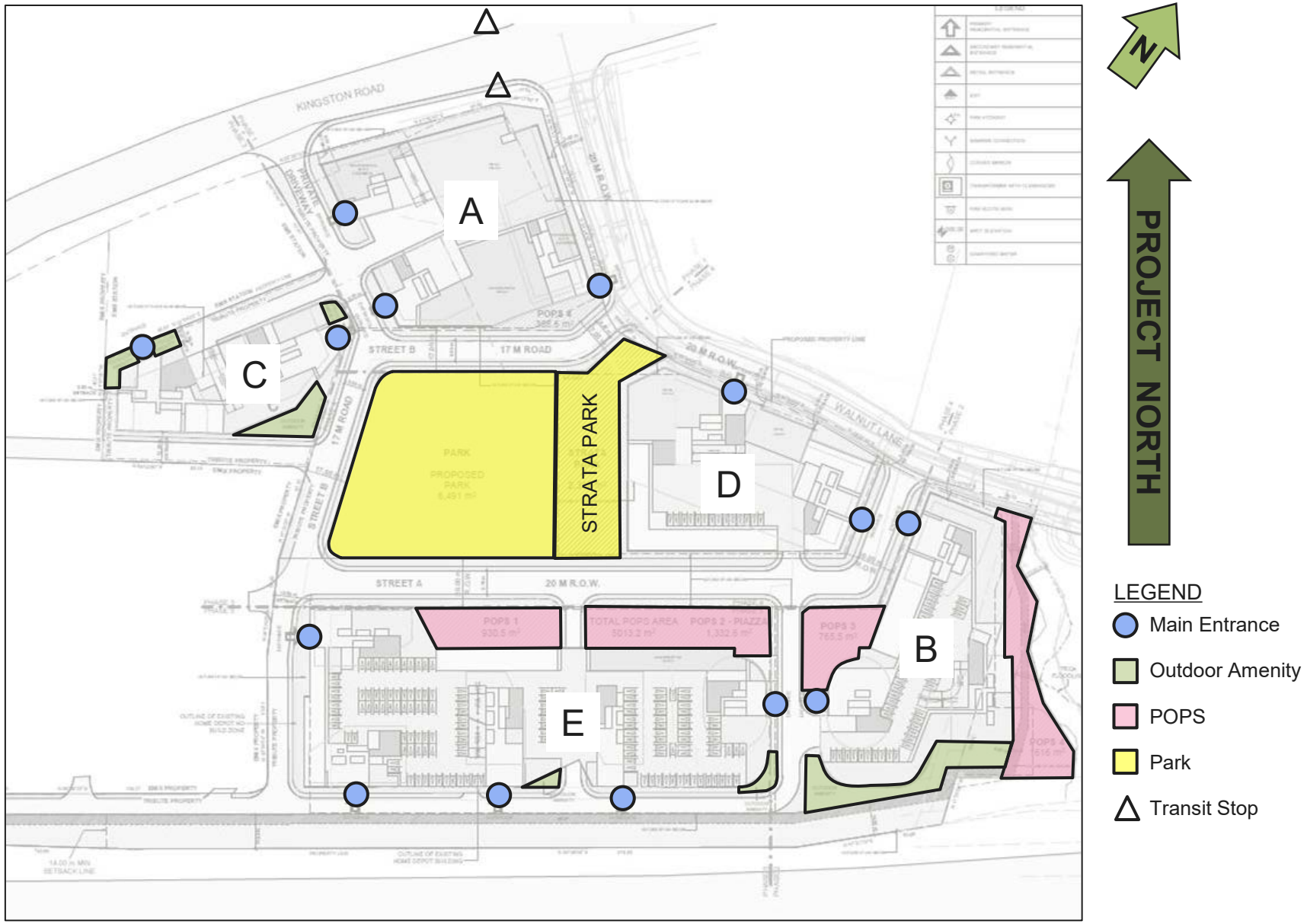

Figure 3a: Areas of interest – Grade
Credit: Turner Fleischer Architects Inc.

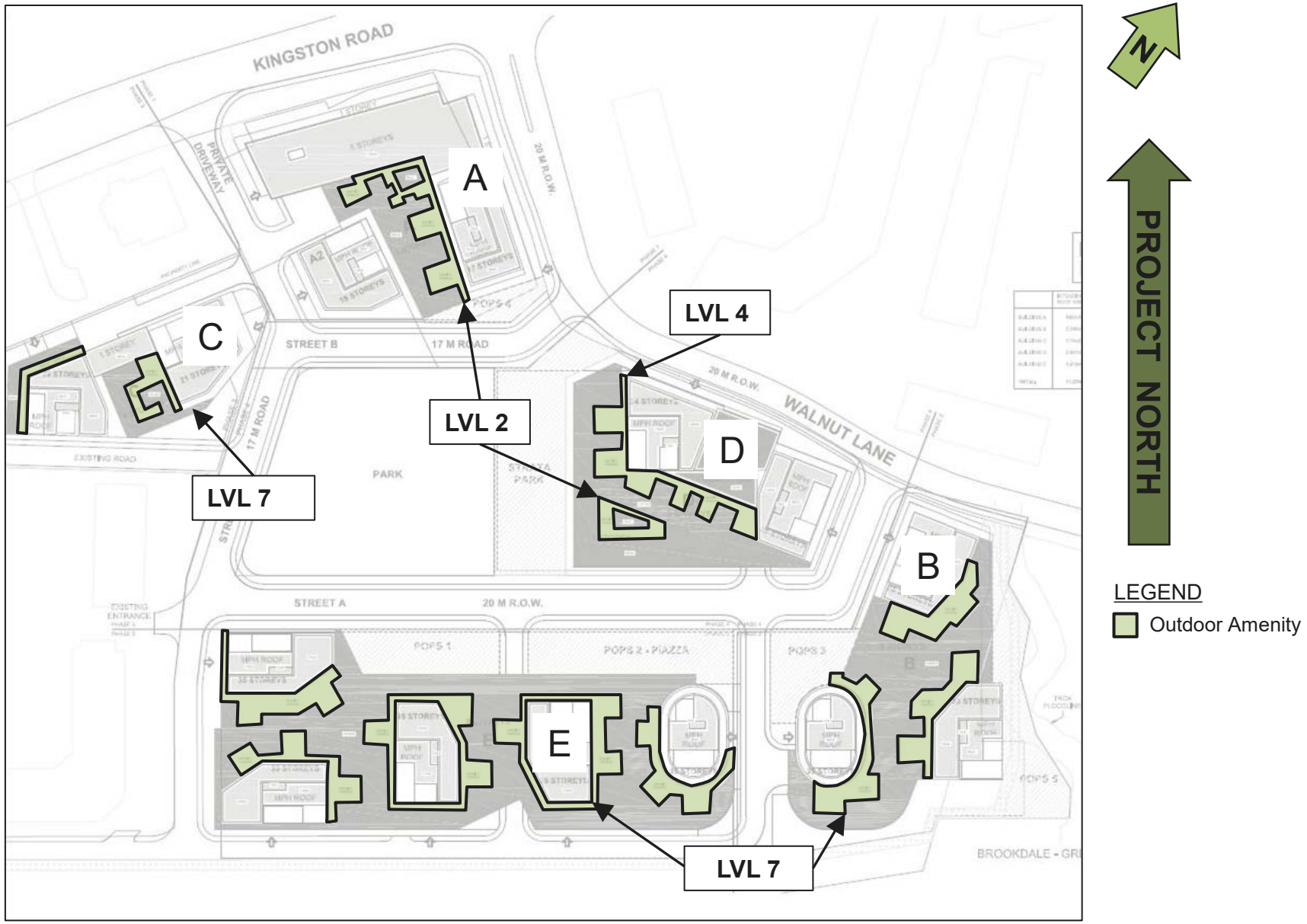

Figure 3b: Areas of interest – Above Grade
Credit: Turner Fleischer Architects Inc.

2.0 Approach

A screening-level assessment was conducted using computational fluid dynamics (CFD). As with any simulation, there are some limitations with this modelling technique, specifically in the ability to simulate the turbulence, or gustiness, of the wind. Nonetheless, CFD analysis remains a useful tool to identify potential wind issues. This CFD-based wind speed assessment employs a comparable analysis methodology to that used in wind tunnel testing. The results of CFD modelling are also an excellent means of readily identifying relative changes in wind conditions associated with different site configurations or with alternative built forms.

2.1 Methodology

Wind comfort conditions were predicted on and around the development site to identify potentially problematic windy areas. A 3D model of the proposed development, as well as floor plans and elevations, were provided by Turner Fleischer Architects Inc. on November 26, 2024. The simulations were performed using CFD software by Meteodyn Inc. and were conducted on June 16, 2023, for the Existing Configuration, and on December 6, 2024, for the Proposed Configuration.

The 3D space throughout the modelled area (500 m from the development site) is filled with a three-dimensional grid. The CFD virtual wind tunnel calculates wind speed at each one of the 3D grid points. The upstream “roughness” for each test direction is adjusted to reflect the upwind conditions encountered around the site. Wind flows for 16 compass directions were simulated. Although wind speeds are calculated throughout the modelled area, wind comfort conditions were only plotted for a smaller area immediately surrounding the proposed development.

SLR assessed two configurations, for comparison, as follows:

- **Existing Configuration:** Existing site with existing and SPA-approved surroundings.
- **Proposed Configuration:** Proposed development with existing and SPA-approved surroundings.

A view of the 3D model used in the wind comfort analysis for each configuration is shown in Figures 4a and 4b.

The CFD-predicted wind speeds for all test directions and grid points were combined with historical wind climate data for the region to predict the occurrence of wind speeds in the pedestrian realm, and to compare against wind criteria for comfort and safety. The analysis of wind conditions is undertaken for four seasons: Winter (January to March), Spring (April to June), Summer (July to September), and Autumn (October to December). However, only the seasonal extremes of summer and winter are discussed within the report. The results of the analysis for the spring and autumn seasons can be found in Appendix A. Results are presented through discussion of the wind conditions along major streets and the areas of interest. The comfort criteria are based on predictions of localized wind forces combined with frequency of occurrence. Climate issues that influence a person’s overall “thermal” comfort, (e.g., temperature, humidity, wind chill, exposure to sun or shade) are not considered in the comfort rating.

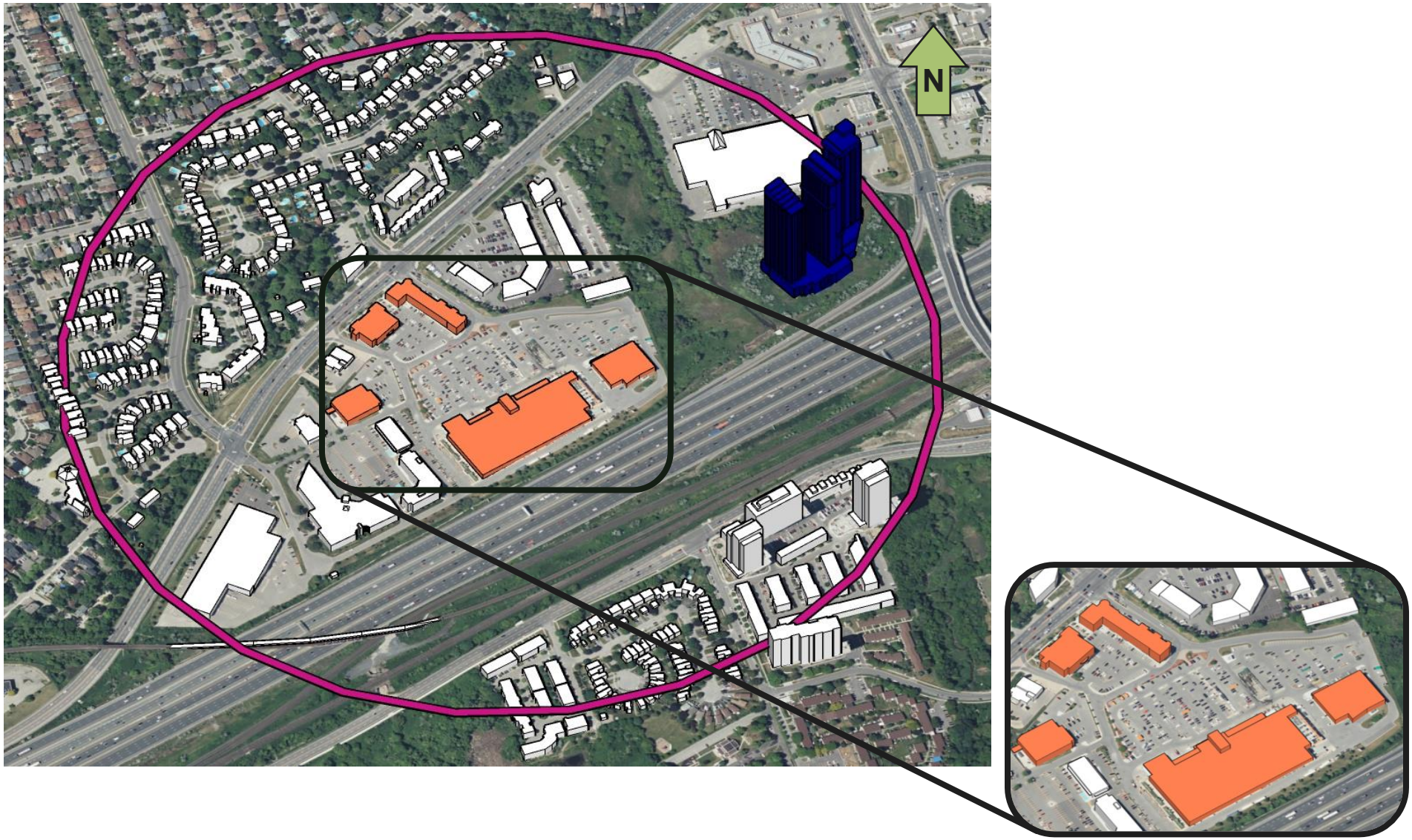

Figure 4a: Massing Model – Existing Configuration

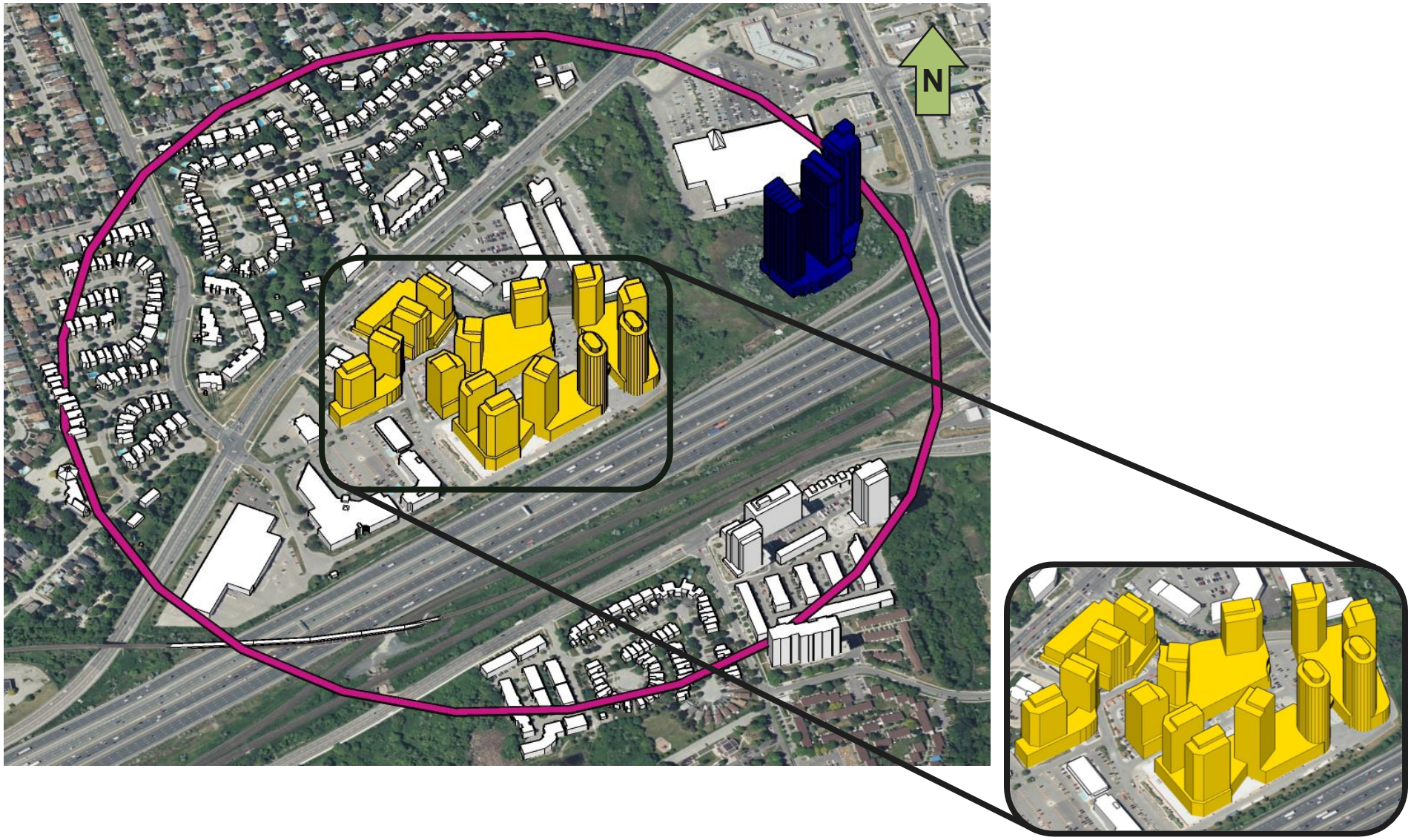

Figure 4b: Massing Model – Proposed Configuration

2.2 Wind Climate

Wind data recorded at Pearson International Airport in Toronto for the period of 1991 to 2020 were obtained and analysed to create a wind climate model for the region. Annual and seasonal wind distribution diagrams ("wind roses") are shown in Figure 5. These diagrams illustrate the percentage of time wind blows from the 16 main compass directions. Of main interest are the longest peaks that identify the most frequently occurring wind directions. The annual wind rose indicates that wind approaching from the northerly through westerly directions are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year.

The directions from which stronger winds (e.g., > 30 km/h) approach are also of interest as they have the highest potential of creating problematic wind conditions, depending upon site exposure and the building configurations. The wind roses in Figure 5 also identify the directional frequency of these stronger winds, as indicated in the figure's legend colour key. On an annual basis, strong winds occur from the northwesterly and westerly sectors. All wind speeds and directions were included in the wind climate model.

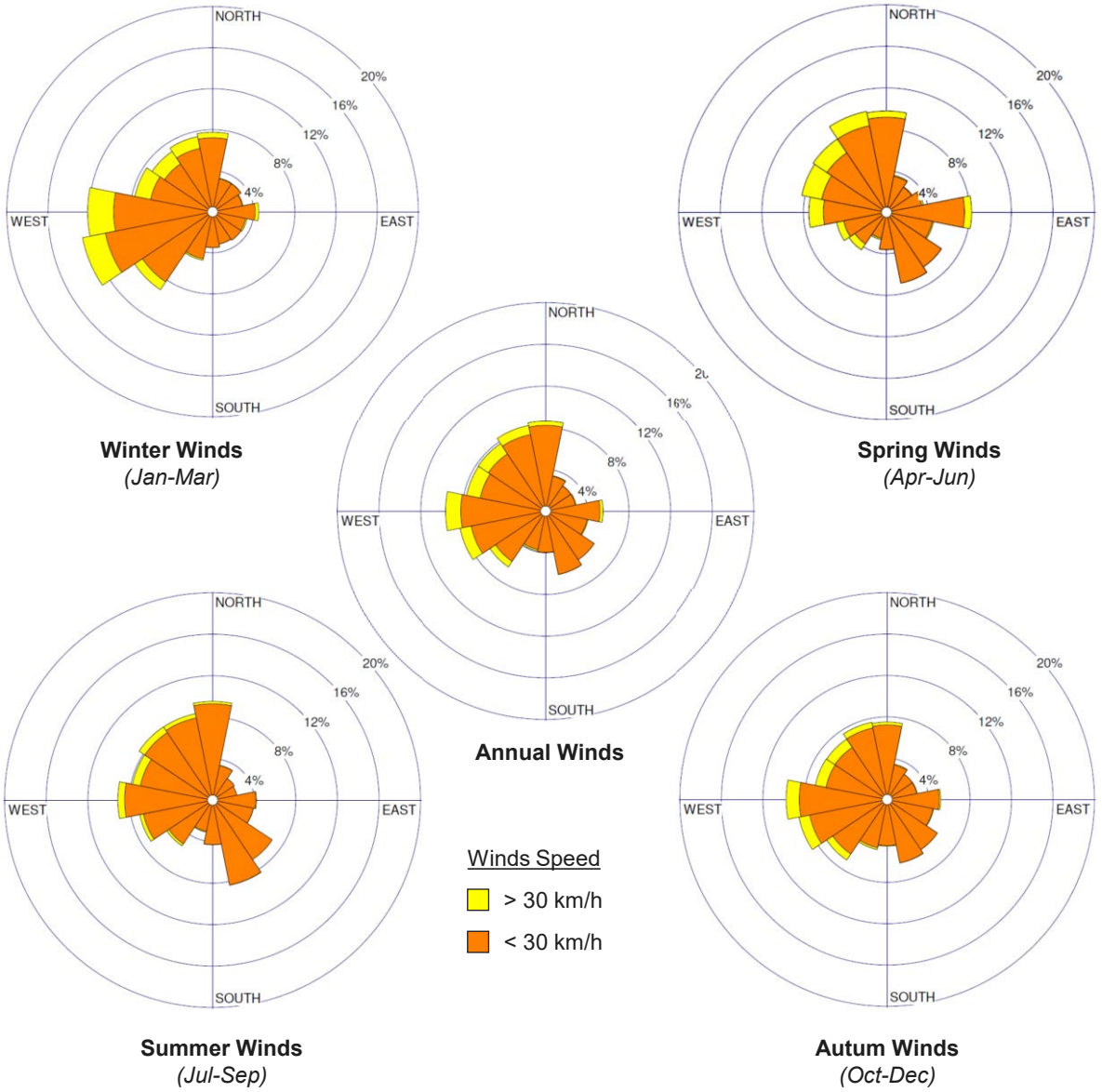

Figure 5: Wind Roses for Toronto Pearson International Airport (1991 to 2020)

3.0 Pedestrian Wind Criteria

Wind comfort conditions are discussed in terms of being acceptable for certain pedestrian activities and are based on predicted wind force and the expected frequency of occurrence. Wind chill, clothing, humidity and exposure to direct sun, for example, all affect a person's thermal comfort; however, these influences are not considered in the wind comfort criteria.

The comfort criteria, which are based on certain predicted hourly mean wind speeds being exceeded 5% of the time, are summarized in Table 1. Generally, this is equivalent to a wind event of several hours duration occurring about once per week.

The criterion for wind safety in the table is based on hourly mean wind speeds that are exceeded once per year (approximately 0.01% of the time). When more than one event is predicted annually, wind mitigation measures are then advised. The wind safety criterion is shown in Table 2.

The criteria for wind comfort and safety used in this assessment are similar to those developed at the Boundary Layer Wind Tunnel Lab of Western University, together with building officials in London, England. They are broadly based on the Beaufort Scale and on previous criteria that were originally developed by Davenport. Similar criteria are used by the Alan G. Davenport Wind Engineering Group Boundary-Layer Wind Tunnel Laboratory for pedestrian wind study projects located around the globe. For a list of references, describing the criteria and history of its development see Section 7.0.

Table 1: Wind Comfort Criteria

Comfort Category	Mean Wind Speed Exceeded 5% of the time	Description of Wind Comfort
Sitting	≤ 14 km/h	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away.
Standing	≤ 22 km/h	Gentle breezes suitable for main building entrances and bus stops.
Walking	≤ 29 km/h	Moderate breezes that can be tolerated if one's objective is to walk, run or cycle without lingering.
Fast Walking	≤ 36 km/h	Strong breezes that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	> 36 km/h	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

Table 2: Wind Safety Criterion

Safety Criterion	Mean Wind Speed Exceeded Once Per Year (0.01%)	Description of Wind Effects
Exceeded	> 72 km/h	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

4.0 Results

Figures 6a through 9b present graphical images of the wind comfort conditions for the summer and winter months around the proposed development. These typically represent the seasonal extremes of best and worst case. Appendix A presents the wind comfort conditions for spring and autumn seasons. The “comfort zones” shown are based on an integration of wind speed and frequency for all 16 wind directions tested with the seasonal wind climate model. The presence of mature trees can lead to wind comfort levels that are marginally more comfortable than shown, during seasons when foliage is present. Appendix B presents the wind safety conditions on an annual basis.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. However, in some climates, these may be difficult to achieve in the winter due to the overall climate. For sidewalks, walkways and pathways, wind conditions suitable for leisurely walking are desirable year-round but may not be feasible in the winter. The presence of benches on a sidewalk, which are an optional use, does not change the overall wind comfort requirement for the sidewalk. Wind conditions of fast walking are satisfactory for loading areas, laneways, and a limited portion of a sidewalk, considering exposure is brief for pedestrians. For main entrances, transit stops, and public amenity spaces such as parks and playgrounds, wind conditions conducive to standing are preferred throughout the year. For on-site amenity areas, wind conditions suitable for sitting or standing are desirable during the summer, with stronger wind flows, conducive to leisurely walking, tolerated in the winter. The most stringent category of sitting is desirable during the summer for dedicated seating areas, such as patios, where calmer wind is expected for the comfort of patrons.

4.1 Building Entrances & Walkways

Existing wind conditions on-site are expected to be comfortable for sitting or standing year-round (Figures 6a and 7a).

In the Proposed Configuration, wind conditions are predicted to generally remain comfortable for sitting or standing in the summer (Figure 6b). An exception is around the northwest corner of Block D, where wind conditions are anticipated to be comfortable for leisurely walking. During the winter season, similar wind conditions are generally anticipated, with wind flows conducive to leisurely walking at a few building corners and in some areas between buildings (Figure 7b). These wind comfort conditions are considered suitable for transient movement.

Wind conditions at the main entrances of the proposed development are generally expected to be suitable for sitting or standing year-round, which is considered suitable for the intended use (Figures 8a and 8b). Exceptions are the entrances of Block B, and the easterly entrance of Block E, where wind speeds conducive to leisurely walking are anticipated to occur in the winter months (Figure 8b). To improve wind conditions, the design team may consider recessing these entrances from the main facade for localized wind protection. Alternative mitigation features such as local screens, canopies, etc. should also be considered as the design progresses.

4.2 Outdoor Amenity Spaces

In the proposed outdoor amenity, POPS, and parks at grade, wind conditions are generally predicted to be comfortable for sitting or standing in the summer, which is considered suitable for the intended use (Figure 8a). Exceptions are in the northeast corner of Strata Park and the POPS east of Block B, where wind conditions are anticipated to be suitable for leisurely walking.

Figure 6a: Existing Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas

Figure 6b: Proposed Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas

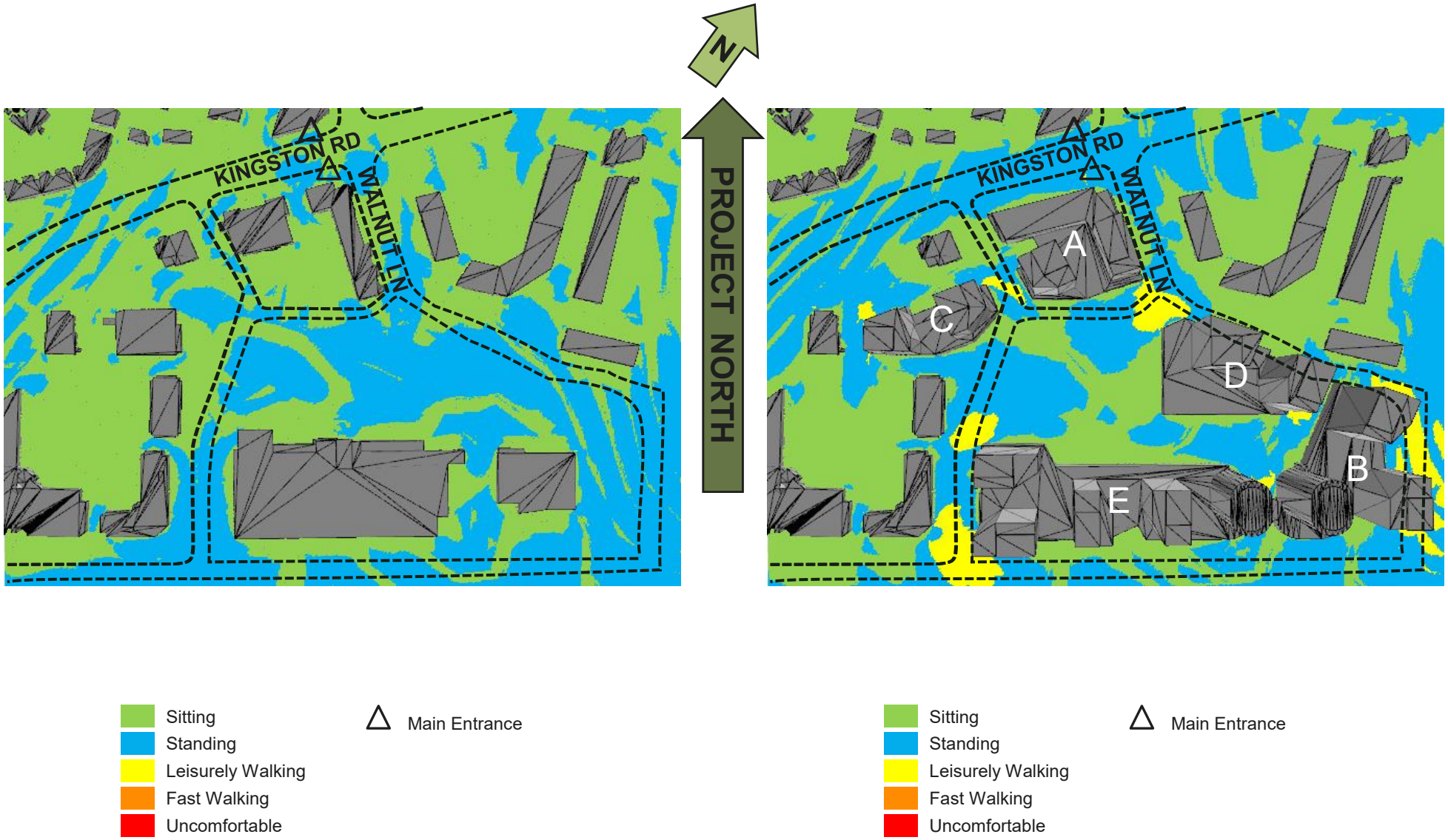

Figure 7a: Existing Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

Figure 7b: Proposed Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

Figure 8a: Proposed Configuration – Pedestrian Wind Comfort Summer – Building Entrances & Walkways

Figure 8b: Proposed Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

During the winter, wind conditions in the parks and POPS are generally predicted to be suitable for sitting or standing, with a few areas conducive to leisurely walking (Figure 8b). Since these areas are not expected to be used frequently during the winter months, stronger wind flows in some localized areas may not be a concern. If improved wind conditions are desired, the design team may consider the use of hard and/or soft landscaping features to provide local wind protection in areas where passive activity is expected.

The proposed development includes numerous amenity terraces. During the summer, wind conditions on the amenity terraces are generally predicted to be comfortable for sitting or standing (Figure 9a). Exceptions are the outdoor amenity terraces of Blocks B, C, and E, where wind conditions in some areas are expected to be comfortable for leisurely walking. During the winter, wind conditions are expected to be suitable for leisurely walking or better on the terraces, with the exceptions of a few localized areas close to building corners, or in the space between the towers, where wind conditions are expected to be suitable for fast walking or uncomfortable (Figure 9b).

The strong wind flows on the terraces are due to the overall exposure of the development to the prevailing northwesterly and westerly winds. These strong wind flows are directed downwards by the mass of the buildings, resulting in wind accelerations on the terraces. In other areas, the prevailing winds are channelled between the towers, resulting in accelerated wind flows across the terraces.

To take advantage of the calmer wind conditions, we recommend planning passive activities where wind conditions are predicted to be conducive to sitting or standing (green and blue regions in Figures 9a and 9b). In addition, we recommend the design team include wind screens along the perimeter of each terrace.

4.3 Surrounding Sidewalks

Existing wind conditions along the sidewalks of Kingston Road and Walnut Lane, including the nearby transit stops along Kingston Road, are expected to be comfortable for sitting or standing year-round (Figures 6a and 7a).

In the Proposed Configuration, wind conditions are generally predicted to be suitable for leisurely walking or better throughout the year on the surrounding sidewalks. At the nearby transit stops along Kingston Road, wind conditions are expected to be comfortable for sitting throughout the year (Figures 6b and 7b).

These wind conditions are satisfactory for the anticipated use.

4.4 Wind Safety

The wind safety criterion is expected to be met on an annual basis in all areas at grade in both the Existing Configuration and Proposed Configuration (Appendix B), including at all entrances, surrounding sidewalks, outdoor amenity spaces at grade, park spaces, and POPS.

However, the safety criterion is expected to be exceeded in the outdoor amenity terraces of Blocks B, C, and E, on an annual basis. Recommendations are provided in Section 4.2.

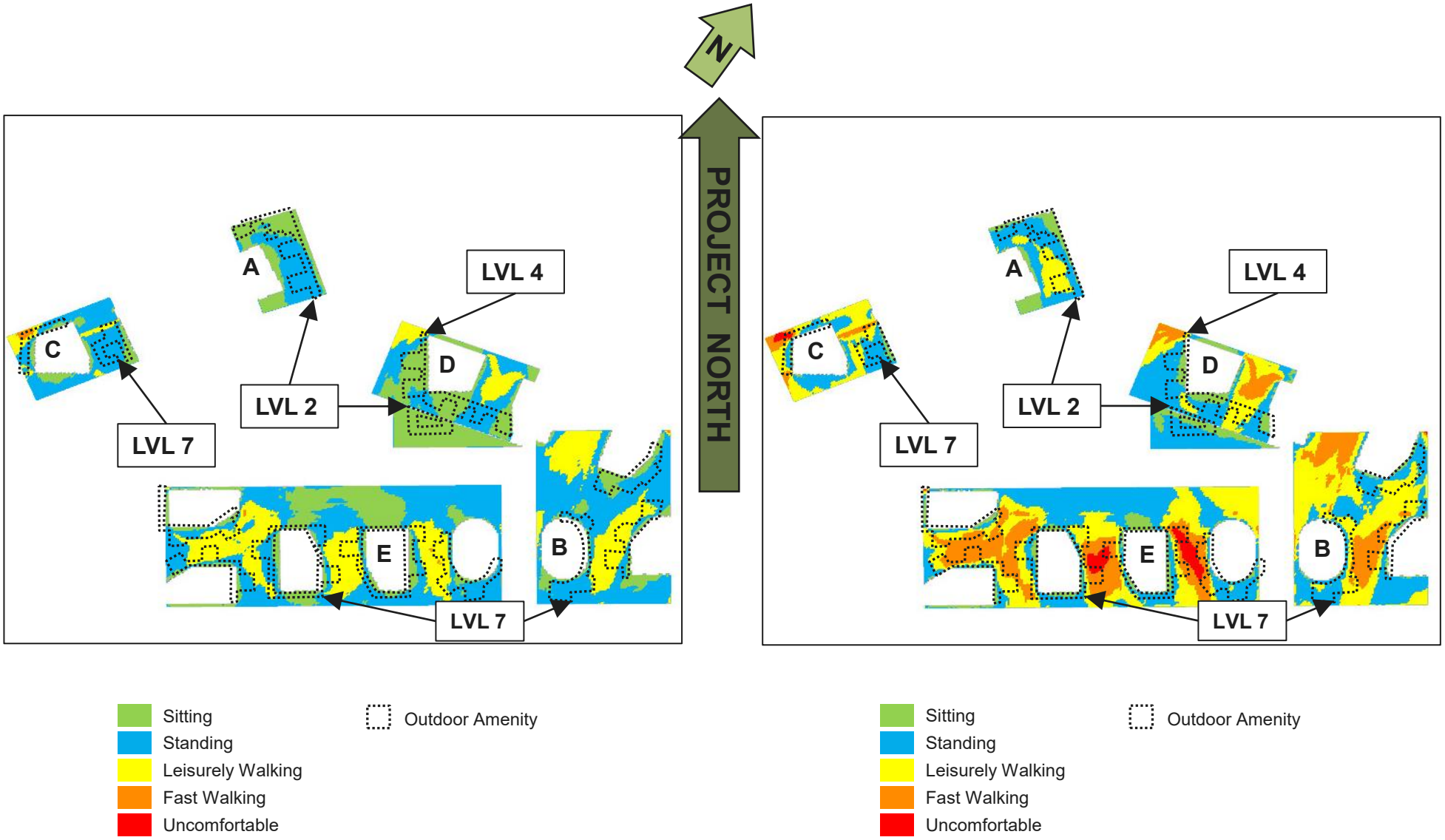

Figure 9a: **Proposed Configuration – Pedestrian Wind Comfort Summer – Amenity Terraces**

Figure 9b: **Proposed Configuration – Pedestrian Wind Comfort Winter – Amenity Terraces**

5.0 Conclusion & Recommendations

The pedestrian wind conditions predicted for the proposed 1101, 1105, & 1163 Kingston Road development in Pickering have been assessed through qualitative computational fluid dynamics modelling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is expected to be met at all areas on-site and surrounding the development at grade in both the Existing Configuration and Proposed Configuration. The safety criterion is also expected to be exceeded in the outdoor amenity terraces of Blocks B, C, and E. Recommendations are provided.
- Wind conditions on the site, including entrances and amenity spaces, are generally expected to be suitable for the intended use year-round. Recommendations are provided for the main entrances in specific areas.
- Wind conditions on the proposed terraces are generally predicted to be suitable for the intended use in the summer. Recommendations are provided to improve wind conditions and allow for more use throughout the year.
- On the sidewalks surrounding the proposed development, wind conditions are suitable for the intended use.
- We recommend confirming these wind conditions through a quantitative wind tunnel study as the project progresses SPA. SLR will work with the owner and the design team to help develop appropriate wind control measures where necessary.

6.0 Statement of Limitations

This report has been prepared by SLR Consulting (Canada) Ltd. (SLR) for Tribute (Brookdale) Ltd. (Client) in accordance with the scope of work and all other terms and conditions of the agreement between such parties. SLR acknowledges and agrees that the Client may provide this report to government agencies, interest holders, and/or Indigenous communities as part of project planning or regulatory approval processes. Copying or distribution of this report, in whole or in part, for any other purpose other than as aforementioned is not permitted without the prior written consent of SLR.

Any findings, conclusions, recommendations, or designs provided in this report are based on conditions and criteria that existed at the time work was completed and the assumptions and qualifications set forth herein.

This report may contain data or information provided by third party sources on which SLR is entitled to rely without verification and SLR does not warranty the accuracy of any such data or information.

Nothing in this report constitutes a legal opinion nor does SLR make any representation as to compliance with any laws, rules, regulations, or policies established by federal, provincial territorial, or local government bodies, other than as specifically set forth in this report. Revisions to legislative or regulatory standards referred to in this report may be expected over time and, as a result, modifications to the findings, conclusions, or recommendations may be necessary.

7.0 References

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Appendix A

Pedestrian Wind Comfort Analysis
Spring (April – June) and Autumn (October – December)

Figure A1a: Existing Configuration – Pedestrian Wind Comfort Spring – On-site & Surrounding Areas

Figure A1b: Proposed Configuration – Pedestrian Wind Comfort Spring – On-site & Surrounding Areas

Figure A2a: Existing Configuration – Pedestrian Wind Comfort Autumn – On-site & Surrounding Areas

Figure A2b: Proposed Configuration – Pedestrian Wind Comfort Autumn – On-site & Surrounding Areas

Figure A3a: Proposed Configuration – Pedestrian Wind Comfort Spring – Building Entrances & Walkways

Figure A3b: Proposed Configuration – Pedestrian Wind Comfort Autumn – On-site & Surrounding Areas

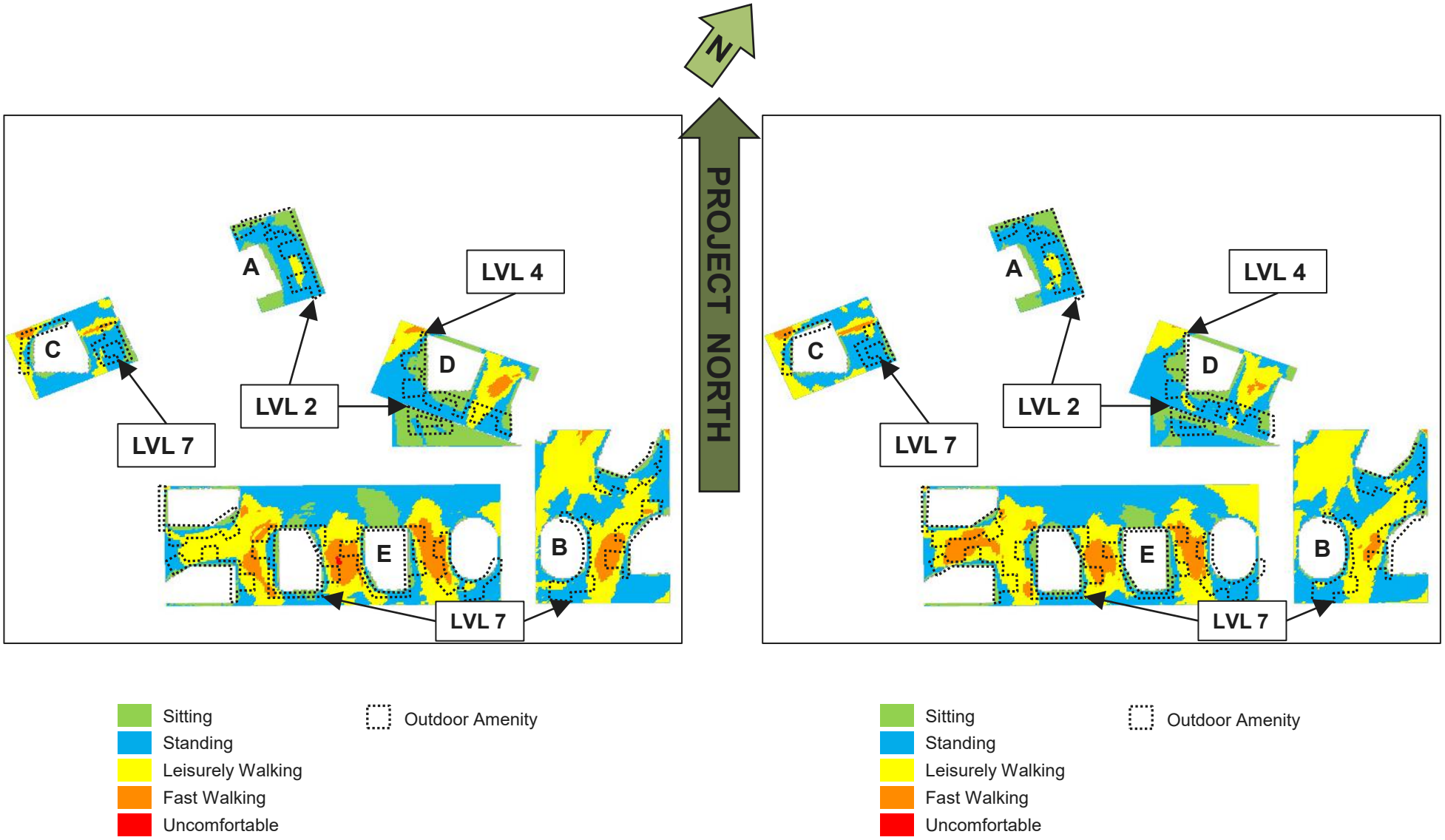

Figure A4a: Proposed Configuration – Pedestrian Wind Comfort Spring – Amenity Terraces

Figure A4b: Proposed Configuration – Pedestrian Wind Comfort Autumn – Amenity Terraces

Appendix B

Pedestrian Wind Safety Analysis
Annual

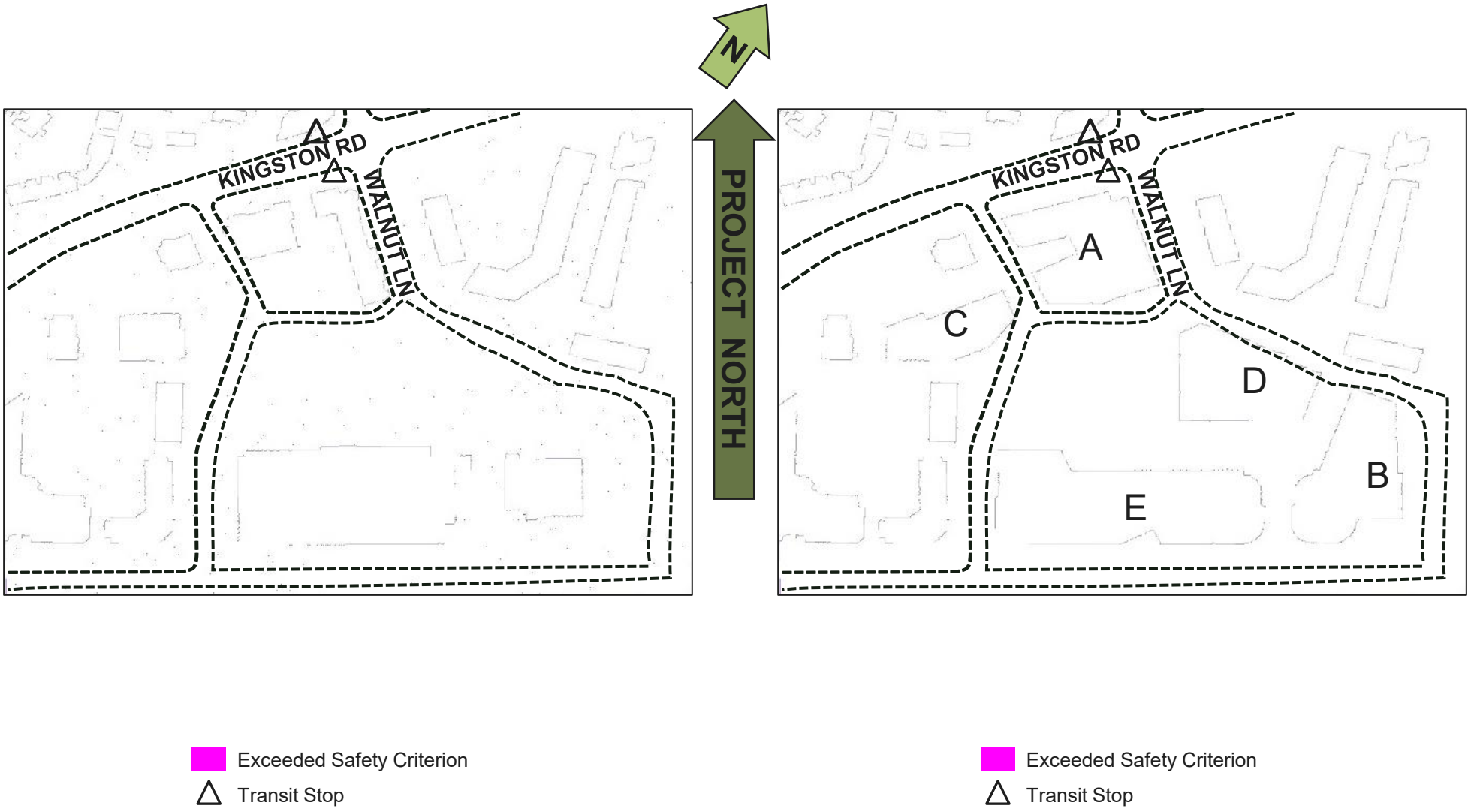

Figure B1a: Existing Configuration – Wind Safety Annual – On-site & Surrounding Areas

Figure B1b: Proposed Configuration – Wind Safety Annual – On-site & Surrounding Areas

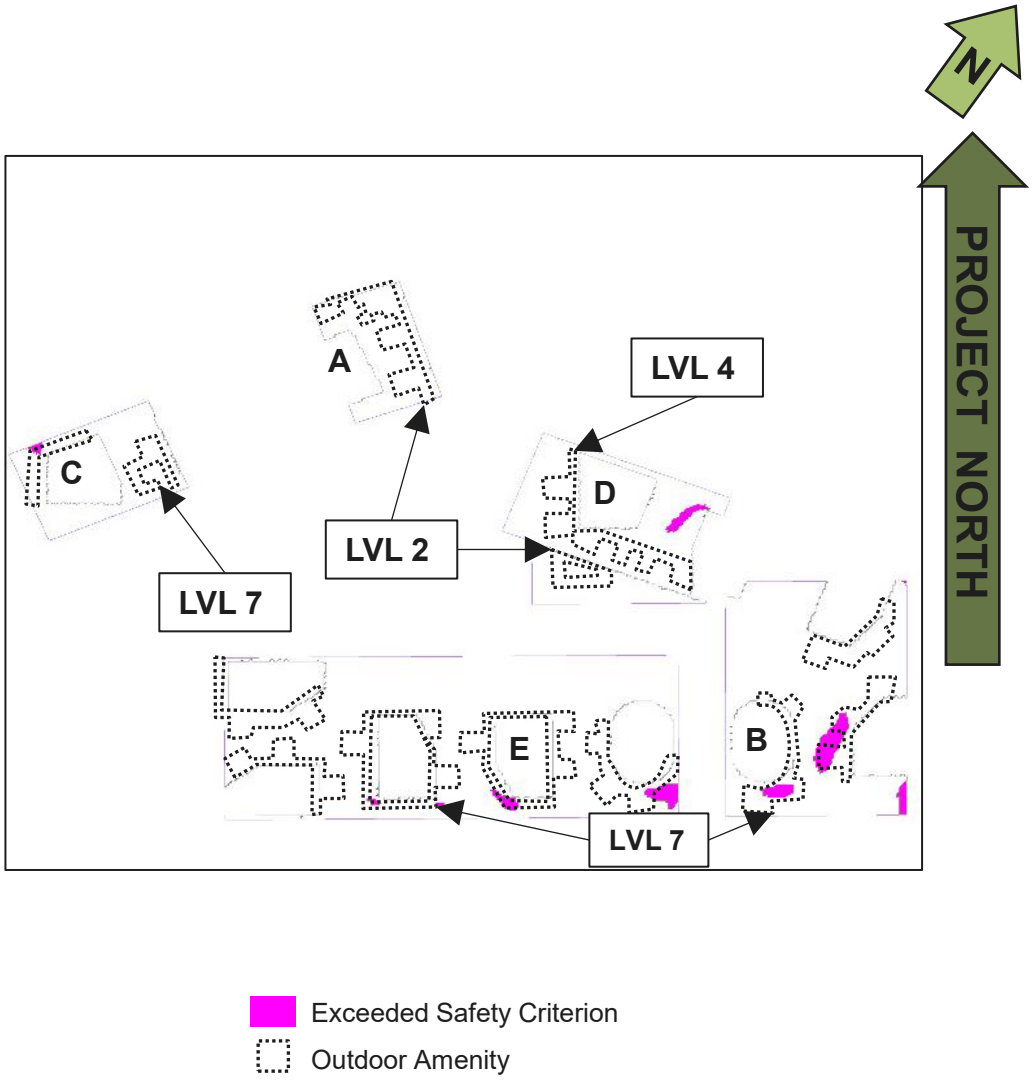

Figure B2: Proposed Configuration – Wind Safety Annual – Amenity Terraces