

Glenveagh Living Ltd  
**Castleforbes Development**  
Wind Microclimate Study

Issue 01 | 30 October 2020

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Job number 267064-00

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# Document Verification

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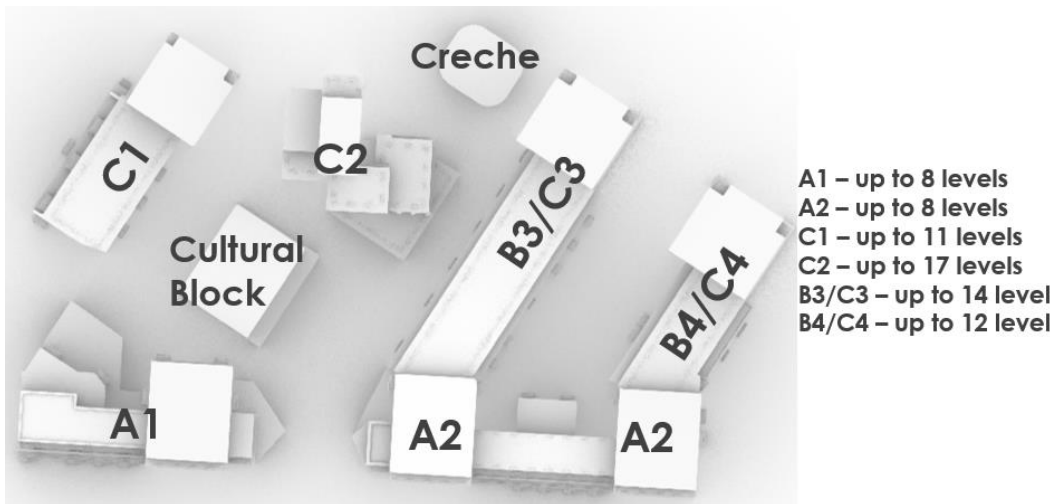
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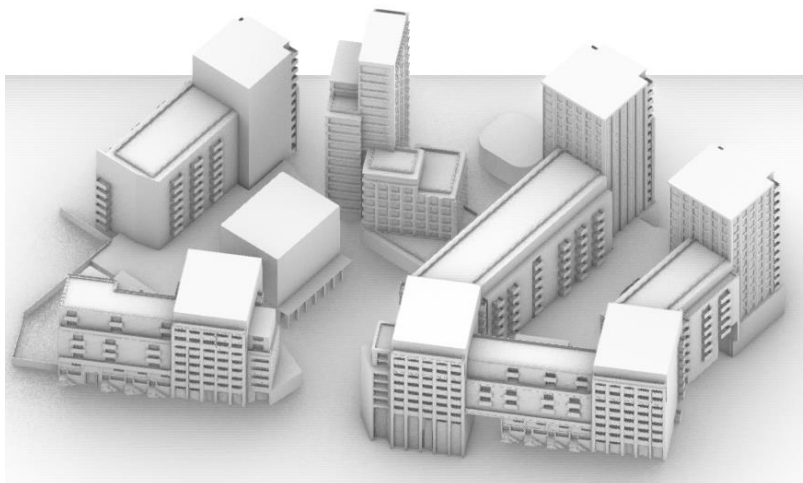
## Executive Summary

The development will consist of the demolition of all structures on the site and the construction of a mixed use residential development set out in 9 no. blocks, ranging in height from 1 to 18 storeys, above part basement/upper ground level, to accommodate 702 no. build to rent residential units, retail/café/restaurant units, cultural building, creche and residential tenant amenity.



**Figure E1:** Proposed Development Layout

The residential buildings are arranged around a central open space (at ground level) and raised residential courtyards at upper ground level over part basement level. The main pedestrian access is located centrally along Sheriff Street with additional access points from East Road and from the eastern end of Sheriff Street. The application also includes for a temporary pocket park on the corner of Sheriff Street Upper and East Road.



**Figure E2:** 3D model of Castleforbes proposed development

In general, the wind conditions are expected to be in ‘sitting’ to ‘standing’ range and the spaces in and around the proposed development are suited to their intended use.

The critical wind directions for this development in terms of pedestrian comfort are the East and West due to their frequency and orientation of the development.

The entrances into the proposed development as well as entrances leading to the terraces are located away from the corners, which is beneficial in avoiding as higher speed winds. The wind conditions are expected to be within the ‘sitting’ and ‘standing’ ranges and therefore, entrances are suitable for their intended use.

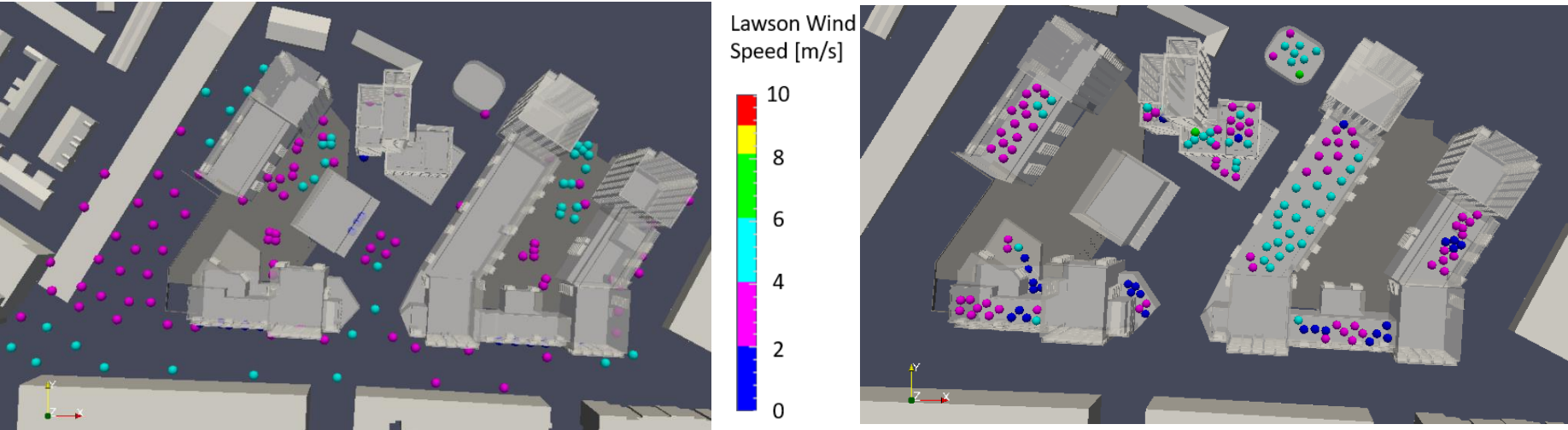
The walkways along East Road and Sheriff St. are well sheltered from most wind directions as adjacent existing and permitted developments are similar in heights. Wind condition along these walkways are expected to be within ‘sitting’ and ‘standing’ range and therefore walkways are considered suitable for their intended use. In the short-term, the southeastern corner of Block A2 may be windy at times due to easterly winds funnelling down Sherriff Street. This winds at this corner will ease in time as it becomes sheltered by the permitted hotel and office development to the east (DCC Reg. Ref. 3433/19).

Public spaces including central plaza and the western podium to the west are acceptable for ‘sitting’ activities. Landscaping will further enhance the attractiveness of these spaces for pedestrians and other occupants.

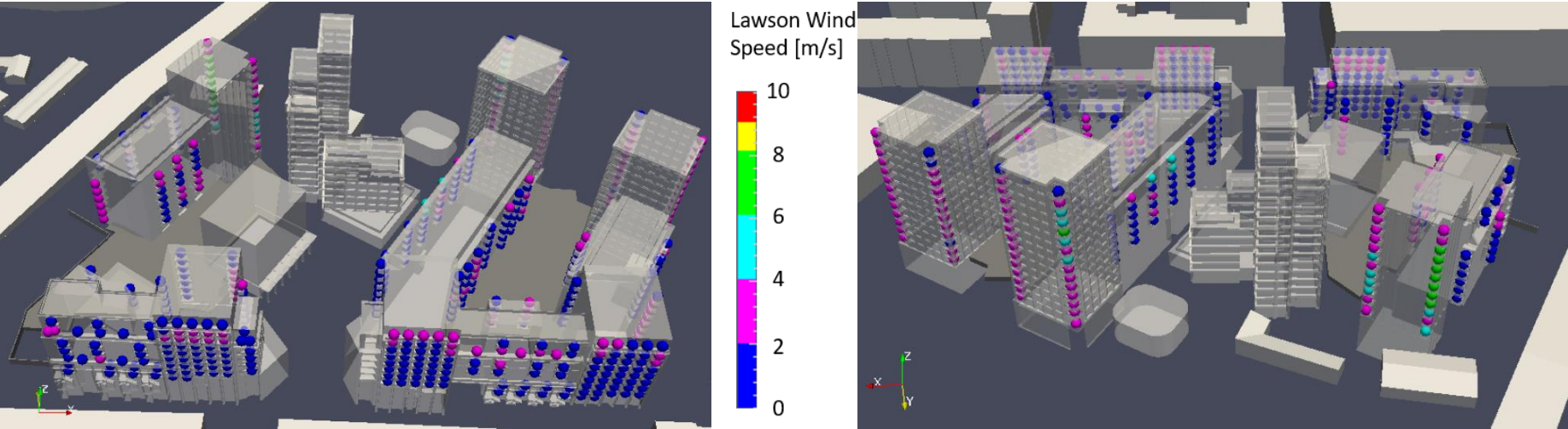
The eastern podium may experience windy conditions at the northern end and calmer conditions further south. The southern end is acceptable for ‘sitting’ activities. The provision of dense hedging and raised planters as well with 2.4m high glass winter garden balustrade around the eastern podium assists in providing better protection from the wind. These measures are insufficient at alleviating the worst wind effects completely, however, it should be noted that the stronger winds will only occur for a few hours each year (fewer than 28 hours a year i.e. 0.32% of the time). These events are likely to coincide with adverse weather conditions when ‘sitting’ is less desirable and less likely to occur. Moreover, there are other spaces on the same podium will remain more suited to ‘sitting’ even during these adverse weather events.

In general, wind conditions on terraces are expected to be in the ‘sitting’ to ‘standing’ range and most of the terraces are suitable for their intended use. However, further wind shielding and landscaping is required on terraces of the Blocks B3/C3 and B4/C4 to attain wind conditions that would provide a suitability comfortable and safe environment for occupants. The stronger winds will likely occur during adverse weather conditions when terraces are more likely unoccupied (i.e. 0.28% of the time). Additionally, it is considered that during these adverse wind conditions, the management company would likely restrict access for health and safety reasons.

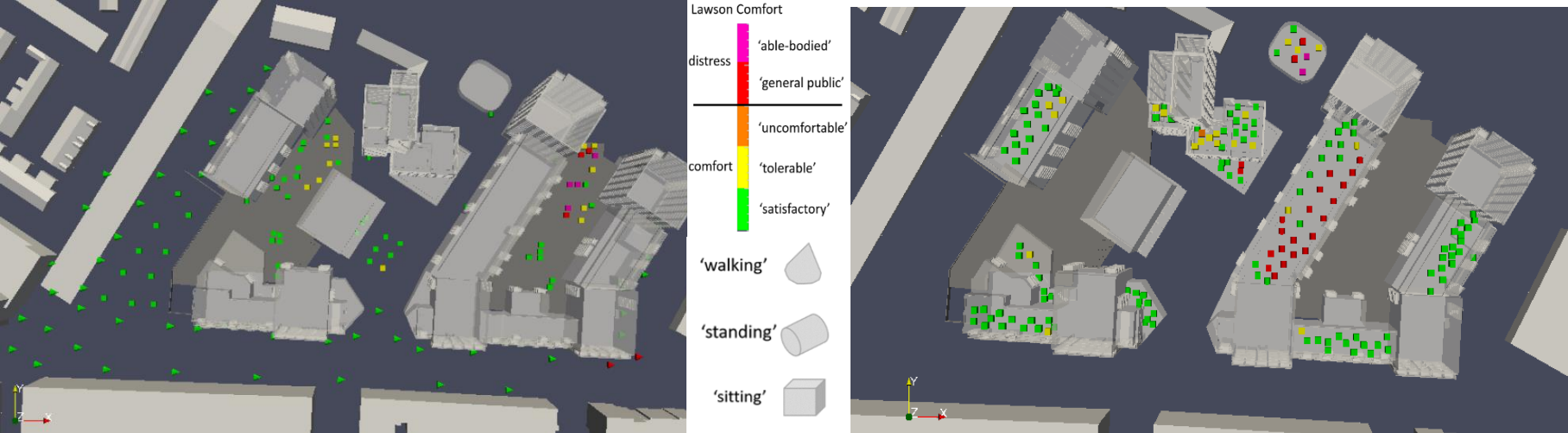
Overall, the proposed development contains many high quality public spaces that pedestrians and occupants undertaking a wide variety of activities will find comfortable and attractive for the majority of the wind conditions.



**Figure E1:** Lawson wind speeds (m/s) at ground level (left) and terraces (right) without any mitigation

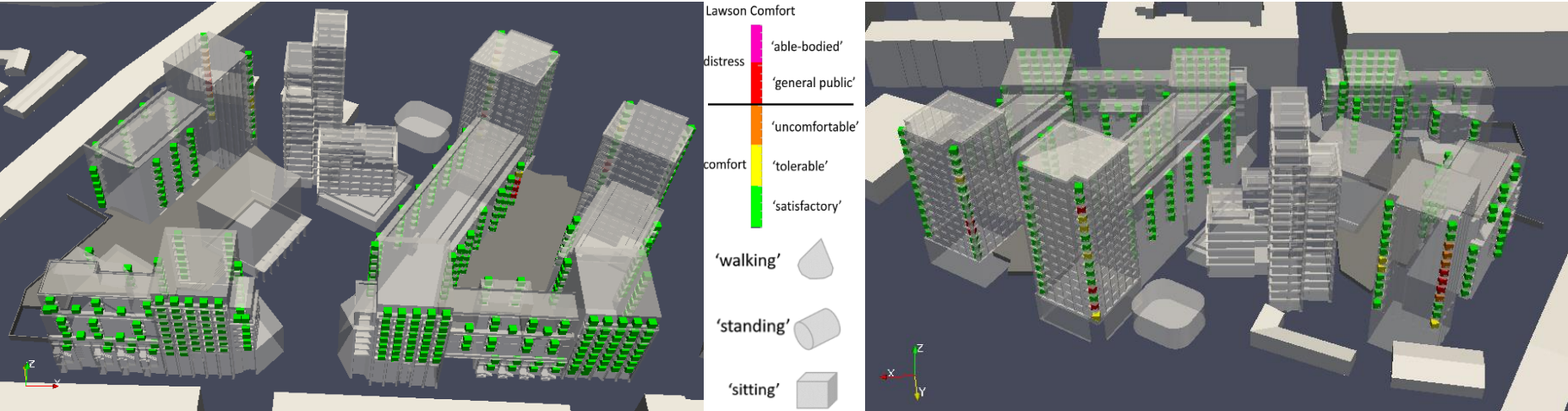


**Figure E2:** Lawson wind speeds (m/s) at balconies without any mitigation

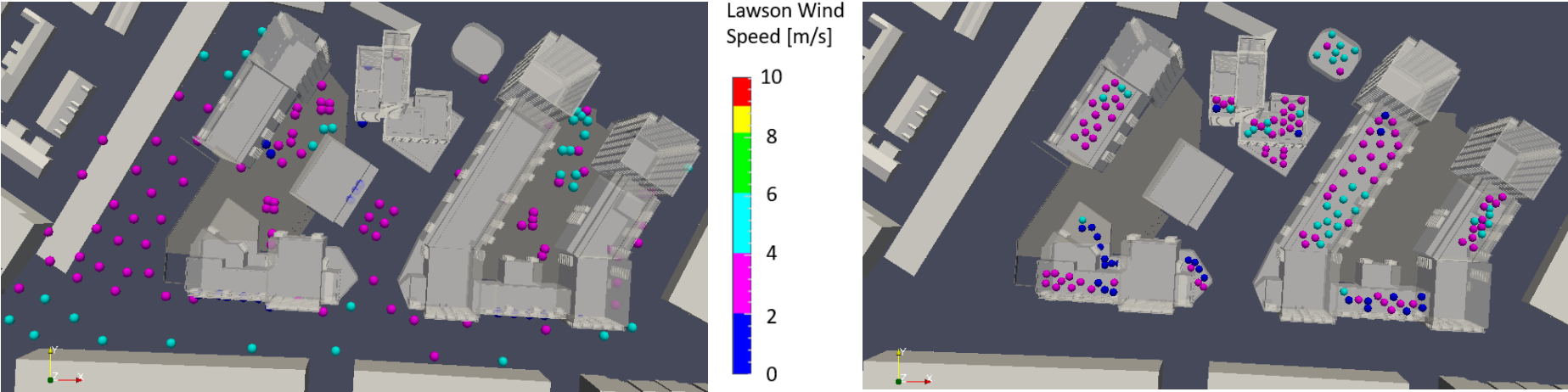


**Figure E4:** Lawson comfort criteria at ground level (left) and terraces (right) without any mitigation

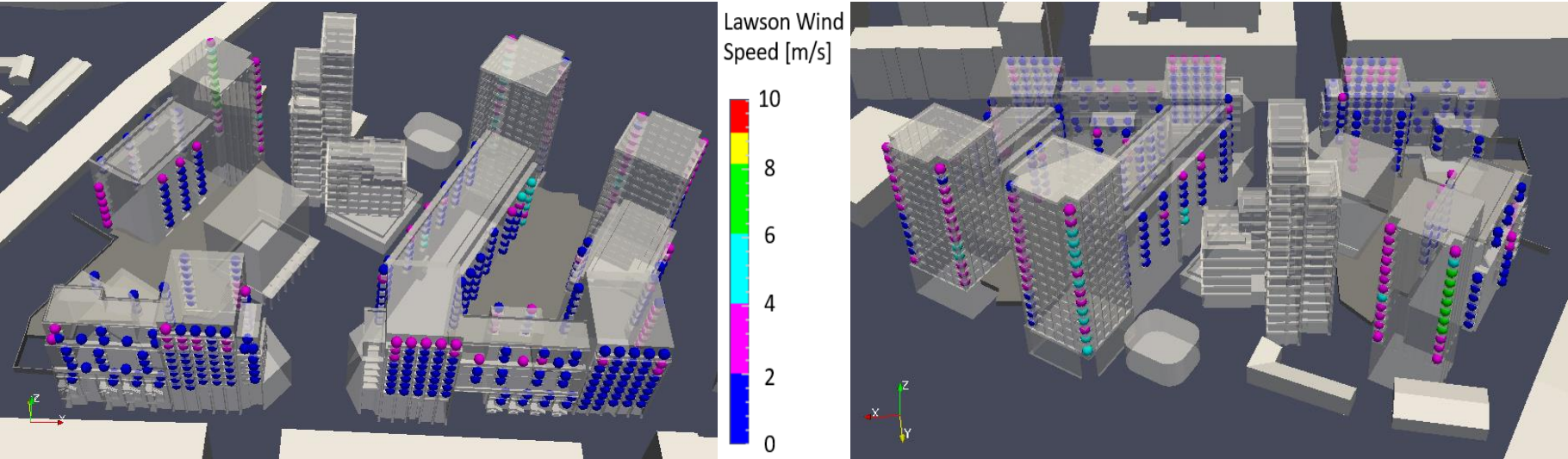




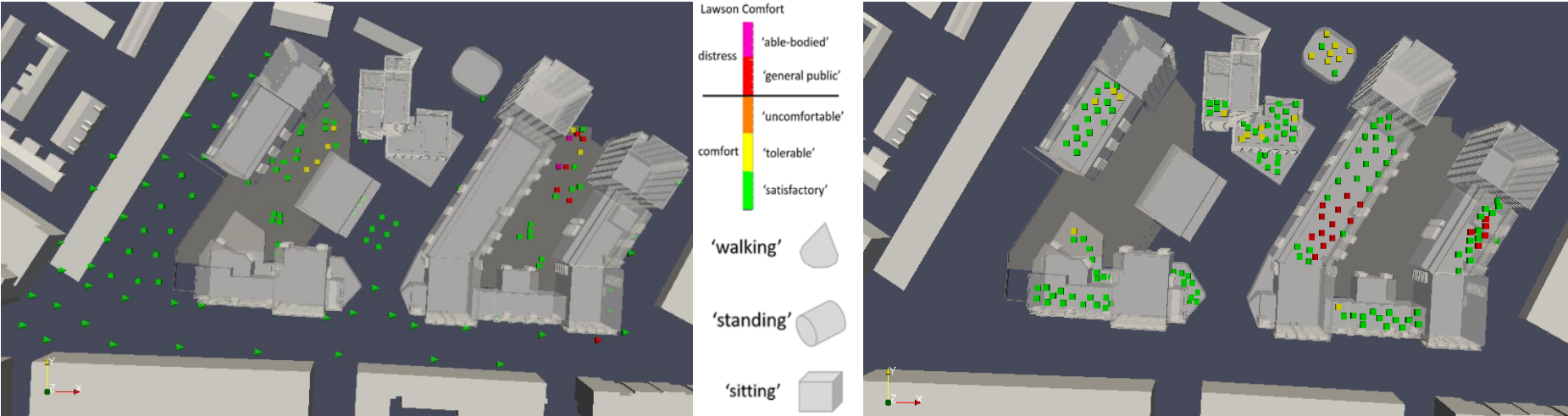
**Figure E5:** Lawson comfort criteria at balconies without any mitigation



**Figure E6:** Lawson wind speeds (m/s) at ground level (left) and terraces (right) with mitigation measures



**Figure E7:** Lawson wind speeds (m/s) at balconies with mitigation measures



**Figure E8:** Lawson comfort criteria at ground level (left) and terraces (right) with mitigation measures

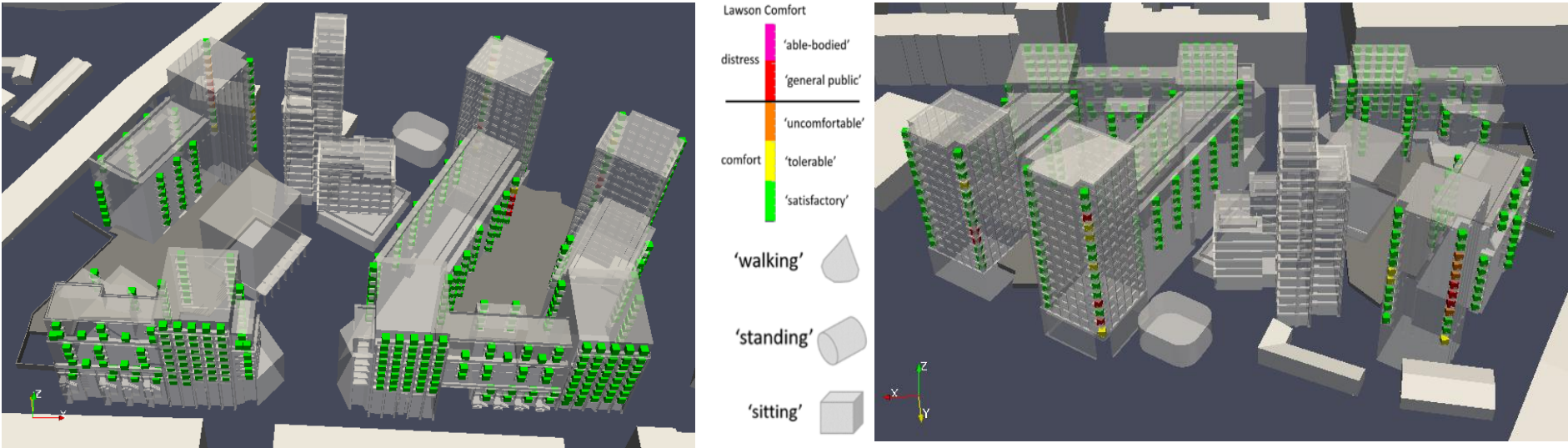


Figure E9: Lawson comfort criteria at balconies with mitigation measures

# 1 Introduction

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## 1.1 Overview

The proposed development is situated on Sheriff Street Upper and East Road, Dublin 1, immediately south of the railway yard, to the north of the River Liffey and east of Dublin Port.

During the design process, the influence of the development of the local wind microclimate and its impact on the quality of the pedestrian environment was examined. This report describes the methods used to assess these impacts in terms of pedestrian comfort and safety and outlines how the findings informed the design process.

This report assesses the impact of the proposed development on the wind conditions affecting pedestrian activities in areas within and surrounding the development. The erection of new taller buildings may alter the flow of the wind in the surrounding area. The windiness depends on both the massing of the buildings within their surroundings, their orientation with respect to the wind, and the local climate. Therefore, it is necessary to ascertain if the proposed development enhances or reduces the quality of the public realm. The assessment of discomfort and distress of pedestrians has been carried out in accordance with the Lawson Comfort Criteria [1].

## 1.2 Objectives

The objectives of the wind assessment are as follows:

- To ascertain the level of pedestrian wind comfort at sensitive receptors (i.e. walkways, entrances, public spaces and balconies) within and in the vicinity of the apartment/commercial blocks within the proposed development;
- To propose potential mitigation measures and evaluate their effectiveness, as appropriate; and
- To report on the environmental wind conditions associated with the proposed development for incorporation into a planning report.

## 2 Study Methodology

It is important to understand the wind microclimate around a proposed development in order to understand the level of pedestrian comfort. The assessment has been undertaken in the following key locations:

- Pedestrian thoroughfares;
- Entrances;
- Public Spaces;
- Balconies;
- Terraces.

In addition, the study has examined if any additional mitigation measures, such as canopies, screens and landscaping are required.

### 2.1 Lawson Comfort Criteria

The criteria used to describe windiness in this study are those of TV Lawson of Bristol University, extracted from “The evaluation of the windiness of a building complex before construction”, TV Lawson, London Docklands Development Corporation. These are used widely in Ireland, UK and around the world.

The acceptability of windy conditions is subjective and depends on several other factors, including but not limited to, normal clothing for the time of the year, expectations of the wind environment, air temperature, humidity and sunshine and most notably the activities to be performed in the area being assessed. The Lawson Criteria describe acceptability for particular activities in terms of 'comfort' and 'distress' (or safety). Acceptable conditions for various activities in order of increasing windiness are described in Table 2.1.

**Table 2.1:** Comfort Criteria as Defined by TV Lawson

Activity	Description
‘sitting’	Regular use for reading a newspaper and eating and drinking
‘standing’	Appropriate for bus stops, window shopping, building entrances, and public amenity spaces such as parks
‘strolling’	General areas of walking and sightseeing
‘business walking’	Local areas around tall buildings where people are not expected to linger

**Note:** A classification of ‘business walking’ does not mean that a location will never be suitable for ‘sitting’, however, it is likely to occur relatively infrequently.

#### 2.1.1 Comfort Levels

The onset of discomfort depends on the activity in which the individual is engaged and is defined in terms of a mean hourly wind speed which is exceeded for 5% of the time. The conditions, as described in Table 2.1 above, are the

limiting criteria for comfort. For ideal conditions, the windiness will be a category better than outlined above. For more sensitive activities, such as regular use for external eating, conditions should be well within the ‘sitting’ category. Ireland is a windier climate than the UK, where these criteria were developed. It is generally accepted that residents in windier climates are more resilient to stronger winds. Therefore, a slight exceedance of the limiting criteria for comfort is not considered significant.

## 2.1.2 Distress Levels

There is a criterion to define the onset of distress. For the ‘General Public’, this is equivalent to an hourly mean speed of 15 m/s and a gust speed of 28 m/s to be exceeded less often than once a year. This is intended to identify wind conditions which less able individuals or cyclists may find physically difficult. Conditions in excess of this limit, may be acceptable for optional routes and routes which less physically able individuals are unlikely to use.

There is a further limiting distress criterion beyond which even ‘Able-Bodied’ individuals may find themselves in difficulties at times. This corresponds to a mean speed of 20 m/s and a gust speed of 37 m/s to be exceeded less often than once a year. Aerodynamic forces may exceed body weight in stormy conditions, which makes it difficult for anyone to remain standing. Where wind speeds exceed these values, pedestrian access should be limited.

**Table 2.2:** Distress Criteria as defined by TV Lawson






Activity	Description
General Public Access	Above which the less able and cyclists may at times find conditions physically difficult
Able-bodied Access	Above which it may become impossible at times for an able-bodied person to remain standing

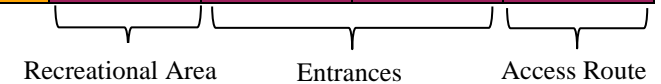


**Table 2.3: Lawson comfort criteria**

Beaufort Scale	Wind Effects on the Environment	Wind Speed (m/s)		Activity			
		At 10m	threshold	'sitting'	'standing'	'strolling'	'business walking'
0 - 1	Calm – no significant wind	<1.5					
2	Wind felt on the face, leaves rustle	1.5 – 3.3					
3	Leaves and twigs move, wind carries small flags	3.4 – 5.4	4.0				
4	Dust and papers raised from the ground, small branches are agitated	5.5 – 7.9	6.0				
5	Wind is felt on the body, small trees move	8.0 – 10.7	8.0				
6	Difficult to walk straight, umbrellas are difficult to use, large branches begin to move	10.8 – 13.8	10.0				
7	Difficult to walk into the wind, trees are completely moving	13.9 – 17.1					
8	Storm – walking is hampered, branches break	17.2 – 20.7	15.0				
9	Storm – risk of losing balance, dangerous to walk	> 20.8	20.0				

**Legend**

	Acceptable	}	Comfort Criteria
	Tolerable		
	Unacceptable		
	Dangerous – General Public including Cyclists	}	Distress Criteria
	Dangerous – Able-bodied Pedestrians		

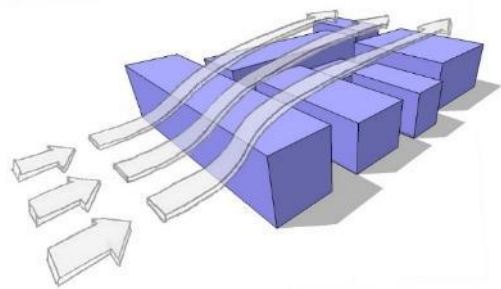


## 2.2 Key Flow Mechanisms

There are certain flow patterns that can result in increased flow velocities. The main flow mechanisms of concern are described below:

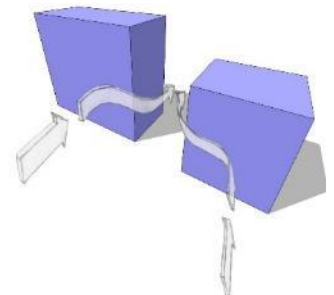
### 1. Exposure and Shelter:

When buildings of similar height are in close proximity to each other, the first line of buildings can shelter the buildings behind from the wind. However, if the gap is relatively large, the building upstream may not provide adequate shelter. In this case, the higher velocity high level wind from above may descend to ground and therefore, this may create an inclement environment for pedestrians.



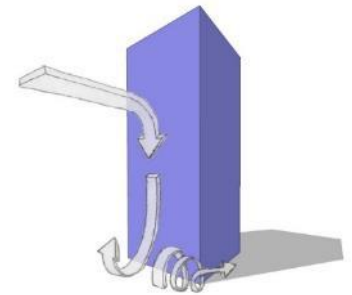
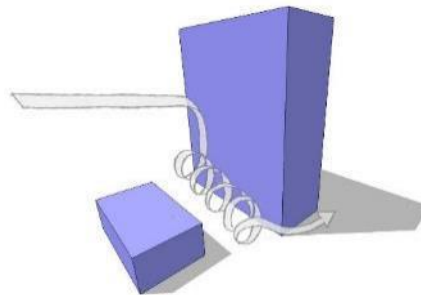
### 2. Funnelling:

When the gap between buildings is relatively narrow in comparison to their overall width, a large volume of wind is forced through the narrow opening. It is necessary for the wind speed to increase through the opening, which can result in discomfort for pedestrians.



### 3. Downdraft:

When buildings are considerably taller than the other buildings in their surroundings, they can redirect the high-speed winds that they interact with at a high level down to ground in the form of a downdraft. The downdraft effect can be further exacerbated by lower level buildings in close proximity upstream.



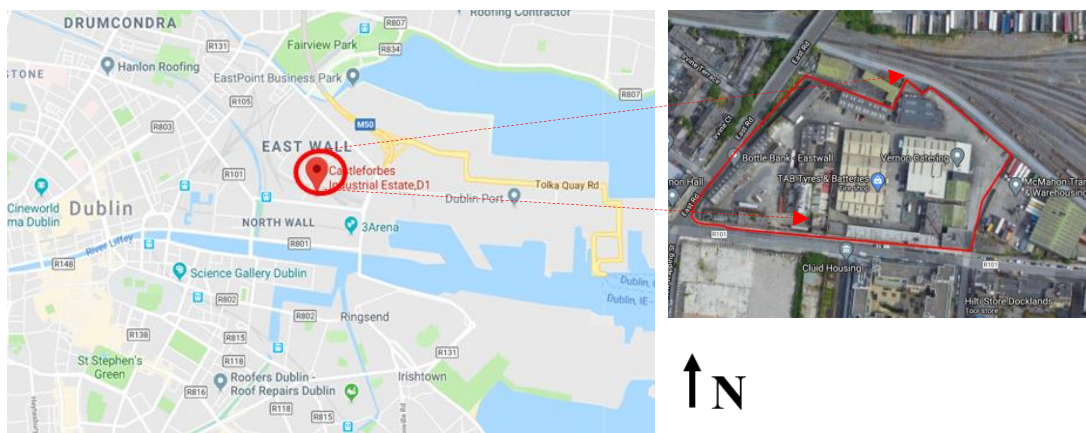
## 2.3 Computational Fluid Dynamics

The wind microclimate analysis that is expected to be experienced by pedestrians and other users of the proposed development is conducted with the aid of Computational Fluid Dynamics (CFD), which is a numerical technique to simulate fluid flow, heat and mass transfer, chemical reaction and combustion, multiphase flow, and other phenomena related to fluid flows. Modelling in CFD includes three main stages: pre-processing, simulation and post-processing. Computational Wind Engineering (CWE) is a branch of CFD concerned with behaviour of wind. It can be used to understand the wind flow through an urban environment and the effect of a proposed development on the local wind microclimate.

## 3 Existing Receiving Environment

### 3.1 Site Location and Surrounding Area

The Castleforbes commercial and residential development is situated on Sheriff Street immediately south of the railway yard in the East Wall area of the city (Figure 3.1). The northern and eastern boundary of the site bounds with railway yard. The southern boundary is constrained by Sheriff Street Upper. Industrial, commercial, leisure and retail land uses are all present in proximity. There are existing residential apartment blocks of similar height and scale in the lands adjacent to the south and lower level terraced housing situated on the opposite side of the East Road to the west.



**Figure 3.1:** Proposed development location

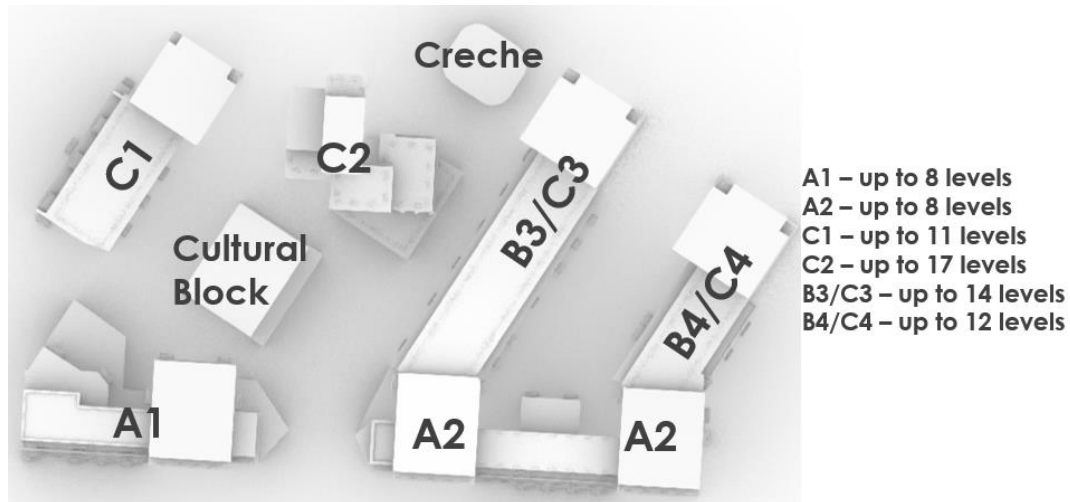
#### 3.1.1 Planned and Permitted Developments

The study considers planned and permitted developments in the immediate vicinity of the proposed development. The proposed development is considered within the context of all surrounding permitted developments. However, the study also considers the impact of the planned development 7 to 10-storey hotel alongside a 6 to 9-storey commercial office building located immediately east of the proposed development due to their proximity to the proposed development.

### 3.2 Characteristics of the Proposed Development

The development will consist of the demolition of all structures on the site and the construction of a mixed use residential development set out in 9 no. blocks, ranging in height from 1 to 18 storeys, above part basement/upper ground level, to accommodate 702 no. build to rent residential units, retail/café/restaurant units, cultural building, creche and residential tenant amenity.

The site will accommodate car parking spaces, bicycle parking, storage, services and plant areas.



**Figure 3.3:** Proposed development layout

The residential buildings are arranged around a central open space (at ground level) and raised residential courtyards at upper ground level over part basement level. Ground floor level uses located onto Sheriff Street and into the central open space include a cultural building, retail/restaurant/cafe units, and tenant amenity space.

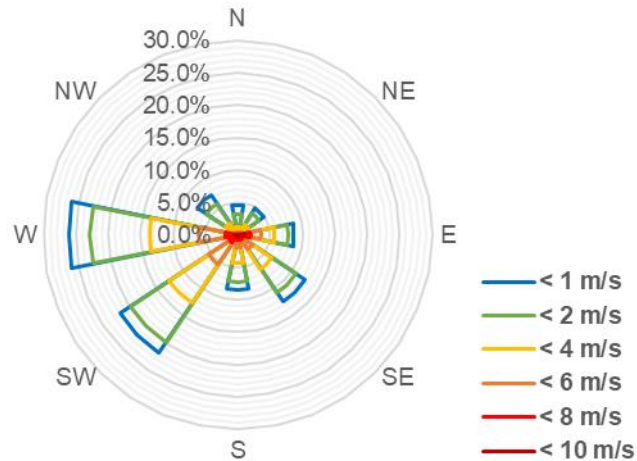
Two vehicular access points are proposed along Sheriff Street, and the part basement car parking is split into two areas accordingly, accommodating bicycle parking spaces, car parking spaces, plant, storage areas and other associated facilities.

The main pedestrian access is located centrally along Sheriff Street with additional access points from East Rd and from the eastern end of Sheriff Street.

The application also includes for a temporary pocket park on the corner of Sheriff Street Upper and East Rd to be provided as a temporary development prior to additional future development on this part of the site (DCC Reg. Ref. 2143/20). A detailed development description is set out in the Statutory Notices.

### 3.3 Wind Microclimate

Met Eireann's meteorological station at Dublin Airport is the closest meteorological station to Dublin and to the site. The expected statistics for wind strength and direction are based on historic wind data recorded at this weather station. The meteorological data, which was associated with the hourly wind speeds recorded over a 30-year period between 1988 and 2018, was analysed. The data is recorded at a weather station at the airport, which is located 10m above ground or 71mOD.



**Figure 3.5:** Dublin Airport Wind Rose

In this study, winds were considered to approach from eight distinct sectors. A Weibull distribution was fitted to the wind data for each sector through the adoption of an appropriate dispersion parameter,  $c$ , and shape parameter,  $k$ , given in the table below. The 95<sup>th</sup> percentile and ‘once-a-year’ wind speeds were derived from the subsequent cumulative Weibull distributions.

**Table 3.1:** Weibull distribution parameters (based on wind speed in m/s)

Wind Direction	N	NE	E	SE	S	SW	W	NW
Directional probability, $p$	5.6%	5.3%	9.1%	13.1%	9.0%	22.5%	27.4%	8.1%
Dispersion parameter, $c$	4.0	5.0	4.8	5.3	6.0	7.0	6.4	4.7
Shape parameter, $k$	1.5	1.9	1.7	1.9	1.8	2.3	1.9	2.0

In order to account for differences in topography and terrain exposure, the local wind data from Dublin Airport was transposed to the development site using the ESDU (Engineering Sciences Data Unit) methodology, which is compatible with Irish practice for wind loading. The transformation considers the exposure of the site, which is a measure of the terrain roughness (i.e. size and number of obstacles) upstream of the site. The exposure is dependent on the direction of the oncoming wind.

## 4 Detailed Quantitative Analysis

A comprehensive analysis was undertaken to quantify the pedestrian comfort level at key locations in the domain using computational fluid dynamics (CFD). In general, the proposed development is likely to provide a comfortable and an attractive environment for pedestrians and occupants for the majority of wind conditions. The prevailing winds are easterly and westerly which have the potential, on occasions, to cause conditions that pedestrians may find distressing without the appropriate mitigation measures in place.

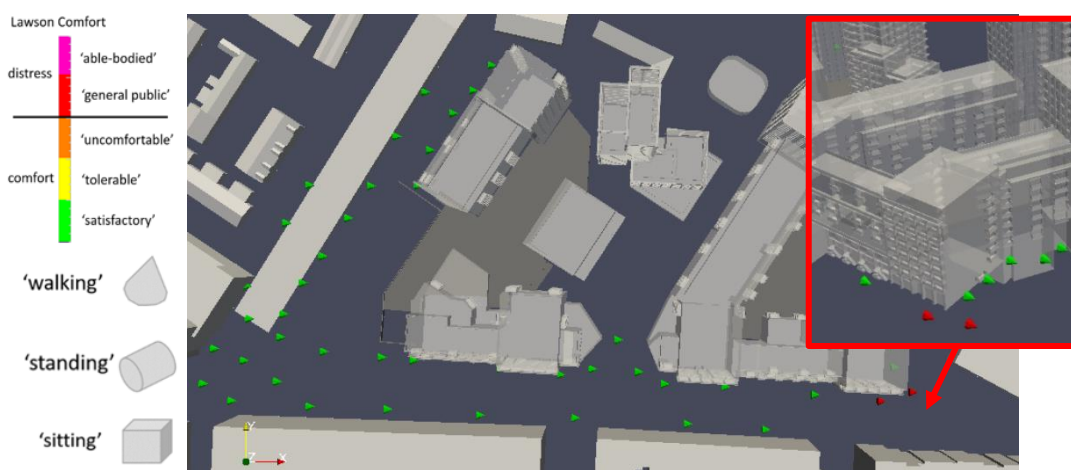
### 4.1 Thoroughfares

In general, the thoroughfares in and around the proposed development are sheltered from the wind. The blocks along East Road are similar in height to the adjacent existing and permitted developments. This assists in sheltering the thoroughfares below from the prevailing winds from the south and west. The wind conditions are expected in the 'standing' range and therefore, they are considered suitable for their intended use.

#### 4.1.1 Sheriff Street Upper

At the southern boundary of the proposed development, Sheriff Street Upper provides connectivity between the proposed development and its surroundings. Pedestrians and cyclists will use Sheriff St. to access other places in the city. There are entrances directly accessing the development from Sheriff St.:

- Two vehicular accesses to the development;
- Pedestrian access to the central plaza of the development.



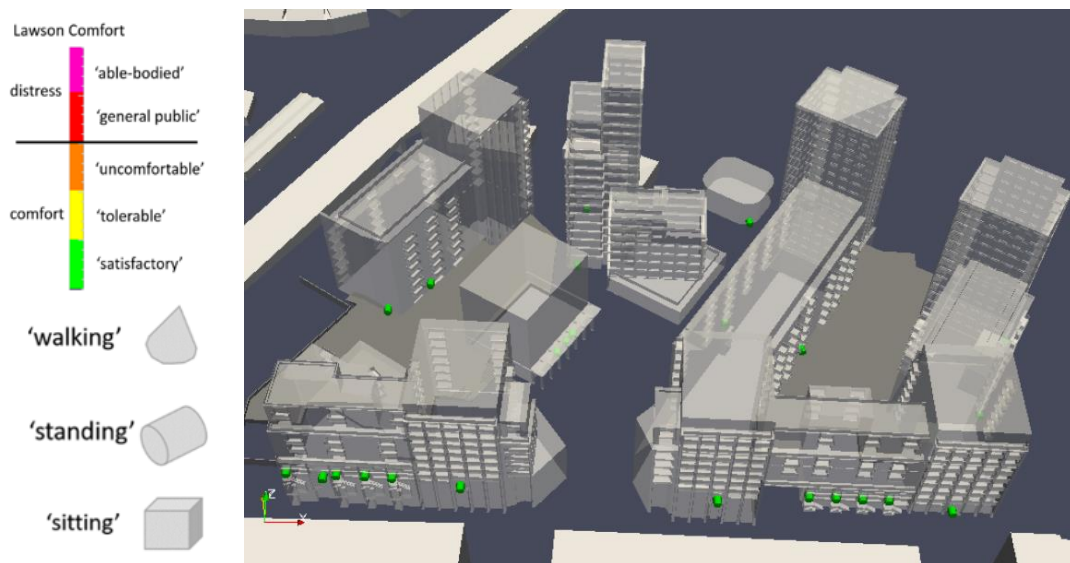
**Figure 4.1:** Lawson comfort at thoroughfares without wind mitigation

Sheriff Street is a single carriageway road with on-street parking and pedestrian footpaths on either side and therefore, it will be used as a thoroughfare by pedestrians. Sheriff St. is sheltered from most wind directions due to its orientation and width in conjunction the adjacent developments of similar height. In general, the wind conditions are expected in the ‘standing’ range (i.e. wind speeds <math><6\text{m/s}</math>). The southeastern corner of Block A2 may be windy at times due to easterly winds funnelling down Sherriff Street. Wind conditions may lead to more vulnerable pedestrians feeling some distress, although these conditions will likely be prevalent for fewer than 15 hours a year (i.e. 0.17% of the time).

The provision of trees and other landscaping features along Sheriff Street as proposed will be helpful in disrupting the wind and providing more localised shelter for pedestrians.

## 4.2 Entrances

The entrances are located near the centre of the buildings and away from the corners of the blocks, where the higher speed winds are more likely to occur. The wind conditions will be comfortable for ‘standing’ and therefore, the entrances are considered suitable for their proposed use.



**Figure 4.2** Lawson comfort at entrances without wind mitigation

## 4.3 Public Spaces

The residential blocks are arranged around a central pedestrian plaza and two elevated communal amenity courtyards.

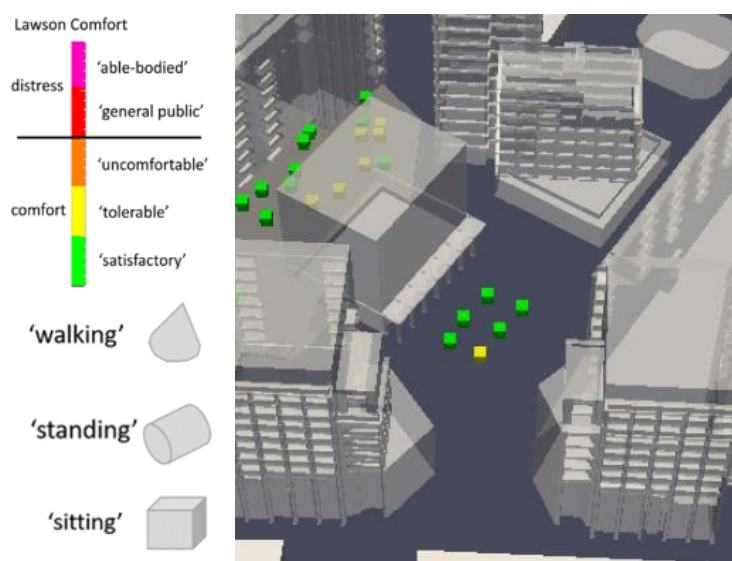
### 4.3.1 Central plaza

The central plaza is a multi-functional space, which includes:

- The main pedestrian access into the development;

- access to raised courtyards;
- entrances to residential blocks;
- amenity and leisure spaces for pedestrians;
- café / restaurant / retail units;
- new cultural / community building.

The Central Plaza is well sheltered from all wind directions by Blocks A1, B1, C2, B3/C3 and Cultural Block. Wind speeds remain within the ‘sitting and ‘standing’ ranges. Therefore, the Central Plaza is considered suitable for its intended use. The proposed landscape will be beneficial in providing more shelter to the central plaza users and ensuring pleasant environment for the occupants.



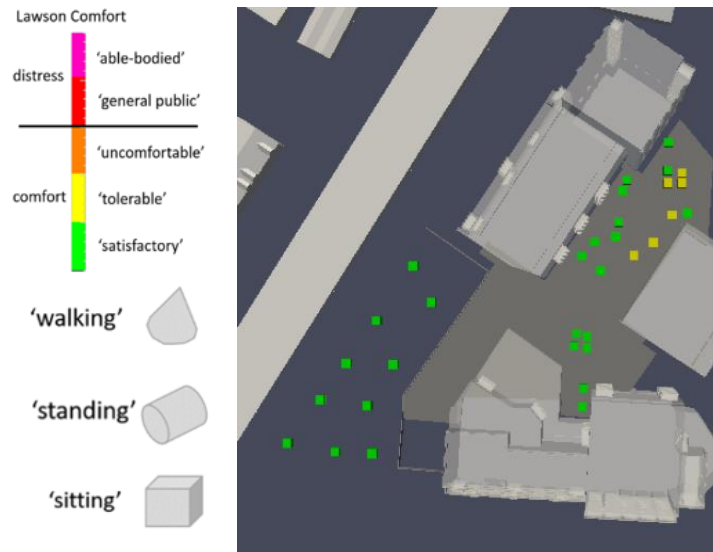
**Figure 4.3:** Lawson comfort at central plaza without wind mitigation

### 4.3.2 Western Podium and Car Park to the West

The Western Podium can be accessed from the central plaza via stairs and from East Road at the west boundary of the development or through the car park through vehicular access on Sheriff St. Upper. It facilitates access into the surrounding blocks through designated entrances as well as acting as amenity and leisure space for occupants. It also provides for public permeability through to East Road.

The courtyard is well sheltered by the surrounding blocks with expected wind conditions in ‘sitting’ to ‘standing’ range. This courtyard is considered to be appropriate for the intended use. The provision of landscaping will be beneficial in order to enhancing this pleasant environment for pedestrians and occupants.





**Figure 4.4:** Lawson comfort at western podium and car park without wind mitigation

### 4.3.3 Eastern Podium

The Eastern Podium is a multi-functional courtyard on a raised podium on the eastern side of the proposed development, between Blocks A2, B3/C3 and B4/C4. It facilitates access into the surrounding blocks through designated entrances as well as acting as amenity and leisure space for occupants.



**Figure 4.5:** Lawson comfort at eastern podium without wind mitigation

In general, the southern side of the podium is sheltered and it is only exposed to calm to moderate breezes (wind speeds <4m/s). This makes it an attractive space for ‘sitting’. However, northern end is more exposed given it is open to the adjoining railyard. At times, strong easterly winds penetrate into the courtyard generating considerable windiness. The winds at the northeastern end are anticipated in the ‘standing’ range and may even cause distress for a few hours each year. The provision of screens and denser more robust landscaping, as discussed in

Section 5.1 below, is required in obstructing and disrupting the wind to alleviate the worst effects of these winds.

#### 4.3.4 Terraces

Due to their elevation, the roof terraces are more exposed to the wind and are expected to be windy as a consequence. The windiest conditions will likely coincide with the most adverse weather events. It is recommended that the management company would limit or restrict access to the external roof terraces, where required (e.g. if Met Éireann issue a notification of a yellow, orange or red wind warning event).

#### 4.3.5 Entrances

The entrances providing access to the terraces are located near the centre of the buildings and away from the corners of the blocks, where the higher speed winds occur. The wind conditions are suitable for ‘sitting’ to ‘standing’ activities and therefore, the entrances are considered suitable for their proposed use.



**Figure 4.6:** Lawson comfort at terrace entrances without wind mitigation

#### 4.3.6 Blocks A1 and A2

Terraces on Blocks A1 and A2 are expected to be suitable for sitting in general due to the relative height of the blocks in comparison to their surroundings. The wind speeds on the terraces are expected to be suitable for sitting (i.e. wind speeds <math><4\text{m/s}</math>) (Figure 4.2). There are two isolated spots on the Block A1 lower eastern terrace which might experience wind conditions in the ‘standing’ range. This terrace will benefit from landscape provision.

### 4.3.7 Block C1

Wind conditions anticipated on the larger portion of Block C1 terrace is expected to be suitable for 'sitting' activities, although there are a few isolated spots more suited for 'standing'. In general, the terrace is expected to be suitable for its intended use and landscape treatment will further enhance the space for occupants.

### 4.3.8 Block C2

Block C2 has four terraces on the 2<sup>st</sup>, 6<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> floor levels. In general, these terraces are mostly suited to their intended use.

The Terrace on the 2<sup>nd</sup> level is well sheltered and benefits from its orientation. The wind conditions on this terrace are expected to be suitable for 'sitting' activities.

The sixth floor terrace benefits from the buildings to the west, which provide shelter to this terrace from prevailing southwest and west winds. This terrace is protected from easterly winds by the taller Blocks B3/C3.

The exposure of the 8<sup>th</sup> floor terrace results in a windy space. The provision of better wind shielding and landscape treatments, such as hedges and trees, are required to produce a space more suited for 'sitting'.

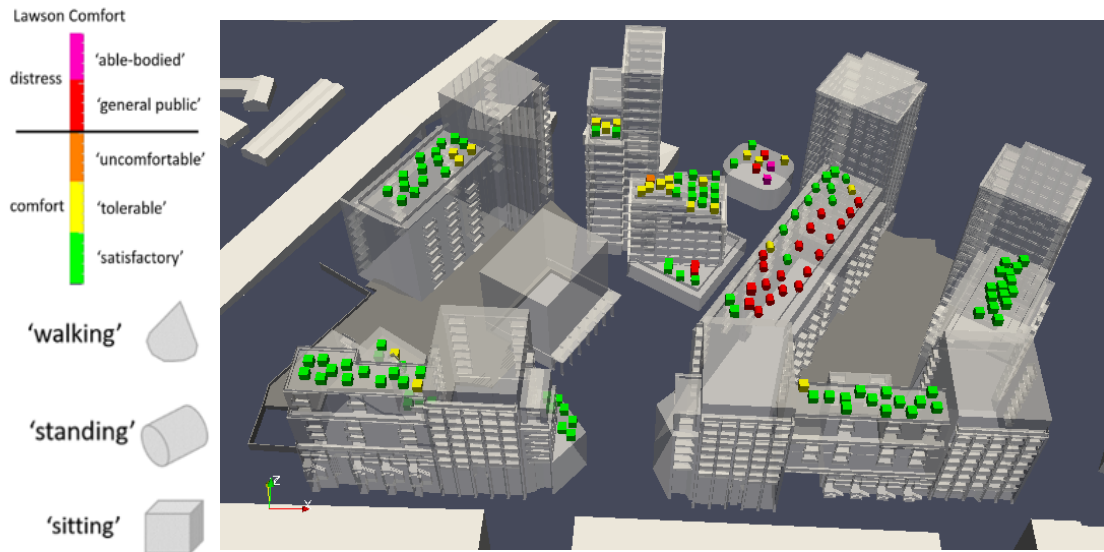
The 12<sup>th</sup> floor terrace, while higher, benefits from the nearby tower to the east, which affords it shelter. Wind conditions on this terrace are expected to be in the 'sitting' to 'standing' range.

### 4.3.9 Blocks B3/C3

The Blocks B3/C3 terrace is exposed to east and west winds due to its height. While the terrace is more appropriate for 'standing', significant windiness may be encountered on the terrace on occasion. The primary function of this space is for active and recreational uses and under these circumstances, the space is considered suitable for its intended use for the majority of the wind conditions.

### 4.3.10 Blocks B4/C4

The wind screens on the upper terrace on the Block B4/C4 provide adequate protection from the wind and wind conditions are appropriate for 'sitting' activities. The lower terrace is windier due to a downdraft off Block C4 above. This terrace is more suited for 'standing', although stronger winds may be present at limited times.



**Figure 4.7:** Lawson comfort at terraces without wind mitigation

## 4.4 Balconies

### 4.4.1 Blocks A1, A2 and B4/C4

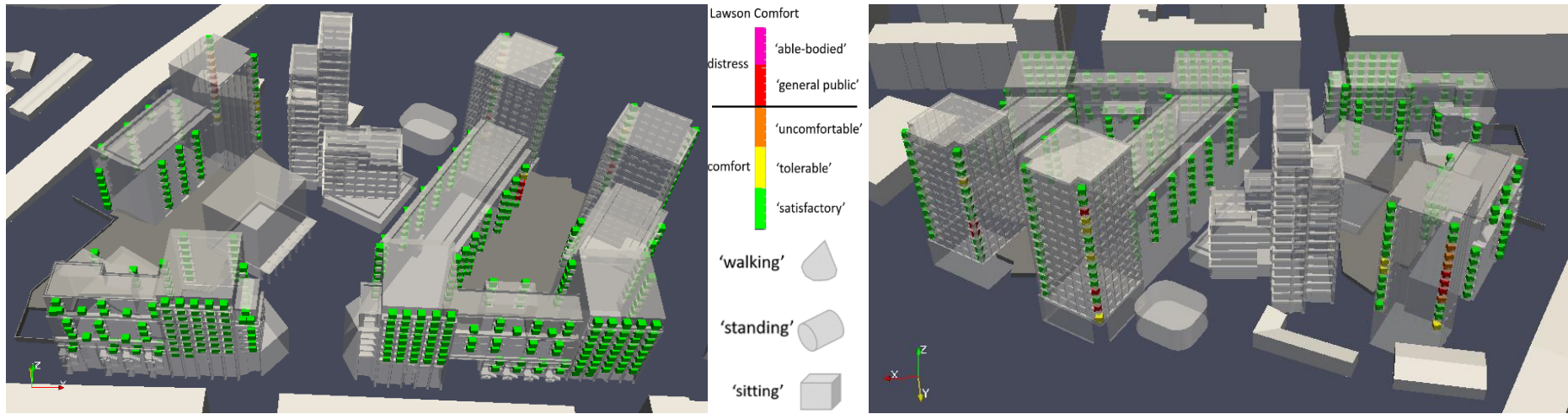
In general, these balconies are well positioned and sheltered as wind conditions are expected to experience wind conditions suitable for 'sitting' activities. The balconies are considered suitable for their intended use.

### 4.4.2 Block C1

Majority of the balconies at block C1 are expected to be suitable for their intended use as wind conditions are expected to be in the 'sitting' range. Few balconies on the northwest and northeast corners are expected to experience more windy conditions as they are located at the corners where high wind speeds may occur. These corners balconies will be comfortable for 'sitting' less often than desirable, however, they will continue to be attractive spaces for more than 85% of the year.

### 4.4.3 Block B3/C3

In general, the Block B3/C3 balconies are expected to be suitable for their intended use as the anticipated wind conditions are in the 'sitting' range. High level corner balconies may experience more windiness. These corners balconies will be comfortable for 'sitting' less often than desirable, however, they will continue to be attractive spaces for more than 85% of the year.



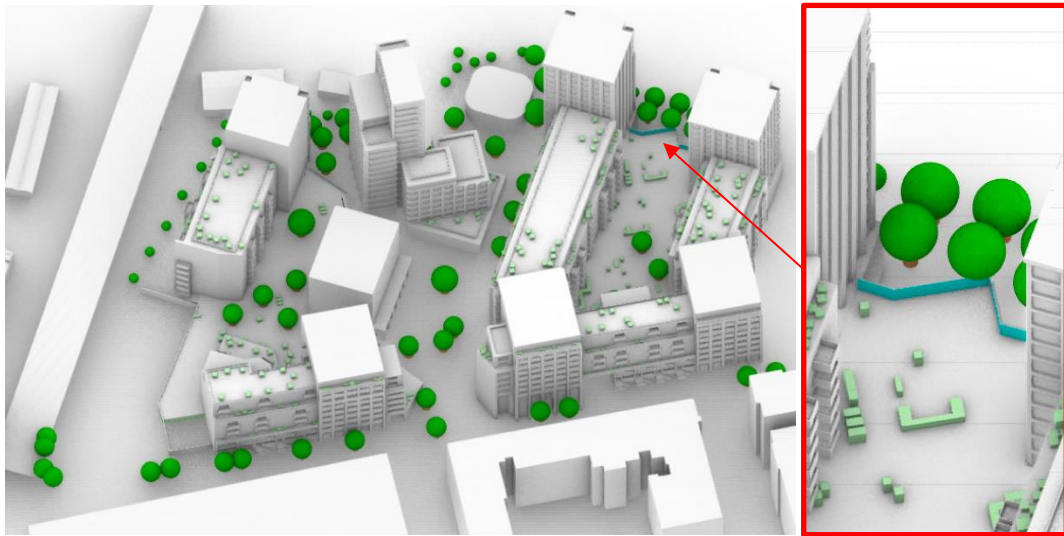
**Figure 4.8:** Lawson comfort at balconies without wind mitigation

## 5 Mitigation

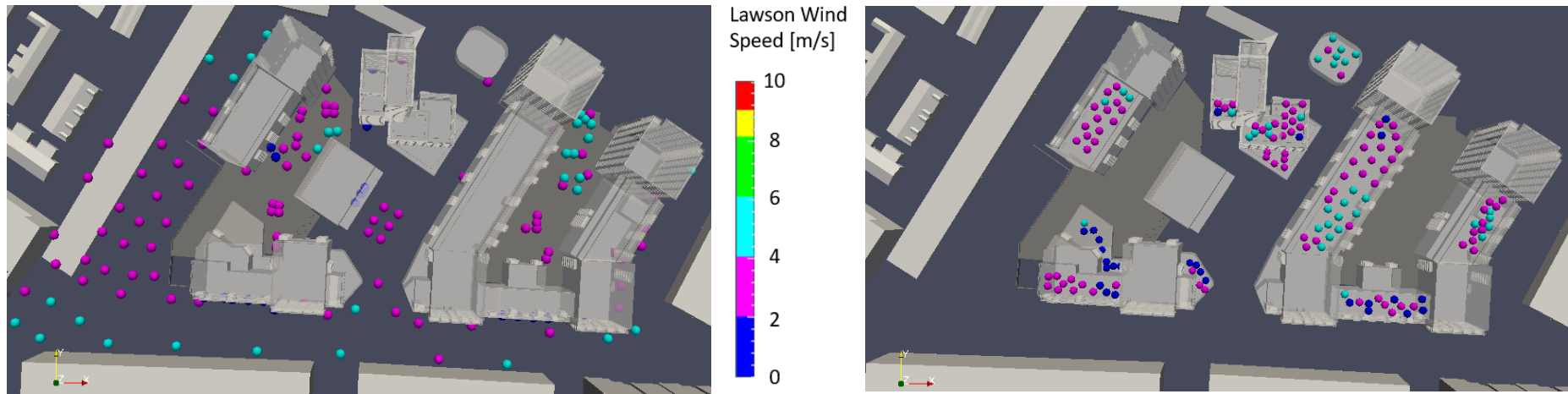
This assessment was undertaken in order to assess the effectiveness of the wind mitigation measures at alleviating the more frequently occurring windiness.

Mitigation measures included:

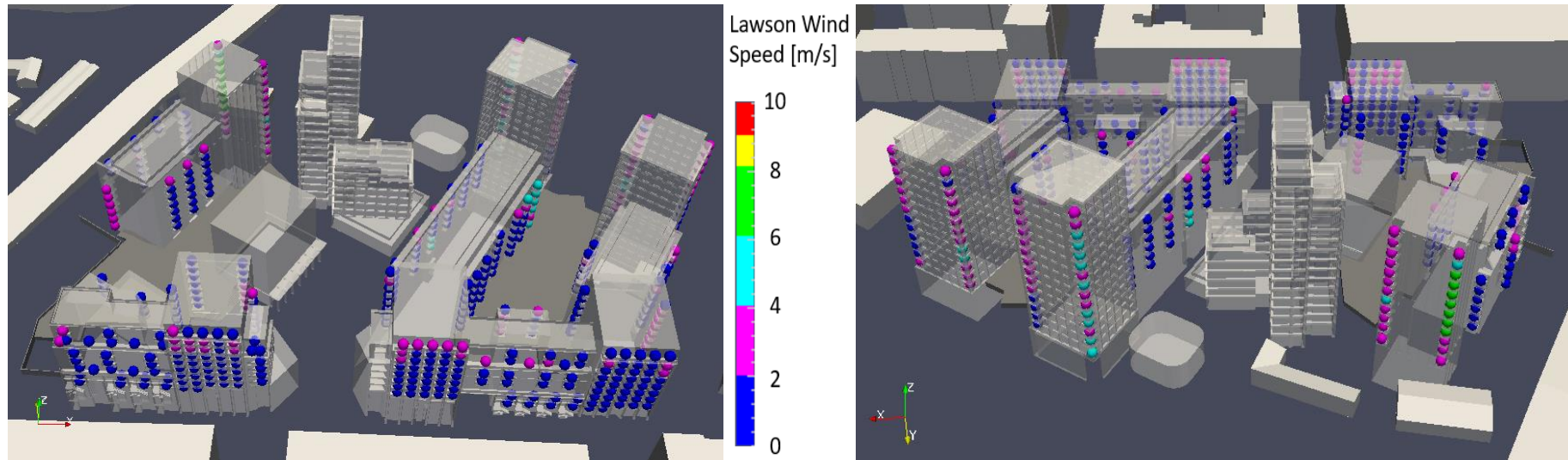
- A. A 2.4m height glass winter garden balustrade along northeast side of the eastern podium;
- B. Incorporation of proposed soft landscaping along the podiums and terraces.



**Figure 5.1:** Proposed landscape design with 2.4m height glass balustrade

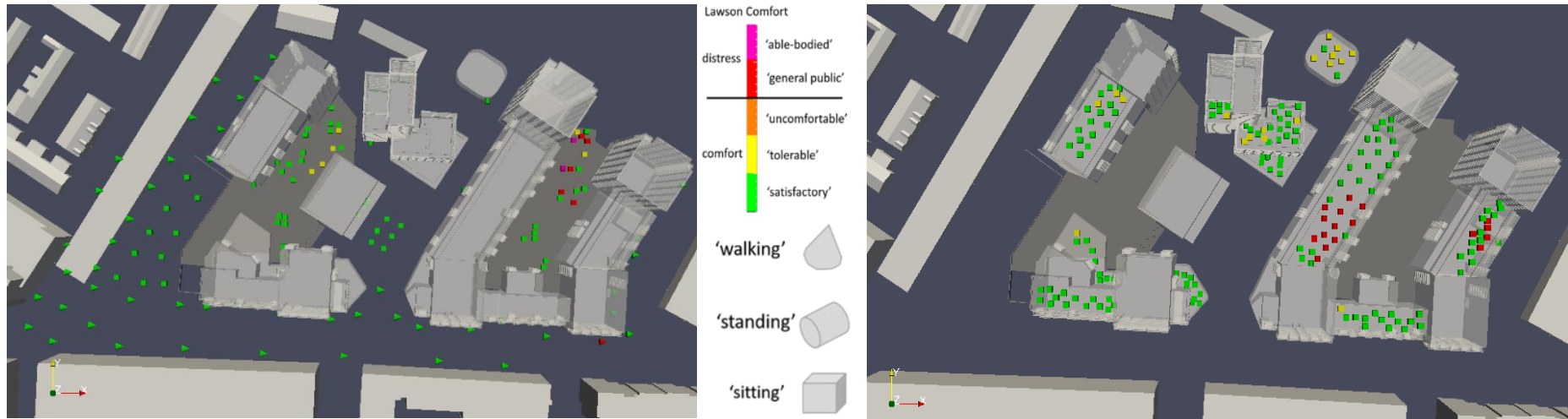


**Figure 5.2:** Lawson wind speeds (m/s) at ground level (left) and terraces (right) with mitigation measures

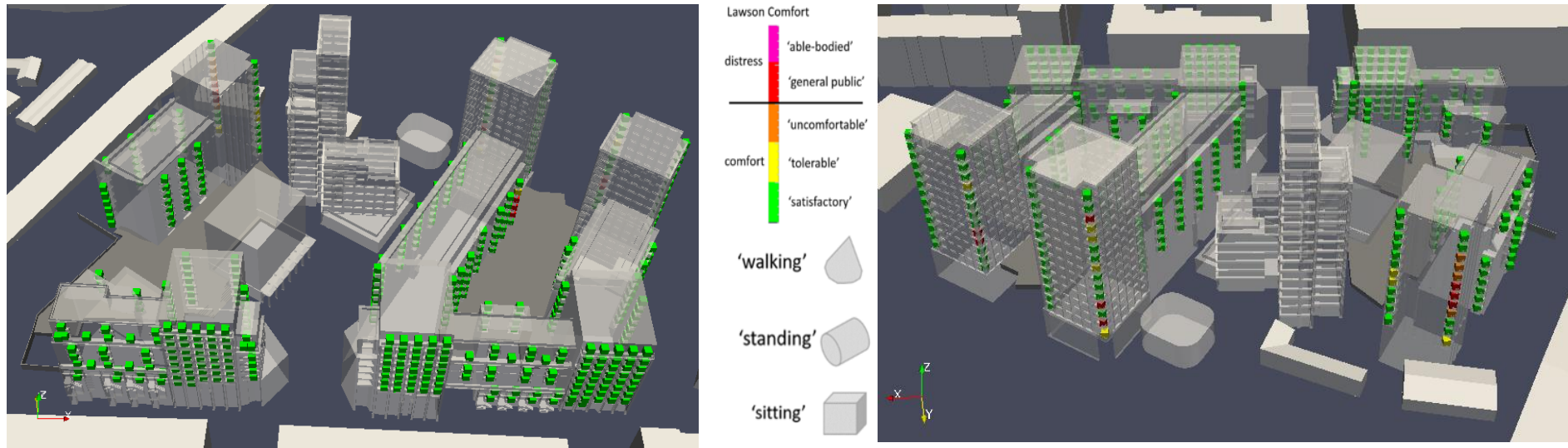


**Figure 5.3:** Lawson wind speeds (m/s) at balconies with mitigation measures





**Figure 5.4:** Lawson comfort at ground level (left) and terraces (right) with mitigation measures

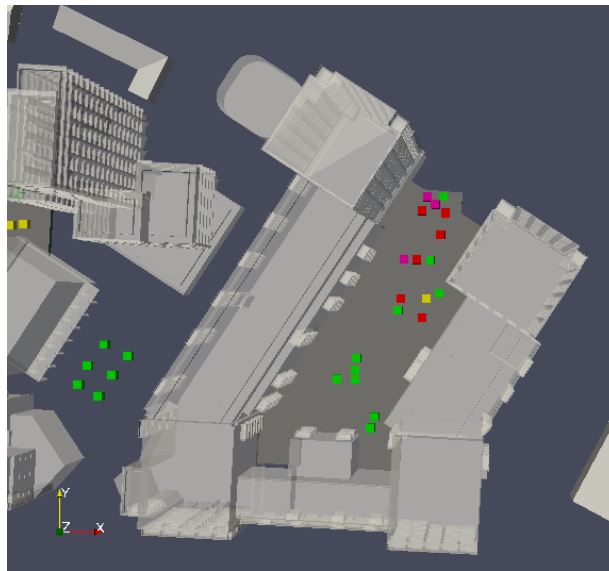


**Figure 5.4:** Lawson comfort at balconies with mitigation measures

## 5.1 Eastern Podium

The provision of dense hedging and raised planters as well with 2.4m high glass winter garden balustrade around the eastern podium does provide some localised shelter from the wind. This helps to reduce some windiness at the northern end of the courtyard. However, it is insufficient to alleviate the issue completely and some less desirable windiness will remain, although less often than without the wind mitigation measures.

It should be noted that the stronger winds will only occur for a few hours each year. It is expected that more vulnerable pedestrians may experience distress fewer than 52 hours a year (i.e. 0.59% of the time). These events are likely to coincide with adverse weather conditions when pedestrians unlikely to use the sitting area. Moreover, the are other spaces on the same podium will remain more suited to 'sitting' even during these adverse weather events.



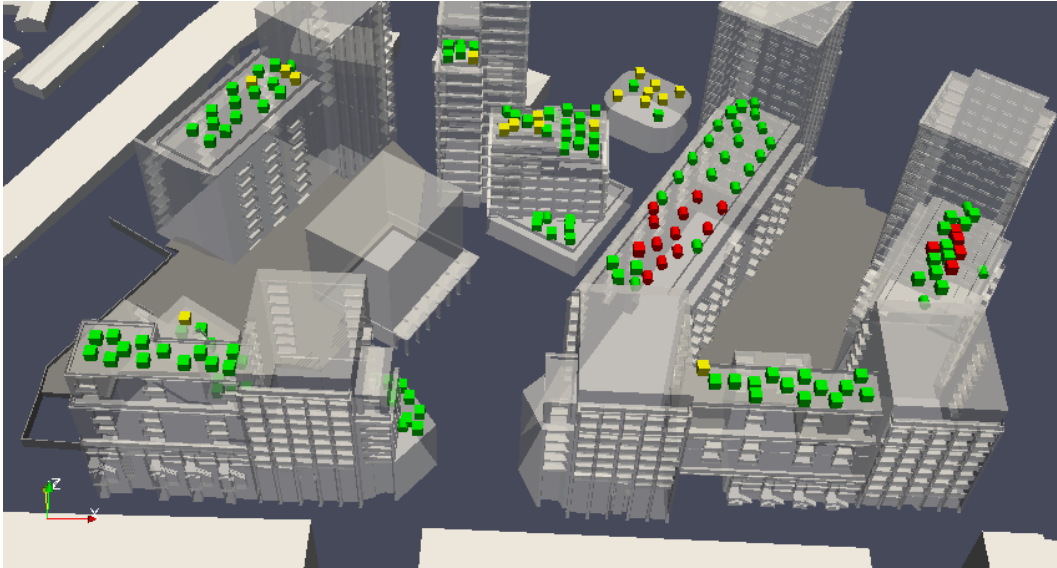
**Figure 5.2:** Lawson comfort at eastern podium with wind mitigation

## 5.2 Terraces

The provision of landscape along the terraces assist in providing localised protection from the wind and helps creating a more comfortable environment for 'sitting' activities, however, some general windiness will remain on Blocks B3/C3 and B4/C4. The primary function of this space is for active and recreational uses and under these circumstances, the space is considered suitable for its intended use for the majority of the wind conditions.

It is expected that more vulnerable user may experience distress fewer than 15 hours a year (i.e. 0.17% of the time). These events are likely to coincide with

adverse weather conditions when terraces are unlikely to be used and it is recommended that the management company should restrict access.



**Figure 5.3:** Lawson comfort at terraces with wind mitigation

## 6 Cumulative Impact

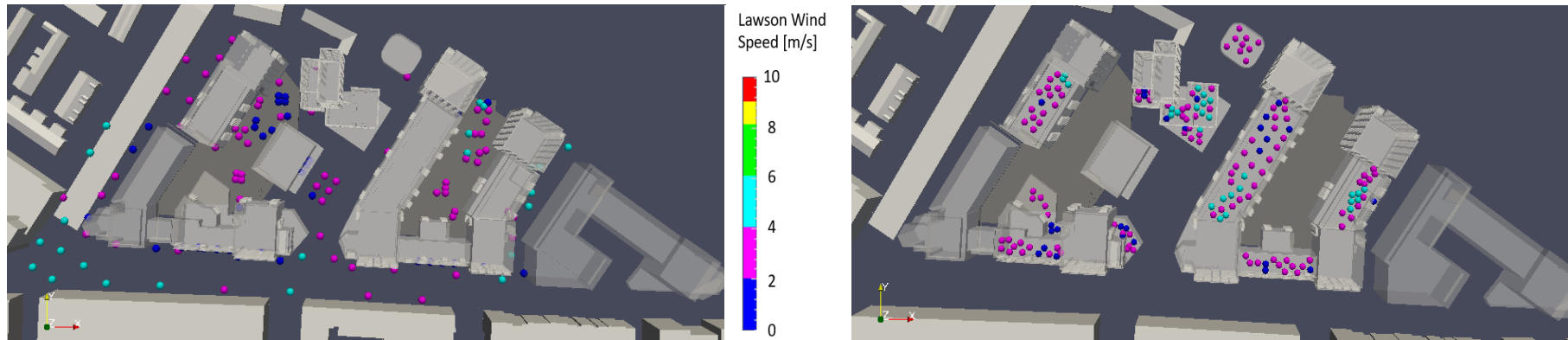
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A comprehensive analysis of cumulative impact of proposed Castleforbes development and planned development of hotel and commercial office building located immediately to the east (DCC Reg. Ref. 3433/19) and hotel to the west (DCC Reg. Ref. 2143/20) has been undertaken.

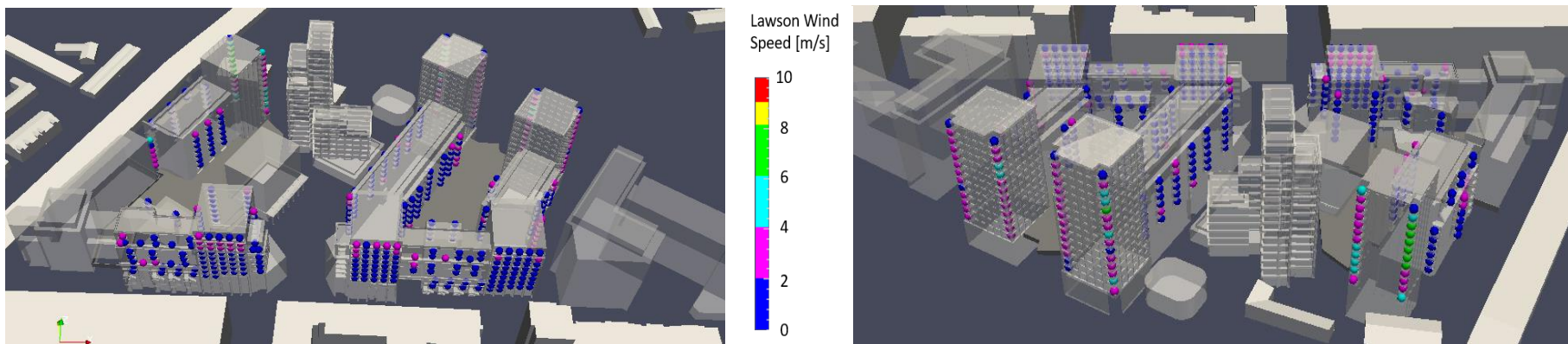
The commercial office and hotel building to the east of proposed development will be beneficial in sheltering the corner of Block A1 and disrupting east wind effect in general.

The hotel to the west will provide additional shelter to the western courtyard.

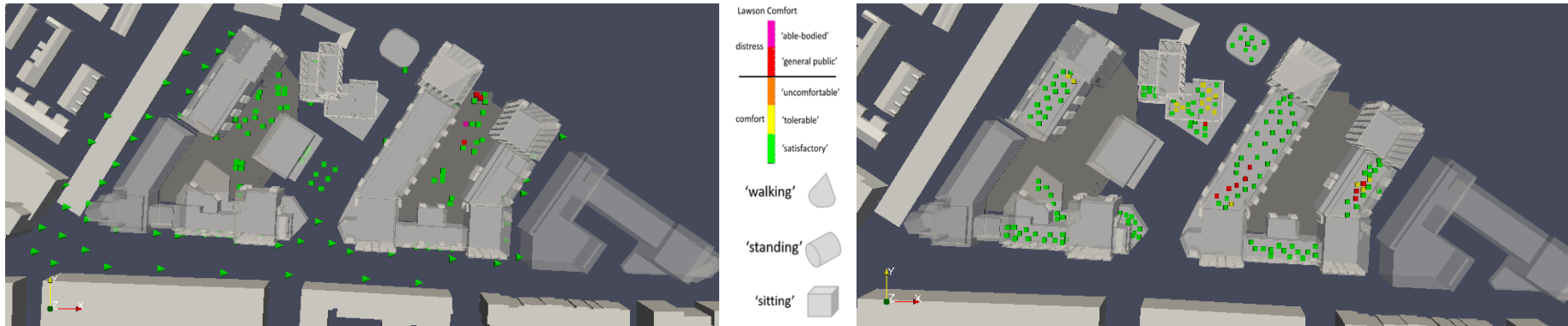
Overall, proposed development will benefit and will be additionally sheltered by planned developments to the west and east.



**Figure 6.1.** Lawson wind speeds (m/s) at ground (left) and terraces (right) level with cumulative impact



**Figure 6.2.** Lawson wind speeds (m/s) at balconies with cumulative impact



**Figure 6.3** Lawson comfort at ground (left) and terraces (right) level with cumulative impact



**Figure 6.4** Lawson comfort at balconies with cumulative impact

## 7 Conclusions

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In general, the wind conditions are expected to be in ‘sitting’ to ‘standing’ range and the spaces in and around the proposed development are suited to their intended use.

The critical wind directions for this development in terms of pedestrian comfort are the East and West due to their frequency and orientation of the development.

The entrances into the proposed development as well as entrances leading to the terraces are located away from the corners, which is beneficial in avoiding as higher speed winds. The wind conditions are expected to be within the ‘sitting’ and ‘standing’ ranges and therefore, entrances are suitable for their intended use.

The walkways along East Road and Sheriff St. are well sheltered from most wind directions as adjacent existing and permitted developments are similar in heights. Wind condition along these walkways are expected to be within ‘sitting’ and ‘standing’ range and therefore walkways are considered suitable for their intended use. The windiness at the Block A2 corner will be removed with the construction of the hotel and office block nearby (DCC Reg. Ref. 3433/19).

Public spaces including central plaza and western podium are acceptable for ‘sitting’ activities. Landscaping will only enhance the comfort of the spaces.

The eastern podium may experience windy conditions at the northern end and calmer conditions further south. The southern end is acceptable for ‘sitting’ activities. The provision of dense hedging and raised planters as well with 2.4m high glass winter garden balustrade around the eastern podium assists in providing better protection from the wind. These measures are insufficient at alleviating the worst wind effects completely. However, it should be noted that the stronger winds will only occur for a few hours each year (fewer than 52 hours a year i.e. 0.58% of the time). These events are likely to coincide with adverse weather conditions when ‘sitting’ is less desirable and less likely to occur. Moreover, there are other spaces on the same podium will remain more suited to ‘sitting’ even during these adverse weather events.

In general, wind conditions on terraces are expected to be in the ‘sitting’ to ‘standing’ range and most of the terraces are suitable for their intended use. However, further wind shielding and landscaping is required on terraces of the Blocks B3/C3 and B4/C4 to attain wind conditions that would provide a suitability comfortable and safe environment for occupants. The stronger winds will likely occur during adverse weather conditions when terraces are more likely to be unoccupied (i.e. 0.17% of the time). Additionally, it is considered that during these adverse wind conditions the management company would likely restrict access for health and safety reasons.

Overall, the proposed development contains many high quality public spaces that pedestrians and occupants undertaking a wide variety of activities will find comfortable and attractive for the majority of wind conditions.

## References

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Lawson, TV, 2001, 'Building Aerodynamics', Imperial College Press, London.

Met Éireann, 2018. [www.meteireann.ie](http://www.meteireann.ie) visited on 23rd July 2018.