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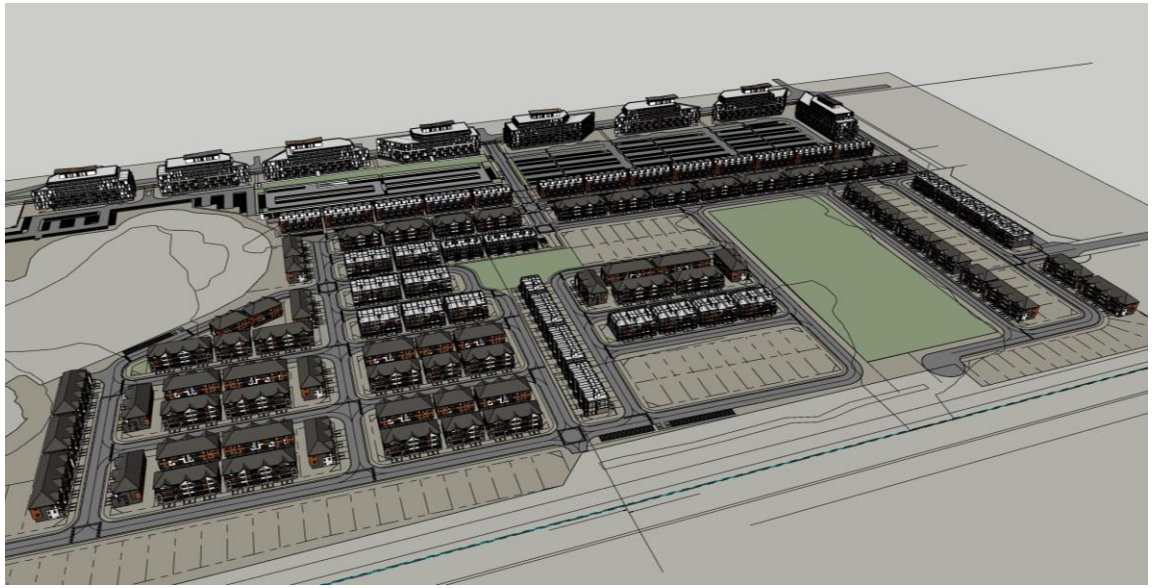
Date: December 4, 2023

Re: Pedestrian Wind Assessment

Killaly Street West
Port Colborne, ON

SLR Project #241.V13413.00001



Credit: ICON Architects

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Revision	Date	Prepared by	Checked by	Approved by
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2	December 4, 2023	Nishat Nourin	Stefan Gopaul	Tahrana Lovlin

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1.0 Introduction

SLR Consulting (Canada) Ltd. (SLR) was retained by Mapleview to conduct a pedestrian wind assessment for the proposed subdivision development at Killaly Street West in Port Colborne, Ontario. This report is in support of the combined Official Plan Amendment (OPA), Zoning Bylaw Amendment (ZBA), and Draft Plan of Subdivision (DPS) application of the development.

1.1 Existing Site

The proposed development is located southwest of the intersection of Killaly Street West and West Side Road in Port Colborne, Ontario. The site is currently an undeveloped lot. **Figure 1** provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth Pro images dated May and June 2023. Several images of the site and surroundings are included in **Figures 2a** through **2d**.

Immediately surrounding the site are low-rise commercial developments and residential buildings to the north and east, the Port Colborne Harbour Railway line and undeveloped land to the south, and farmland to the west and northwest. Beyond the immediate surroundings are low-rise residential and commercial buildings to the north, east and south, with mainly undeveloped lands to the west and northwest.

Typically, developments with Site Plan Approval (SPA) within a 500 m radius are included as existing surroundings. For this assessment, there were no such developments in the vicinity.

Figure 1: Aerial view of existing site & surroundings
Credit: Google Earth Pro, dated 7/8/2018

Figure 2a: Looking west at the site
Credit: Google Earth Pro, Dated June 2023

Figure 2b: Looking east along Killaly Street West
Credit: *Google Earth Pro, Dated June 2023*

Figure 2c: Looking west along Killaly Street West
Credit: *Google Earth Pro, Dated June 2023*

Figure 2d: Looking south along West Side Road
Credit: *Google Earth Pro, Dated May 2023*

1.2 Proposed Development

The proposed development, which consists of 29 hectares, will include eight mixed-use eight-storey buildings (Building 1 through 8), along the south side of Killaly Street West, with townhouses and single-family homes proposed for the rest of the site. The woodlot on the east side of the site will be retained. **Figure 3** illustrates a rendering of the proposed development.

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.

There is a transit stop nearby along Killaly Street West, to the east of the proposed site. On site, there is an outdoor amenity space to the south of Buildings 1 and 2 (**Figure 4**). In addition, an outdoor amenity space is located on the roof of the parking garage to the south of Buildings 3 and 4.

Although the entire proposed site was modeled, our assessment focused on the eight-storey buildings on the north side of the site, as well as their nearby surroundings.

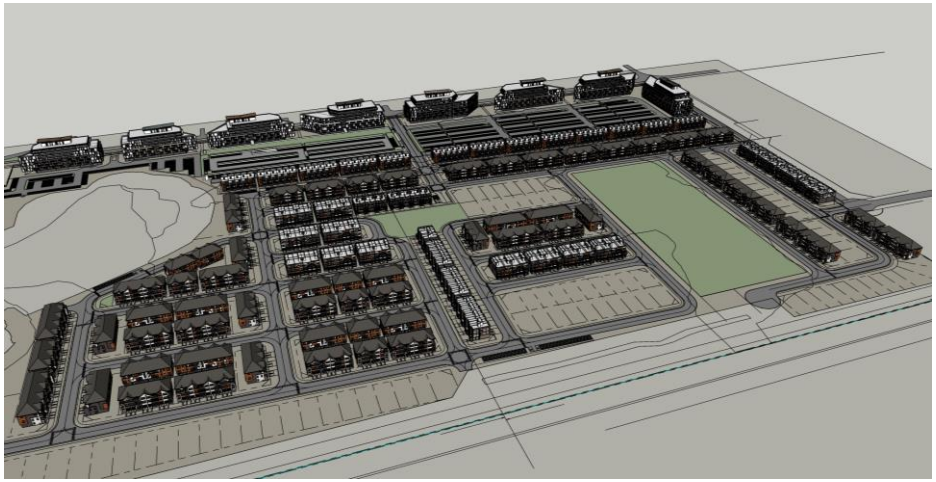

Figure 3: Rendering of the Proposed Development
Credit: ICON Architects

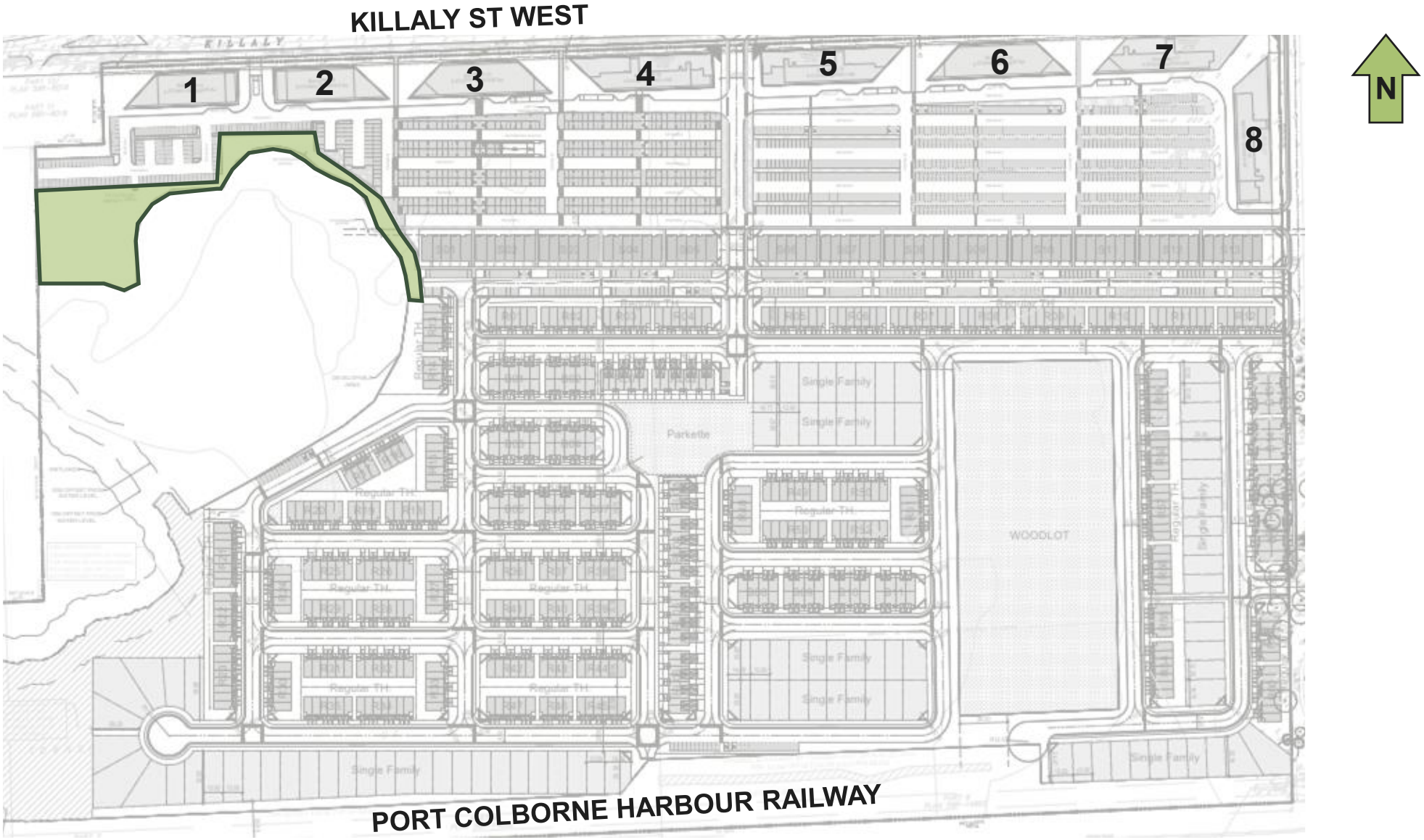

Figure 4: Areas of Interest

2.0 Approach

A qualitative assessment was conducted using computational fluid dynamics (CFD). As with any approach, there are some limitations with this analysis technique, specifically in the ability to simulate the turbulence of the wind. Nonetheless, a qualitative CFD analysis is a useful tool to identify potential wind issues, as it employs a comparable analysis methodology to that used in quantitative wind tunnel testing.

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, was provided by ICON Architects on September 28, 2023. A view of the 3D model used in the computer wind comfort analysis is shown in **Figure 3.** This model included surrounding buildings within 500 m from the study site centre. The simulations were performed using CFD software by Meteodyn Inc.

The 3D space throughout the modeled area 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 modeled 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 surroundings.
- **Proposed Configuration:** Proposed development with existing surroundings.

A view of the two configurations are shown in **Figures 5a** and **5b.**

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. This analysis was conducted for the Existing Configuration and Proposed Configuration. The analysis of wind conditions is undertaken for two seasons: Winter (November to April) and Summer (May to October).

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.

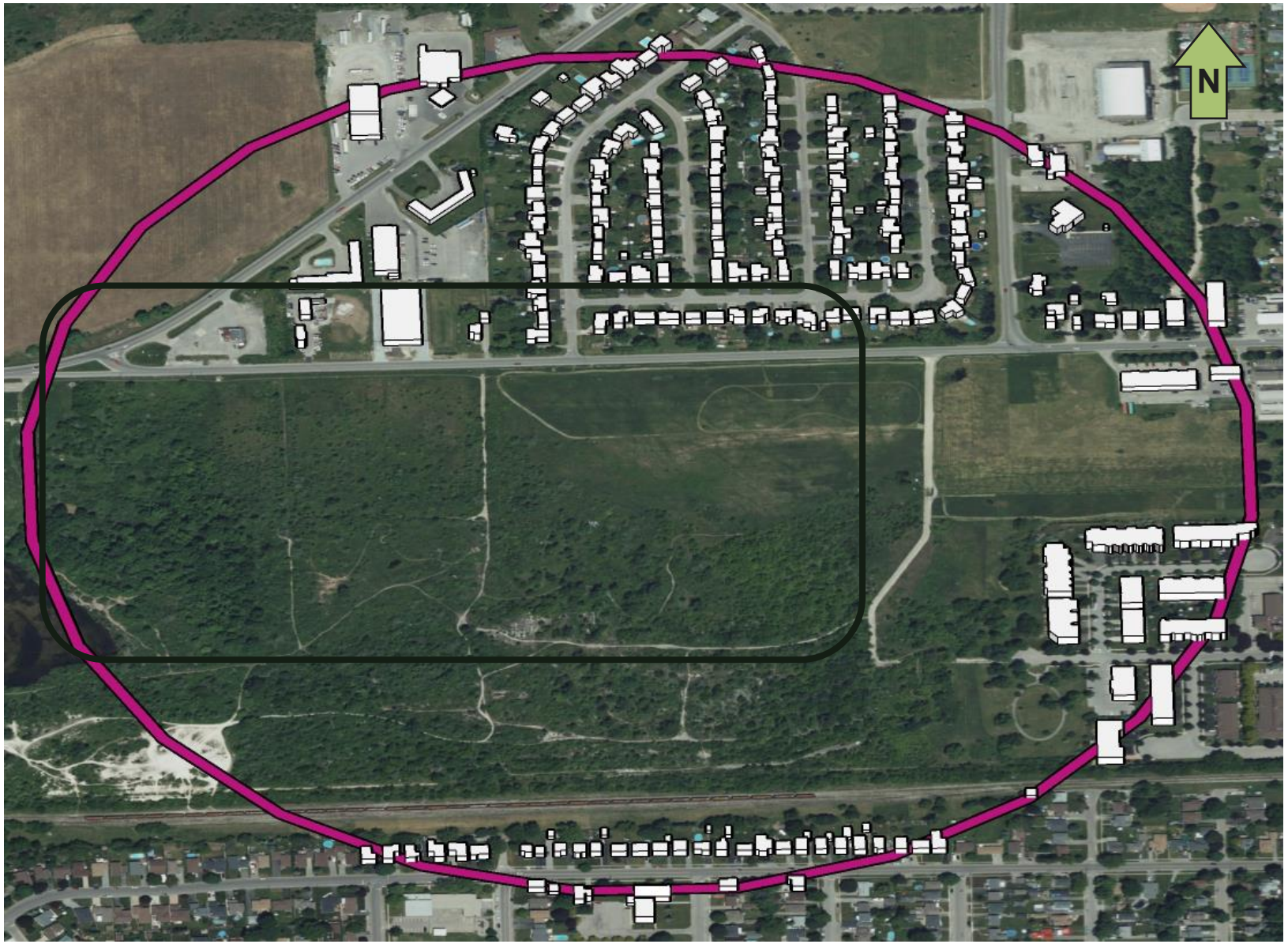

Figure 5a: Existing Configuration

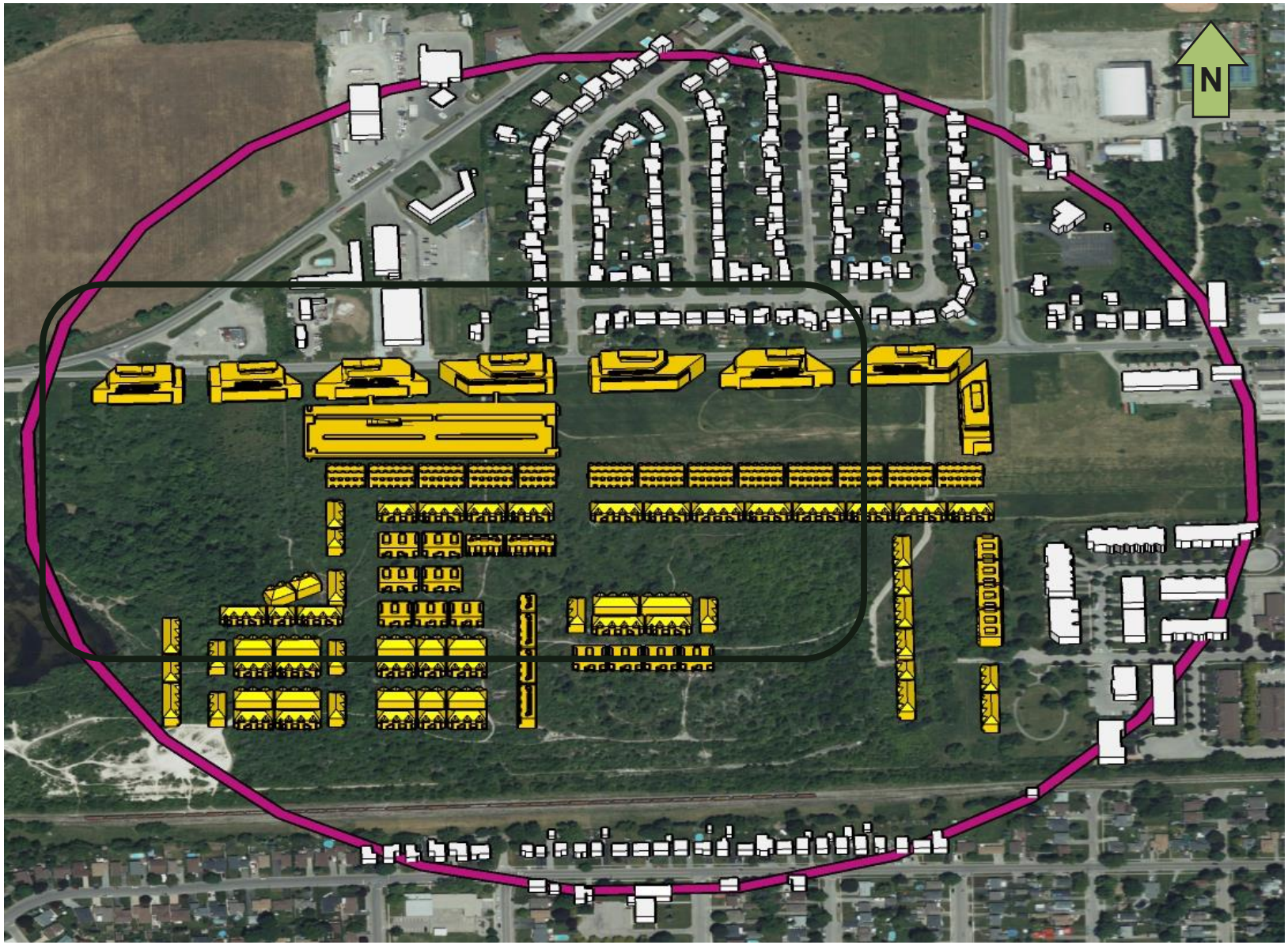

Figure 5b: Proposed Configuration

2.2 Wind Climate

Wind data recorded at Niagara Central Dorothy Rungeling Airport for the period of 2006 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 6.** 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 south through west 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 6** 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 west and west-northwest directions. All wind speeds and directions were included in the wind climate model.

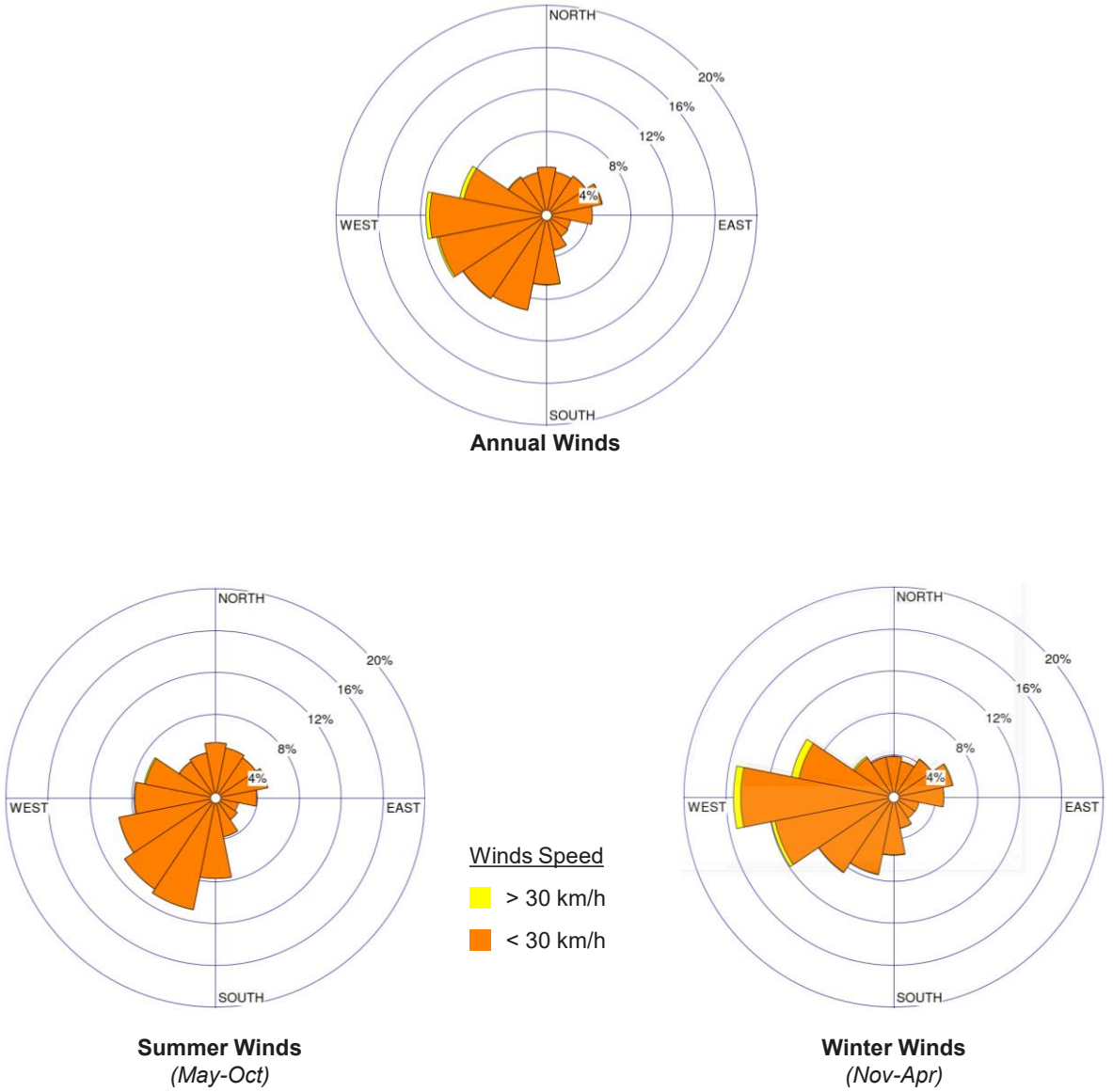

Figure 6: Wind roses for Niagara Central Dorothy Rungeling Airport (2006-2020)

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 GEM wind speeds being exceeded 20% of the time, are summarized in Table 1. By allowing for a 20% exceedance, it assumes wind speeds will be comfortable for the corresponding activity at least four out of five days. The comfort criteria consider only daytime hours, between 6:00am and 11:00pm. GEM is defined as the maximum of either mean wind speed or gust wind speed divided by 1.85.

The criterion for wind safety in the table is based on hourly gust wind speeds that are exceeded nine hours per year (approximately 0.1% of the time). When the criterion is exceeded, wind mitigation measures are advised. The wind safety criterion is shown in Table 2.

These criteria are based on the *Pedestrian Level Wind Study Terms of Reference Guide* of the Niagara Region, which came into effect in July 2022.

Table 1: Wind Comfort Criteria

Comfort Category	GEM Wind Speed Exceeded 20% of the time	Description of Wind Comfort
Sitting	≤ 10 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	≤ 15 km/h	Gentle breezes suitable for main building entrances and bus stops.
Walking	≤ 20 km/h	Moderate breezes that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	> 20 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	Gust Wind Speed Exceeded Once Per Year (0.1%)	Description of Wind Effects
Exceeded	> 90 km/h	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

4.0 Results

Figures 7a through **10b** 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. 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 A** 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 comfort suitable for walking are desirable year-round but may not be feasible in the winter. 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 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 on-site wind conditions are expected to be comfortable for sitting year-round (**Figures 7a and 8a**).

In the Proposed Configuration, on-site wind conditions, including in the amenity space to the south of Buildings 1 and 2, are predicted to be comfortable for sitting or standing throughout the year (**Figures 7b, 8b and 9a, 9b**). These wind conditions are considered suitable for the intended use.

4.2 Amenity Terrace

In the outdoor amenity area on the roof of the parking garage (Level 2), wind conditions are predicted to be comfortable for sitting or standing throughout the year (**Figures 10a** and **10b**), which is considered suitable for an outdoor terrace intended for passive use.

4.3 Surrounding Sidewalks

Existing wind conditions along the sidewalks of Killaly Street West, Main Street West and Sheba Crescent, as well as at the nearby transit stop along Killaly Street West, are expected to be suitable for sitting year-round (**Figures 7a** and **8a**).

With the proposed development in place, wind conditions are predicted to be suitable for sitting or standing throughout the year on the surrounding sidewalks, including the transit stop along Killaly Street West (**Figures 7b** and **8b**). These wind conditions are satisfactory for the anticipated use.

4.4 Wind Safety

The wind safety criterion is expected to be met in all on-site and off-site areas for both the Existing Configuration and Proposed Configuration on an annual basis (**Appendix A**).

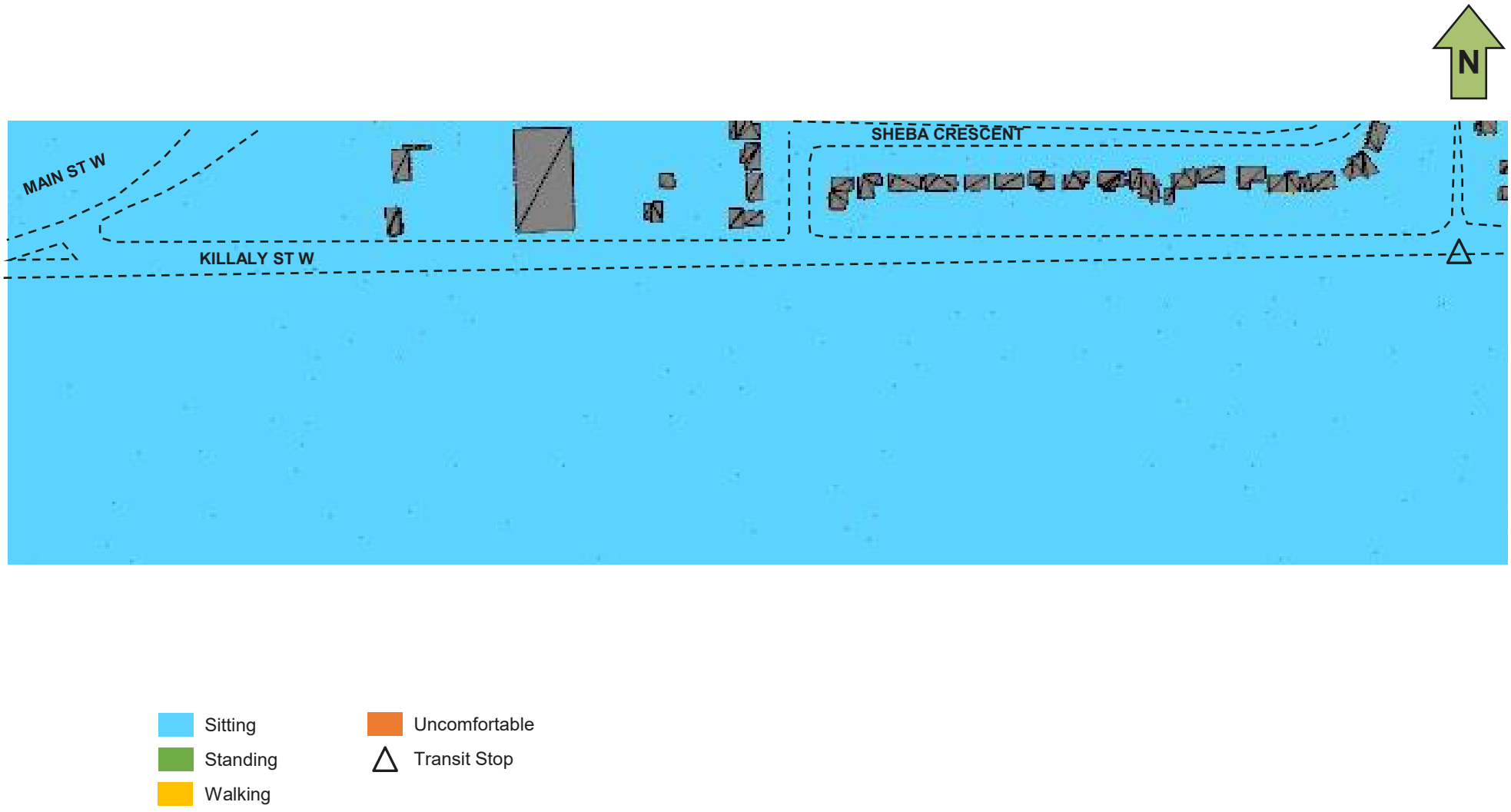

Figure 7a: Existing Configuration – Pedestrian Wind Comfort: Summer – On-site & Surrounding Areas

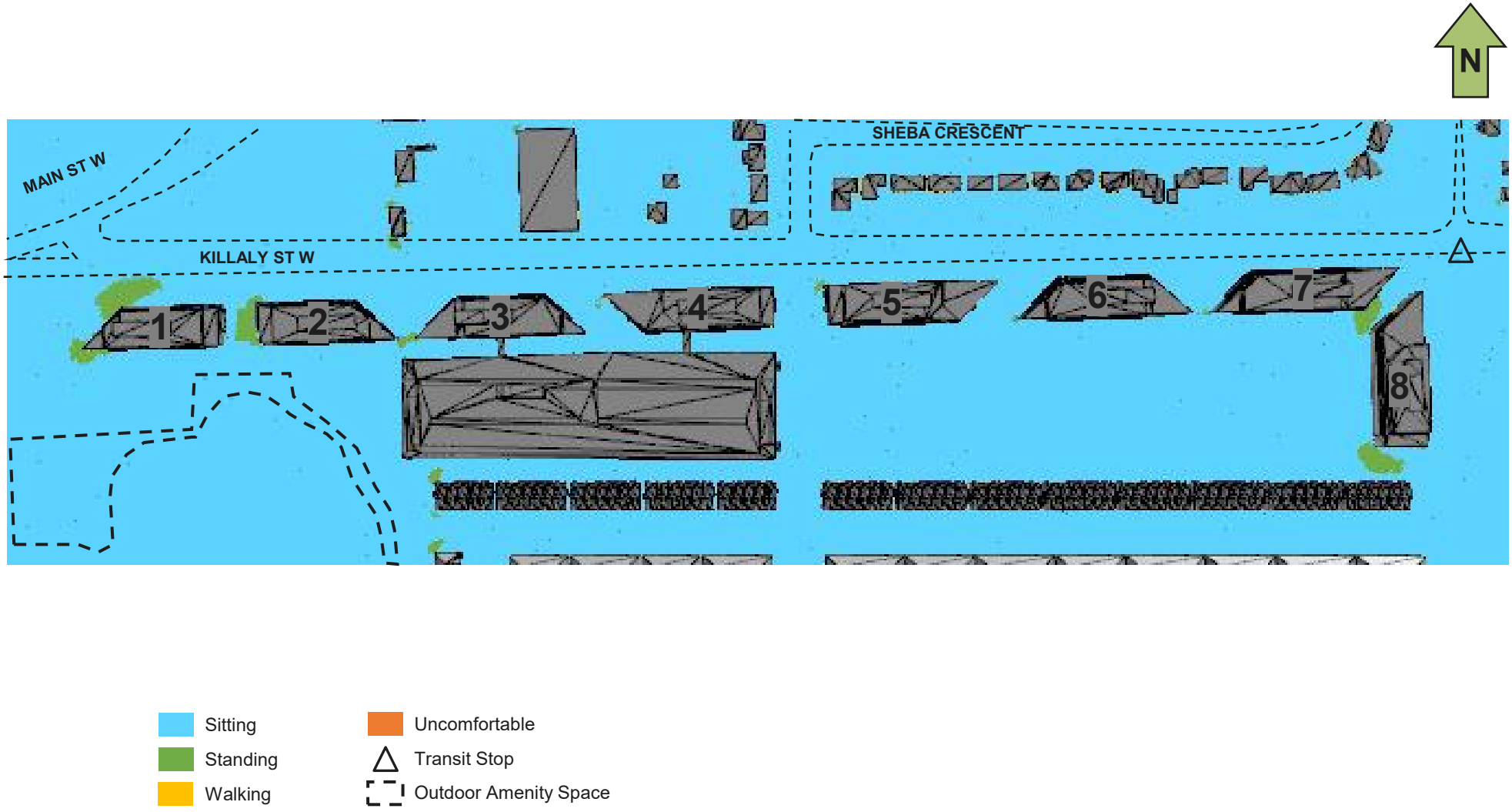

Figure 7b: Proposed Configuration – Pedestrian Wind Comfort: Summer – On-site & Surrounding Areas

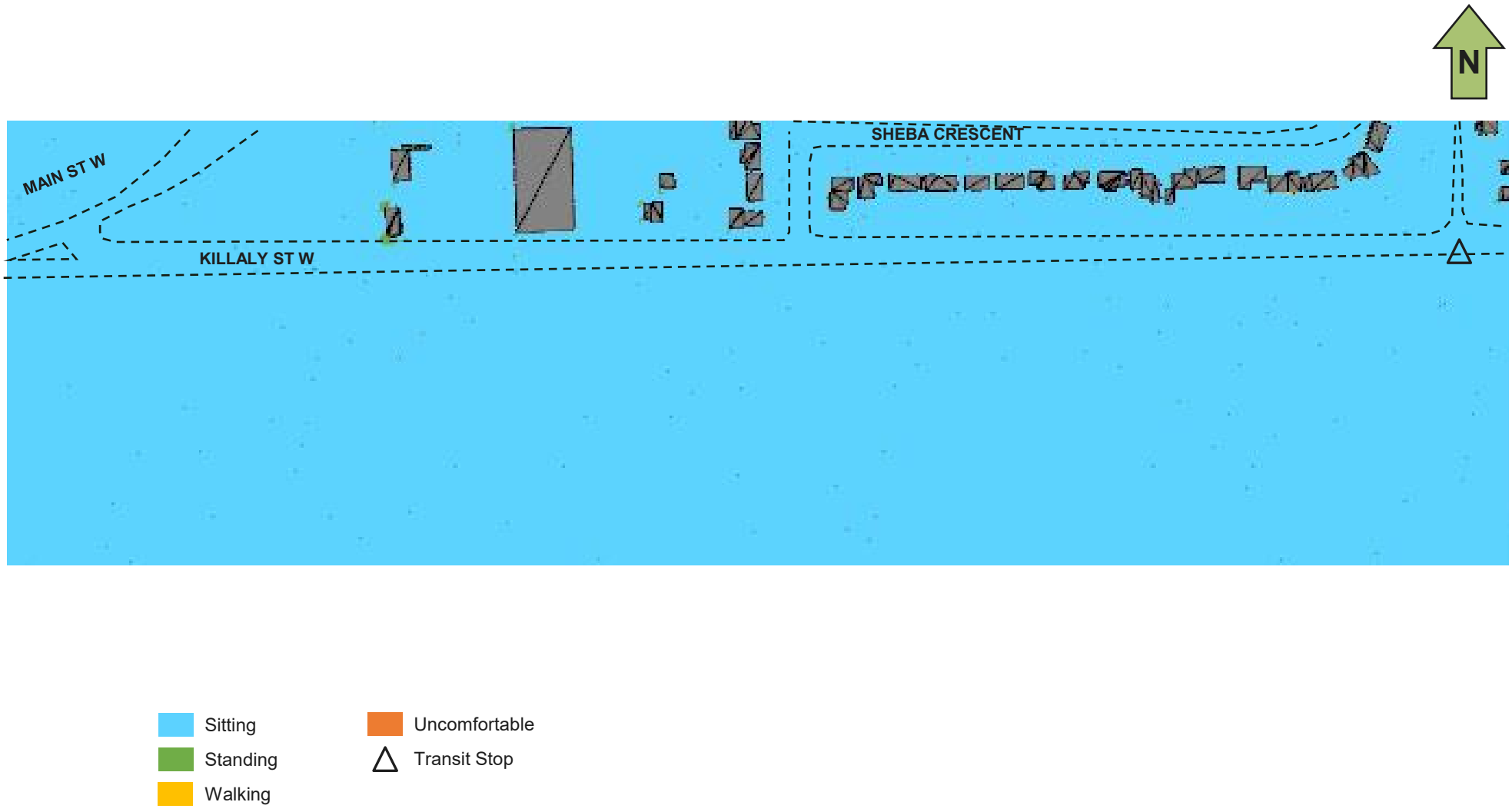

Figure 8a: Existing Configuration – Pedestrian Wind Comfort: Winter – On-site & Surrounding Areas

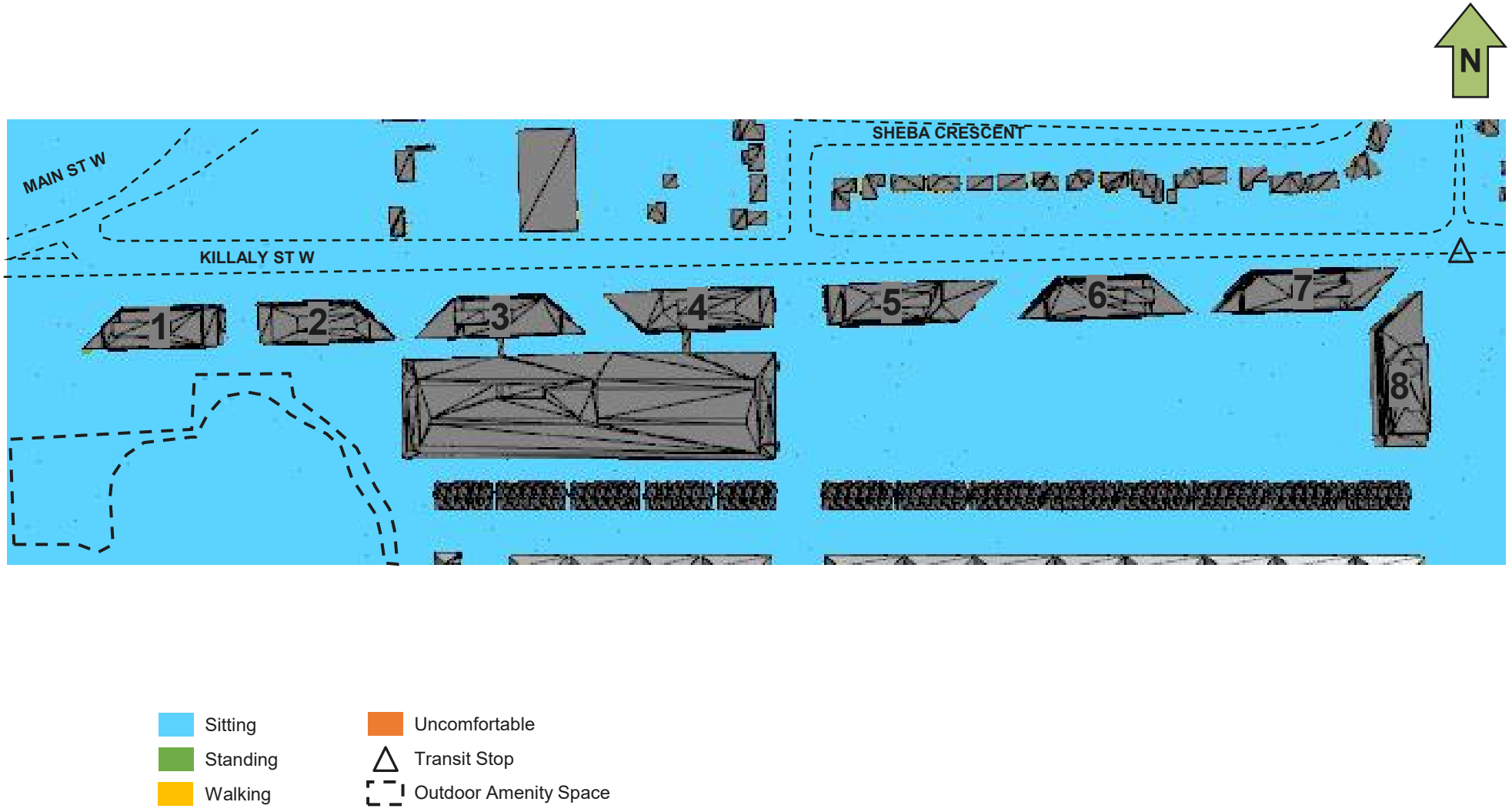

Figure 8b: Proposed Configuration – Pedestrian Wind Comfort: Winter – On-site & Surrounding Areas

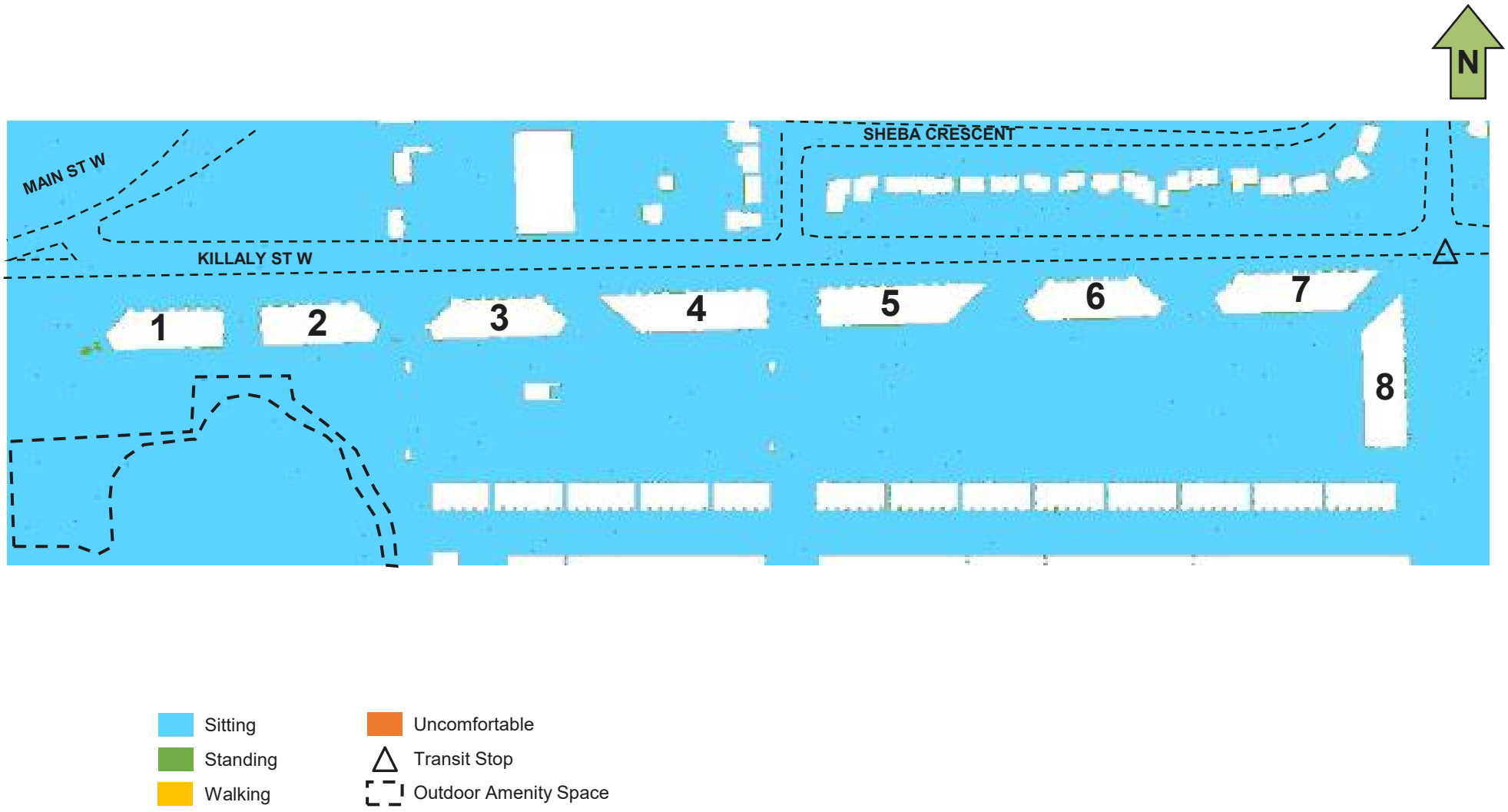

Figure 9a: Proposed Configuration – Pedestrian Wind Comfort: Summer – Building Entrances & Walkways

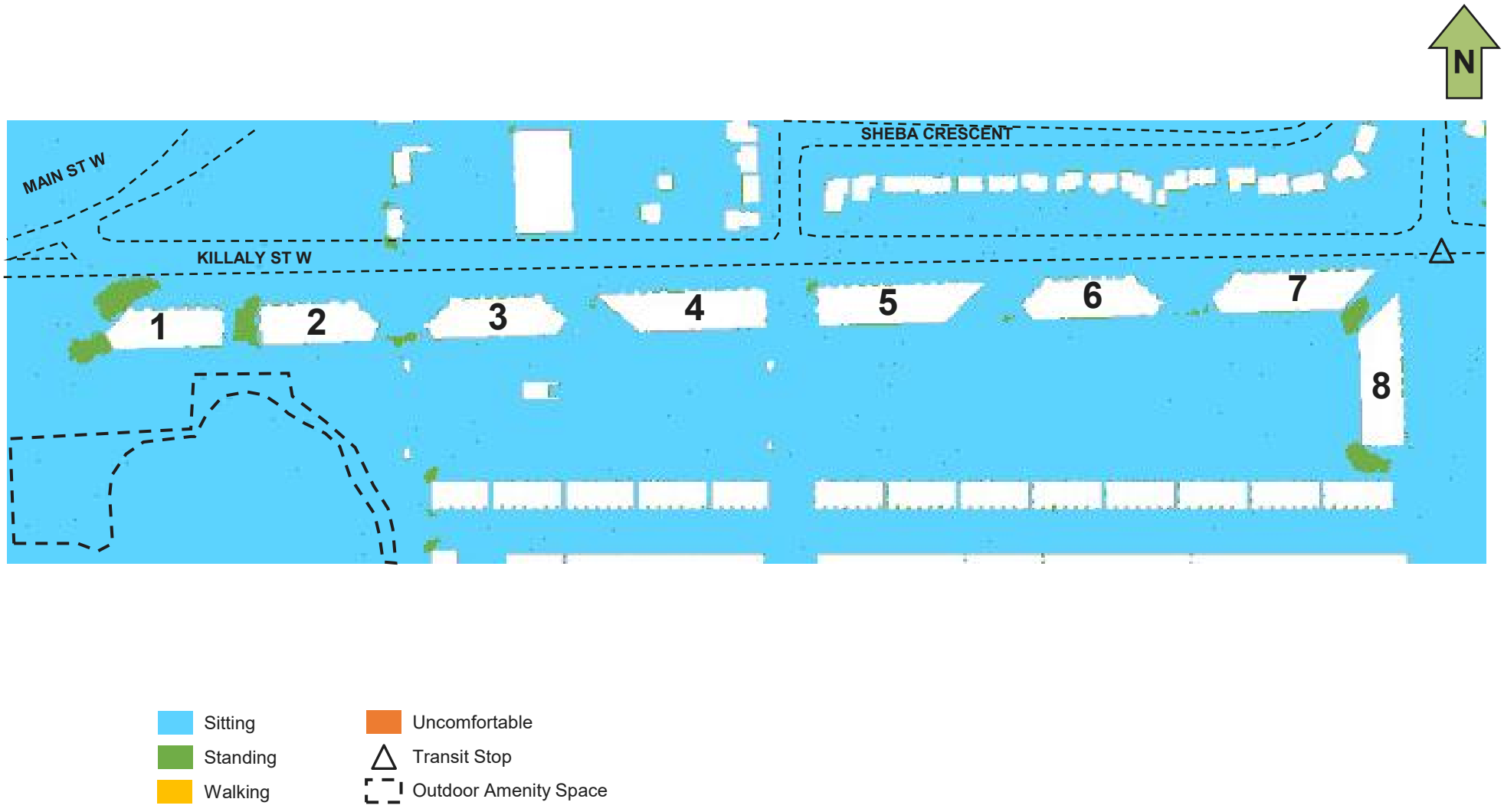

Figure 9b: Proposed Configuration – Pedestrian Wind Comfort: Winter – Building Entrances & Walkways

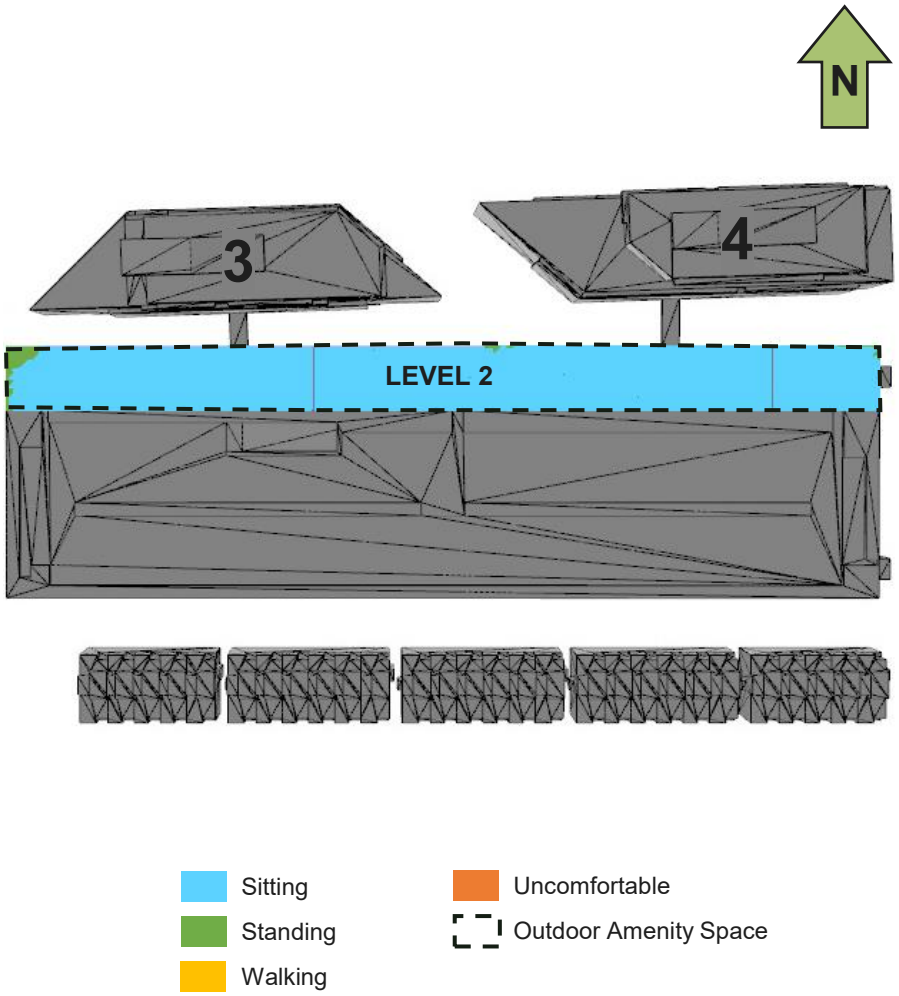

Figure 10a: Proposed Configuration – Pedestrian Wind Comfort Summer – Amenity Terrace

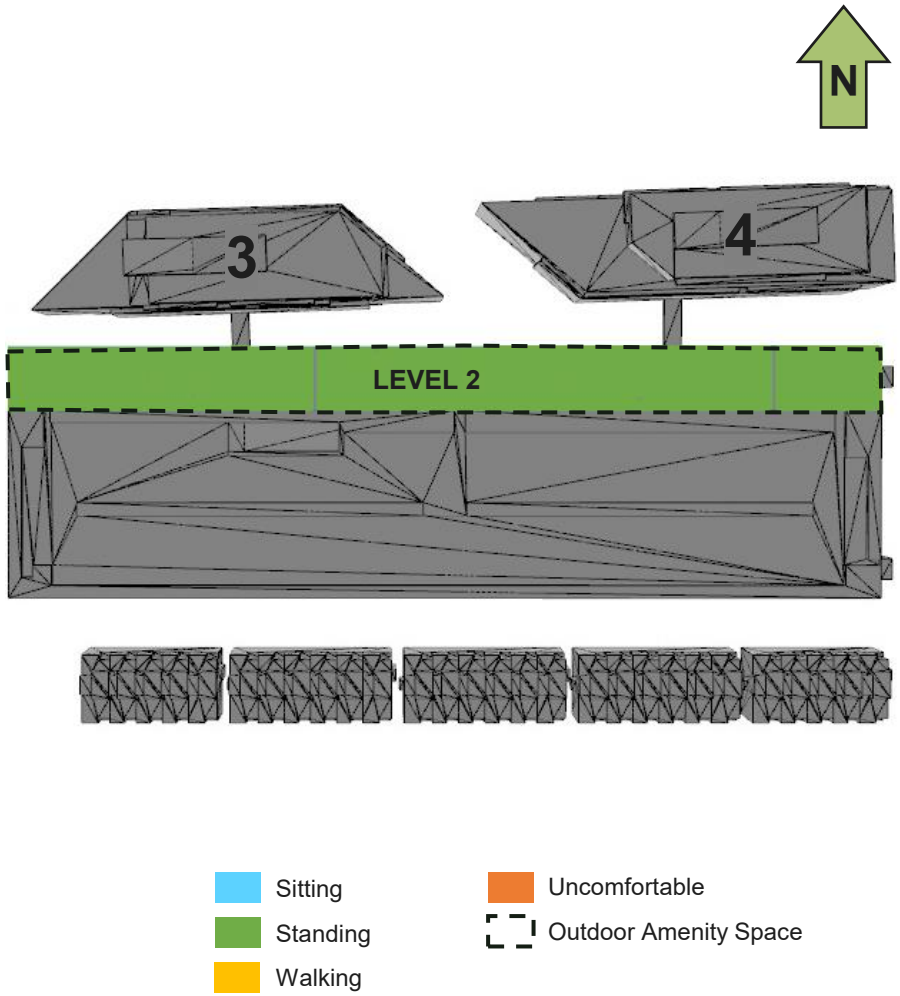

Figure 10b: Proposed Configuration – Pedestrian Wind Comfort Winter – Amenity Terrace

5.0 Conclusion & Recommendations

The pedestrian wind conditions predicted for the proposed Killaly Street West Sub-division Development in Port Colborne, have been assessed through CFD modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is met at all areas on site and immediately surrounding the development in both the Existing Configuration and Proposed Configuration.
- On-site wind conditions around proposed Buildings 1 through 8 are expected to be suitable for the intended use year-round.
- On the sidewalks surrounding the proposed development, wind conditions are suitable for the intended use.

6.0 Limitations of Liability

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7.0 References

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Appendix A

Pedestrian Wind Safety Analysis
Annual

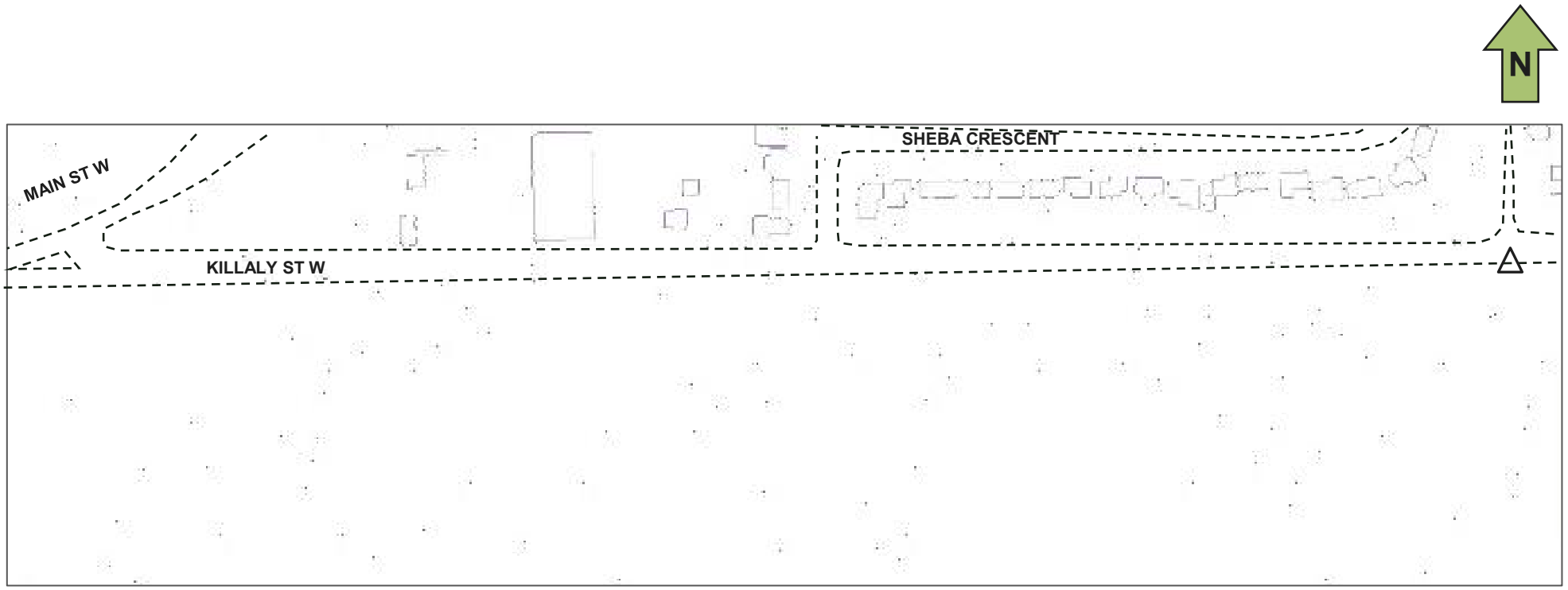

Figure A1a: Existing Configuration – Wind Safety: Annual – On-site & Surrounding Areas

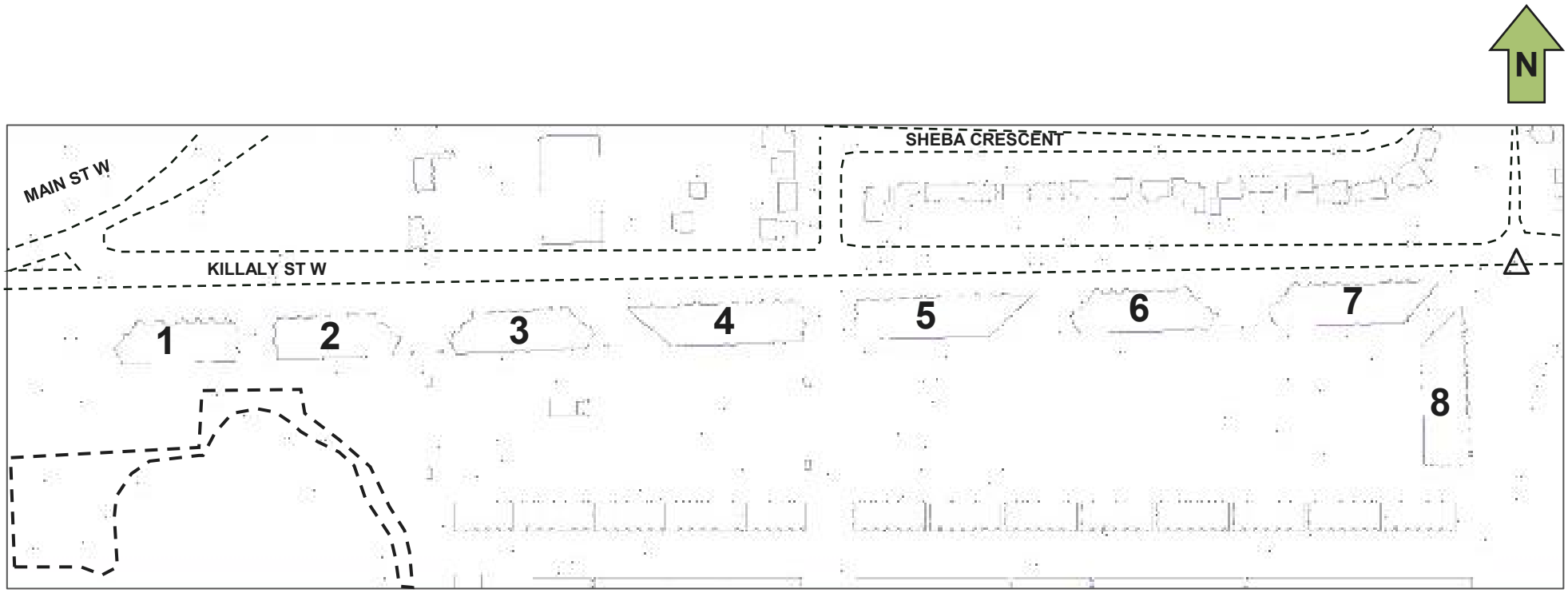

Figure A2a: Existing Configuration – Wind Safety: Annual – On-site & Surrounding Areas

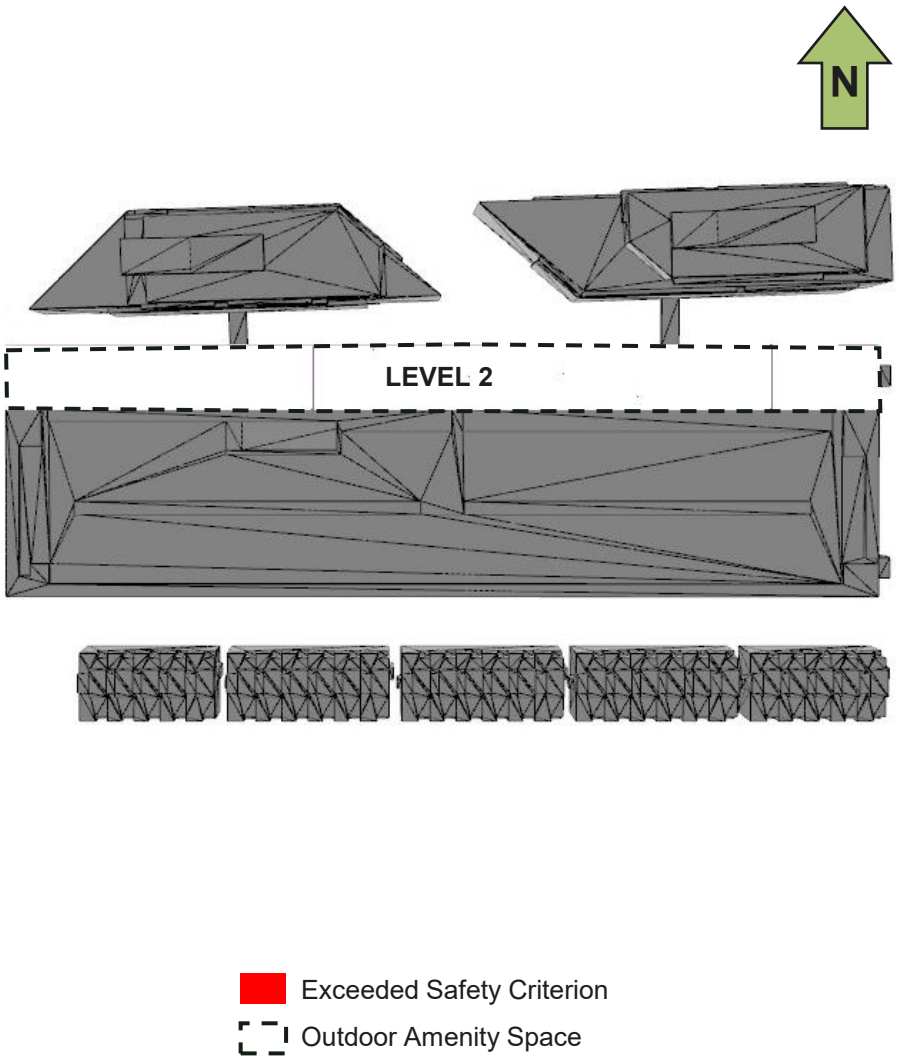

Figure A2b: Proposed Configuration – Wind Safety Annual – Amenity Terrace