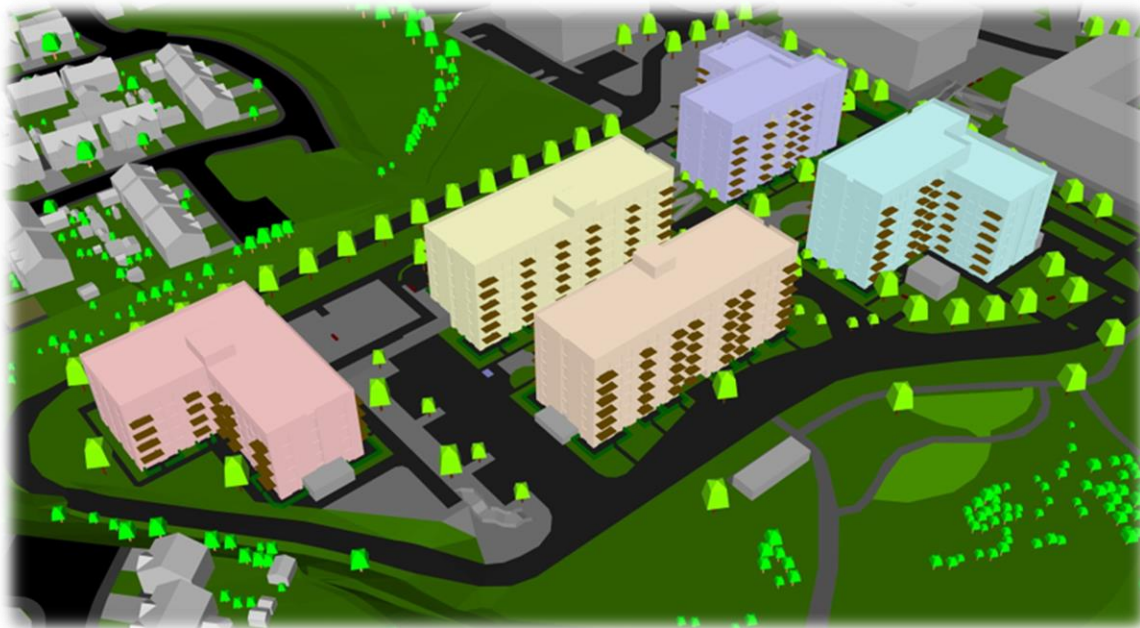




Parkway Valley, Limerick

Wind Microclimate Study



Report For: Kirkland Investments Ltd.

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1 Introduction and Methodology

IES Consulting have been commissioned to study the impact of wind around the proposed Parkway Valley development located in Limerick, Ireland. The analysis will focus on the balconies of blocks A, B, C, D and E and amenities around the site.

The analysis will use the Lawson Criteria as a reference to assess the wind effects. It is an industry-standard approach, and that is the most widely used reference for assessing pedestrian comfort. It considers the air speed at the location as well as the frequency of its occurrence. It consists of two assessment criteria:

1. The first criteria assess whether the air movement will be comfortable for the pedestrian for different types of activities.
2. The second criteria assess the feeling of safety or distress by the pedestrian at higher air speeds.

The following simulation report describes the modelling methodology used in the study, including the assumptions made and the calculations used to determine the boundary conditions and the results obtained from the simulations.



2 Executive Summary

In summary, the analysis resulted in the following:

1. Sitting and Standing Comfort Criteria
 - a. Balcony Spaces: excellent compliance – No further mitigation required
 - b. Ground Amenities: Good compliance – No further mitigation required
2. Walking Comfort Criteria: excellent compliance – No further mitigation required.
3. Safety Criteria: excellent compliance with Lawson's Normal and Sensitive Pedestrian Safety Criteria.

3 Key Findings

For this analysis, 8 steady-state Computational Fluid Dynamics (CFD) simulations were performed for the main wind directions (N, NE, E, SE, S, SW, W, and NW), and the annual average wind speed was obtained from the Limerick weather dataset. The simulation results were extrapolated from annual weather data to obtain the most probable local airspeed for each hour of the year. A statistical analysis was performed on this dataset to check compliance against Lawson's Pedestrian Comfort criterion.

The following table provides values for Lawson's Pedestrian Comfort Assessment criteria for various activities.

Category	Pedestrian Activity	Threshold mean hourly wind speed not to be exceeded for more than 5% of the time (m/s)
C1	Business Walking	10
C2	Leisurely Walking	8
C3	Standing	6
C4	Sitting	4

Table 1: Lawson's Pedestrian Comfort Assessment Criteria for various activities

The following table provides values for Lawson's Pedestrian Safety Assessment criteria.

Category	Pedestrian Type	Threshold mean hourly wind speed not to be exceeded more than once per annum (m/s)
S1	Typical Pedestrian	20
S2	Sensitive Pedestrian	15

Table 2: Lawson's Pedestrian Safety Assessment Criteria

The results are presented as false-colour contour images showing the percentage of the year during which the local air speed is likely to exceed a given value at each location of interest. The air speed threshold value is noted in the title of the colour legend within the top left corner of each image. Note that the scale for the comfort criterion results ranges from 0.1% to 100% (as a percentage of the year). This is with reference to Table 1 above. The scale for the safety-criteria result images ranges from 0.001% to 1% (as a percentage of the year). This is with reference to Table 2 above.

The median wind speed recorded was more than 5 m/s for Limerick's climatic conditions. That means that for 50% of the year, the wind speed in Limerick is higher than 5 m/s. The Lawson's Sitting Criterion requires the local air speed to be no more than 4m/s for 95% of the year. Thus, the Lawson's Sitting Criterion presents the task of improving 10 times over the climatic conditions at the location of interest within Limerick. This can be achieved through appropriate landscaping and wind-mitigation measures.

3.1 Collective Results

[Figure 1](#) shows the collective results for wind comfort at the 5% threshold, as noted above. These results were summed to calculate the total number of hours in which a given pedestrian activity class exceeds the 5% yearly threshold, based on the hierarchy of wind speed. [Figure 1](#) illustrates the collective results of wind comfort for the 5% threshold. These results were summed to calculate the total number of hours that a given pedestrian activity class exceeds the 5% yearly threshold. The sitting comfort indicates that the wind speed was lower than 4m/s, while the rest of the classes were above this threshold. It is worth noting that when a space is classified under a certain activity class, it will also meet the requirements of all activity classes above it in the hierarchy scale. For example, if a space is comfortable for sitting, it will also be comfortable for standing and walking.



Figure 1: Collective Results: 5% Threshold

The following areas show good compliance with Lawson's Sitting and Standing Comfort Criteria:

- Amenity around Block E.
- Basketball Court and Outdoor amenities towards the north of Block E.
- Between Block C and D.
- Green corridor.
- Between block A & B.
- Creche play area and children's playground.
- Community gardens.
- Plaza and public realm.
- Amenities around the medical buildings.
- Proposed seating towards the west of Block D.

The entire site showed excellent compliance with the Walking activities. No location exhibited completely uncomfortable conditions anywhere around the site at 5% threshold limits.

It is worth noting that a pedestrian activity class is merely a statistical assessment of the local wind climate. When a region is classified as a certain class, this does not mean that people are prevented from engaging in that activity for a long period of time. Rather, it only means that for more than 5% of the time (per year), the wind speed for this activity could result in an uncomfortable environment. However, during the remaining times of the year, this activity can be considered comfortable.

3.2 Sitting and Standing Comfort Results

The Lawson's Sitting Comfort Criterion states that the local air speed at designated locations should not exceed 4 m/s for more than 5% of the year. The Lawson's Standing Comfort Criterion states that the local air speed at designated locations should not exceed 6 m/s for more than 5% of the year.

3.3 Balconies

3.3.1.1 Block A

[Figure 2](#) to [Figure 5](#) illustrate Lawson's Sitting and Standing Comfort Criteria results on the balconies of Block A.

The results showed excellent compliance and met the requirements of Lawson's Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion's requirement.

No Mitigation measures recommended.

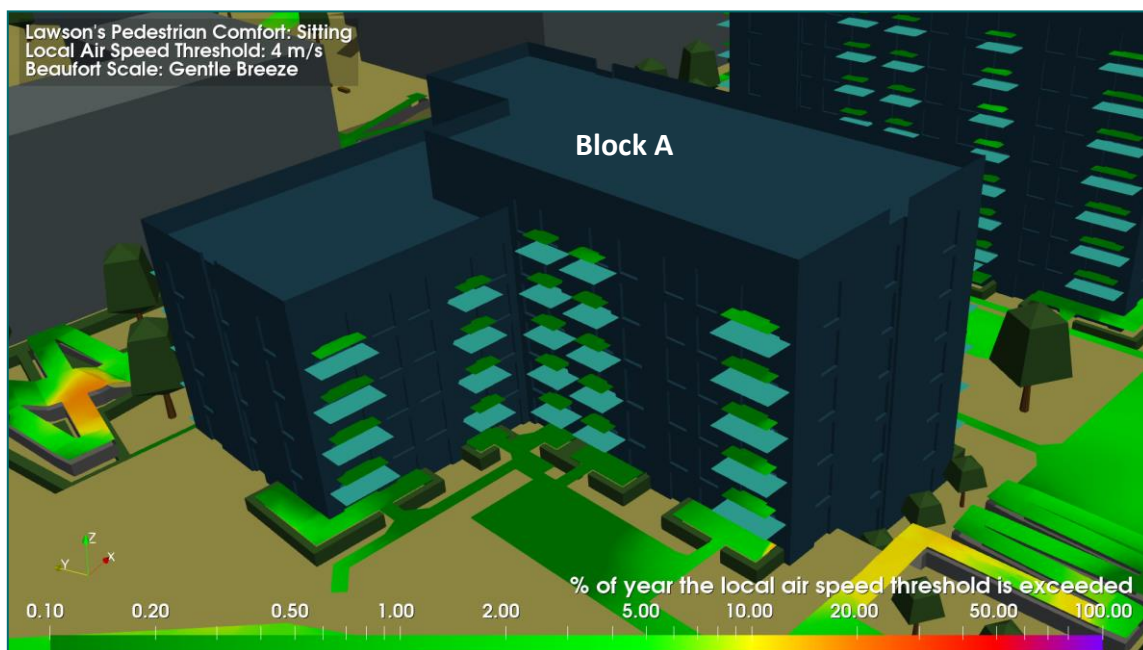


Figure 2: Sitting Comfort Criterion: Balconies: Block A: View from the southwest

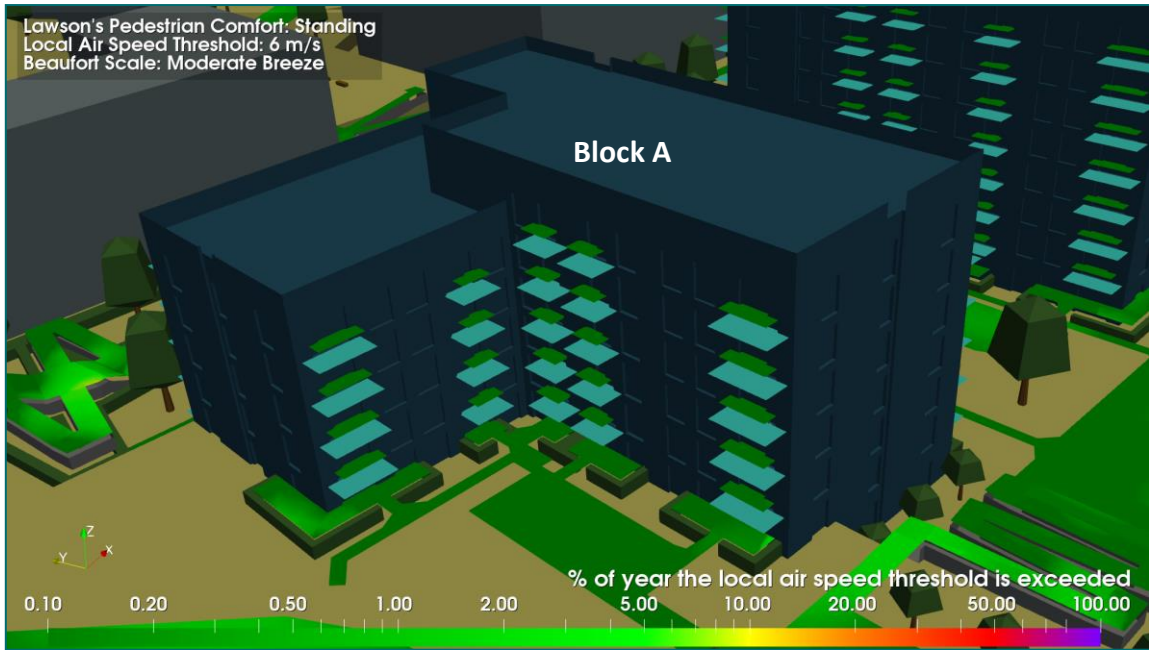


Figure 3: Standing Comfort Criterion: Balconies: Block A: View from the southwest



Figure 4: Sitting Comfort Criterion: Balconies: Block A: View from the northeast

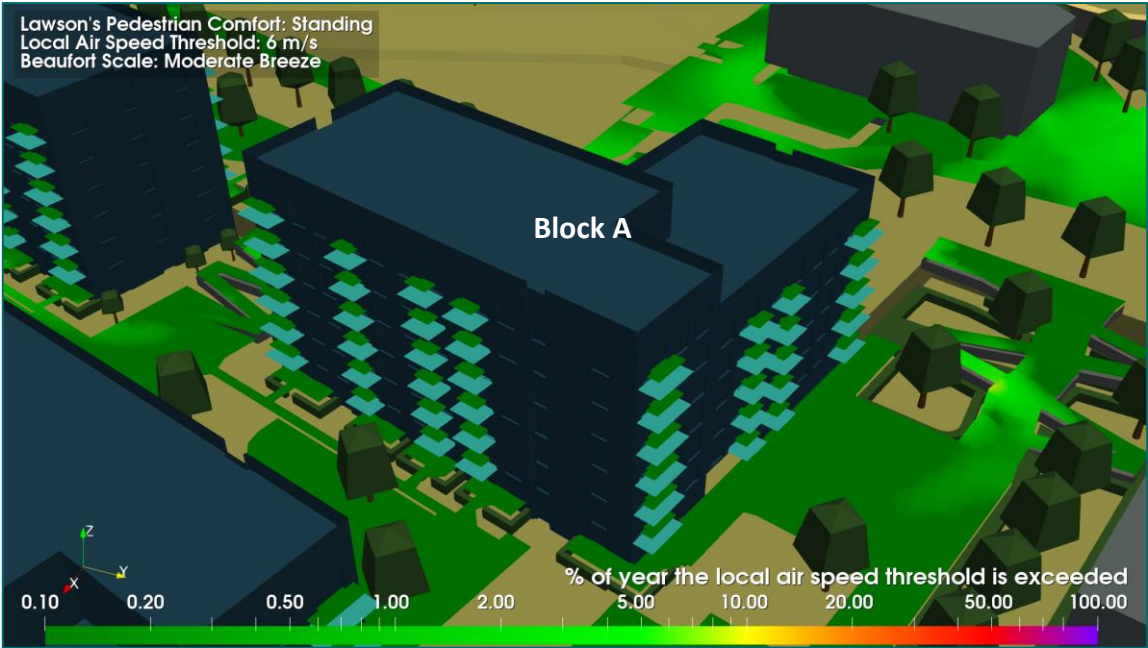


Figure 5: Standing Comfort Criterion: Balconies: Block A: View from the northeast

3.3.1.2 Block B

Figure 6 to Figure 9 illustrate Lawson’s Sitting and Standing Comfort Criteria results on the balconies of Block B.

The results showed excellent compliance and met the requirements of Lawson’s Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion’s requirement.

No mitigation measures recommended.

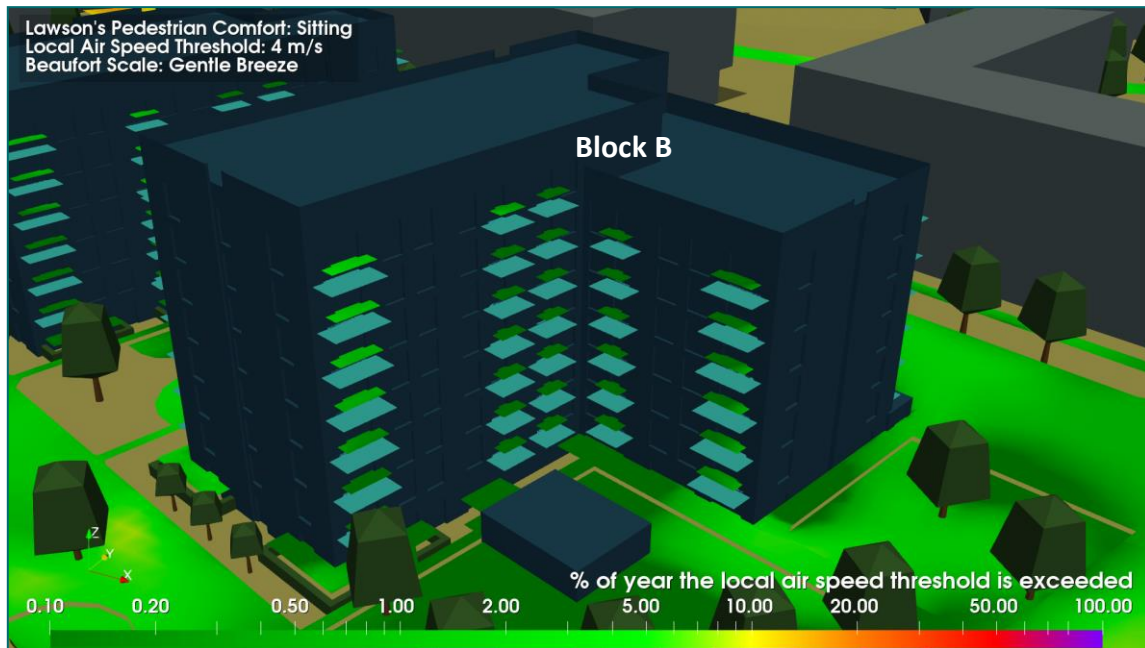


Figure 6: Sitting Comfort Criterion: Balconies: Block B: View from the southeast

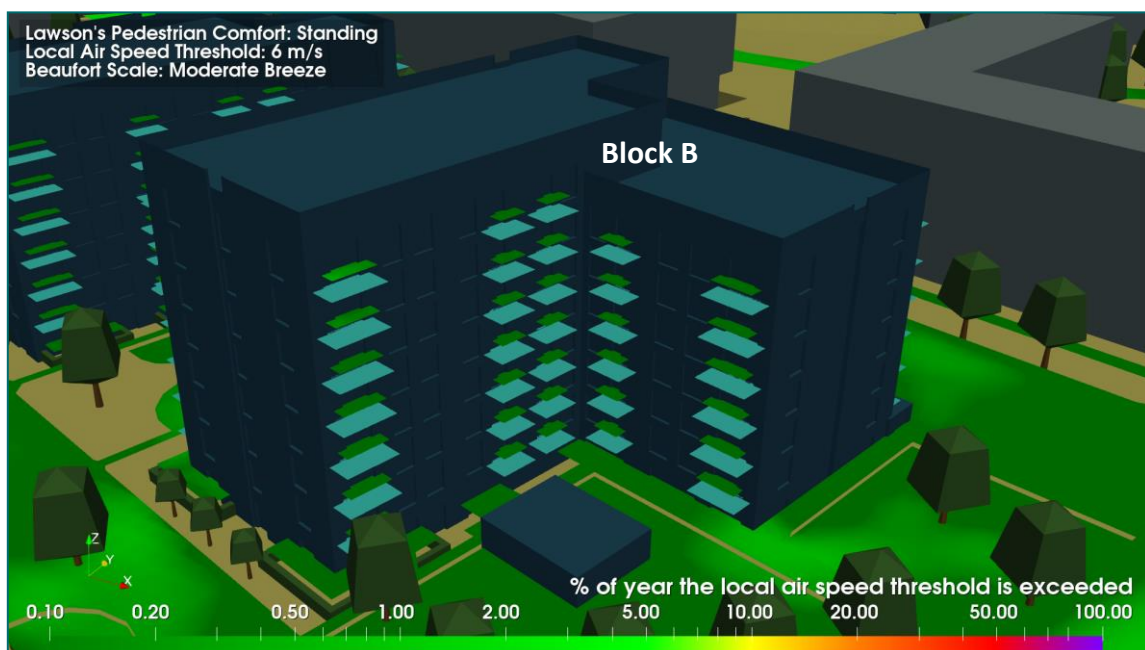


Figure 7: Standing Comfort Criterion: Balconies: Block B: View from the southeast

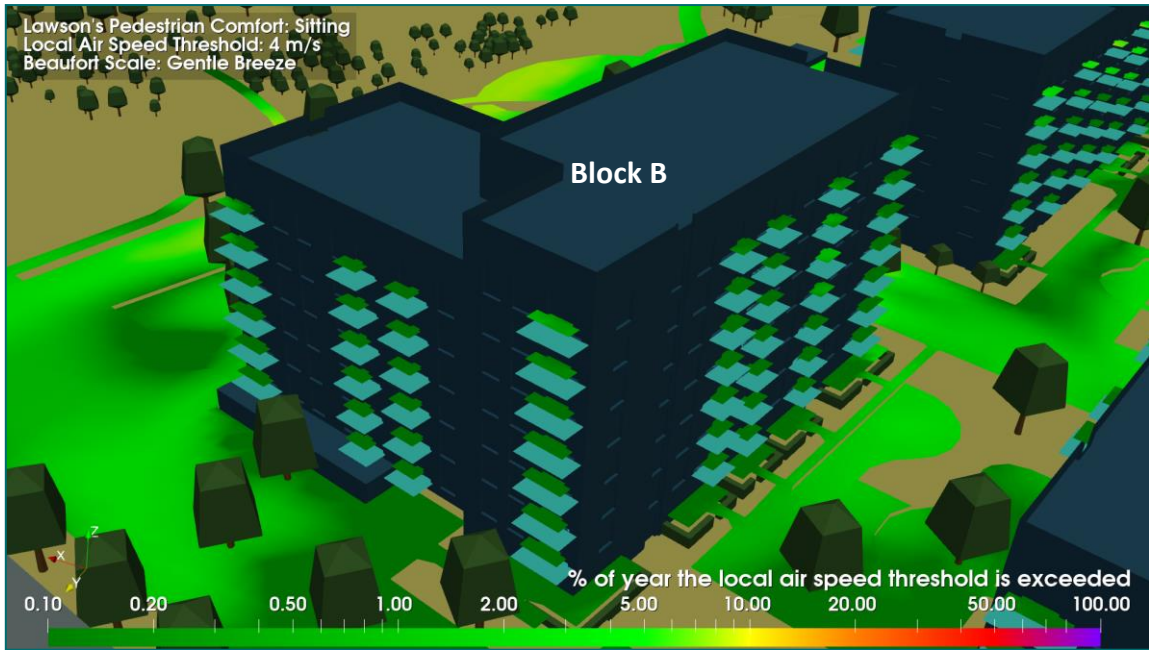


Figure 8: Sitting Comfort Criterion: Balconies: Block B: View from the northwest

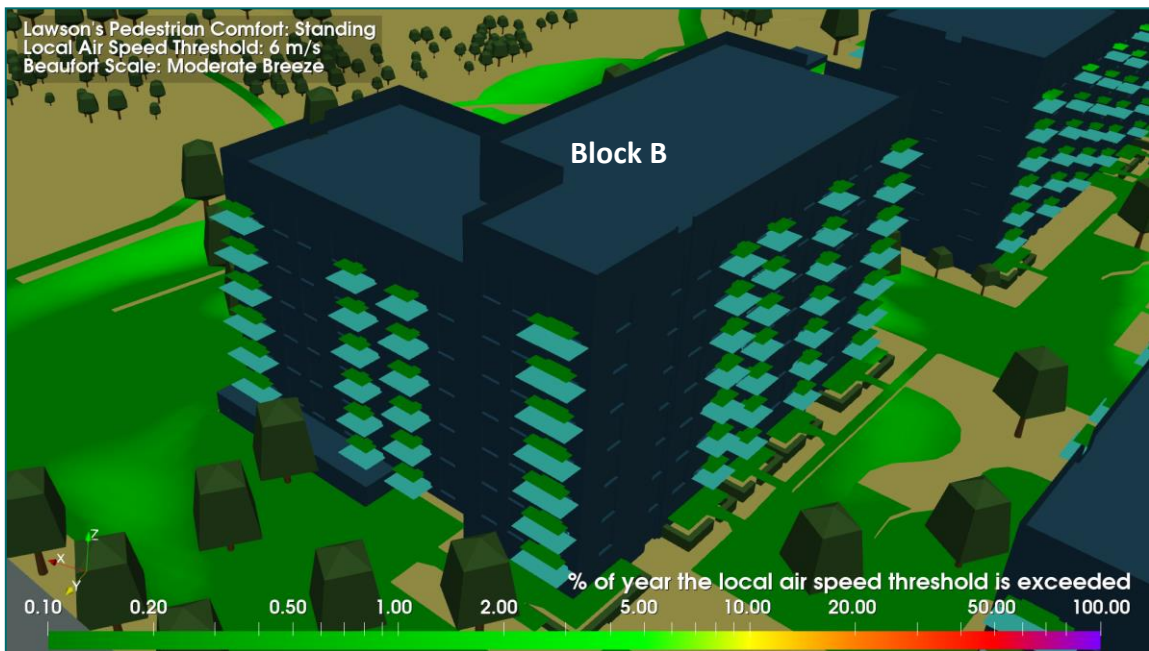


Figure 9: Standing Comfort Criterion: Balconies: Block B: View from the northwest

3.3.1.3 Block C

Figure 10 to Figure 13 illustrate Lawson’s Sitting and Standing Comfort Criteria results on the balconies of Block C.

The results showed excellent compliance and met the requirements of Lawson’s Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion’s requirement.

No Mitigation measures recommended.



Figure 10: Sitting Comfort Criterion: Balconies: Block C: View from the east



Figure 11: Standing Comfort Criterion: Balconies: Block C: View from the east

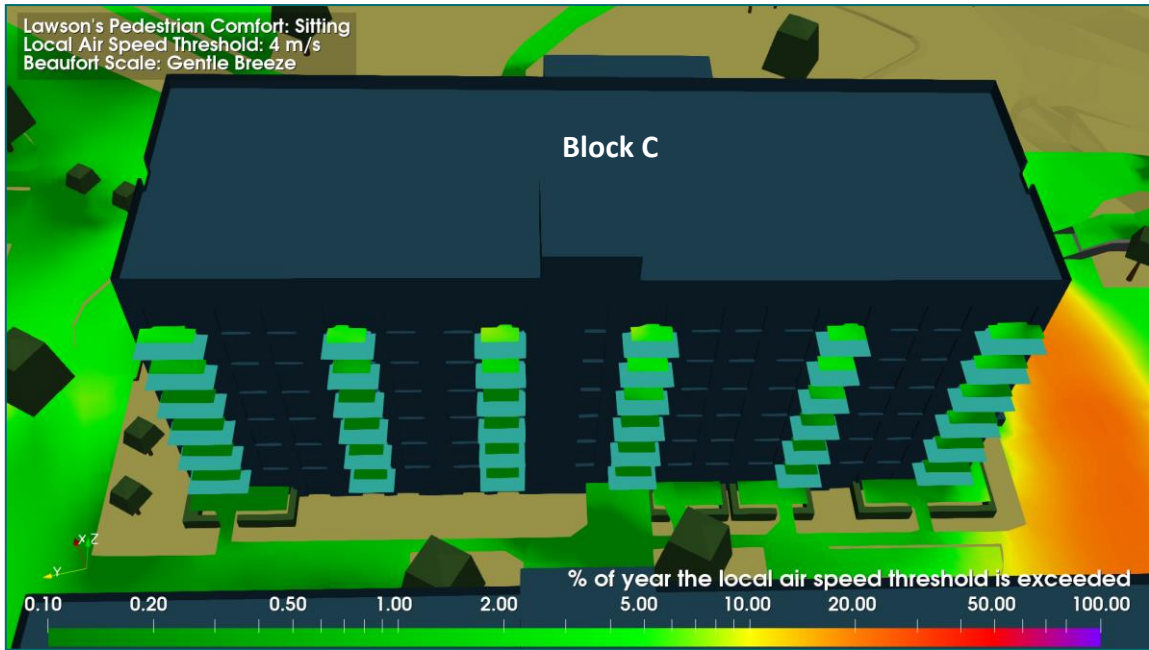


Figure 12: Sitting Comfort Criterion: Balconies: Block C: View from the west: 5% threshold

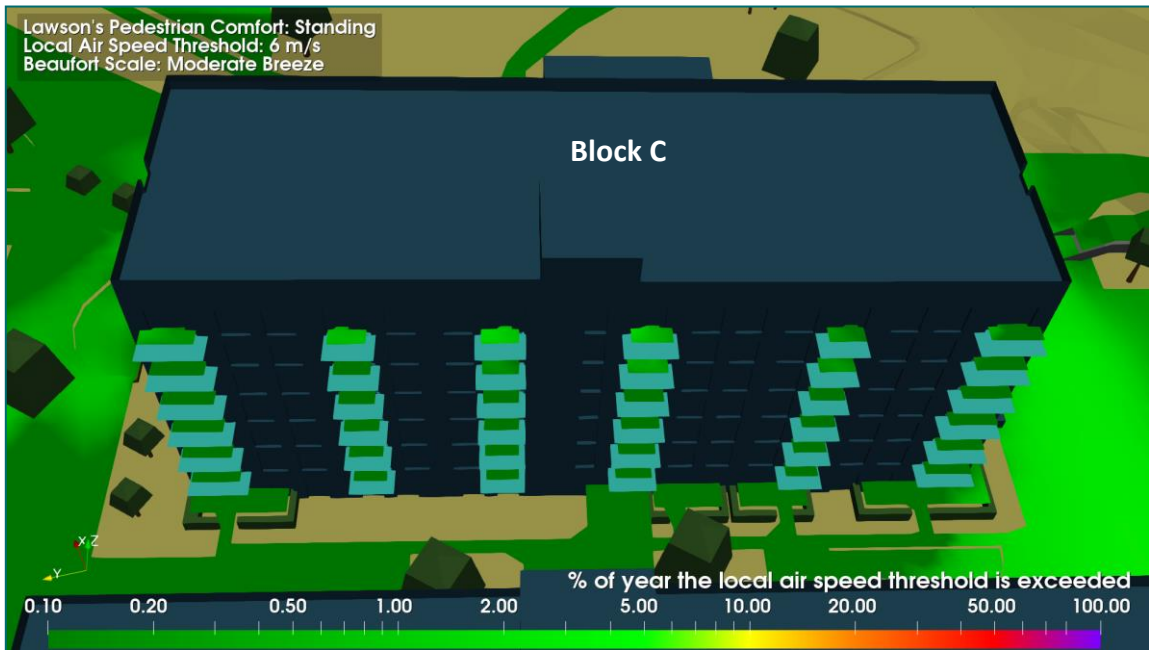


Figure 13: Standing Comfort Criterion: Balconies: Block C: View from the west

3.3.1.4 Block D

Figure 14 to Figure 17 illustrate Lawson’s Sitting and Standing Comfort Criteria results on the balconies of Block D.

The results showed excellent compliance and met the requirements of Lawson’s Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion’s requirement.

No Mitigation measures recommended.

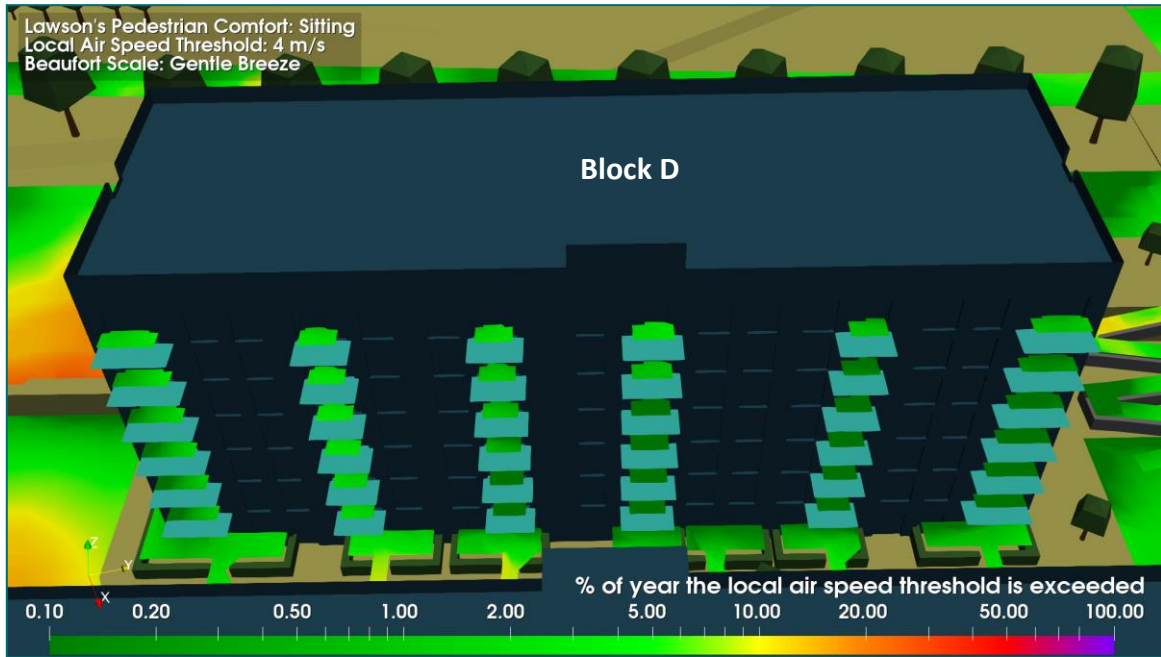


Figure 14: Sitting Comfort Criterion: Balconies: Block D: View from the east



Figure 15: Standing Comfort Criterion: Balconies: Block D: View from the east

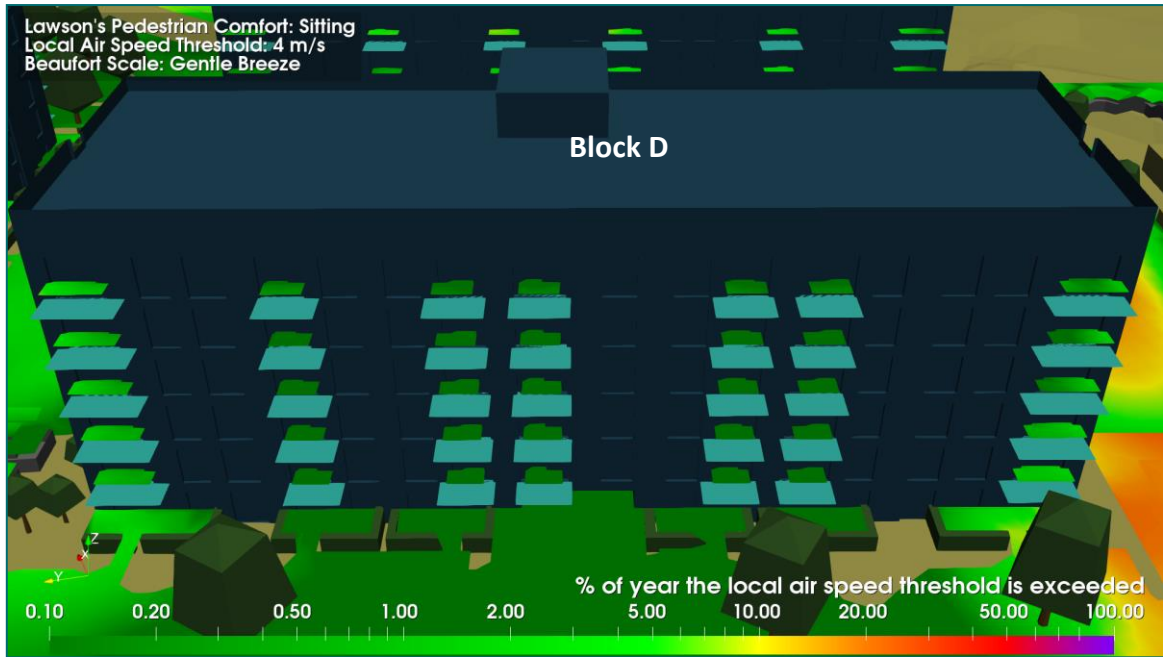


Figure 16: Sitting Comfort Criterion: Balconies: Block D: View from the west: 5% threshold

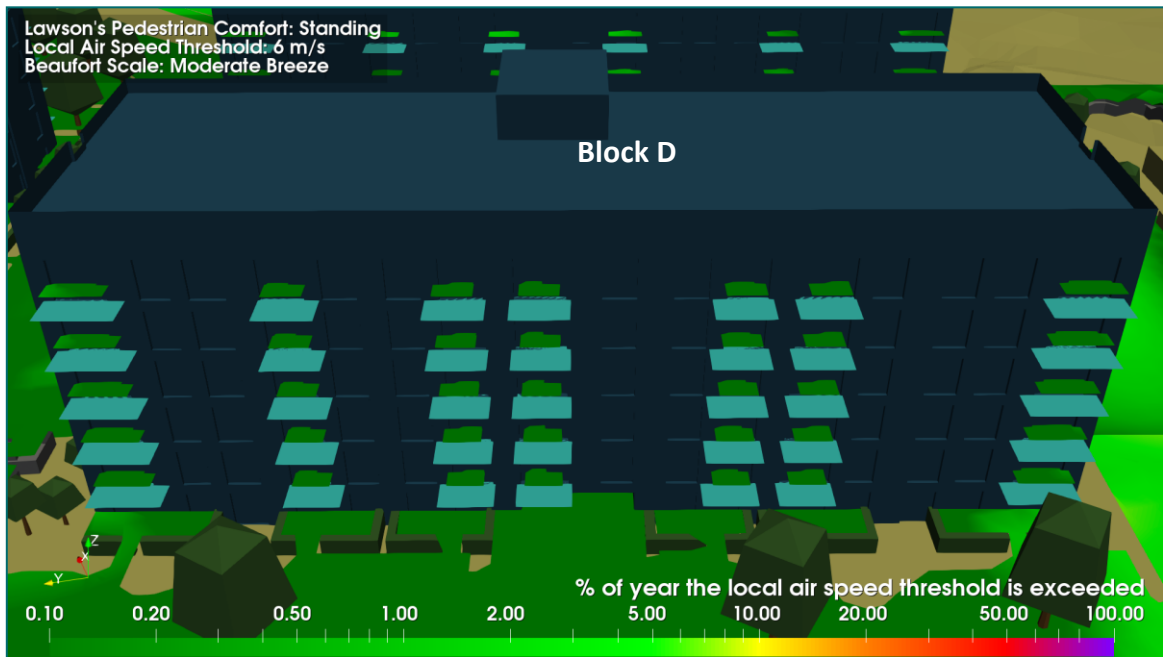


Figure 17: Standing Comfort Criterion: Balconies: Block D: View from the west

3.3.1.5 Block E

[Figure 18](#) to [Figure 21](#) illustrate Lawson's Sitting and Standing Comfort Criteria results on the balconies of Block E.

The results on the majority of the balconies showed excellent compliance and met the requirements of Lawson's Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion's requirement.

The corners of a single balconies with yellow contours have slightly exceeded the compliance with Lawson's sitting comfort for more the 5% of the year, as seen in [Figure 18](#). The local airspeed is likely to exceed 4 m/s for up to 10% of the year at these locations. The exceedance is not beyond 10% of the year These balconies were affected by the prevailing westerly and southwesterly winds.

When comparing the results for these locations to Lawson's Standing Comfort Criterion, they demonstrate excellent compliance, i.e., the local air speed does not exceed 6 m/s for more than 5% of the year (refer to [Figure 19](#)). Of the 10% of the year when the local air speed exceeds 4 m/s, most of that collective time, it does not exceed 6 m/s. The local air speed on the balconies will be less than 4 m/s for 90% of the year and between 4 and 6 m/s for 10% of the year.

Any noted exceedance can be considered marginal and will not create an unpleasant environment. The local air speed is only going to be greater than a gentle breeze, but frequently less than a moderate breeze. Such conditions are unlikely to affect the suitability of this private space for personal recreation.

No mitigation measures recommended.

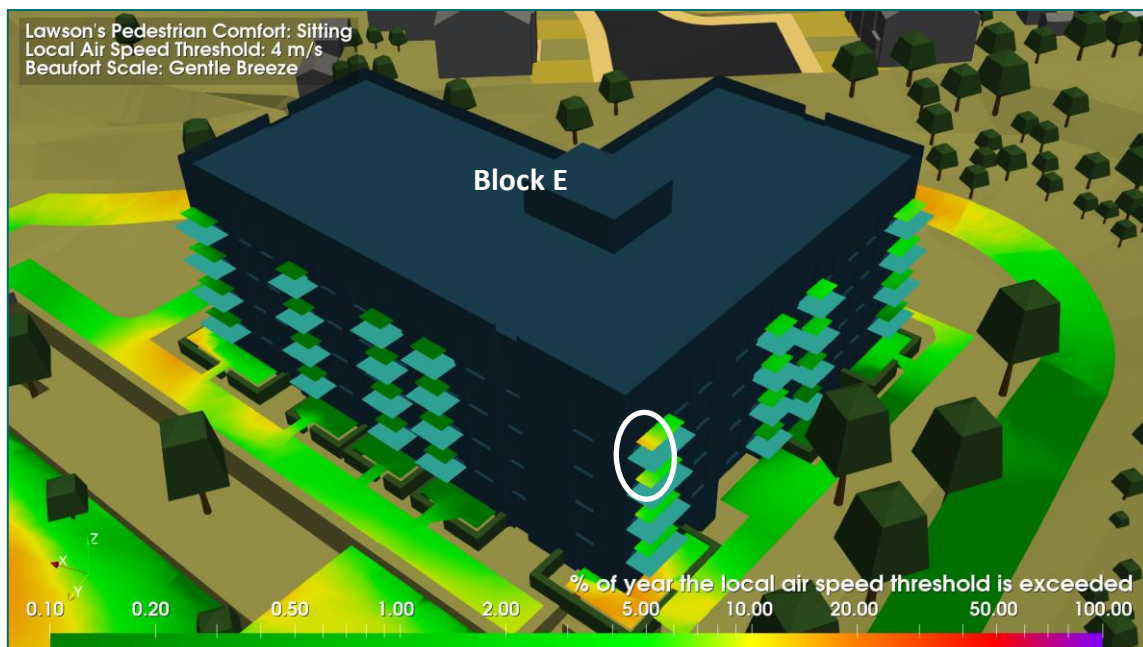


Figure 18: Sitting Comfort Criterion: Balconies: Block E: View from the northwest: 5% threshold

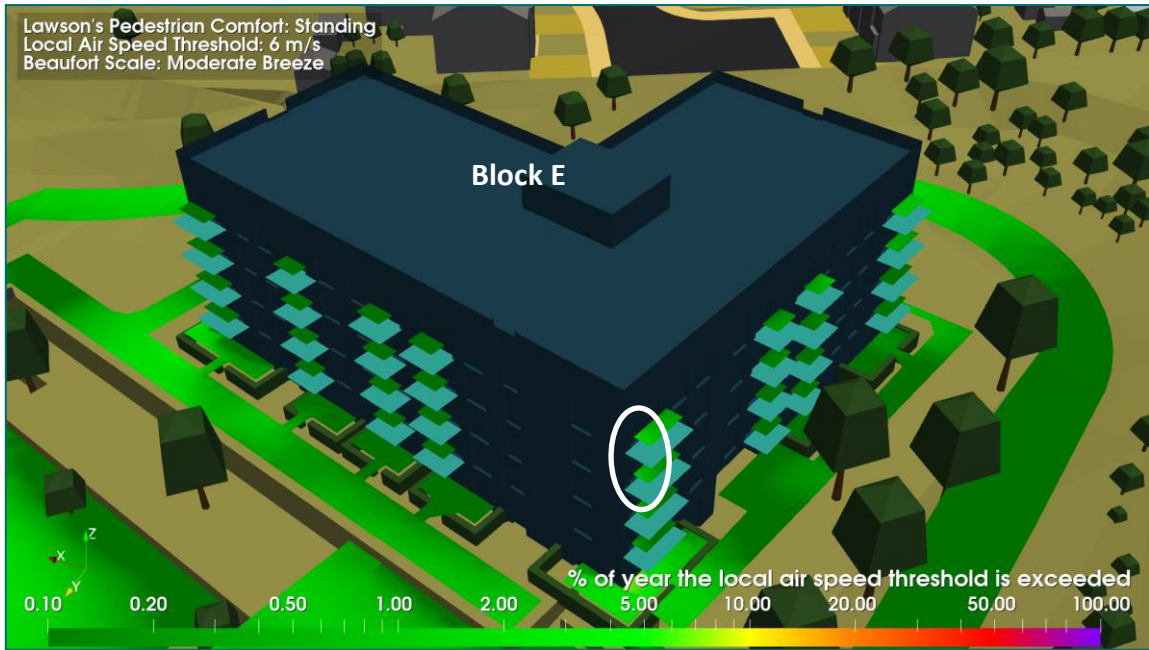


Figure 19: Sitting Comfort Criterion: Balconies: Block E: View from the northwest: 10% threshold

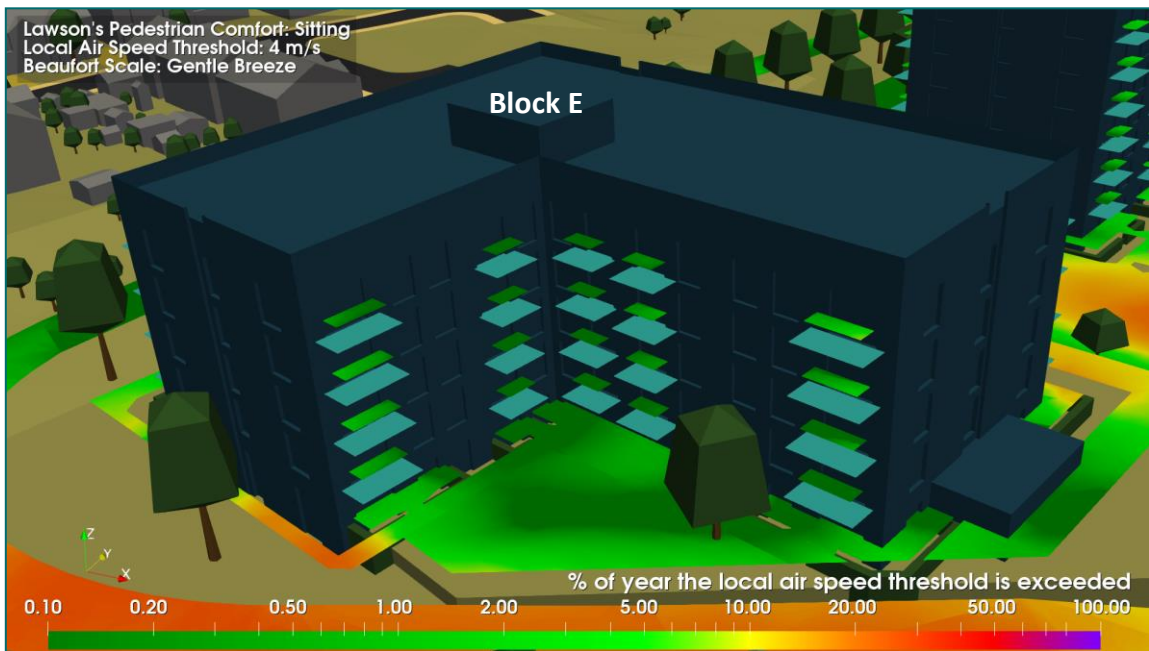


Figure 20: Standing Comfort Criterion: Balconies: Block E: View from the northwest

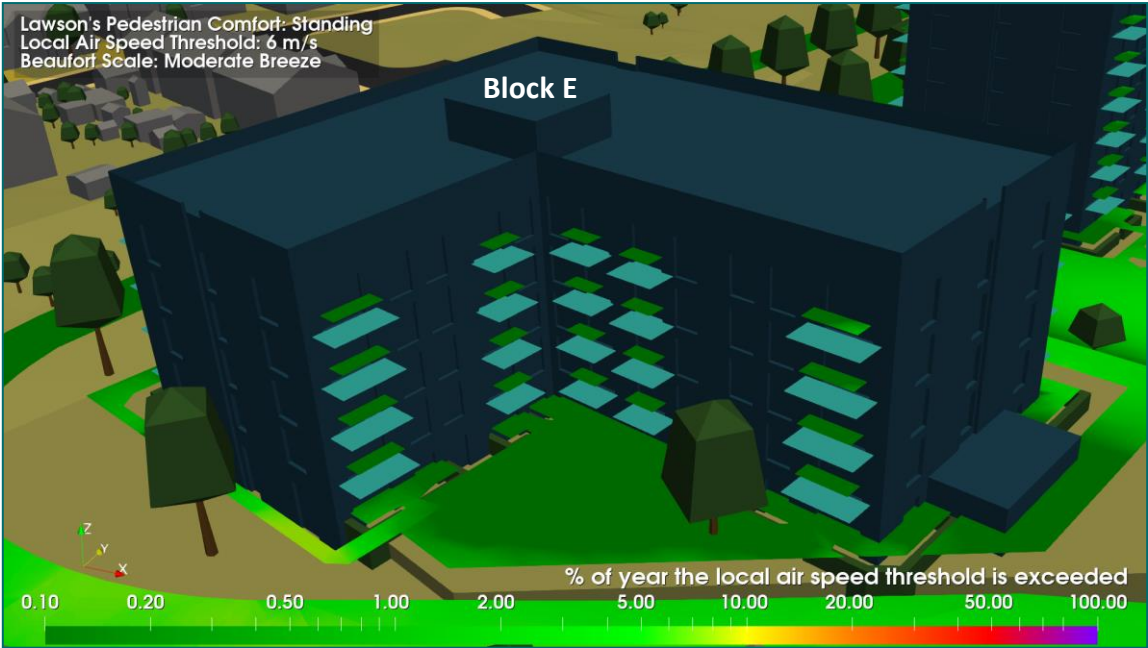


Figure 21: Sitting Comfort Criterion: Balconies: Block E: View from the southeast

3.4 Ground Amenity Spaces

3.4.1 Amenity around Block E

[Figure 22](#) and [Figure 23](#) illustrate Lawson's Sitting and Standing Comfort Criteria results for the ground amenity spaces located around Block E. The results showed excellent compliance and fully met the requirements of Lawson's Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion's requirement.

A few portions on the west and north side of Block E, outlined in blue, show an exceedance of Lawson's Sitting Comfort Criterion. These portions are visible in the yellow and orange contours in [Figure 22](#) and [Figure 23](#). The local air speed is likely to exceed 4 m/s for up to 20% of the year at these locations. These portions mostly use for walking purposes.

No further mitigation measures are recommended.

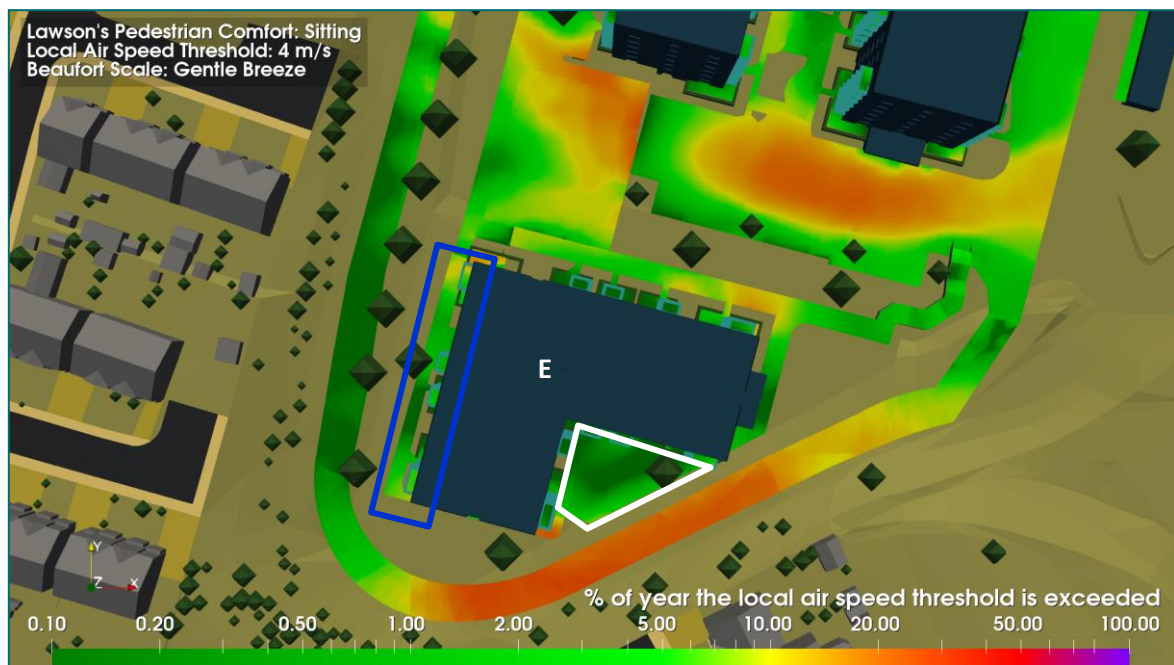


Figure 22: Sitting Comfort Criterion: Ground Amenities: Amenity around Block E



Figure 23: Standing Comfort Criterion: Ground Amenities: Amenity around Block E

3.4.2 Basketball Court and Outdoor amenities towards the north of Block E

[Figure 24](#) and [Figure 25](#) illustrate Lawson's Sitting and Standing Comfort Criteria results on the Basketball court and outdoor amenities towards the north of Block E. The portion outline blue shows the outdoor amenities and white show basketball courts.

The results showed good compliance and fully met the requirements of Lawson's Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion's requirement.

Some of the locations visible in the yellow and orange contours show limited compliance with the requirements of Lawson's Sitting Comfort Criterion. The local air speed is likely to exceed 4 m/s for up to 20% of the year at these locations. These areas are affected by the prevailing southwesterly and westerly winds.

When comparing the results for these locations to Lawson's Standing Comfort Criterion, the local air speed demonstrates excellent compliance, exceeding 6 m/s for less than 5% of the year. See [Figure 25](#). Of the 20% of the year when the local air speed exceeds 4m/s, three-quarters of that collective time (i.e. 15% of the year), it does not exceed 6m/s. The local air speed in these spaces will be less than 4 m/s for 80% of the year and between 4 and 6 m/s for 15% of the year.

Any exceedance noted can be considered very marginal and will not lead to an environment that is unpleasant to use. The local air speed is only going to be greater than a gentle breeze, but frequently less than a moderate breeze. Such conditions are unlikely to affect the usability of this space for personal recreation.

No further mitigation measures are recommended.

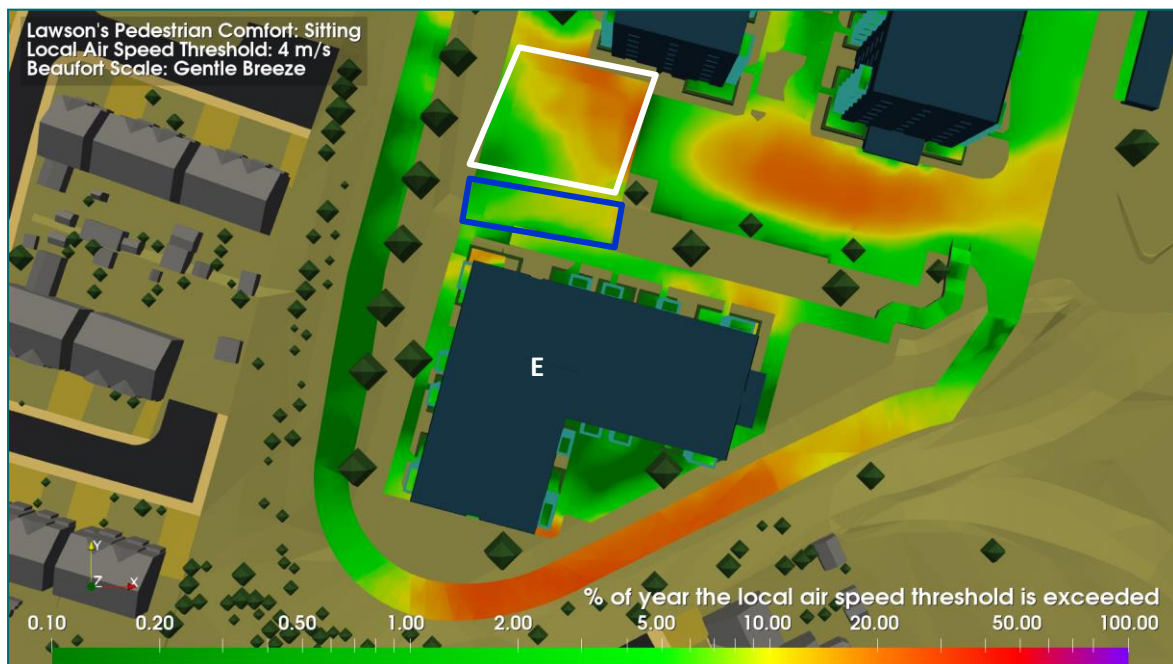


Figure 24: Sitting Comfort Criterion: Ground Amenities: Basketball court & outdoor amenities

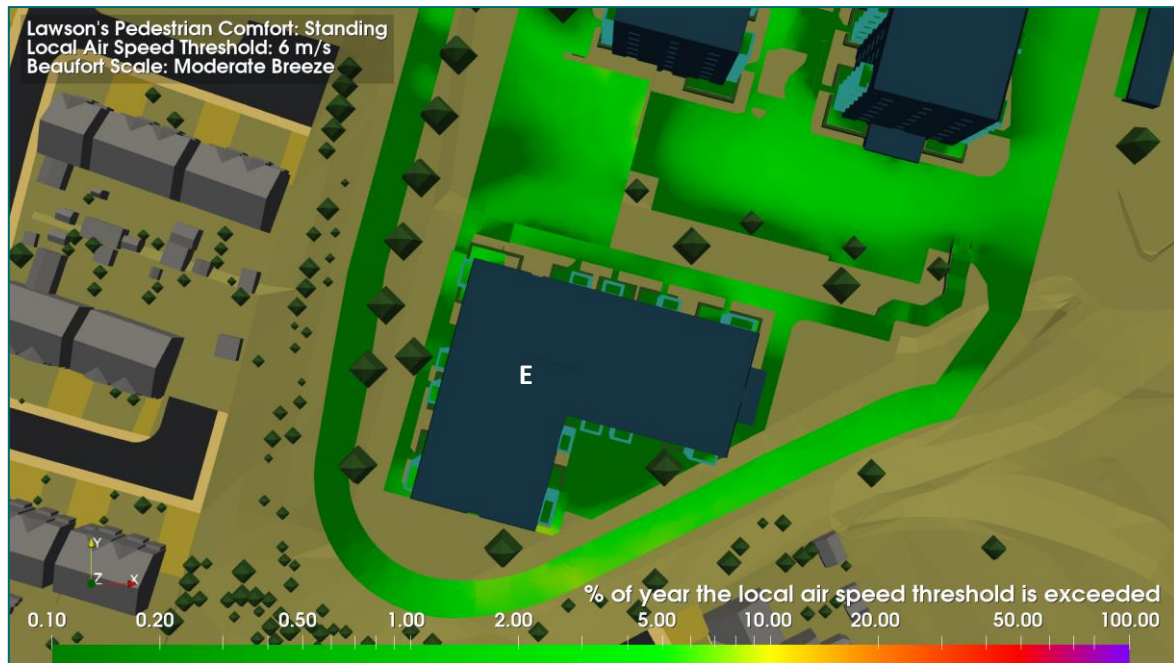


Figure 25: Standing Comfort Criterion: Ground Amenities: Basketball court & outdoor amenities

3.4.3 Between Block C & D

[Figure 26](#) and [Figure 27](#) illustrate Lawson's Sitting and Standing Comfort Criteria results on the between Block C & D.

The results showed good compliance and fully met the requirements of Lawson's Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion's requirement.

When comparing the results for these locations to Lawson's Standing Comfort Criterion, the local air speed demonstrates excellent compliance, exceeding 6 m/s for less than 5% of the year. See [Figure 27](#). Of the 20% of the year when the local air speed exceeds 4m/s, three-quarters of that collective time (i.e. 5% of the year), it does not exceed 6m/s. The local air speed in these spaces will be less than 4 m/s for 80% of the year and between 4 and 6 m/s for 15% of the year.

Any exceedance noted can be considered very marginal and will not lead to an environment that is unpleasant to use. The local air speed is only going to be greater than a gentle breeze, but frequently less than a moderate breeze. Such conditions are unlikely to affect the usability of this space for personal recreation.

No further mitigation measures are recommended.

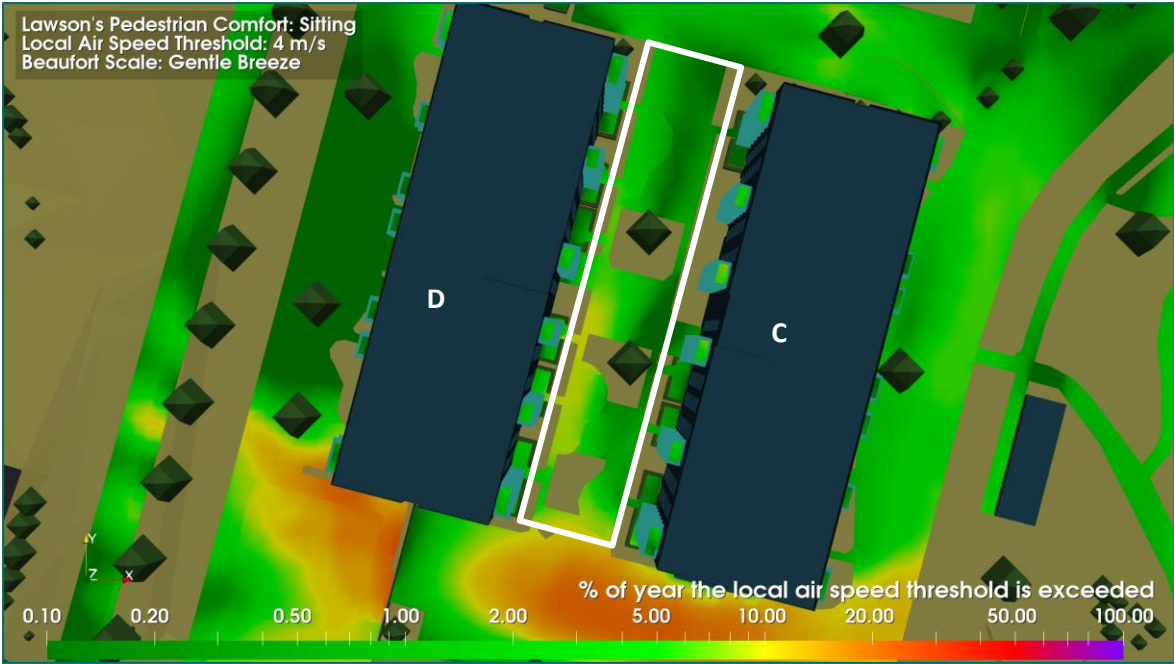


Figure 26: Sitting Comfort Criterion: Ground Amenities: between Blocks C and D

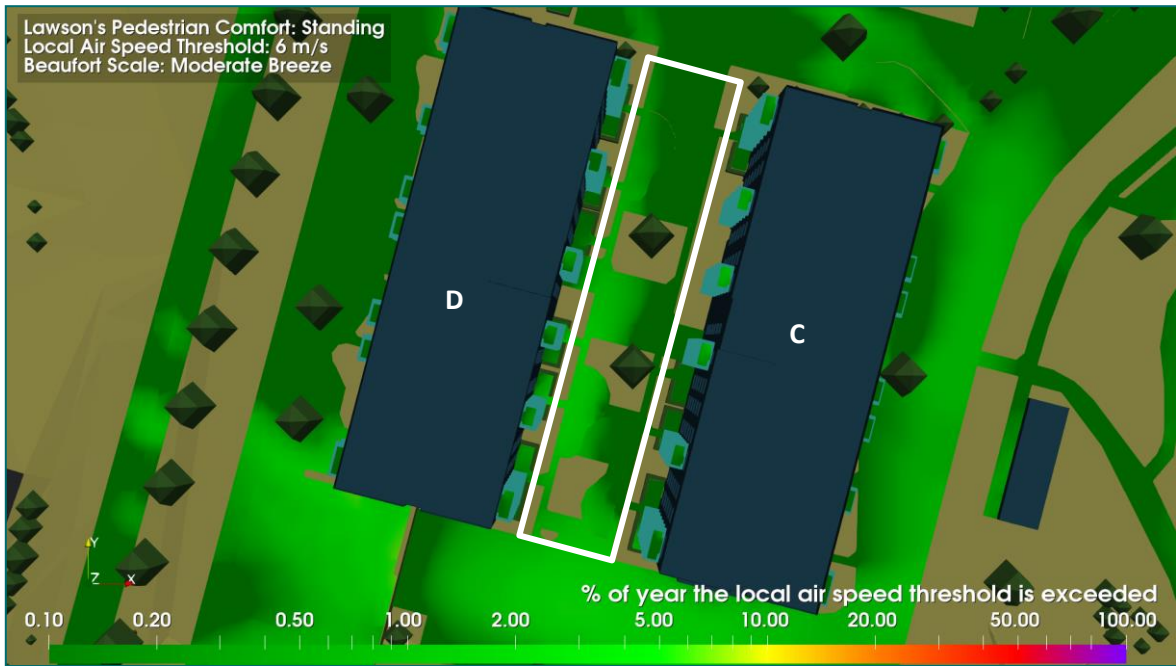


Figure 27: Standing Comfort Criterion: Ground Amenities: between Blocks C and D

3.4.4 Green corridor

Figure 22 and Figure 23 illustrate Lawson’s Sitting and Standing Comfort Criteria results for the ground amenity green corridor. The results showed excellent compliance and fully met the requirements of Lawson’s Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion’s requirement.

No further mitigation measures are recommended.

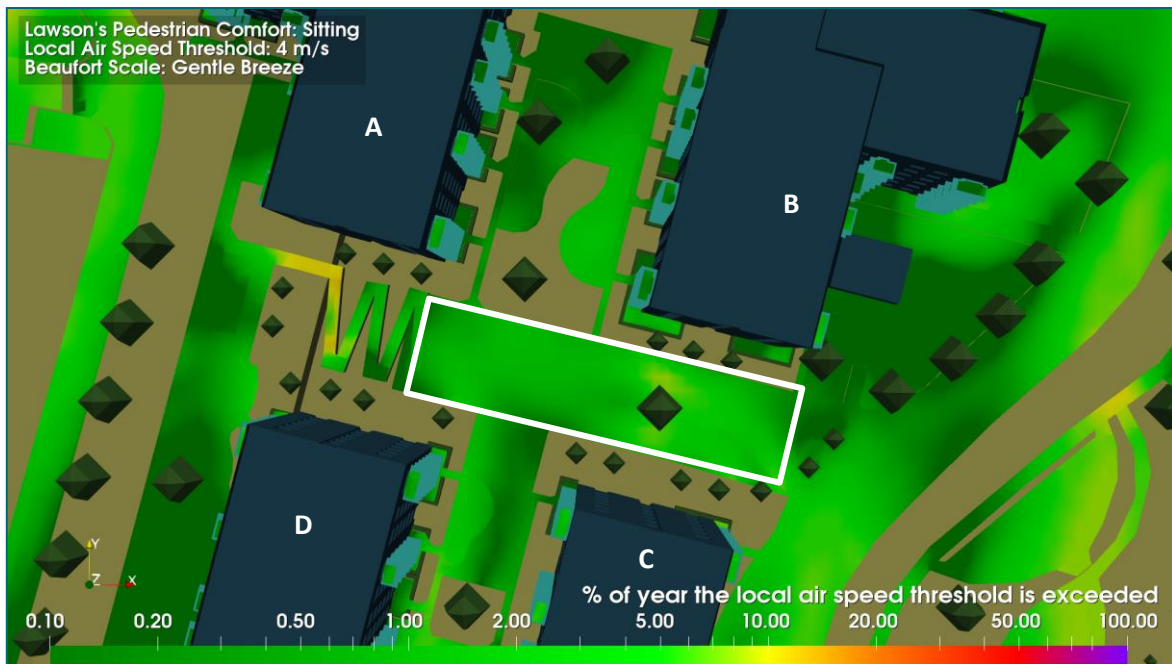


Figure 28: Sitting Comfort Criterion: Ground Amenities: Green corridor



Figure 29: Standing Comfort Criterion: Ground Amenities: Green corridor

3.4.5 Between Block A & B

Figure 22 and Figure 23 illustrate Lawson’s Sitting and Standing Comfort Criteria results for the ground amenity between Block A and B. The results showed excellent compliance and fully met the requirements of Lawson’s Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion’s requirement.

No further mitigation measures are recommended.

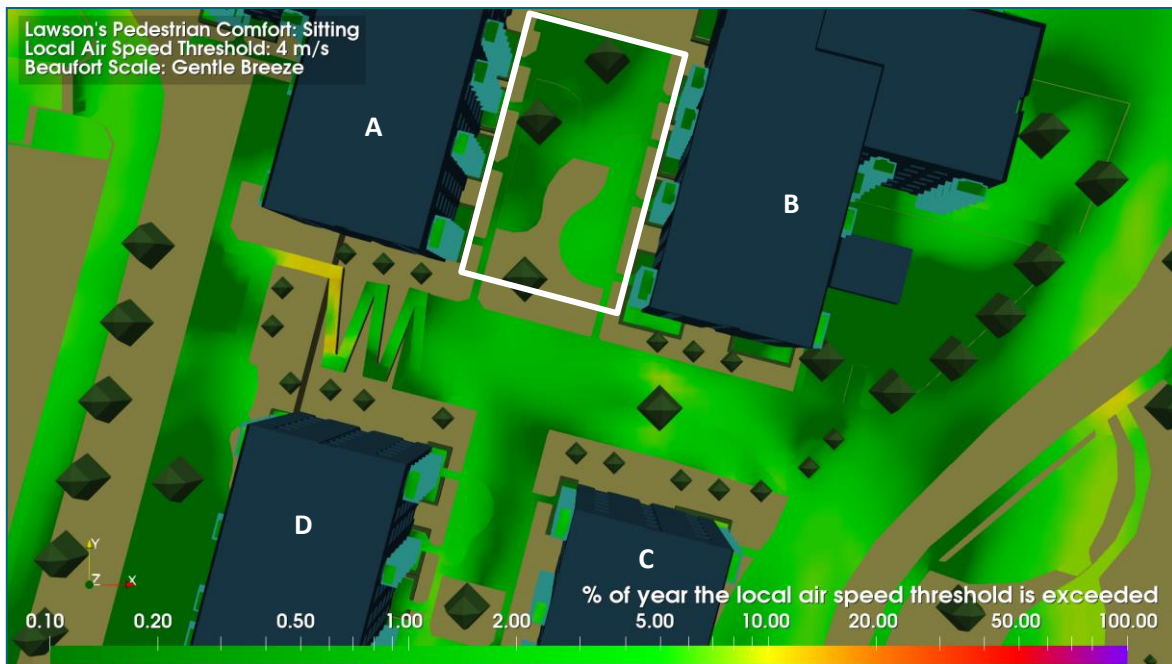


Figure 30: Sitting Comfort Criterion: Ground Amenities: Green corridor



Figure 31: Standing Comfort Criterion: Ground Amenities: Green corridor

3.4.6 Creche Play Area and Children's Playground

[Figure 22](#) and [Figure 23](#) illustrate Lawson's Sitting and Standing Comfort Criteria results for the Creche Play Area and Children's Playground located towards east and the southeast of Block B. The results showed excellent compliance and fully met the requirements of Lawson's Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion's requirement.

No further mitigation measures are recommended.



Figure 32: Sitting Comfort Criterion: Ground Amenities: Creche Play Area and Children's Playground



Figure 33: Standing Comfort Criterion: Ground Amenities: Creche Play Area and Children's Playground

3.4.7 Community Gardens

[Figure 34](#) and [Figure 35](#) illustrate Lawson's Sitting and Standing Comfort Criteria results on the Community Gardens located towards the east of the site.

The results showed excellent compliance and met the requirements of Lawson's Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion's requirement.

No further mitigation measures are recommended.



Figure 34: Sitting Comfort Criterion: Ground Amenities: Community Garden



Figure 35: Standing Comfort Criterion: Ground Amenities: Community Garden

3.4.8 Plaza and Public Realm

[Figure 36](#) and [Figure 37](#) illustrate Lawson’s Sitting and Standing Comfort Criteria results on the Plaza and Public Realm towards north of Blocks A and B.

The results showed good compliance and met the requirements of Lawson’s Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion’s requirement.

No further mitigation measures are recommended.



Figure 36: Sitting Comfort Criterion: Ground Amenities: Plaza and Public Realm

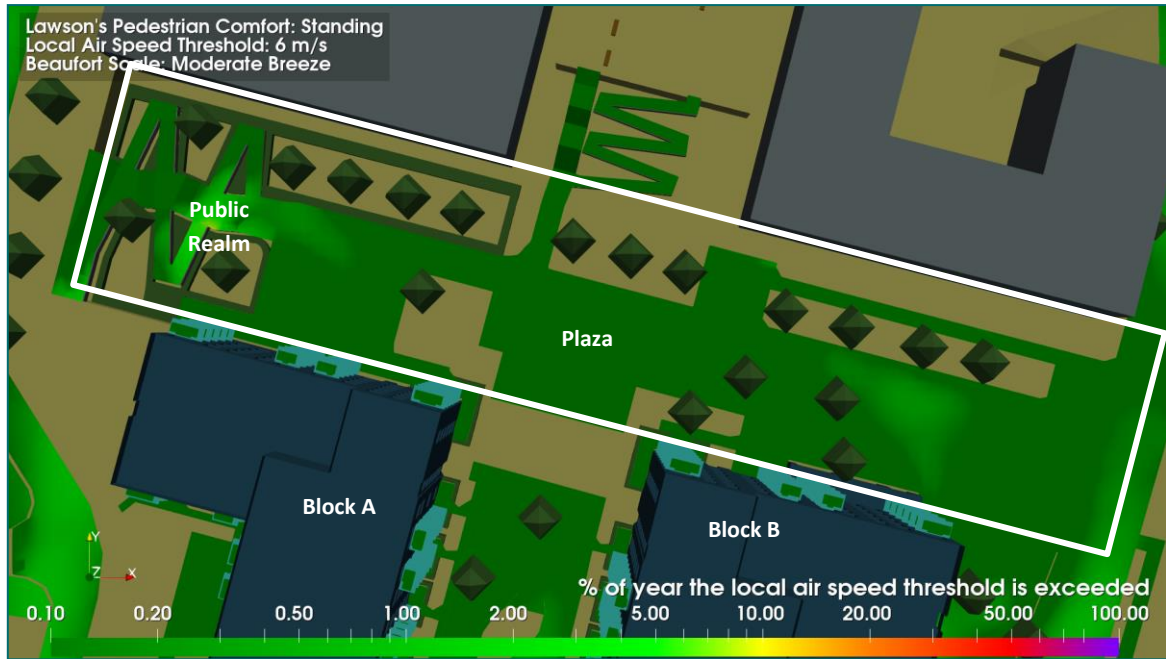


Figure 37: Standing Comfort Criterion: Ground Amenities: Plaza and Public Realm

3.4.9 Amenities around the Medical Building

[Figure 38](#) and [Figure 39](#) illustrate Lawson’s Sitting and Standing Comfort Criteria results on the ground amenity spaces located between Blocks B2 and C2.

The results showed excellent compliance and fully met the requirements of Lawson’s Sitting and Standing Comfort Criterion for the full year on the seating areas outlined in white. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion’s requirement.

No further mitigation measures are recommended.

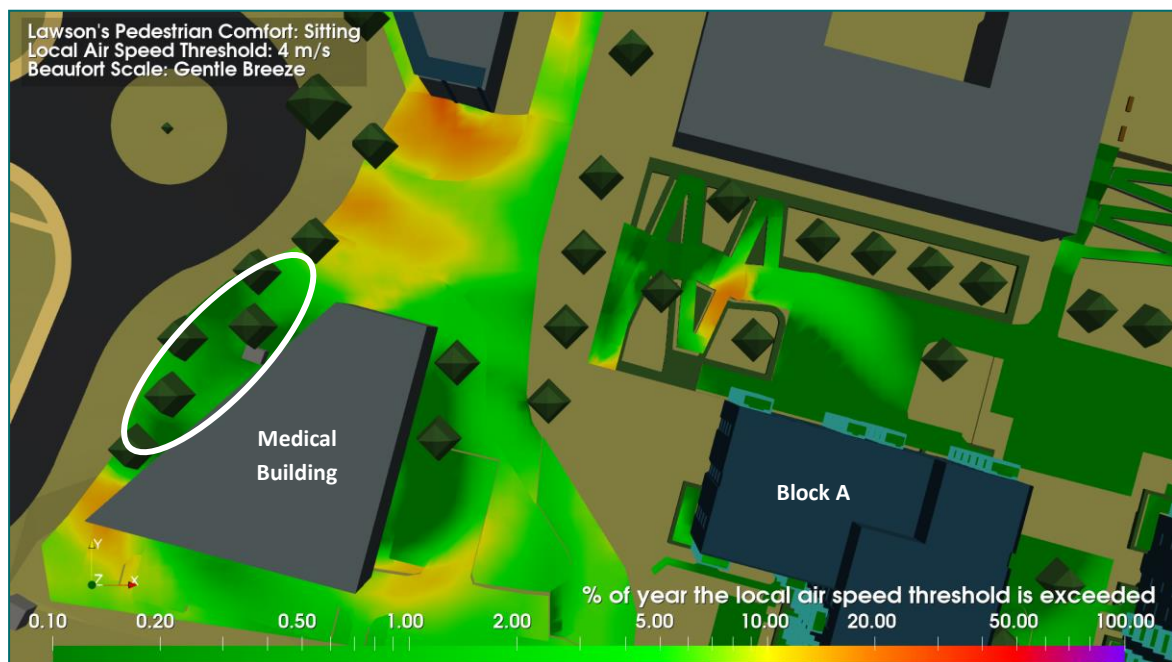


Figure 38: Sitting Comfort Criterion: Ground Amenities: around the Medical Building

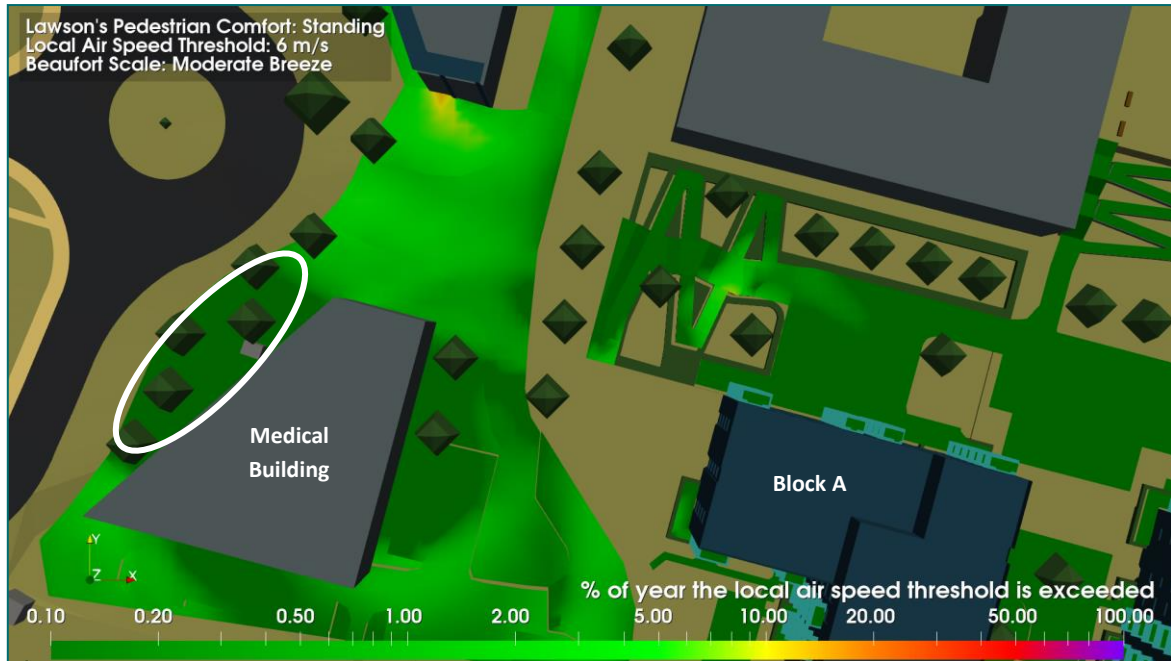


Figure 39: Standing Comfort Criterion: Ground Amenities: around the Medical Building

3.4.10 Proposed seating towards the west of Block D

[Figure 40](#) and [Figure 41](#) illustrate Lawson’s Sitting and Standing Comfort Criteria results on the seating areas located towards the west of Block D.

The results showed excellent compliance and fully met the requirements of Lawson’s Sitting and Standing Comfort Criterion for the full year. The local air speed does not exceed 4m/s and 6m/s for more than 5% of the year as per the criterion’s requirement.

No further mitigation measures are recommended.

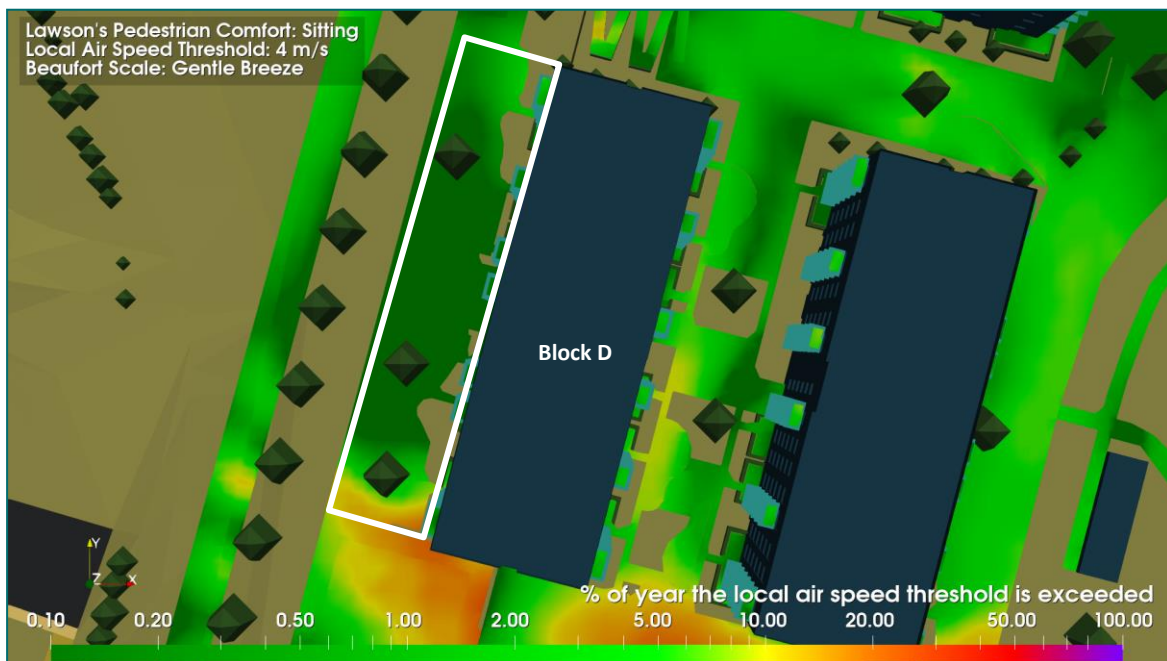


Figure 40: Sitting Comfort Criterion: Podium Amenities: towards the west of Block D

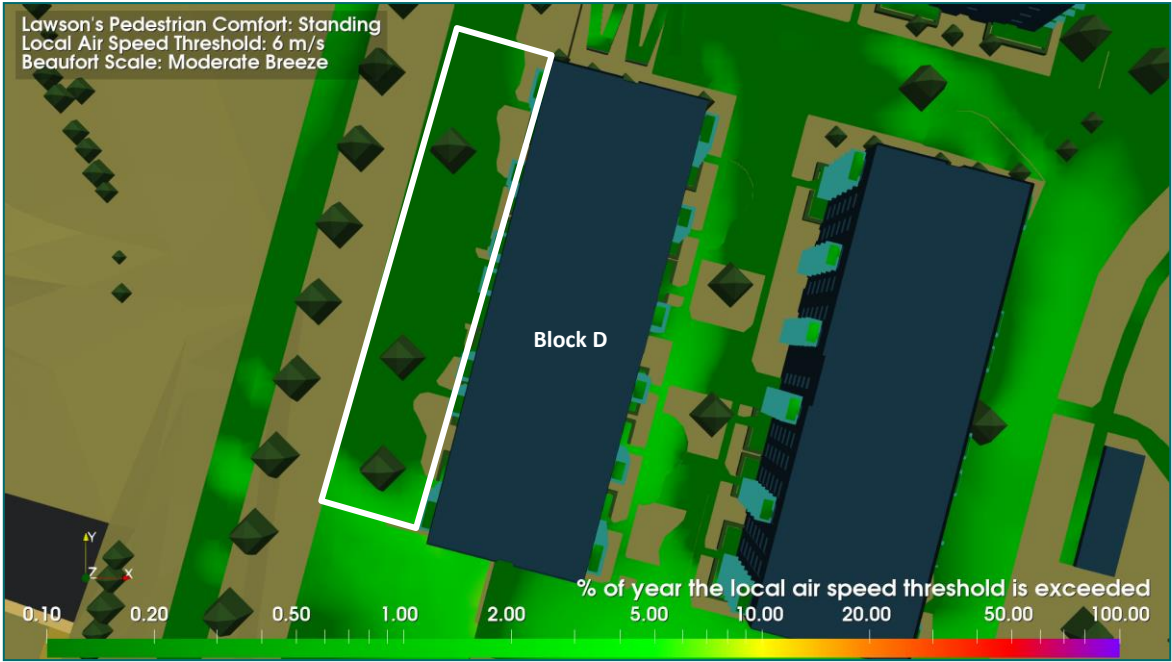


Figure 41: Standing Comfort Criterion: Ground Amenities: towards the west of Block D

3.5 Walking Comfort Results

The Lawson’s Leisure Walking Comfort Criterion states that the local air speed at designated locations should not exceed 8 m/s for more than 5% of the analysed duration along the various paths around the development. Additionally, the Lawson’s Business Walking Comfort Criterion states that the local air speed at designated locations should not exceed 10 m/s for more than 5% of the analysed duration along the various paths around the development. These show excellent compliance with the requirements of Lawson’s Leisure Walking and Business Walking Comfort Criterion. The local air speed does not exceed 8 m/s and 10 m/s for more than 5% of the year, respectively. [Figure 42](#) and [Figure 43](#) below show the results of walking comfort criteria.



Figure 42: Leisure Walking Comfort Criterion: View from the top



Figure 43: Business Walking Comfort Criterion: view from the top

3.6 Safety Criteria

The Lawson’s Normal Pedestrian Safety Criterion states that the local air speed at designated locations should not exceed 20 m/s for more than 0.01% of the duration analysed. Additionally, the Lawson’s Sensitive Pedestrian Safety Criterion states the local air speed at designated locations should not exceed 15 m/s for more than 0.01% of the duration analysed. The Sensitive Pedestrian Safety Criterion applies to the vulnerable population, such as pensioners and children. Note the limit of the criterion is 0.01% and not 5% as with the comfort criterion. The results of the normal and sensitive pedestrian were observed to be below 0.01% of the year.



Figure 44: Normal Pedestrian Safety Criterion: Balconies: View from the south



Figure 45: Sensitive Pedestrian Safety Criterion: Balconies: View from the south

4 Weather Data

The analysis is based on the 'IRL_ST_Shannon.AP.039620_TMYx.2009-2023.epw' weather file. The variation of wind speed recorded in the weather file is illustrated in [Figure 46](#) below. [Figure 47](#) illustrates the wind direction variation, and [Figure 48](#) illustrates the wind rose.

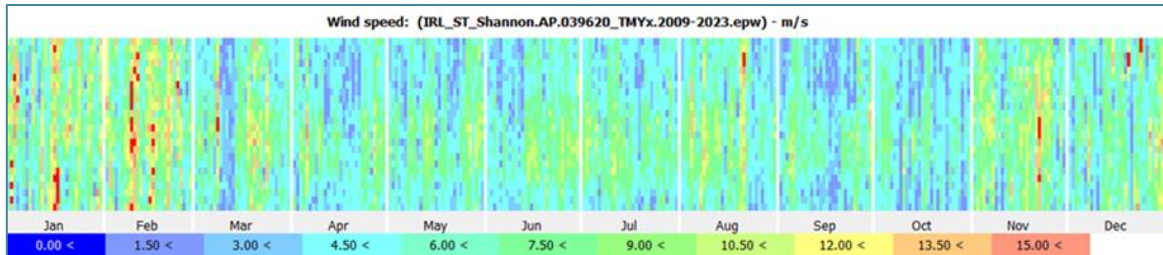


Figure 46: Wind speed variation

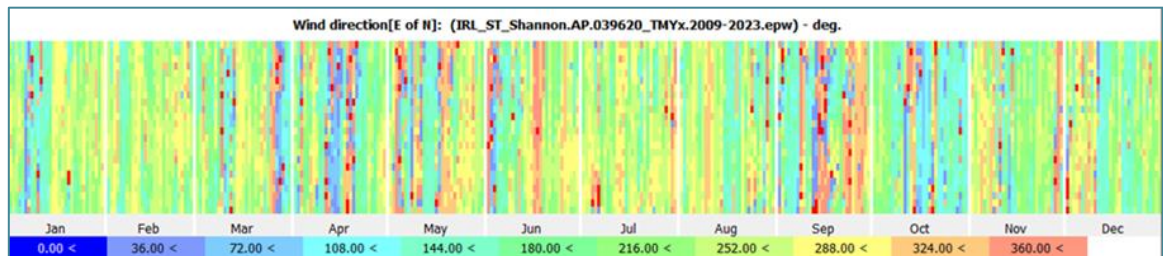


Figure 47: Wind direction variation

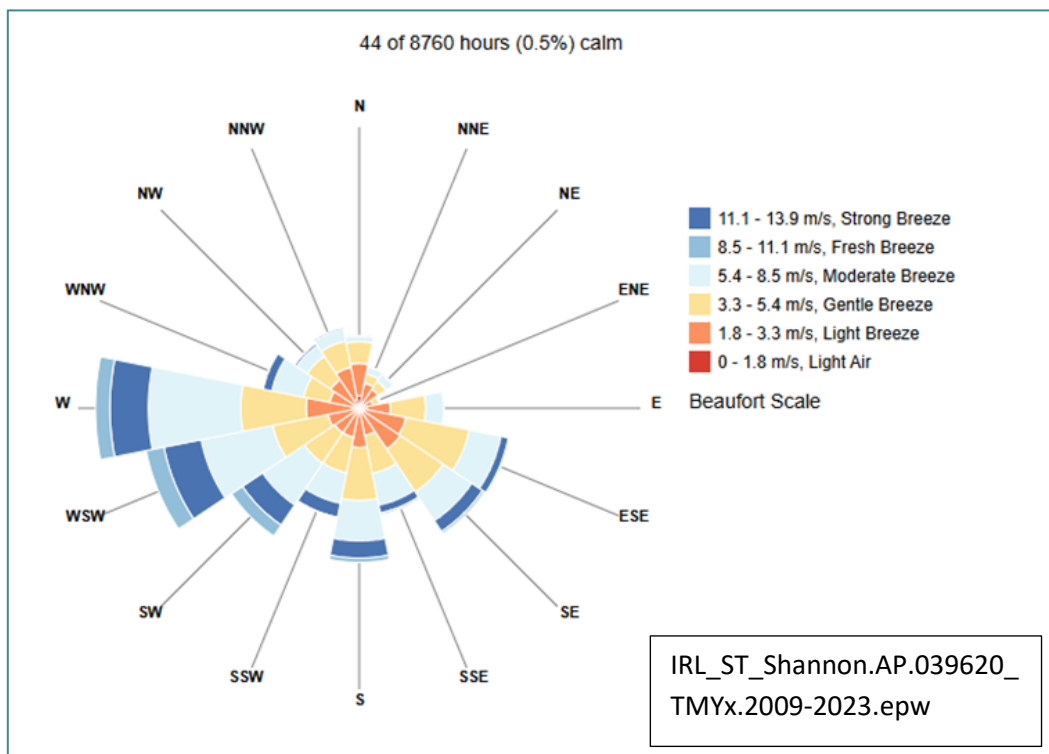


Figure 48: Wind rose

Based on this, the mean wind speed recorded was **5.3m/s** with a westerly prevailing direction.

5 Wind Boundary Layer

In an atmospheric boundary layer, the wind speed increases with height due to the influence of surface roughness (i.e. the presence of buildings, trees, roads, etc., on the ground), see [Figure 49](#).

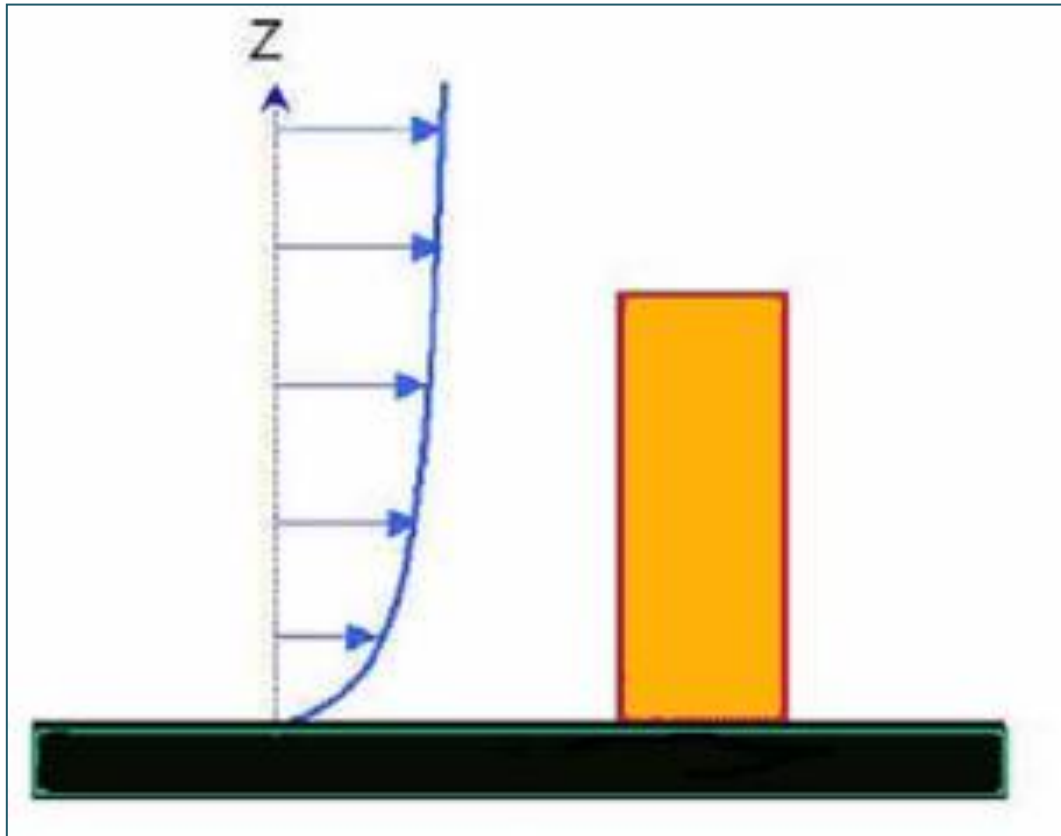


Figure 49: Typical velocity profile of an atmospheric boundary layer

In the current CFD modelling, the velocity profile was generated according to the parameterised ASHRAE methodology described below. This allows for different wind profiles across various terrain types: open country, urban, and city centre.

The wind speed U_H at height H above the ground is given by:

$$U_H = U_{met} \left(\frac{\delta_{met}}{H_{met}} \right)^{a_{met}} \left(\frac{H}{\delta} \right)^a \dots \dots \dots (Eq. 1)$$

Where,

- a** = Exponent in power law wind speed profile for local building terrain
- δ** = fully developed strong wind atmospheric boundary layer thickness (m)
- a_{met}** = Exponent for the meteorological station

δ_{met} = Atmospheric boundary thickness at the meteorological station (m)

H_{met} = Height at which meteorological wind speed was measured (m)

U_{met} = Hourly meteorological wind speed, measured at height H_{met} (m/s)

The parameters for different types of terrain are given in Table 1.

Table 1: Atmospheric boundary layer parameters

Terrain Category	Description	a	δ
1	Large city centres - 50% of buildings above 21m over a distance of at least 2000m upwind.	0.33	460
2	Urban, suburban, wooded areas.	0.22	370
3	Open, with scattered objects generally less than 10m high.	0.14	270
4	Flat, unobstructed areas exposed to wind flowing over a large water body (no more than 500m inland).	0.10	210

For the current project, we used the atmospheric boundary layer corresponding to the Terrain Category 2, i.e. the suburban site type. The meteorological data was taken on Category 3 terrain at a height of 10m.

6 Methodology for Pedestrian Comfort Calculation

The methodology for the analysis was as follows:

- 1) The annual mean wind speed was determined from the 'IRL_ST_Shannon.AP.039620_TMYx.2009-2023.epw' weather file.
- 2) 8 steady state CFD simulations were performed corresponding to the 8 directions – SW, W, NW, N, NE, E, SE and S, respectively.
- 3) The local air speed at various designated locations around the site was recorded for each of the simulations.
- 4) This value was compared to the meteorological wind speed used, and the magnification factor at that location for the corresponding wind direction was determined.
- 5) The magnification factor was used to determine the air speed at the designated locations for the various recorded values of the wind speed and direction in the weather file, thus generating the local air speeds at designated locations for a year.
- 6) These recorded values were compared to the Lawson Pedestrian Comfort/Safety Criteria.

6.1 Lawson Pedestrian Comfort/Safety Criteria

The Lawson Criteria¹ were used as a reference to assess the wind effects. It is the most widely used reference for assessing pedestrian comfort. It considers the air speed at the location as well as the frequency of its occurrence. It consists of two assessment criteria:

3. The first criteria assess whether the air movement will be comfortable for the pedestrian for different types of activities.
4. The second criteria assess the feeling of safety or distress by the pedestrian at higher air speeds.

The following table gives the values for Lawson's Pedestrian Comfort Assessment Criteria for various activities.

Category	Pedestrian Activity	Threshold mean hourly wind speed not to be exceeded for more than 5% of the time (m/s)
C1	Business Walking	10
C2	Leisurely Walking	8
C3	Standing	6
C4	Sitting	4

The following table gives the values for Lawson's Pedestrian Safety Assessment criteria.

Category	Pedestrian Type	Threshold mean hourly wind speed not to be exceeded more than once per annum ² (m/s)
S1	Typical Pedestrian	20
S2	Sensitive Pedestrian	15

¹T. V. Lawson (2001) *Building Aerodynamics*, Imperial College Press, London.

²Once per annum means the safety threshold is not exceeded 0.01% of the year.

The median wind speed recorded was 5.3 m/s for Limerick's climatic conditions. That means, for 50% of the year, the wind speed is higher than 5 m/s. The Lawson's Sitting Criterion requires the local air speed to be more than 4 m/s for no more than 5% of the year. Thus, the Lawson's Sitting Criterion presents a task of being 10 times better than the climatic conditions at the location of interest.

7 CFD Model

The CFD model was created based on the CAD drawings provided.

7.1 Model Geometry

[Figure 50](#) to [Figure 59](#) illustrate the geometry as modelled.

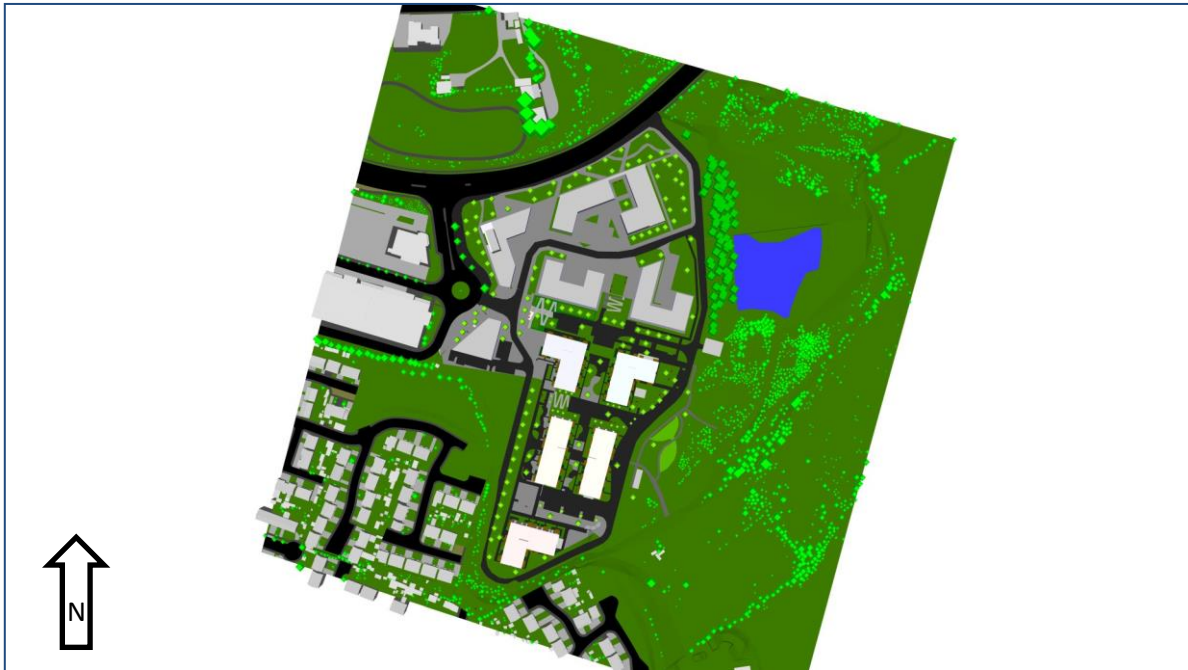


Figure 50: Plan view of the site



Figure 51: Plan view of the site



Figure 52: View of the site from the south



Figure 53: Main Scenario: View of the site from the southwest

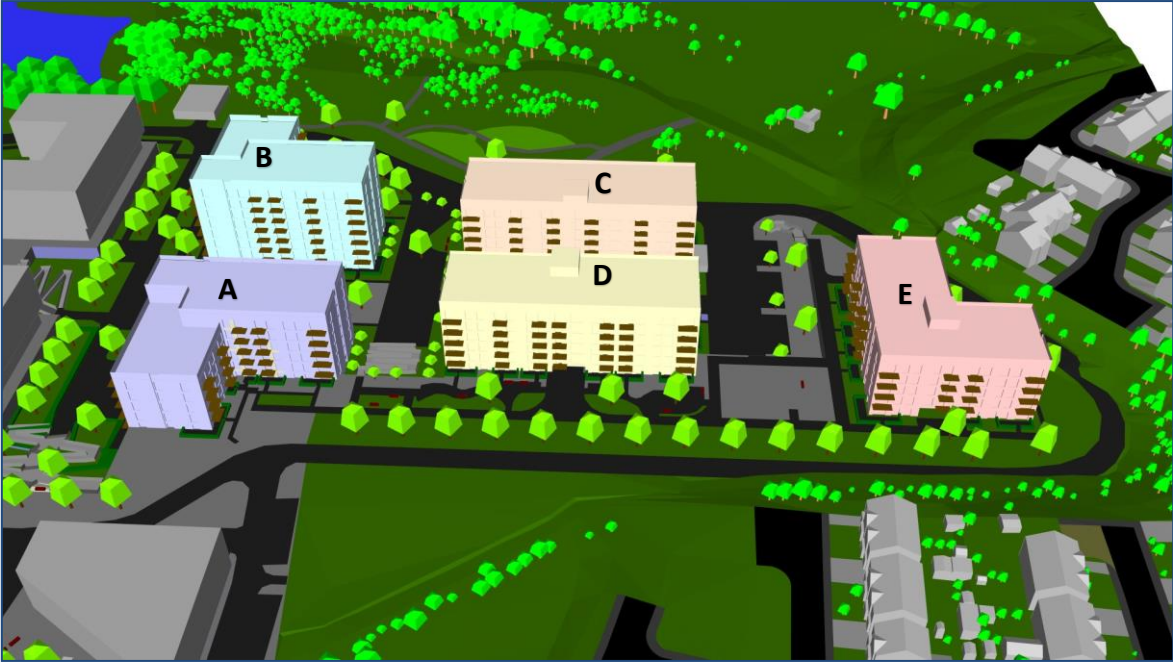


Figure 54: View of the site from the west

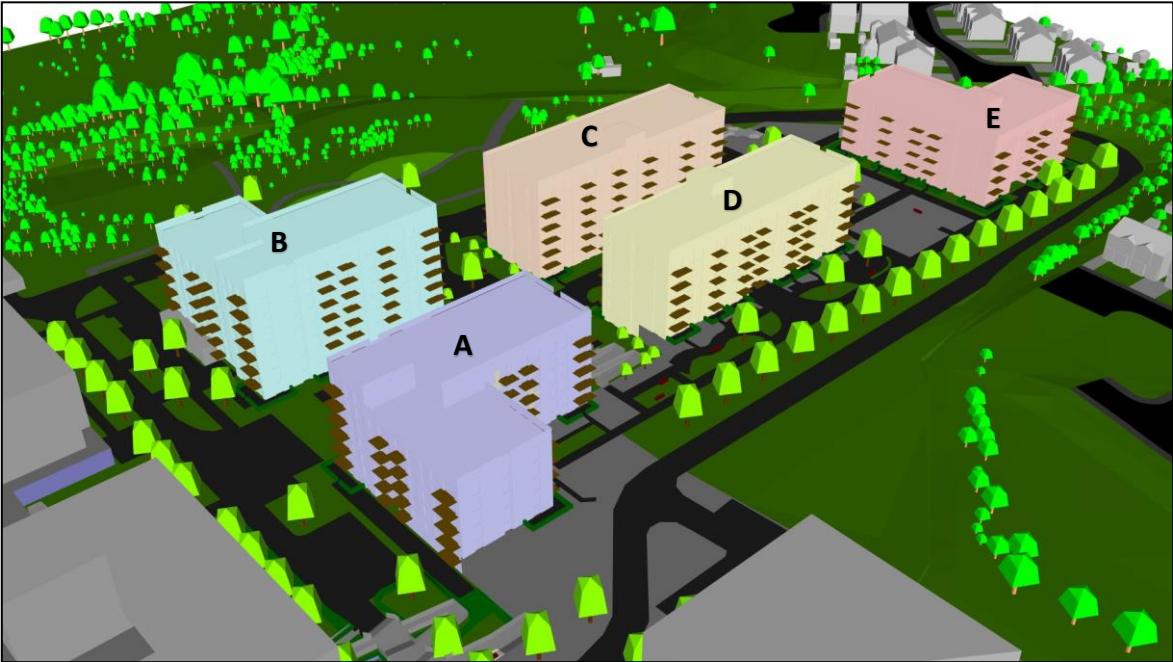


Figure 55: View of the site from the northwest



Figure 56: View of the site from the north

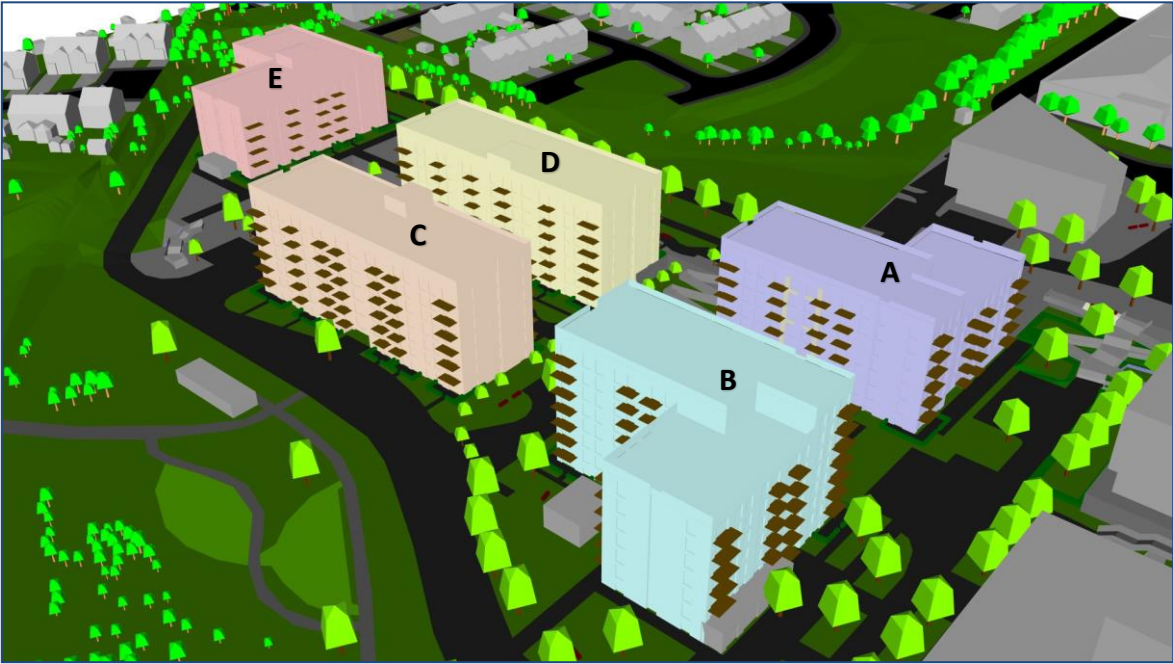


Figure 57: View of the site from the northeast



Figure 58: View of the site from the east

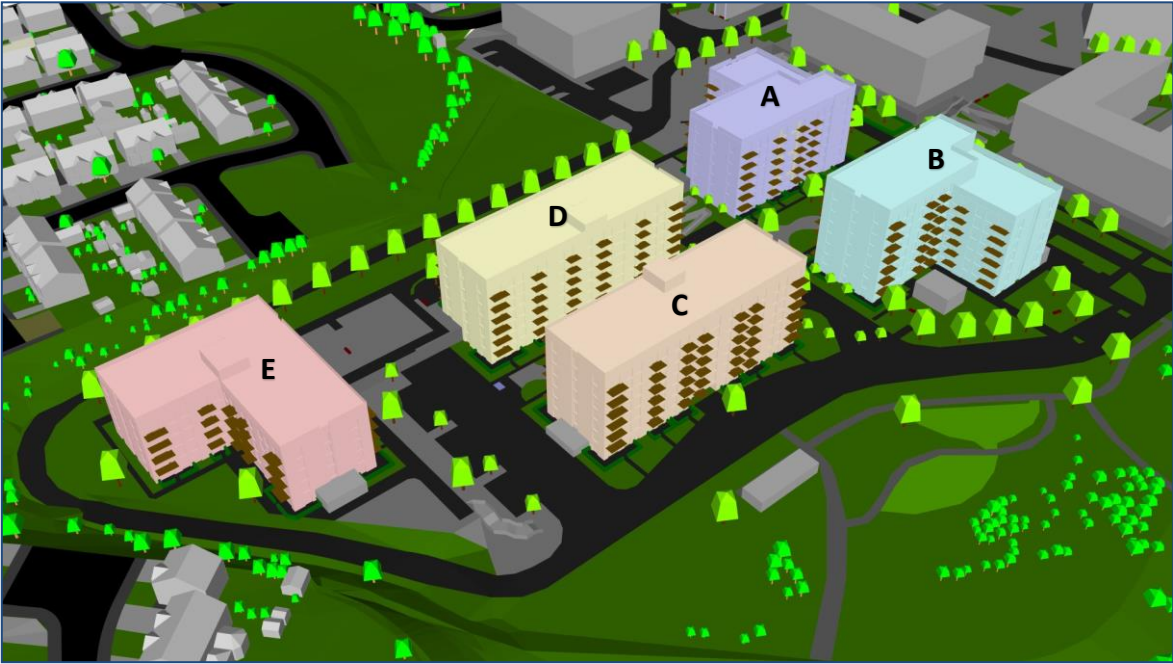


Figure 59: View of the site from the southeast

8 Conclusion

It was observed that,

1. The following Ground amenity spaces showed excellent results and fully met the requirements of the Sitting and Standing Comfort Criteria.
 - Amenities towards the southeast of Block E
 - Basketball Court and Outdoor amenities towards the north of Block E
 - Podium amenities towards the west of Block D
 - Amenities between Blocks C and D
 - Amenities of the Green Corridor
 - Amenities between Blocks A and B
 - Amenities towards the west of Block A
 - Creche Play area and Children's Playground towards the east of Block B
 - Community Gardens
 - Plaza and Public Realm
 - Seating amenities towards the west of the medical building.
2. Basketball court and outdoor amenities towards the north of Block E showed good results and fully met the requirements of the Sitting and Standing Comfort Criteria.
3. All balconies of Blocks A, B, C, D, and E showed excellent results and fully met the requirements of the Sitting and Standing Comfort Criteria.
4. Overall results of the walking comfort show excellent compliance with Lawson's Leisure Walking and Business Walking Comfort Criteria throughout the site, including Plaza, Green Corridor, Proposed Pedestrian Link and Public Realm.
5. The Lawson's Normal and Sensitive Pedestrian Safety Criteria are achieved throughout the site.

The site meets Lawson's Standing and Sitting criteria when used together in all amenity spaces. It also meets Lawson's Walking criteria requirements on all pathways.

9 Appendix

9.1 Comfort Criteria

Figure 60 to Figure 68 show the percentage of the year the hourly wind speed exceeds the threshold value for the comfort criteria, such as Sitting, Standing, Leisurely Walking and Business Walking for all seasons. The threshold values are 4 m/s, 6 m/s, 8 m/s and 10 m/s respectively.

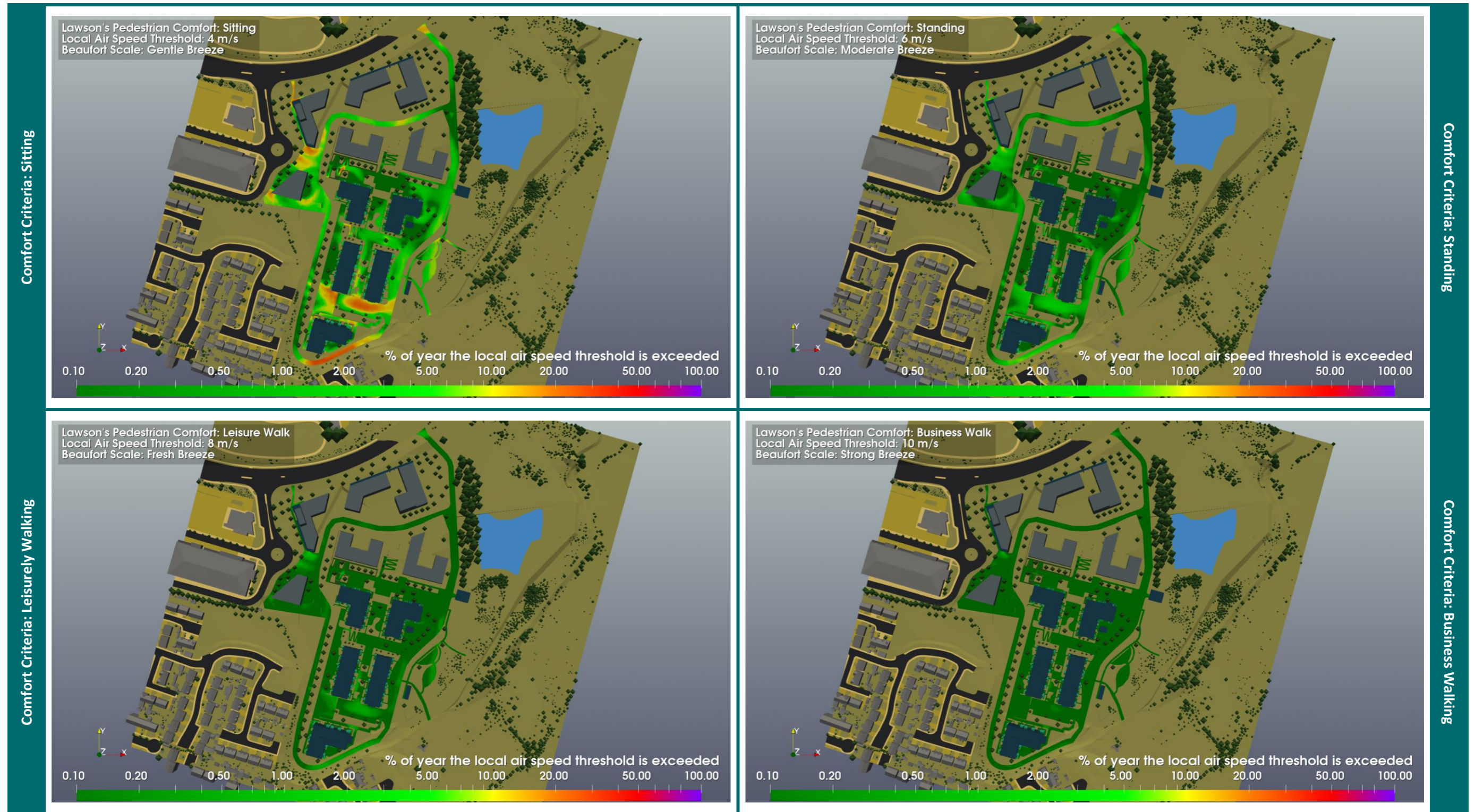


Figure 60: Comfort Criteria: All Seasons: Plan view

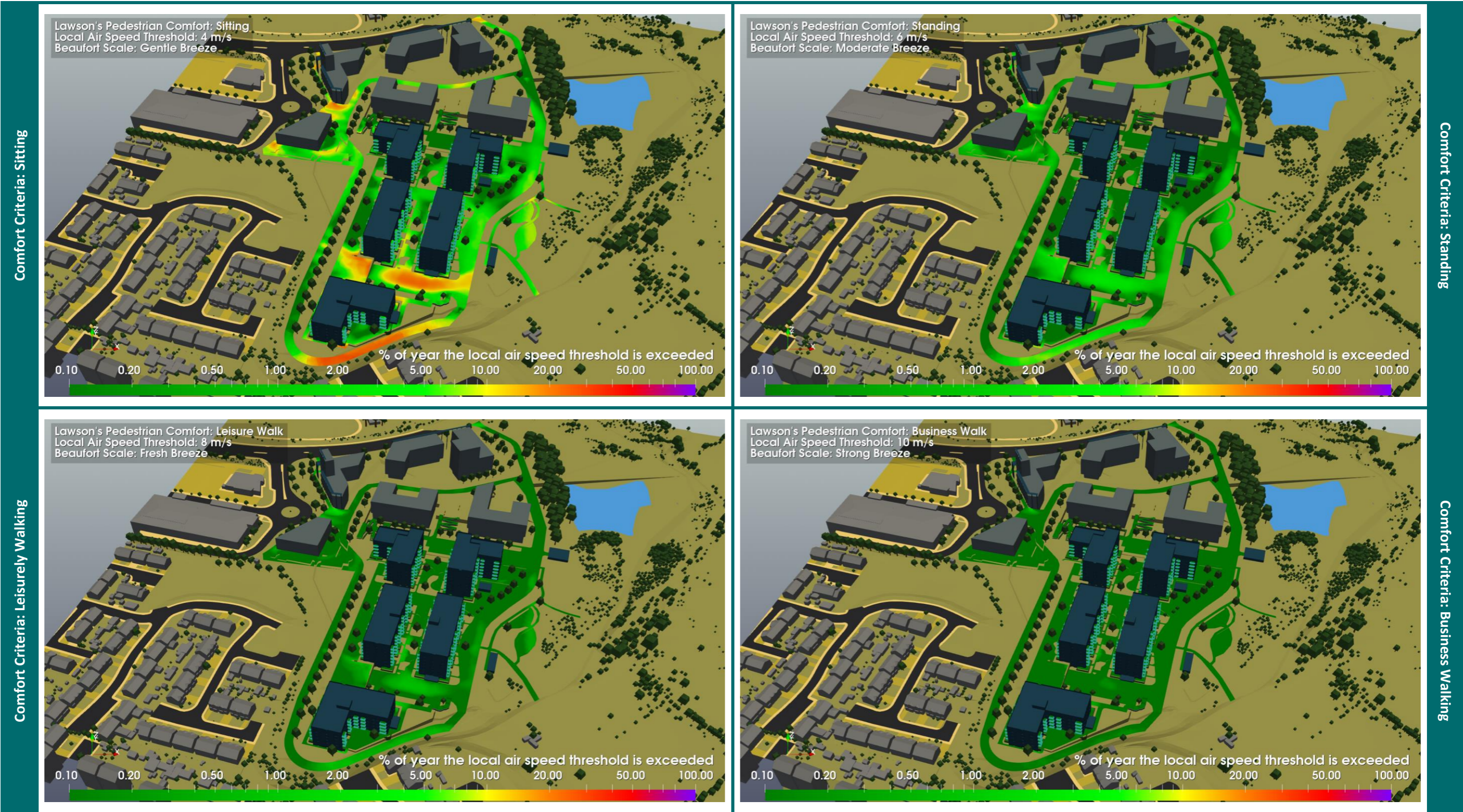


Figure 61: Comfort Criteria: View from the south

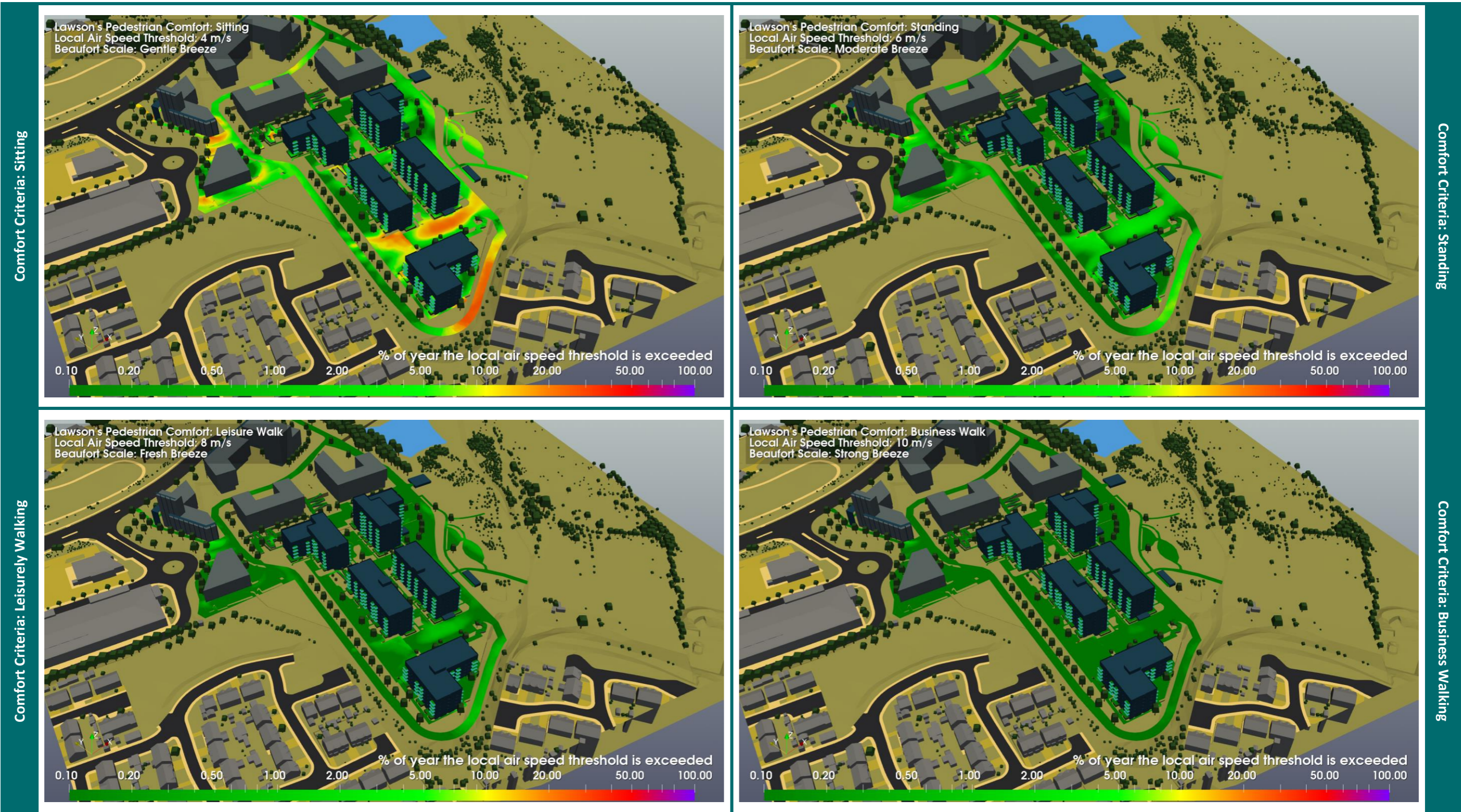


Figure 62: Comfort Criteria: View from the southwest



Figure 63: Comfort Criteria: View from the west



Figure 64: Comfort Criteria: View from the northwest

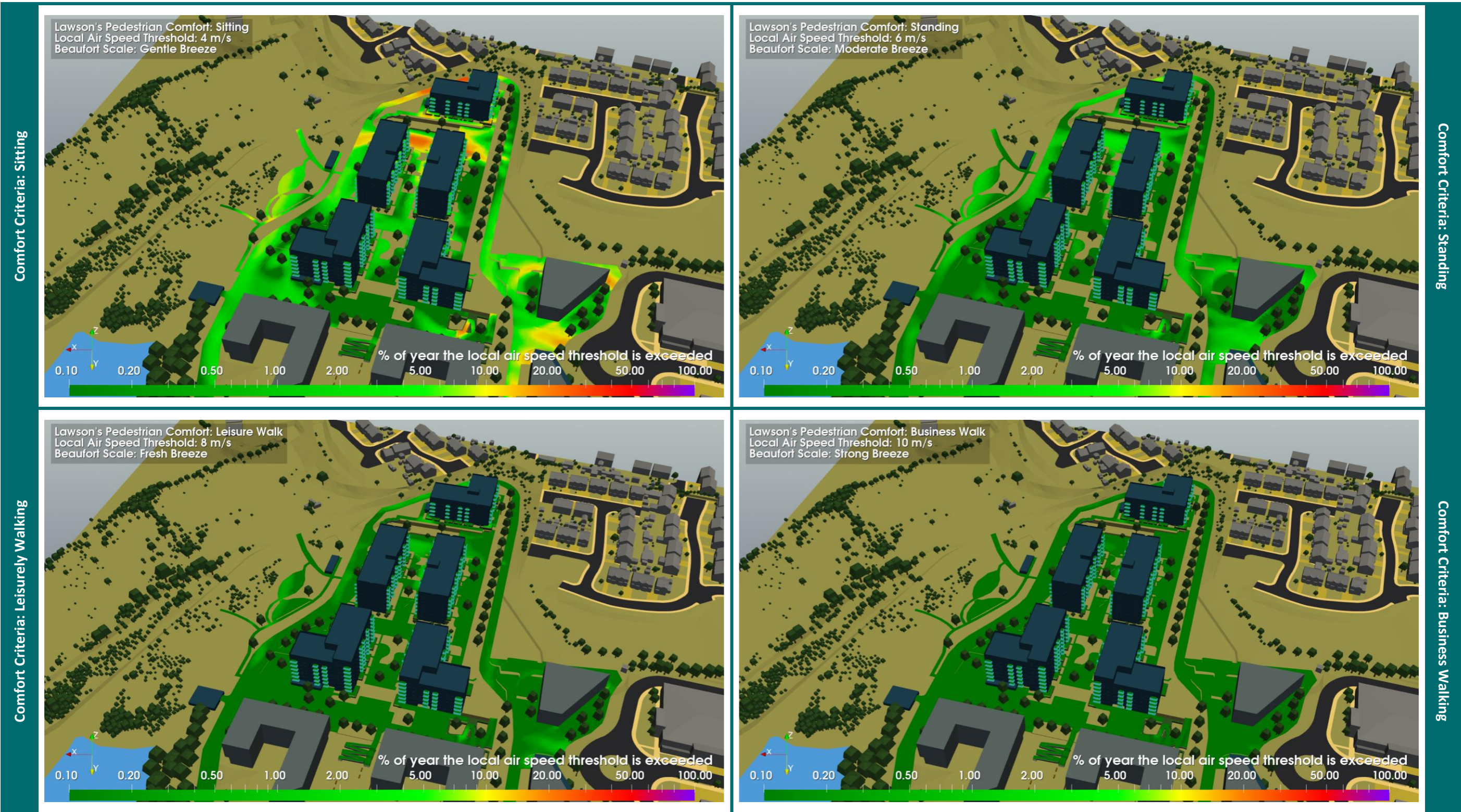


Figure 65: Comfort Criteria: View from the north

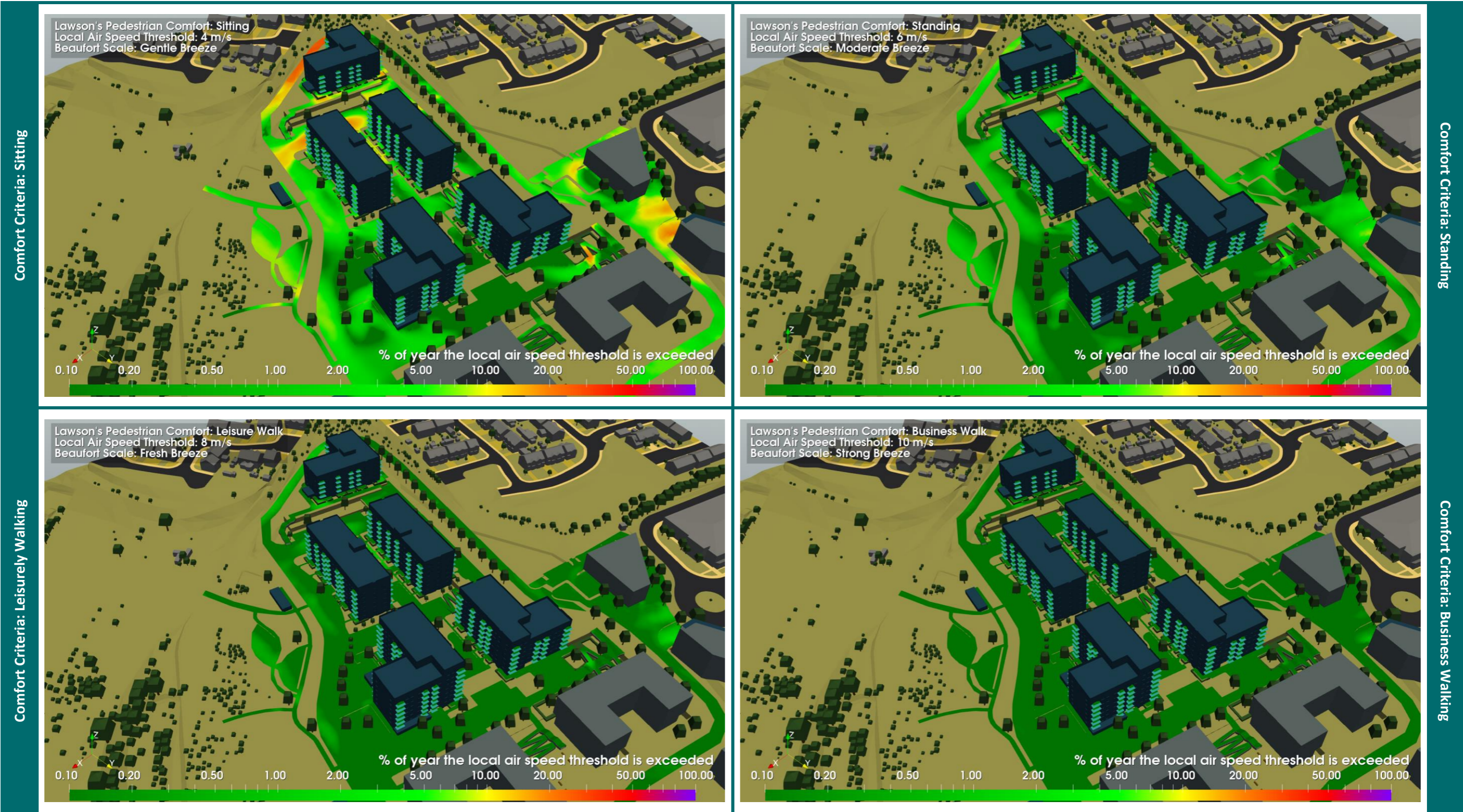


Figure 66: Comfort Criteria: View from the northeast

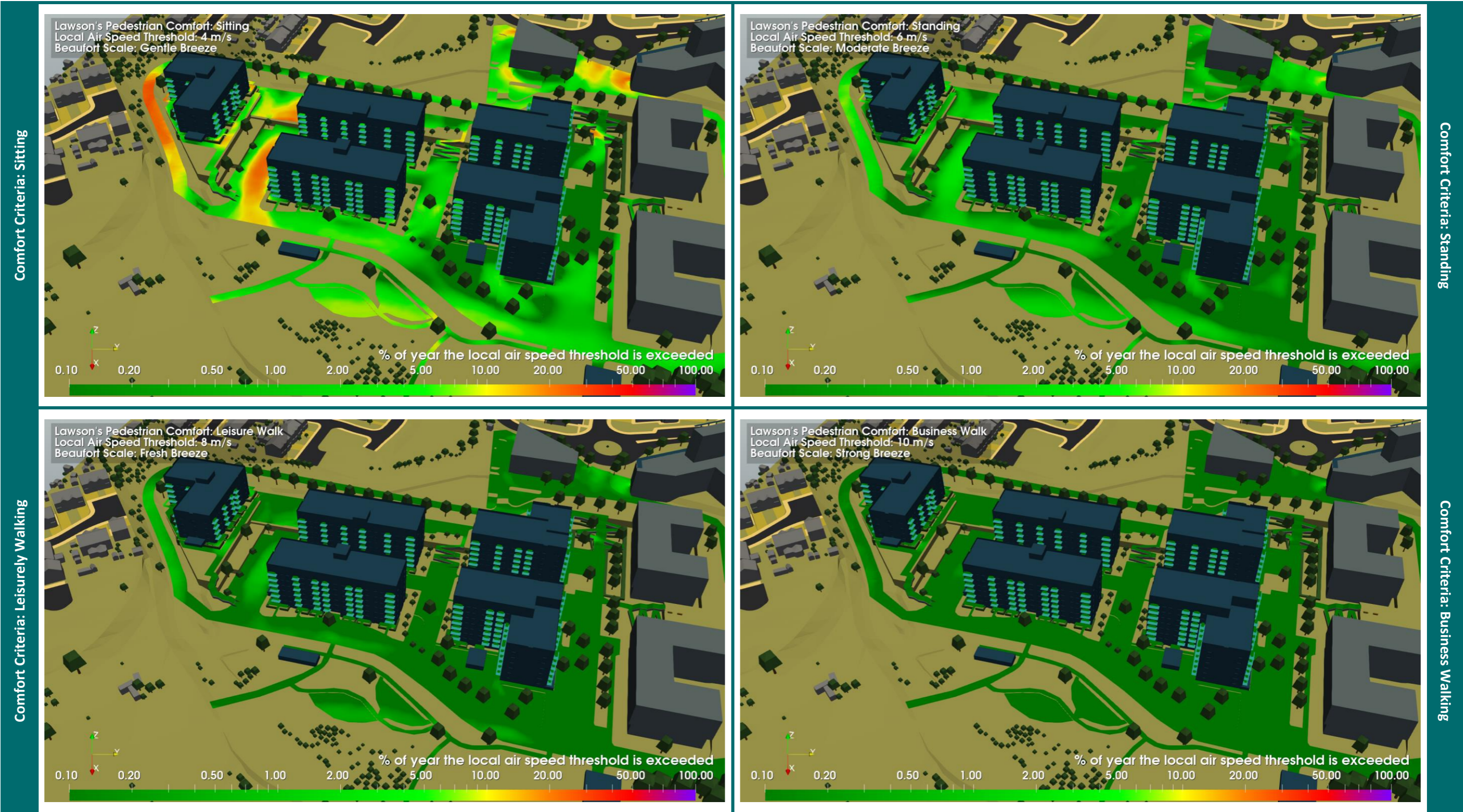


Figure 67: Comfort Criteria: View from the east

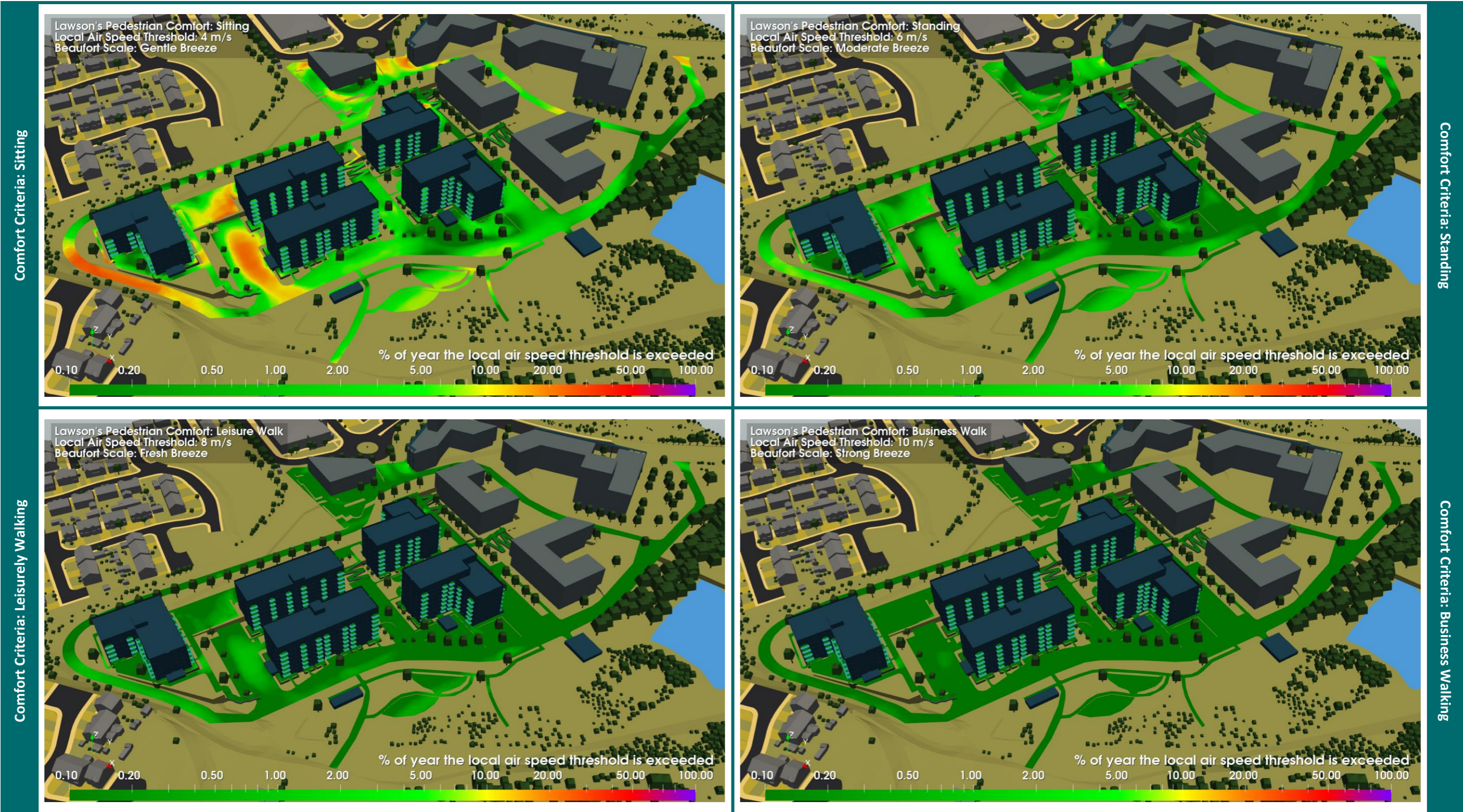


Figure 68: Comfort Criteria: View from the southeast

9.2 Safety Criteria

Figure 69 to Figure 77 show the percentage of the year the hourly wind speed exceeds the threshold value for the safety criteria for all seasons. The threshold values are 20 m/s for a normal pedestrian and 15 m/s for a sensitive pedestrian.

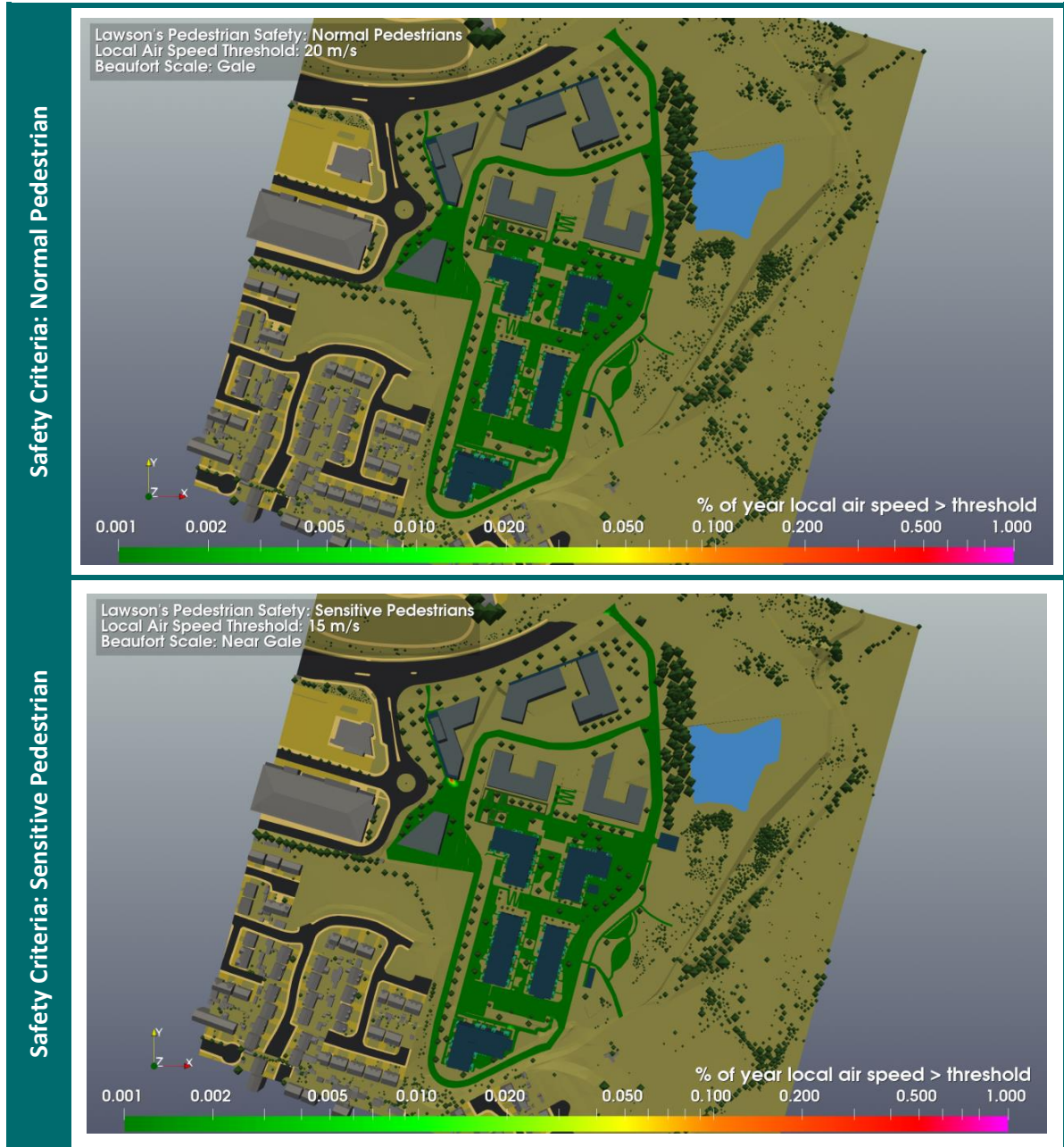


Figure 69: Safety Criteria: Plan view

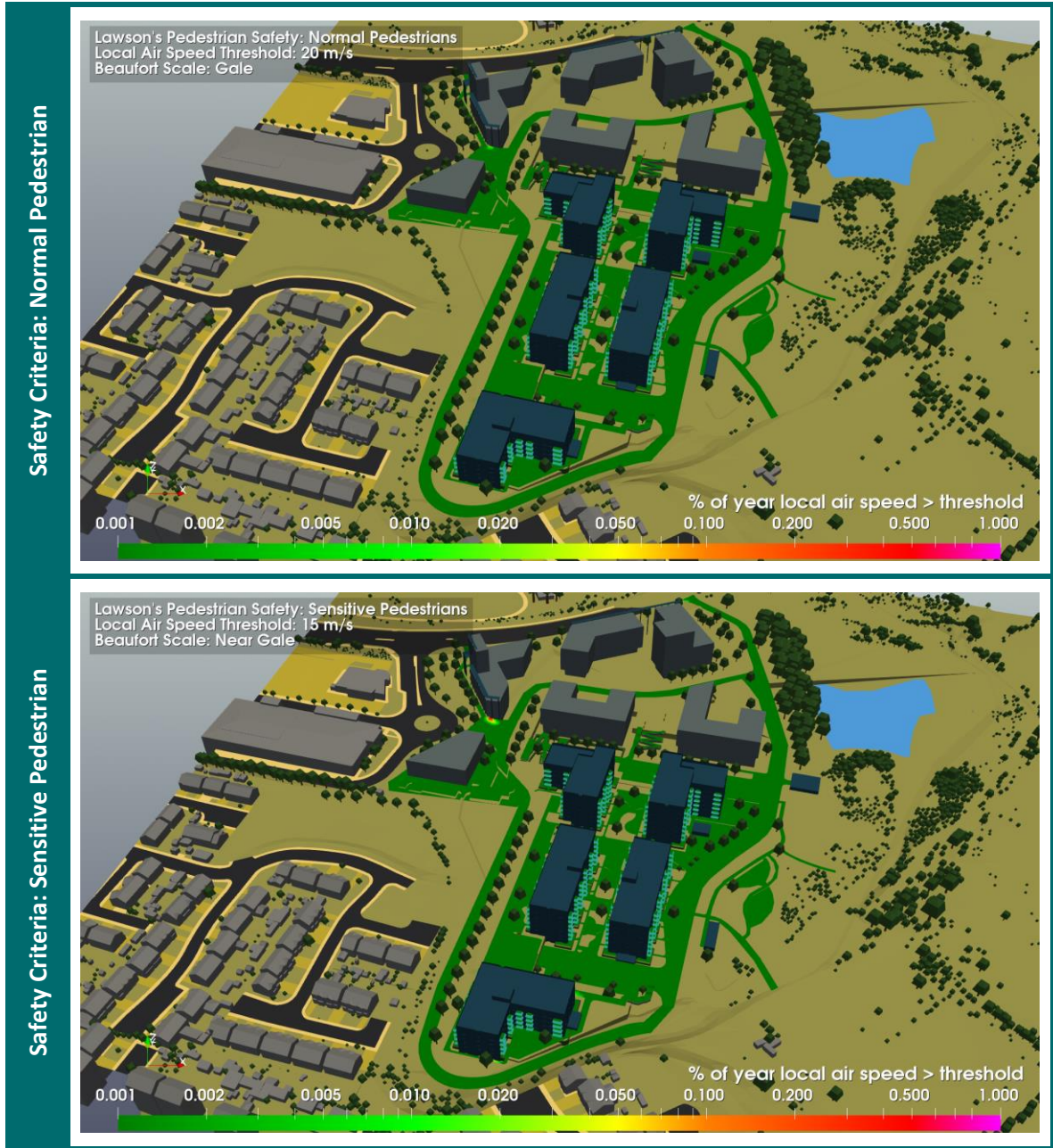


Figure 70: Safety Criteria: View from the south

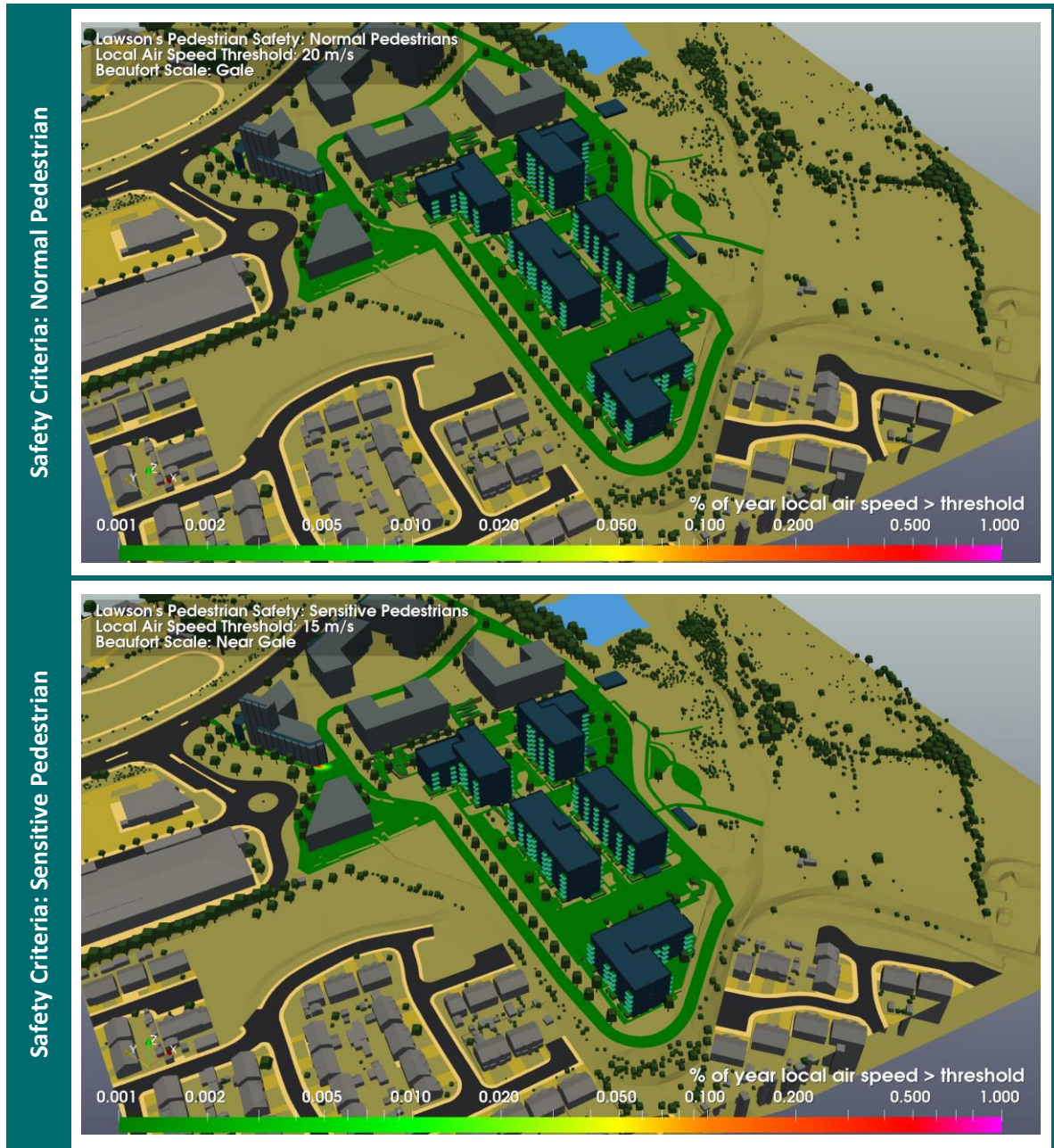


Figure 71: Safety Criteria: View from the southwest



Figure 72: Safety Criteria: View from the west



Figure 73: Safety Criteria: View from the northwest

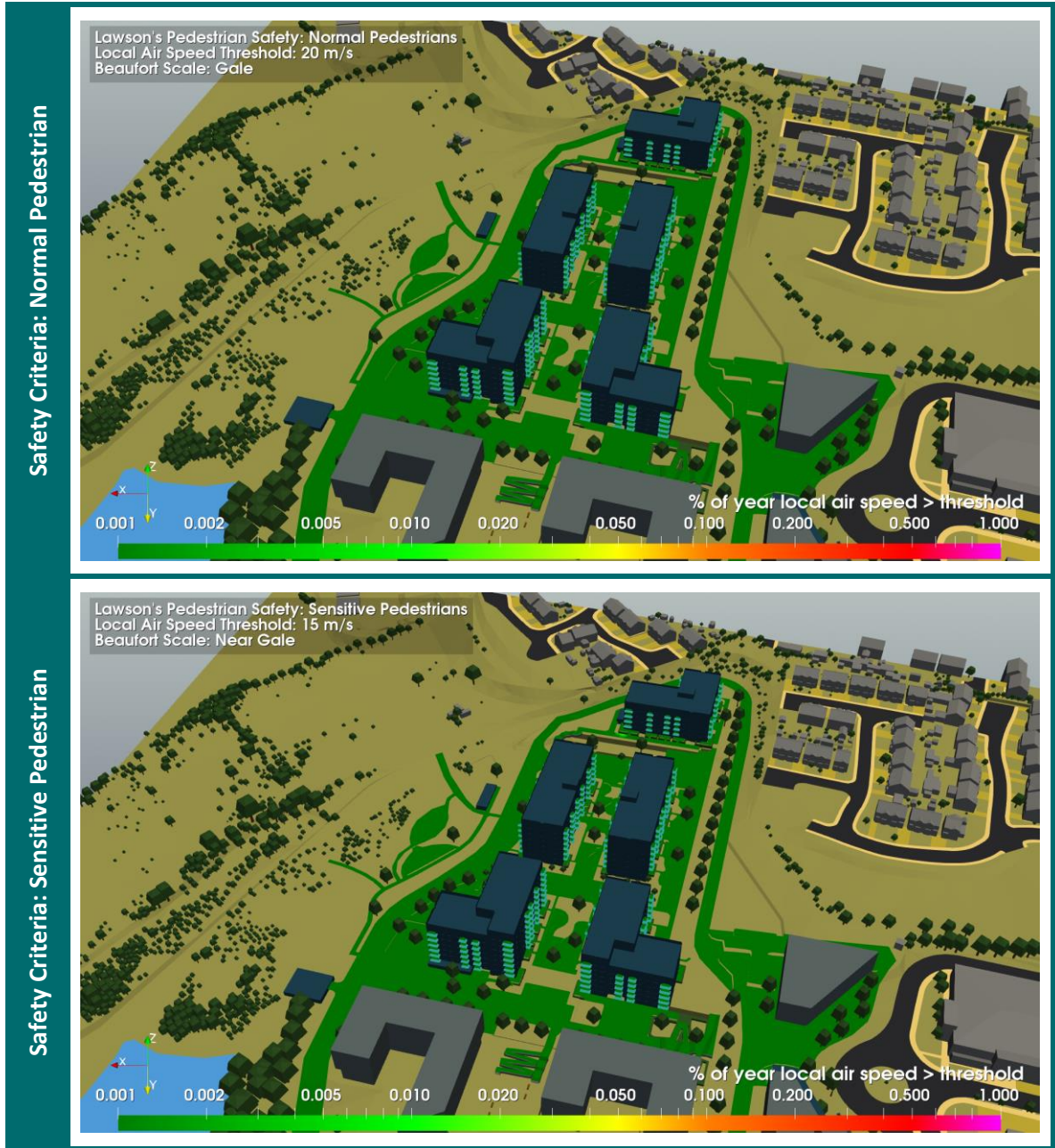


Figure 74: Safety Criteria: View from the north

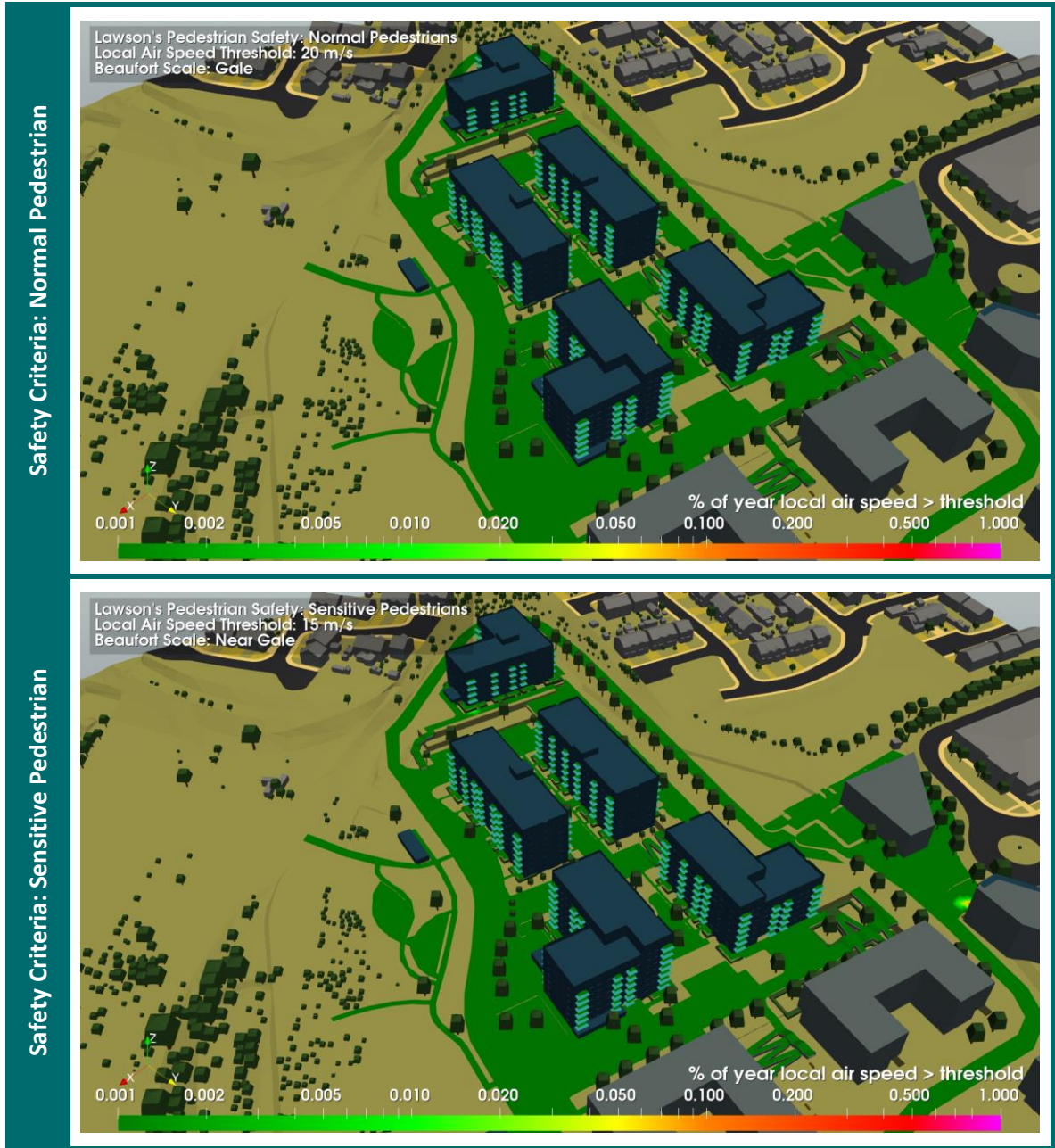


Figure 75: Safety Criteria: View from the northeast

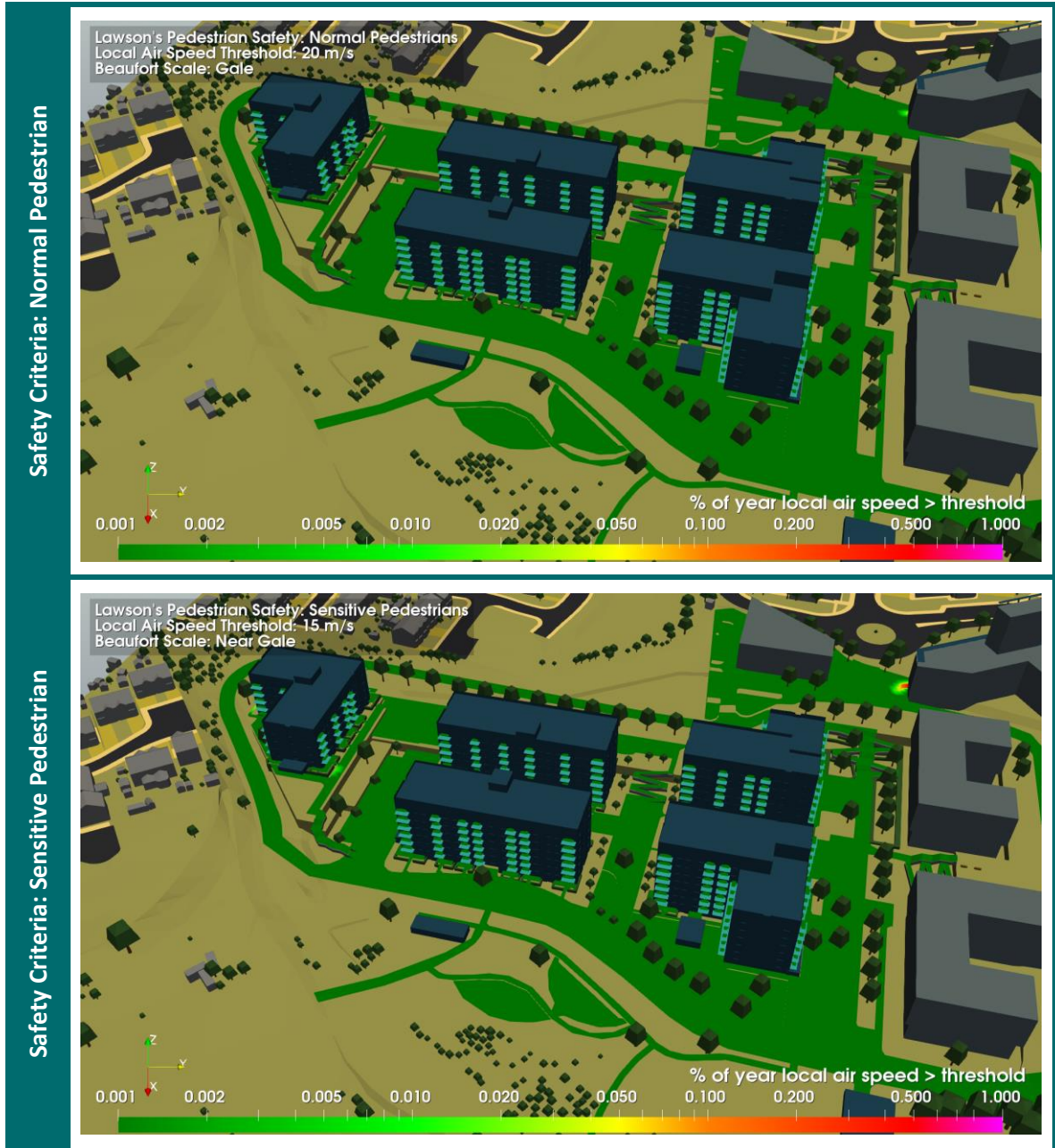


Figure 76: Safety Criteria: View from the east

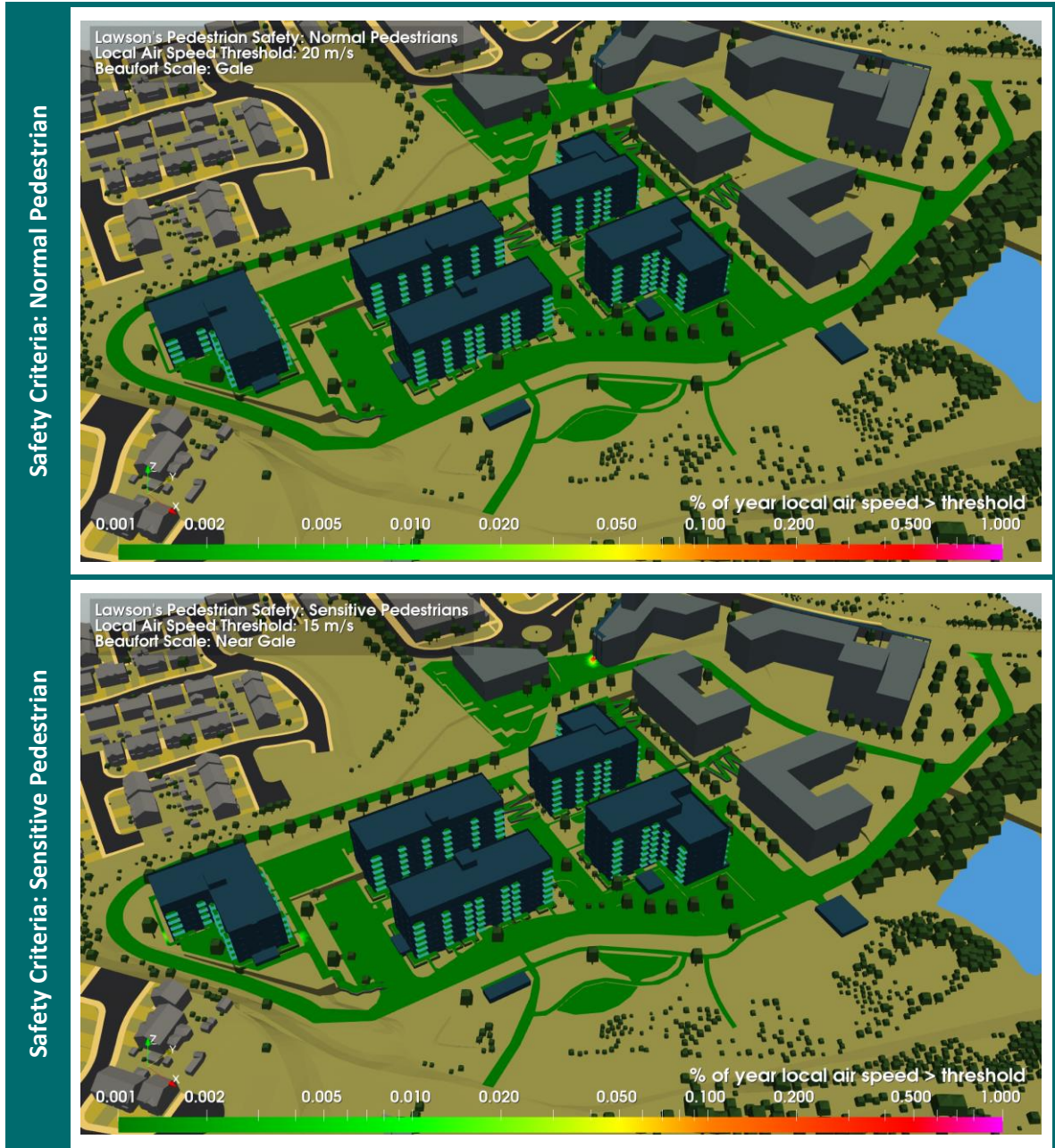


Figure 77: Safety Criteria: View from the southeast

