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6200 Microclimate Impact Assessment

Microclimate assessment report with focus on wind impacts

Phase 1 - The Meadows - Bessborough

Proposed Residential Development

Bessborough,
Ballinure,
Blackrock,
Co. Cork

Estuary View Enterprises 2020 Ltd

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Contents

1 Introduction

1.1 Report purpose

The aim of the assessment is to evaluate the potential risk of elevated wind speeds / microclimate impacts arising as a result of the proposed development.

1.2 Instruction

DKPartnership (DKP) have been commissioned by Estuary View Enterprises 2020 Ltd, to carry out the analysis and report for the proposed development at Bessborough, Co. Cork.

1.3 Brief development description

The construction of a residential development of 280 no. residential apartment units with supporting tenant amenity facilities, café, crèche, and all ancillary site development works. The proposed development includes 280 no. apartments to be provided as follows: Block A (6 no. studio apartments, 14 no. 1-bedroom, 34 no. 2-bedroom & 1 no. 3-bedroom over 1-6 storeys), Block B (37 no. 1-bedroom & 49 no. 2-bedroom over 6-10 storeys), Block C (31 no. 1-bedroom, 36 no. 2-bedroom & 6 no. 3-bedroom over 5-9 storeys) and Block D (30 no. 1-bedroom, 31 no. 2-bedroom & 5 no. 3-bedroom over 6-7 storeys). The proposal includes a new pedestrian/cycle bridge over the adjoining Passage West Greenway to the east, connecting into the existing down ramp from Mahon providing direct access to the greenway and wider areas.
The proposed development provides for outdoor amenity areas, landscaping, under-podium and street car parking, bicycle parking, bin stores, 2 no. substations one of which is single storey free standing, a single storey carpark access building, public lighting, roof mounted solar panels, wastewater infrastructure including new inlet sewer to the Bessborough Wastewater Pumping Station to the west, surface water attenuation, water utility services and all ancillary site development works. Vehicular access to the proposed development will be provided via the existing access road off the Bessboro Road. Part of the proposed development is situated within the curtilage of Bessborough House which is a Protected Structure (Reference: RPS 490).

2 Executive summary

2.1 Analysis conducted

This report determined the existing environment using available data from the Irish Meteorological Service (MET Eireann). Using appropriate guidelines a desk-based analysis evaluated the potential for the proposed development to lead to amplified wind speed. The wind speeds at the proposed development were compared with appropriate wind comfort criteria.

2.2 Guideline's overview

There are no national planning policies directly related to wind microclimate however the following guidance documents were followed and reviewed:

- BRE DG 520 Wind microclimate around buildings. Brings together the latest information on wind environment around buildings. The general principles of wind flow around buildings and techniques for mitigating unacceptable wind speeds are discussed and advice is given on the methods and criteria for assessing pedestrian wind comfort.
- Wind Microclimate Guidelines for Developments in the City of London, August 2019.
- Building Aerodynamics, Imperial College London, Imperial College Press, 2001. Shows practicing architects and engineers the information which wind engineers can present to ensure that the effects of wind are considered in building design.

2.3 Microclimate summary

The assessment identified the existing baseline levels in the region of the proposed development by an evaluation of MET Eireann historical monitoring data. A desk-based assessment was used to determine any significant effects on the wind microclimate and compared the predicted wind speeds with appropriate comfort criteria. The following conclusions were made:

- The wind profile around the proposed development used long term annual average meteorological data collected at Cork Airport Weather Station, the dominant wind directions for the site are identified as south south-west, south-west and north north-west with an average of 19 km/h wind speed.
- This corresponds to average wind speeds of Beaufort scale 3, which is described as a 'gentle breeze'. Conditions around the site during the summer season are expected to be calmer compared to the windiest season, because wind speeds are lighter in the summer.
- Using BRE guidelines the effects of the proposed blocks A, B, C and D were analysed. It can be expected that the proposed development will not lead to any significant impacts of accelerated wind-speeds.
- The wind comfort assessment in relation to the Lawson criteria was analysed for winter and summer season wind comfort category levels. Overall, the wind comfort assessment determined the following (see image 5.3 and 5.4):
- Pedestrian access routes / walkways within and around the site and public amenity areas can all be considered suitable for their intended purpose.
- The wind comfort can be described as acceptable for the typical wind conditions experienced in County Cork (i.e.19km/h wind speed, the calculated average frequency of winds at 19km/h or less is 62% per year).
- The wind comfort can be described as tolerable during days of wind speeds above 28km/h (the calculated average frequency of winds above 28 km/h is 14% per year).

In conclusion, based on the examination conducted the proposed development would have no significant adverse impacts with regard to microclimate.

Category	Mean and GEM wind speed (5% exceedance)
Frequent Sitting	9 km/h
Occasional Sitting	14.4 km/h
Standing	21.6 km/h
Walking	28.8 km/h
Uncomfortable	>28.8 km/h

Image 5.3: expected winter season wind comfort levels (during worst-case scenario)

Image 5.4: expected summer season wind comfort levels (during worst-case scenario)

2.4 Recommendations / mitigation measures

Construction phase: No mitigation measures required however sections of the site shall be enclosed by high hoarding as part of a construction management plan which would assist in mitigating wind speeds around the perimeter.
Operational phase: it is anticipated that in general the wind speeds will be suitable for 'standing' along pedestrian routes and 'frequent sitting to standing' conditions for the public amenity areas. Design mitigation measures which have been incorporated into the proposed designs include; The development building entrances have been located well away from corners. The option to plant windbreaks, particularly evergreens in between some of the gaps between the blocks and around the edge of the development on the southern aspects to help mitigate any elevated wind speeds felt at ground level.

3 Geographical overview

3.1 Project overview

Image 3.1 the (google) site map below indicates the location of the site area approximately outlined.

Image 3.1 proposed development site outline

4 Approach and methodology

4.1 Assessment approach

A desk-based assessment was used to determine any significant effects on the wind microclimate. The assessment includes establishing the existing baseline wind climate, evaluating the potential for the proposed development to lead to amplified wind speed and comparing the site predicted wind speeds with appropriate comfort criteria.

4.2 Ireland's wind climate

In Ireland the prevailing wind direction is between south and west. Wind blows most frequently from the south and west for open sites while winds from the northeast or north occur least often. In January the southerly and south-easterly winds are more prominent than in July, which has a high frequency of westerly winds. Easterly winds occur most often between February and May and are commonly accompanied by dry weather. Average annual wind speeds range from 10km/h to 28km/h. The wind at a particular location can be influenced by a number of factors such as obstruction by buildings or trees, the nature of the terrain and deflection by nearby mountains or hills. A series of monitoring stations are located across the country, these stations collect wind data for public information.

4.3 Beaufort scale

The Beaufort scale is a way of estimating the wind strength according to the appearance of the sea (or on land).

		wind speed		
Scale	Description	km/h	knots	Effects
0	Calm	<1	<1	No noticeable wind, smoke rises vertically
1	Light air	1-5	1-3	Direction of wind shown by smoke drift but not wind vanes
2	Light breeze	6-11	4-6	Wind felt on face, leaves rustle
3	Gentle breeze	12-19	7-10	Wind extends light flag, leaves in constant motion
4	Moderate breeze	20-28	11-16	Raises dust and loose paper; hair disarranged, clothing flaps
5	Fresh breeze	29-38	17-21	Small trees in leaf begin to sway; limit of agreeable wind on land
6	Strong breeze	39-49	22-27	Umbrellas used with difficulty; force of the wind felt on the body; wind noisy, frequent blinking
7	Near gale	50-61	28-33	Inconvenience felt when walking; difficult to walk steadily; hair blown straight
8	Gale	62-74	34-40	Generally impedes progress; walking difficult to control; great difficulty with balance in gusts
9	Strong gale	75-88	41-47	People blown over by gusts; slight structural damage
10	Storm	89-102	48-55	Seldom experienced inland; trees uprooted, significant structural damage
11	Violent storm	103-117	56-63	Very rarely experienced; accompanied by widespread structural damage
12	Hurricane	>117	>64	Countryside devastated; winds of this force only occur in hurricanes and tornadoes

Table 4.1: Beaufort scale and wind speed

4.4 Receiving environment at Bessborough

The nearest weather station to the proposed development site collecting detailed weather records is Cork Airport which is located approximately 10km away. The meteorological data has been examined to identify the prevailing wind direction and average wind speeds. Table 4.2 – 4.4 shows the averages over 30 year periods, Image 4.1 illustrates these monthly wind speeds on a graph, Image 4.2 illustrates the prevailing wind direction for Cork Airport and image 4.3 illustrates the average hourly wind speeds recorded at Cork airport.

wind (knots)	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Mean monthly speed	12.1	12.0	11.6	10.3	10.1	9.4	9.0	9.0	9.4	10.7	10.9	11.6
Max gust	78	83	70	62	59	49	57	54	58	75	66	80
Max mean 10-minute speed	52	54	43	40	40	33	40	38	39	48	46	56
Mean no. of days with gales	2.3	1.8	1.3	0.3	0.3	0.0	0.1	0.2	0.3	1.0	1.2	1.9

Table 4.2: Wind data at Casement 1981-2010 – 30 year average

wind (knots)	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Mean monthly speed	12.4	12.3	11.7	10.3	10.1	9.3	8.9	8.8	9.7	10.9	11.2	12.1
Max gust	94	83	70	62	59	49	57	54	58	75	66	80
Max mean 10-minute speed	58	54	43	40	40	33	40	38	39	48	46	56
Mean no. of days with gales	2.8	1.9	1.5	0.3	0.3	0.0	0.1	0.2	0.5	1.0	1.5	2.3

Table 4.3: Wind data at Casement 1971-2000 – 30 year average

wind (knots)	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Mean monthly speed	12.9	12.6	12.3	11.0	10.6	9.5	9.1	9.2	10.3	11.2	11.6	12.4
Max gust	94	83	70	63	60	51	57	54	64	75	66	68
Max mean 10-minute speed	58	54	44	41	41	36	40	38	45	48	46	46
Mean no. of days with gales	3.2	2.2	1.7	0.7	0.4	0.1	0.1	0.2	0.7	1.2	1.8	2.5

Table 4.4: Wind data at Casement 1961-1990 – 30 year average

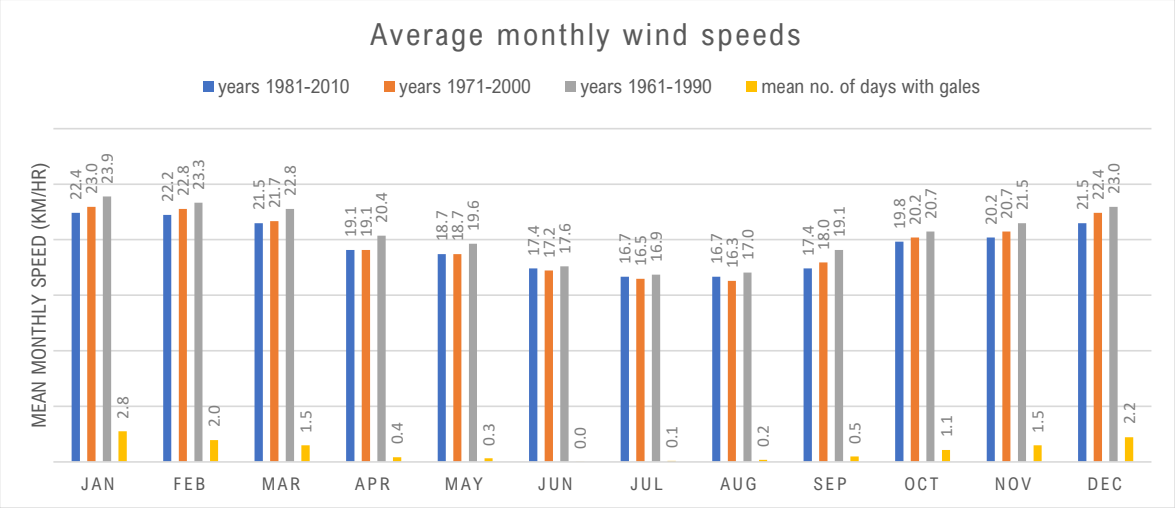

Image 4.1: Mean monthly wind speed (years 1961-2010) at Cork Airport

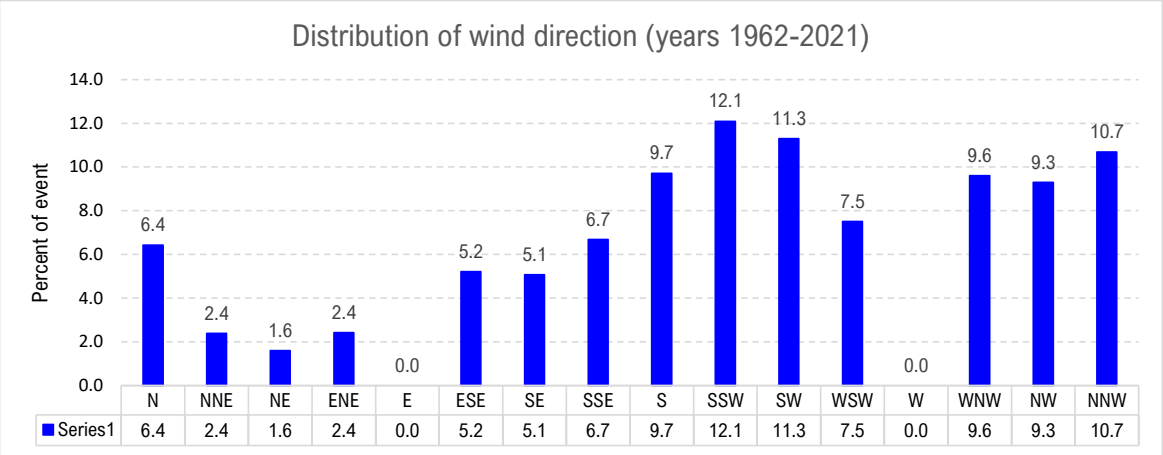

Image 4.2: Wind direction data at Cork airport - 59-year period (year 1962-2021)

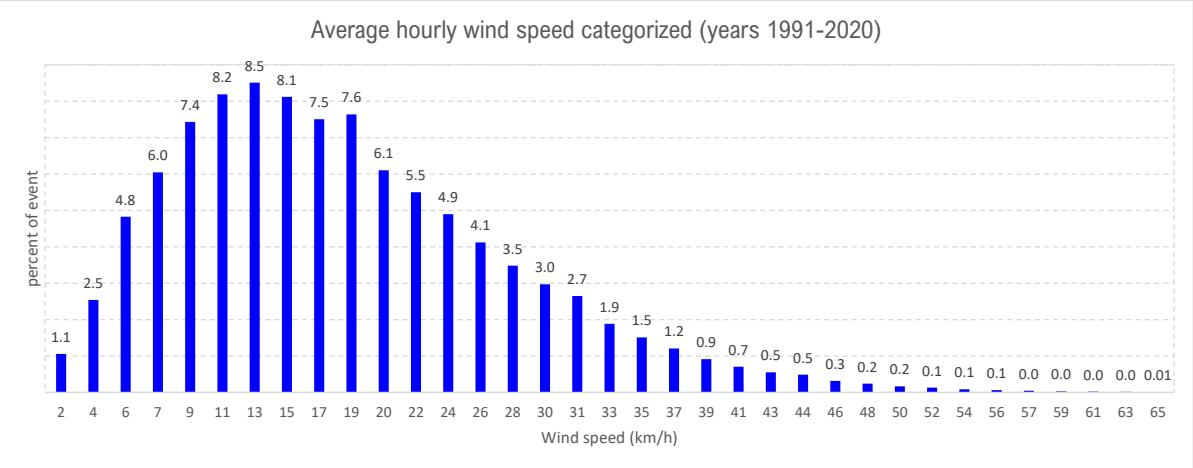

Image 4.3: Average hourly wind speeds recorded at Cork airport - 29-year period (year 1991-2020)

4.5 Significance of data assessed

The data recorded from Met Eireann's historical data during the past shows the predominant wind direction is south south-westerly with an average wind speed of 19km/h (calculated from daily averages over past 59 years, 1962-2021). There is a secondary dominant wind from the south-west direction and north north-west, it is observed other wind directions such as northern winds are infrequent and winds that are strictly east or west are very rare. These conditions are considered to be representative of conditions at the site given the close proximity. The site of the proposed development can be characterised as a site which experiences average wind speeds of Beaufort scale 3, which is described as a 'gentle breeze'. Conditions around the existing site during the summer season are expected to be calmer compared to the windiest season, because winds are lighter in the summer months. Image 4.4 shows the predominant wind directional arrows on the proposed development layout.

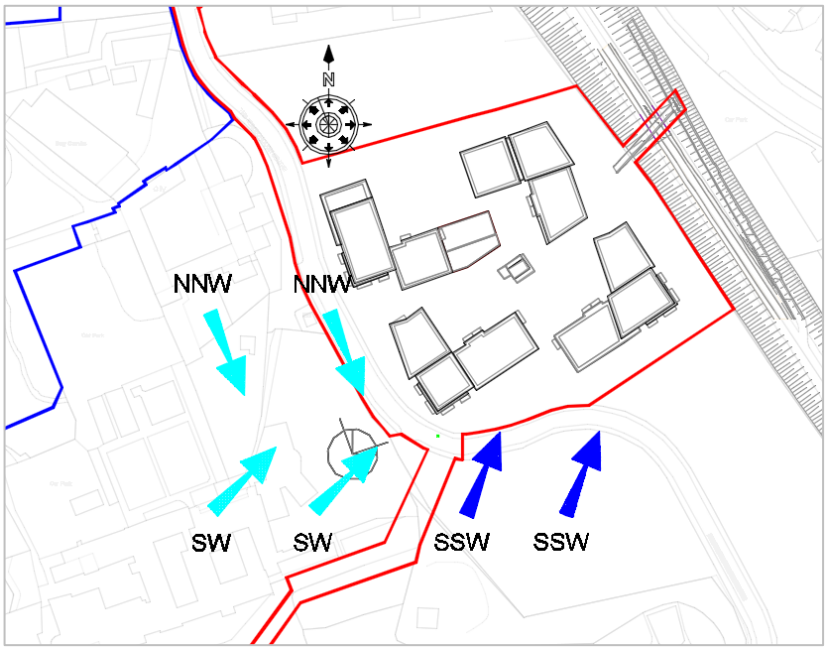

Image 4.4: Orientation of the proposed development relative to prevailing winds

5 Microclimate impact

Potential impact of the proposed development

5.1 Construction phase:

The effects on the wind microclimate at the site during the construction phase is difficult to qualitatively analyse however a professional judgement has been used to assess the likely conditions during this stage of development. On a cleared site, the potential impact with regard to wind would be that the oncoming wind would blow unimpeded across the empty site. Once the proposed development begins construction, localised wind conditions felt at ground level has the potential to vary on a temporary basis. However, as construction of the proposed development proceeds, the wind conditions on the site and surroundings would gradually adjust to those of the completed development. There are no construction microclimate impacts of significance.

5.2 Operational phase:

In general the construction of new buildings can lead to changes to the local wind environment around the building. Negative wind effects in the operational phase would result from wind conditions being more windy than the established comfort threshold for different activities. The following effects of buildings have been analysed:

Building height: Wind speed increases with height above ground therefore the taller a building the higher the wind speeds acting on it, where tall buildings are taken to mean buildings more than 10 storeys high. The proposed residential development for phase 1, the meadows identified in terms of storeys are as follows:
Block A : 1-6 storeys Block B : 6-10 storeys Block C : 5-9 storeys Block D : 6-7 storeys
Using BRE DG520 a check has been carried out to determine if the buildings present a high risk due to height differential. The document notes that the height-to-width (h/w) ratio of > 0.65 should be an 'optimum' target to minimise any wind related impacts. The h/w ratio of the proposed development buildings mostly presents itself in the category of 'good' and 'optimum', see table 5.1 for the h/w ratio summaries.

	(h/w) ratio
Block A	0.65
Block B	0.59
Block C	0.60
Block D	0.63

Table 5.1: h/w ratio summary

BRE recommend tall buildings where possible, be orientated with their narrow face into the prevailing wind. The prevailing wind direction is south south-west. The BRE also suggest wind speed increases can be minimised using large canopies to deflect the wind away from ground level if needed.

Block A's wider facade is facing the prevailing southerly wind however significant shelter is provided by block D. Block A's narrow facade is facing into the third most prevailing wind direction north north-west. Block B's narrow façade is orientated into the prevailing wind with additional shelter provided by block C. Block B's wider facade is facing the third most prevailing wind direction north north-west, and wind conditions of Beaufort scale >7 may cause an increase in wind speeds felt at ground-level. Block C and D's narrow facade is favourably orientated into the prevailing southerly winds. Block C and D's wider facade is facing south-east winds however it can be predicted that this proposed development height will not lead to a significant acceleration of wind-speeds. See Image 5.1 (a-d) for the elevations of the proposed development, Phase 1.

Image 5.1 (a): North elevation

Image 5.1 (b): East elevation

Image 5.1 (c): South elevation

Image 5.1 (d): West elevation

Building wake: Downwind the wind flows around the building and recombines into a region of negative pressure known as the wake. This will continue for between about six and 10 times the building height before the original flow patterns are re-established. The larger the building, the larger the volume of air that must be displaced, and the larger the potential ground-level wind speeds. Tall, isolated slab-sided buildings adjacent to large open spaces and wide streets will tend to produce high wind speeds at pedestrian level. Block A, B, C and D while being larger than their neighbours are not sufficiently isolated or of major adverse different scale to present a high risk in terms of wake flow.

Downwash: When the wind strikes the front face of a building, it will produce wind pressures that reach maximum speeds at a point between about two thirds and three-quarters of the building height. Below this height the wind will tend to be deflected down the front face towards the ground, called downwash, and accelerated around the corners at ground level and can produce areas of high wind speed. Above this height the wind will be deflected upwards and accelerated over the roof. This can also occur when tall and wide building facades face the prevailing winds.

Funnelling and canyon effect: Wind funnelling can occur where there are gaps between buildings. The effect is stronger where the axes of the buildings make an angle of 90°or less. Lawson suggests that the critical gap width for funnelling is between 0.5 and 2.5 times the average building height. Elevated wind speed can also be generated where an opening runs between two tall buildings leading to a canyon effect. The optimum height-to-width ratio for ideal wind comfort is >0.65 as recommended by the BRE, see table 5.2.

		Street canyon height-to-width ratio	
Aspect of design	Optimum	Good	Undesirable
Wind comfort	>0.65	>0.4	<0.3
Sense of enclosure	0.4-0.5	0.33-0.67	<0.3->1.0
Convective cooling	0.4–0.6	< 0.65	> 0.65

Table 5.2: BRE DG520 design summary guidelines

Guidelines recommend long street canyons should not be aligned with the prevailing wind direction. As height-to-width ratio increases, the ground level wind speeds are likely to reduce. At the other extreme very wide streets with height-to-width ratio < 0.3 will not benefit from wind shelter and are likely to be quite exposed. Image 5.2 highlights the areas of potential canyon effect.

	(h/w) ratio	Guideline result category
Canyon 1	0.75	optimum
Canyon 2	0.78	optimum
Canyon 3	0.65	optimum
Canyon 4	0.69	optimum

Table 5.3: Canyon h/w ratio summary

For the proposed development canyon '3' is the only potential canyon facing the dominant wind direction with the least shelter from neighbouring buildings. Canyon 1,2 and 4 align themselves with easterly and westerly winds which are historically recorded are being far less frequent.

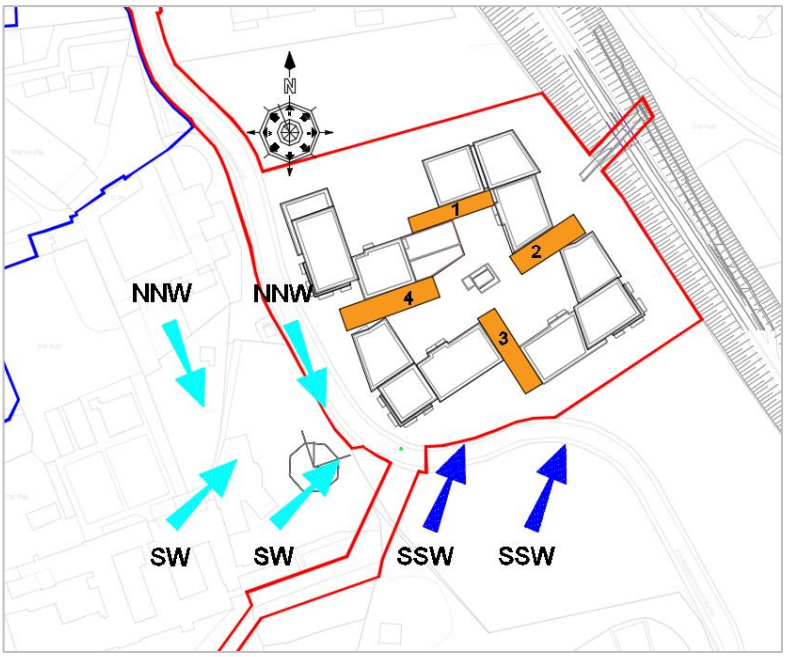

Image 5.2: potential canyon effect (areas highlighted in orange)

5.3 Wind comfort

The wind flow around buildings can have an impact on pedestrian comfort. The most widely used wind comfort criteria are those published by T V Lawson in 1978. The London Guidelines recommend a set of comfort criteria which deviate from the Lawson LDDC comfort criteria. Wind comfort, and the criteria used to evaluate this perception, is based on numerical indicator values which show how people feel in differing wind conditions, at varying activity levels. The city Lawson Criteria are reproduced in table 5.4 below. The desired wind microclimate would typically need to have areas suitable for sitting, standing, strolling, or walking.

Category	Mean and GEM wind speed (5% exceedance)	Description
Frequent Sitting	9 km/h	Acceptable for frequent outdoor sitting use, e.g. restaurant, café.
Occasional Sitting	14.4 km/h	Acceptable for occasional outdoor seating, e.g. general public outdoor spaces, balconies and terraces intended for occasional use, etc.
Standing	21.6 km/h	Acceptable for entrances, bus stops, covered walkways or beneath buildings.
Walking	28.8 km/h	Acceptable for external pavements, walkways.
Uncomfortable	>28.8 km/h	Not comfortable for regular pedestrian access.

Table 5.4: City Lawson Criteria
Note: Gust Equivalent Mean (GEM) speed = max(mean speed, gust speed/1.85)

A full Computational Fluid Dynamics (CFD) Model was not executed for the development. However, the results of this assessment are based on a quantitative assessment using the detailed baseline wind conditions examined at Cork Airport. The winter season's typical wind speed and the summer season's typical wind speed were used to examine the wind comfort. Image 5.3 and 5.4 illustrates the winter and summer season expected wind comfort levels.

The BRE also state It is not reasonable to expect wind conditions to be comfortable for 100% of the time, thus comfort criteria can be given thresholds for a given activity where:
- Unacceptable: unpleasant conditions for the given activity, which should not normally be allowed to occur
- Tolerable: conditions that would be described as 'windy', but which would be tolerated for the given activity
- Acceptable: conditions that will elicit no adverse comments about the wind.

Image 5.3: worst case scenario - winter season wind comfort levels (during windier scenario)

Image 5.4: expected summer season wind comfort levels (during windier scenario)

Pedestrian comfort during the winter season:
Pedestrian access routes / walkways within and around the proposed sites would be suitable for their intended use, having wind conditions ranging from occasional sitting to standing (14.4 -21.6km/h) and some areas along the southern façade expected to experience walking conditions (28.8km/h). These conditions are considered tolerable as these areas are on main route way and are locations where people are expected not to remain for long periods. A number of corners are expected to experience uncomfortable conditions, in particular block C and D when high wind speeds from the south are experienced. Entrances to the development are not located near corners and are located in areas where the expected wind conditions are acceptable, ranging from standing to walking (21.6- 28.8 km/h).

Pedestrian comfort during the summer season:
Pedestrian access routes / walkways within and around the proposed sites would be suitable for their intended use, having wind conditions ranging from occasional sitting to standing (14.4 -21.6km/h). Areas around building corners are expected to experience standing to walking conditions (21.6-28.8 km/h). Entrances to the development shows that the entrances are all well shielded and high wind speeds are not expected in these locations with conditions expected in the occasional sitting to standing (14.4 -21.6km/h) category.

Amenity areas during the winter season:
Given the configuration and orientation of the buildings surrounding the space, the public amenity area is expected to range in conditions from occasional sitting to walking (14.4-28.8km/h) on the north side of the proposed.
wind conditions in the amenity in the centre of the blocks are expected to range in conditions from occasional sitting to standing (14.4-21.6km/h) as the exposure of the amenity space between the buildings are relatively sheltered. The amenity area surrounding the blocks range in conditions from standing to walking (21.6-28.8km/h).

Amenity areas during the summer season:
Given the configuration and orientation of the buildings surrounding the space, the public amenity area is expected to range in conditions from occasional sitting to walking (14.4-28.8km/h) on the north side of the proposed.
wind conditions in the amenity in the centre of the blocks are expected to range in conditions from frequent sitting to standing (9-21.6km/h) as the exposure of the amenity space between the buildings are relatively sheltered. The amenity area surrounding the blocks range in conditions from standing to walking (21.6-28.8km/h).

In summary wind comfort is in line with criteria summarized in table 5.4. Overall, the wind comfort assessment determined that:
- Pedestrian and public amenity areas can all be considered suitable for their intended purpose.
- Pedestrian and public amenity areas wind comfort can be described as acceptable for the typical wind conditions experienced in County Cork (i.e., 19km/h wind speed, average frequency of winds at 19km/h or less is 62% per year).
- Pedestrian and public amenity areas wind comfort can be described as tolerable during days of wind speeds above 28km/h (average frequency of winds above 28 km/h is 14% per year).

6 Conclusion

6.1 Wind impact summary

The assessment identified the existing baseline levels in the region of the proposed development by an evaluation of MET Eireann historical monitoring data. A desk-based assessment was used to determine any significant effects on the wind microclimate and compared the predicted wind speeds with appropriate comfort criteria. The following conclusions were made:

- The wind profile around the proposed development used long term annual average meteorological data collected at Cork Airport Weather Station, the dominant wind directions for the site are identified as south south-west, south-west and north north-west with an average of 19 km/h wind speed.
- This corresponds to average wind speeds of Beaufort scale 3, which is described as a 'gentle breeze'. Conditions around the site during the summer season are expected to be calmer compared to the windiest season, because wind speeds are lighter in the summer.
- Using BRE guidelines the effects of the proposed blocks A, B, C and D were analysed. It can be expected that the proposed development will not lead to any significant impacts of accelerated wind-speeds.
- The wind comfort assessment in relation to the Lawson criteria was analysed for winter and summer season wind comfort category levels. Overall, the wind comfort assessment determined the following:
- Pedestrian access routes / walkways within and around the site and public amenity areas can all be considered suitable for their intended purpose.
- The wind comfort can be described as acceptable for the typical wind conditions experienced in County Cork (i.e.,19km/h wind speed, the calculated average frequency of winds at 19km/h or less is 62% per year).
- The wind comfort can be described as tolerable during days of wind speeds above 28km/h (the calculated average frequency of winds above 28 km/h is 14% per year).

In conclusion, based on the examination conducted the proposed development would have no significant adverse impacts with regard to microclimate.

6.2 Mitigation measures

Construction phase: No mitigation measures required however sections of the site shall be enclosed by high hoarding as part of a construction management plan which would assist in mitigating wind speeds around the perimeter.
Operational phase: it is anticipated that in general the wind speeds will be suitable for 'standing' along pedestrian routes and 'frequent sitting to standing' conditions for the public amenity areas. Design mitigation measures which have been incorporated into the proposed designs include; The development building entrances have been located well away from corners. Whereas it is not particularly required there is the option to plant windbreaks in the form of dense plantation in between the block gaps and around the edge of the development on the southern aspects to help mitigate any elevated wind speeds felt at ground level.

6.3 Monitoring

Construction phase: It is recommended that the local weather conditions should be assessed routinely, particularly for construction works carried out at a height. The Irish Meteorological Service (MET Eireann) issues weather reports where wind forecasts can be reviewed. It is not necessary to specifically monitor wind speed and direction monitoring on site during the construction phase.
Operational phase: It is not necessary to monitor wind speed and direction monitoring on site during the operational phase.