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FORMER CENTRAL RETAIL PARK – THE PARK

Volume 2, Chapter 18 – Wind and Microclimate

Manchester City Council

October 2024

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18. Wind and Microclimate

18.1 Executive Summary

This chapter of the ES assesses the wind conditions at pedestrian level for the Proposed Development. This analysis focuses on the microclimate impacts, particularly wind effects, and includes the findings from Computational Fluid Dynamics (CFD) assessments using Simscale Software to ensure pedestrian comfort and safety.

The wind analysis, conducted by experienced experts using CFD simulations, evaluates existing and proposed conditions, considering both the Proposed Development's landscaping and surrounding buildings. The results indicate that the Proposed Development generally offers comfortable conditions for outdoor dining and sitting, with minimal areas of high wind speeds exceeding 10 m/s. Trees play a crucial role in enhancing wind comfort by acting as natural windbreaks, reducing wind speeds, and creating sheltered zones. No significant effects are predicted during construction or operation.

18.2 Introduction

The Proposed Development is part of the regeneration at the FCRP in Ancoats in Greater Manchester. It is in Manchester City Centre's north-eastern fringe. The Proposed Development is located between Phase 1 and 2 developments that form the wider SRF development.

This chapter assesses the acceptability of wind conditions at pedestrian level within the Proposed Development. The Proposed Development compromises landscaping, street furniture and hardstanding surfaces as outlined in Volume 2, Chapter 2.

As the public spaces will represent a key aspect of the regeneration it is important that a microclimate analysis is undertaken, and local areas of pedestrian discomfort avoided.

This chapter of the ES assesses the potential impacts and associated likely effects of the Proposed Development on the local wind microclimate within and around the Site. It considers the likely effects of wind upon pedestrian comfort and safety and summarises the findings of Computational Fluid Dynamics (CFD) assessments.

The chapter describes the methods used to assess the potential impacts; the baseline conditions currently existing at the Site and the study area; as well as the potential impacts and likely effects on wind microclimate during the construction and operation of the Proposed Development, taking into consideration embedded mitigation measures. Where appropriate, additional mitigation measures required to prevent, reduce, or offset the likely effects are identified.

This chapter is supported by an Appendix (Volume 3, Appendix 18.1) which includes the outputs from the modelling as well as further details of the assumptions used within the modelling.

18.3 Competent expert evidence

This chapter has been prepared by the following competent experts with relevant and appropriate experience:

-
- The assessment was undertaken by a building physics consultant who has over three years' experience in pedestrian wind comfort assessment and is a Chartered member of CIBSE.

18.4 Relevant Legislation and guidance

18.4.1 National Planning Policy

National Planning Policy Framework (NPPF, 2023)

The NPPF does not specifically reference wind or microclimate. However, it does emphasise the benefits of a high-quality built environment, for example:

- Paragraph 126 "Good design […] creates better places in which to live and work and helps make development acceptable to communities."
- Paragraph 130.f) "Planning policies and decisions should ensure that developments create places that are safe, inclusive, and accessible [...] with a high standard of amenity for existing and future users."
- The National Design Guide (2021) states in paragraph 71 that 'Proposals for tall buildings (and other buildings with a significantly larger scale or bulk than their surroundings) require special consideration. This includes…environmental impacts, such as sunlight, daylight, overshadowing and wind. These need to be resolved satisfactorily in relation to the context and local character'.

18.4.2 Local Planning Policy

MCC Core Strategy[1] 2024

Any work will follow the relevant policies for MCC as in Policy EN 2 part of the Manchester's Local Development Framework Core Strategy Development Plan Document to highlight any specific wind microclimate requirement additional to the regional and national planning policies.

18.5 Assessment Method

18.5.1 Computational Fluid Dynamics (CFD)

The wind analysis undertaken informs the design team in making decisions on how to use the external spaces, identifying the level of comfort and discomfort, and enabling optimisation of spaces and vegetation.

Wind can create both positive and negative comfort conditions, as it can enhance thermal comfort during extreme / high temperatures, while it can also decrease pedestrian comfort if it is too strong. However, the level of comfort is dependent on the types of activities performed, for example, higher wind speeds are generally tolerated for active

[1] Core Strategy | Manchester City Council

spaces, such as walkways, cycle lanes, etc., while lower ones are comfortable for spaces allocated for sitting and resting.

The wind analysis presented in this report has been carried out using Computational Fluid Dynamics (CFD), and Simscale platform has been used to perform the simulations.

Transient simulations have been conducted using LBM (Lattice Boltzmann Method) and the k-ω Sheer Stress Transport (SST) turbulence model.

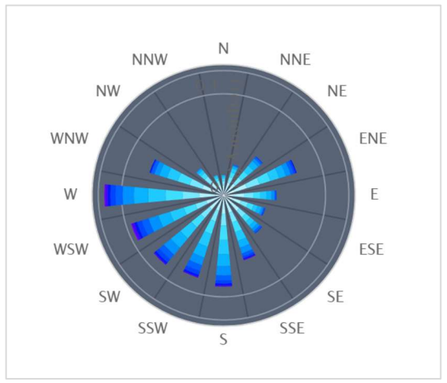
18.5.2 Context and weather

The Site is surrounded by medium-rise commercial developments with lower-rise buildings to the south of the Site. As a result, the wind conditions are dominated by the medium-rise nature of the surrounding buildings.

Wind conditions for the Site have been determined by accessing Meteoblue weather data from within the Simscale platform. This dataset has been the most accurate weather information available for the Site.

The Meteoblue climate data are based on 30 years of hourly weather model simulations and are available for every place on Earth. They give good indications of typical climate patterns and expected conditions (temperature, precipitation, sunshine, and wind). The simulated weather data have a spatial resolution of approximately 30 km and may not reproduce all local weather effects, such as thunderstorms, local winds, or tornadoes, which are out of the scope of this current assessment.

The wind rose indicates that the prevailing wind direction for the Site is west as shown in Figure 18-1.



Wind Direction	Angle	% Occurrence
N	0	2%
NNE	22.5	3%
NE	45	5%
ENE	67.5	8%
E	90	5%
ESE	112.5	4%
SE	135	5%
SSE	157.5	7%
S	180	9%
SSW	202.5	9%
SW	225	9%
WSW	247.5	10%
W	270	**12%**
WNW	292.5	8%
NW	315	4%
NNW	337.5	2%

Figure 18-1 –Site Wind Rose

The weather data set used for this assessment included 16 different wind directions as this approach is typically used in developments of this size and complexity. Therefore, simulations are expected to provide minimal or no variation in the results if performed using additional wind directions. Seasonal wind directions shown in Figure 18-2 below.

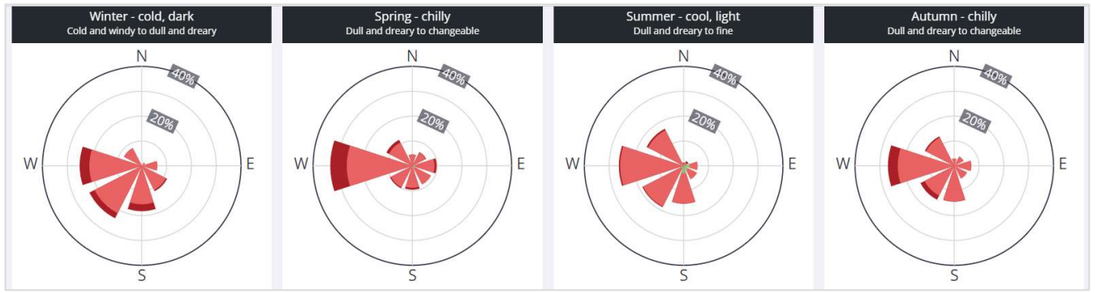


Figure 18-2 – Seasonal Wind Rose

18.5.3 Geometry

A 3D model for the Proposed Development has been provided by the landscape architects, cleaned up on Rhino and imported in the Simscale platform for the analysis as shown in Figure 18-3.

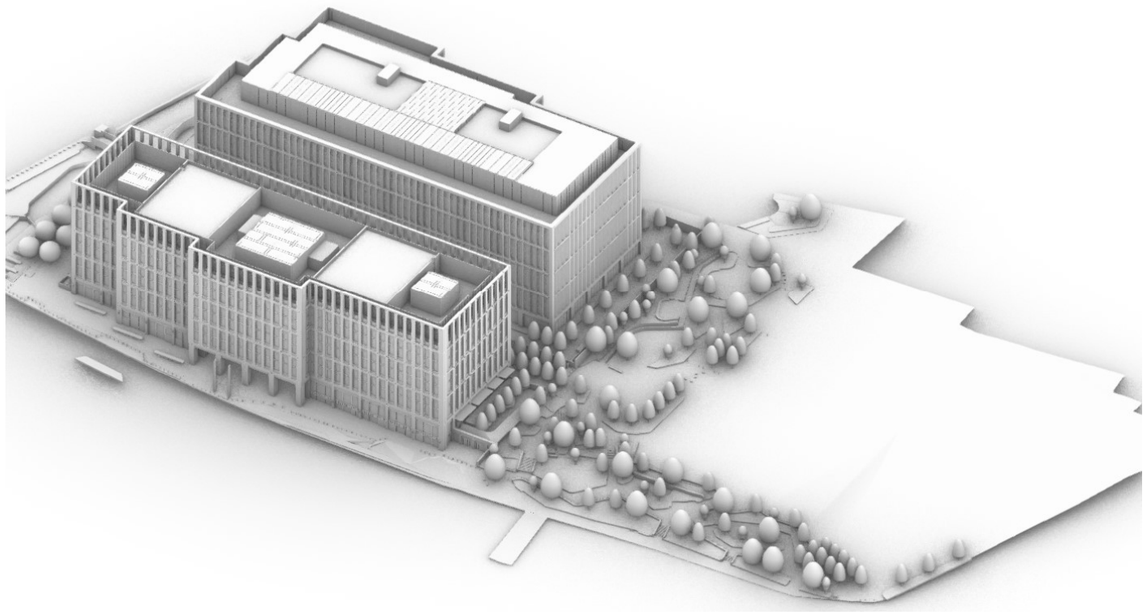


Figure 18-3 - View of Rhino model of the Proposed Development including the completed Phase 1 development

The geometry of the Proposed Development includes the massing of surrounding buildings including that of the Phase 1 development as this will be constructed prior to the Proposed Development. It also includes the topography of the Site as well as proposed trees to analyse the effects of wind on and around the site as much as possible.

18.5.4 Assessment Criteria

Comfort

Wind comfort, and the criterion used to evaluate this perception, is based upon numerical concepts to capture how people feel in different wind conditions, at varying activity levels. To test and determine the level of pedestrian wind comfort in an urban area, many standards exist to aid assessment of predicted comfort conditions for the built environment.

For the purposes of this study, wind conditions have been evaluated against the widely used Lawson Comfort Criteria. Those criteria, named after the researcher T.V Lawson and originally published in 1978, are a series of comfort criteria categories that quantify the worst wind conditions that most pedestrians will consider acceptable in performing specific activities. Wind speeds are measured at 1.5 m above ground level.

The Lawson criteria set threshold wind speeds, and then dictate the probability of wind speeds exceeding that threshold, which is 5% of the time considered.

The most famous of the Lawson criteria, is the London Docklands Development Corporation(LDDC) Wind Comfort Criteria, which has been used for this current assessment and detailed in Table18-1 below.

Table 18-1 Lawson LDDC Wind Comfort Criteria

Category		Wind speed	Fulfilment value	Activity
	A	>2 m/s	<5%	Outdoor Dining
	B	>4 m/s	<5%	Pedestrian Sitting
	C	>6 m/s	<5%	Pedestrian Standing
	D	>8 m/s	<5%	Pedestrian Walking
	E	>10 m/s	<5%	Business Walking
	U	>10 m/s	<5%	Uncomfortable

The Proposed Development is also assessed against The NEN8100 Danger comfort criteria. The NEN 8100 danger comfort criteria is a set of guidelines developed in the Netherlands to ensure safety and comfort in relation to wind conditions around buildings. It is particularly focused on pedestrian safety and comfort in urban environments.

In NEN8100 danger comfort criteria, Safety Criterion (Danger) sets maximum wind speed limits to prevent hazardous conditions that could cause injuries or accidents; Comfort Criterion: Defines wind speed limits for various activities (e.g., sitting, walking) to ensure a comfortable environment for pedestrians.

Safety

Although no additional wind safety requirement is set out by MCC, additional checks have been undertaken against Lawson distress criteria which are generally used to assess pedestrian safety.

The criteria state that for elderly or infirm pedestrians, the hourly mean wind speed should exceed 15 m/s for less than 0.025% of the year (approximately two hours).

Wind speeds that exceed 20 m/s for more than approximately two hours per year represent a safety issue for all members of the population, which would require mitigation to provide an appropriate wind environment.

Should the above be exceeded for more than 0.025% of the year, the method states that engineering judgement is to be used to find alternative pedestrian routes or adopt on-site mitigation measures.

Significance Criteria

Users of the Proposed Development and surrounding areas are considered receptors. All receptors are equally sensitive to the wind microclimate. An unacceptable microclimate occurs if safety criteria are exceeded, or comfort criteria are not met for the existing or planned pedestrian use. All receptors are highly sensitive to local wind conditions and are given equal importance.

The impact magnitude is determined by how much the conditions deviate from the Lawson criteria. Exceeding the safety criteria is critical due to potential harm to pedestrians and is considered a high impact. Not meeting comfort criteria, making it too windy for comfortable use but not unsafe, is considered a medium impact. Minor exceedances of comfort criteria, which are noticeable but tolerable, are considered to have a very low impact.

Exceeding the safety criteria has major effect significance, while exceeding the comfort criteria has moderate or minor significance. In Environmental Impact Assessment (EIA) terms, major and moderate effects are considered significant, whereas minor effects, being tolerable, are not considered significant.

The following are the significance criteria used to assess likely wind conditions due to the Proposed Development:

- **Major Beneficial:** Any effect that improves pedestrian safety, making conditions from unsafe to safe. This is significant.
- **Moderate Beneficial**: Any effect that improves pedestrian comfort from unsuitable to suitable for planned activities. This is significant.
- **Minor Beneficial:** Any effect that improves pedestrian comfort from unsuitable to marginal/tolerable for planned activities, or from marginal/tolerable to suitable for planned activities. This is not significant.
- **Negligible:** Any effect that does not alter the suitability of existing wind conditions with respect to planned activities. This is not significant.
- **Minor Adverse:** Any effect that worsens pedestrian comfort from suitable to marginal/tolerable for planned activities, or from marginal/tolerable to unsuitable for planned activities. This is not significant.
- **Moderate Adverse:** Any effect that worsens pedestrian comfort from suitable to unsuitable for planned activities. This is significant.
- **Major Adverse:** Any effect that adversely affects pedestrian safety, making conditions from safe to unsafe. This is significant.

Scenario Tested

A 3D model of the future existing site within a 240-meter radius from the centre of the Site was constructed. The surrounding proposed buildings in Manchester Digital Campus and cumulative surrounding developments were also constructed, and the following scenarios were modelled in the wind tunnel in the CFD model:

- Scenario 1 – Future baseline layout withn the context of surrounding conditions immediately prior to construction.
- Scenario 2 - Proposed Development layout within the context of the future baseline conditions plus committed developments.

18.5.5 Modelling Limitations

The analysis reported in this document uses CFD models to simulate the likely wind speeds under a variety of wind conditions, for comparison against the London Docklands Development Corporation (LDDC) Lawson comfort criteria. CFD is widely used for this purpose, however, it is important to note that modelling results of physical phenomena have uncertainty and therefore are not intended to provide an exact representation of the real-life performance, as necessary simplifications and assumptions are made.

18.6 Baseline conditions

In the future baseline the Site will be surrounded by medium-rise commercial developments with lower-rise buildings south of the Site, and notably, the Phase 1 development to the immediate west of the Site. As a result, the wind conditions are dominated by the medium-rise nature of the surrounding buildings. Described in terms of the LCC, wind conditions are expected to be suitable for a combination of strolling and short-term standing / sitting and thus suitable for comfortable pedestrian passage.

The baseline conditions are captured within the modelling of Scenario 1, and these are described below.

18.6.1 Scenario 1 – Existing Context

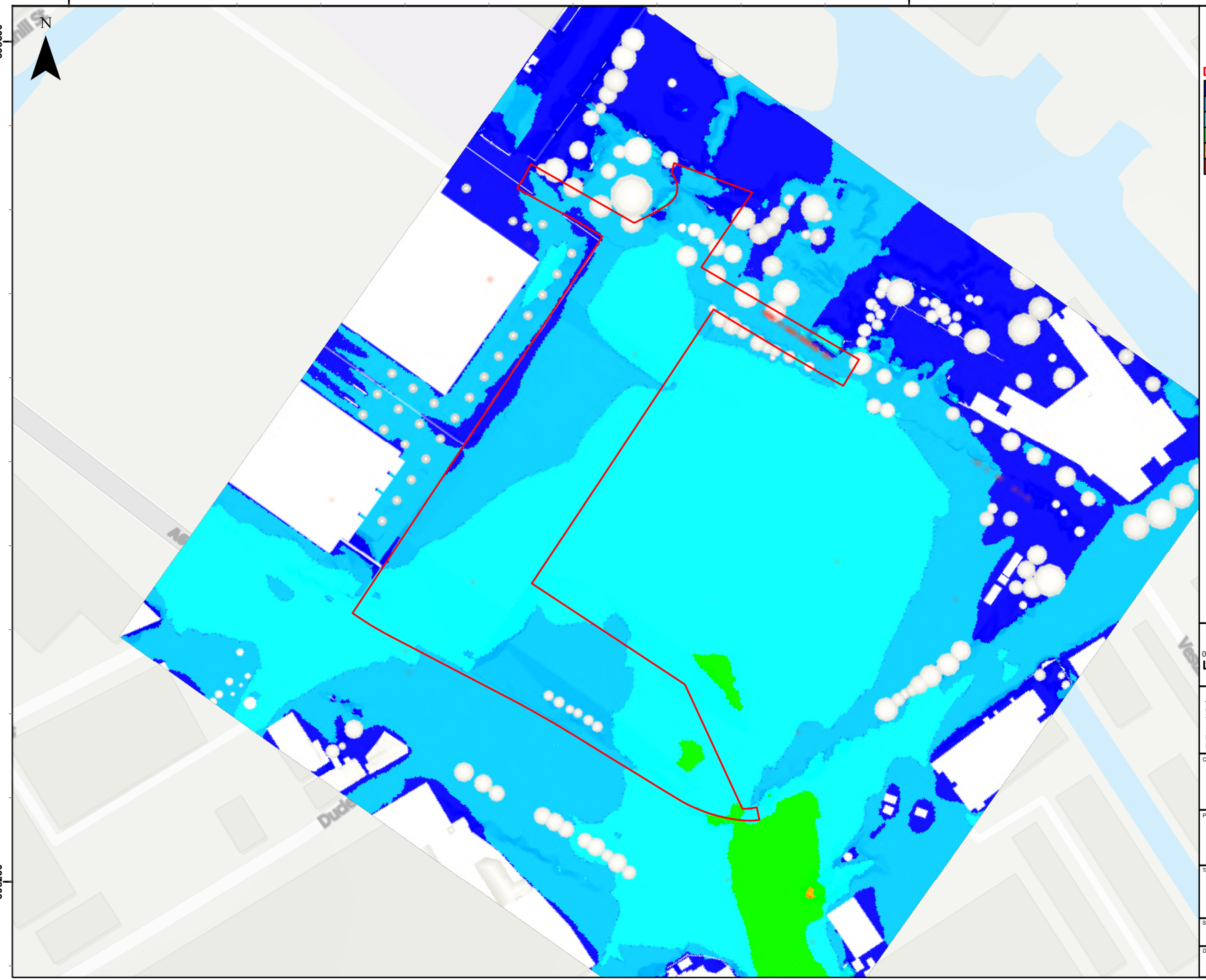
The geometries in this scenario represent a simplified version of the Site and surrounding building massing and height of the buildings within the area, based on the information available.

Figure 18-4 show that no areas of discomfort are present in the assessed existing Scenario. The wind comfort results for the Site are analysed based on the color-coded regions as per the Lawson LDDC comfort criteria.

The Site mostly falls within the blue and light blue regions, indicating that it is generally comfortable for outdoor dining and pedestrian sitting. Areas suitable for standing and walking are present but less frequent. The Site appears to be well-suited for leisurely activities. There are minimal regions where wind speeds exceed 10 m/s, meaning the Site is mostly comfortable for pedestrian use.

Detailed results of wind speed contours for each assessed wind direction are reported in Appendix A.1.

Figure 18-5 indicates that there is no risk presented as per NEN8100 Pedestrian Danger Criteria as the highlighted area within the blue region and it poses no risk concerning high wind speeds.



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Site Boundary

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Dining
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

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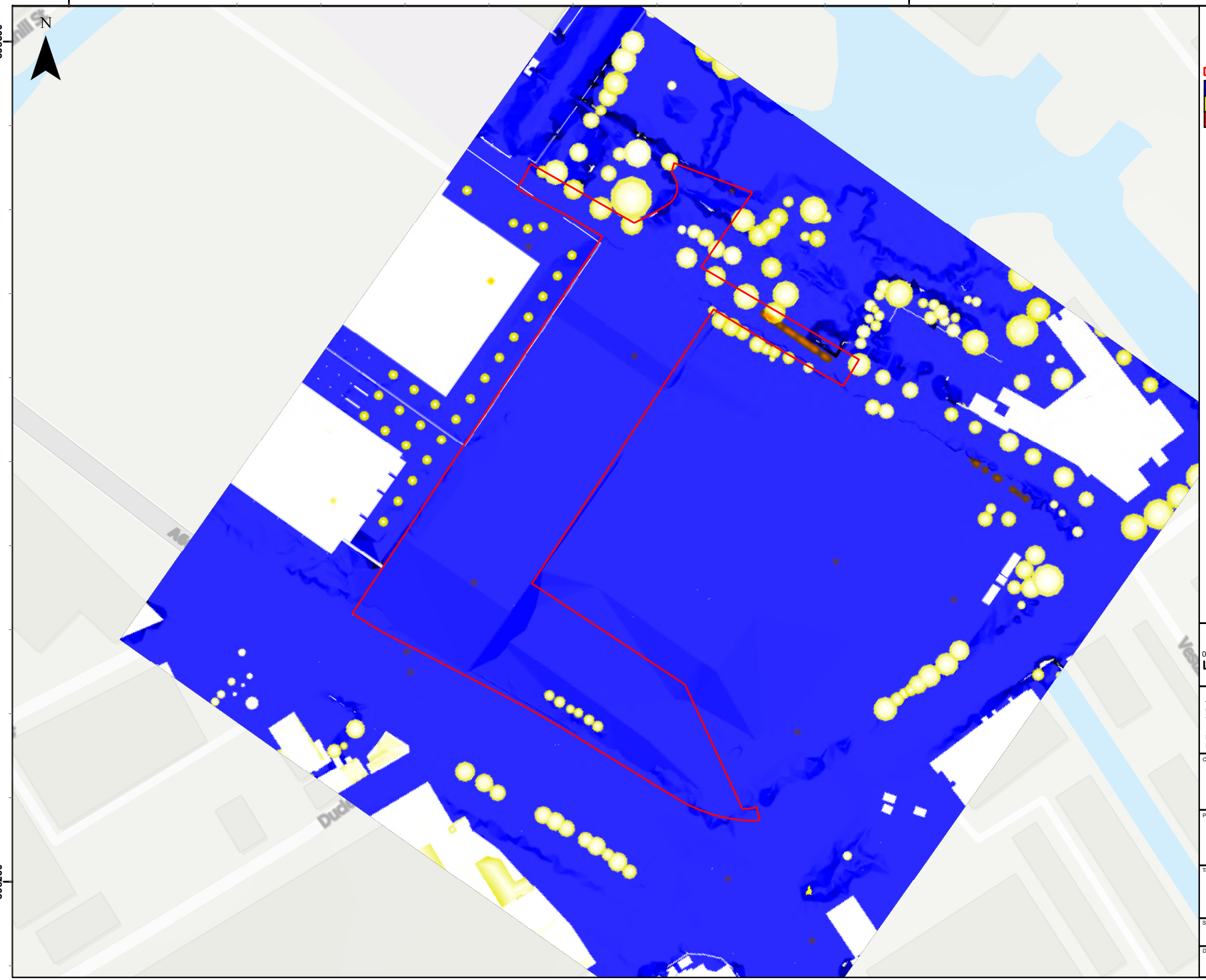
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Title
Lawson LDDC Pedestrian Comfort - Existing

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Site Boundary

A	15 m/s	< 0.05%	No Risk
B	15 m/s	< 0.30%	Limited Risk
C	15 m/s	>= 0.30%	Dangerous

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NEN8100 Pedestrian Danger Comfort - Existing

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18.7 Potential impacts

18.7.1 Construction impacts

While the demolition and construction work are going on, wind might blow through the open areas on the Site, possibly causing inconvenience for people walking by. Because construction sites are usually dusty, people passing through can expect some discomfort. Dust impacts are considered in the Air quality assessment (Volume 2, Chapter 7). Construction phase impacts will be temporary and comprise a gradual change of wind conditions from the future baseline scenario to a permanent scenario with the Proposed Development in operation.

18.7.2 Operational impacts

Users of the Proposed Development will form a new receptor and can be affected by changes to comfort due to wind conditions. The presence of the Proposed Development once operational may change wind conditions and therefore effect pedestrian comfort.

Mitigation measures, including soft and hard landscaping., wind brakers and wind deflectors are incorporated during the Computational Fluid Dynamics (CFD), if required.

18.8 Assessment of effects

18.8.1 Scenario 2 – Proposed Development in Cumulative Surrounding Context

The model includes the 3D model of the Proposed Development design, proposed surrounding buildings, and any landscaping. Figure 18-6 demonstrates that the Phase 1 buildings are affecting the pedestrian wind comfort conditions of MDC and areas around the perimeter of building are experiencing local wind acceleration.

Construction effects

During demolition and construction, wind might blow through open spaces, causing some inconvenience to people walking by. However, construction sites are usually dusty and messy, so pedestrians don't expect high comfort. Since these sites have barriers and limited access, they are less affected by wind than finished buildings. Both pedestrians and construction workers on the Site will find it easy to walk, and comfort will not be significantly affected. Therefore, the impact of wind during construction is temporary, minimal and not significant.

Operation effects

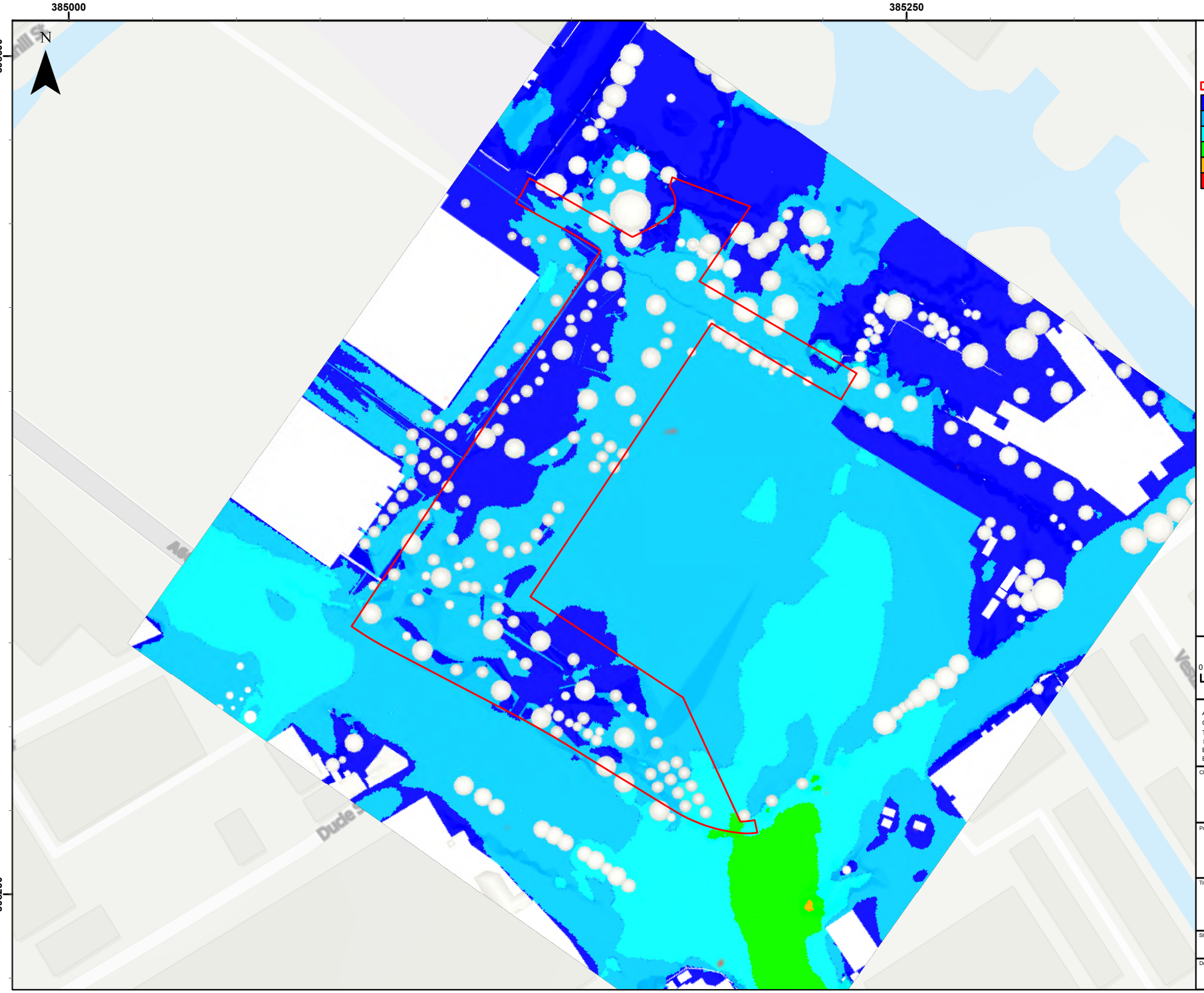
The introduction of the Proposed Development, including soft landscaping/pavements and wind mitigation measures, is expected to ensure that wind conditions within the study area meet safety criteria. The effect of introducing the Proposed Development within the Site is therefore considered to be negligible and not significant when considering the changes in wind conditions pre and post construction.

This section provides a high-level overview of the wind modelling outputs for the Proposed Development. A more detailed overview of the modelling results is provided in Volume 3, Appendix 18.1.

The Proposed Development predominantly falls within the blue and light blue regions, indicating it is generally comfortable for outdoor dining and pedestrian sitting. Areas suitable for standing and walking are present but less frequent, making the Proposed Development well-suited for leisurely activities. There are minimal regions where wind speeds exceed 10 m/s, meaning the Proposed Development is mostly comfortable for pedestrian use.

The presence of trees is likely responsible for the extensive blue and light blue regions in the Proposed Development, indicating very comfortable conditions for outdoor activities. The proposed trees play a crucial role in enhancing wind comfort by reducing wind speeds and increasing the area of comfortable zones.

Detailed results of wind speed contours for each assessed wind direction are reported in Volume 3, Appendix 18.1.



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Site Boundary

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Dining
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

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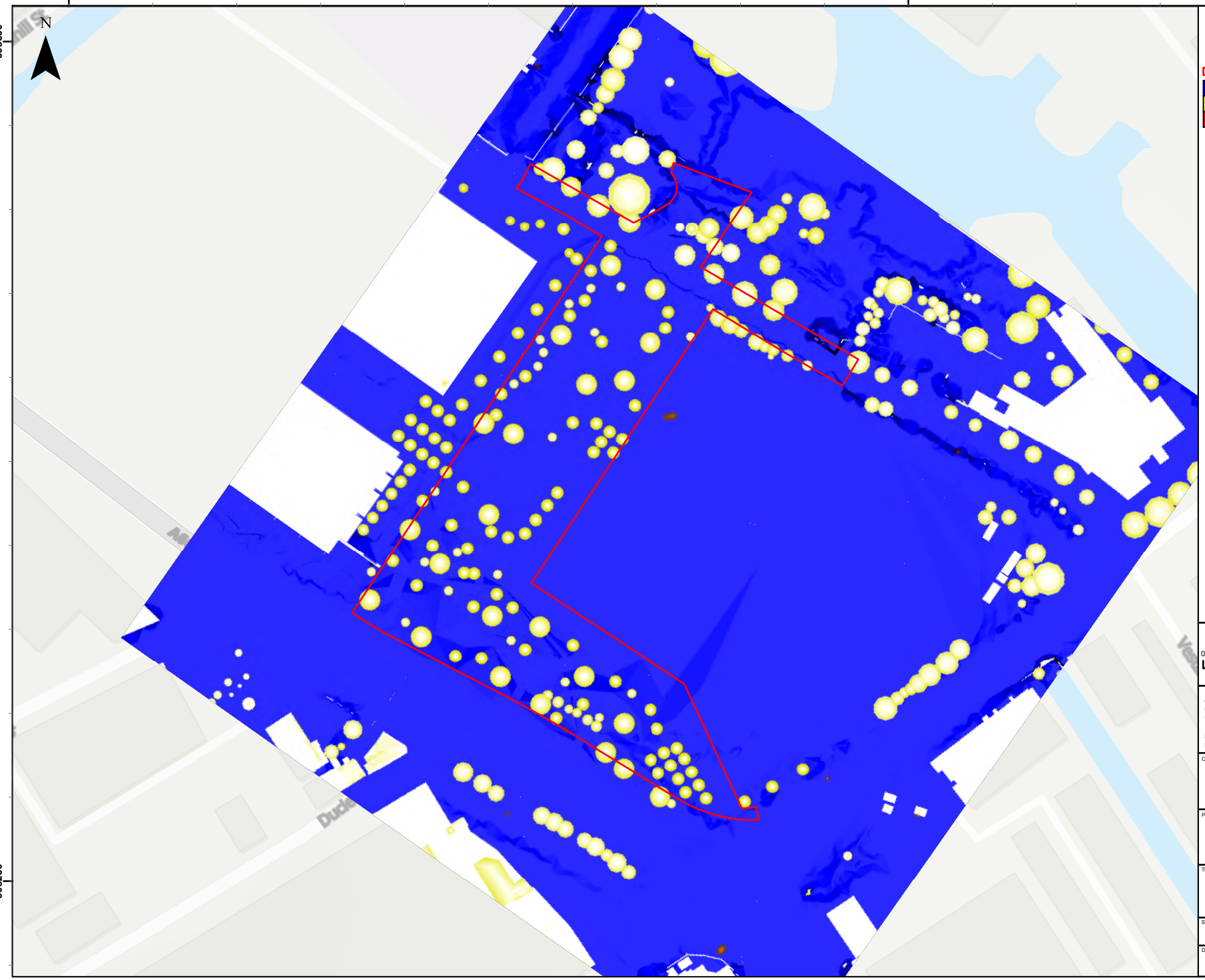
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Lawson LDDC Pedestrian Comfort - Proposed

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Figure 18-6

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Site Boundary				
	A	15 m/s	< 0.05%	No Risk
	B	15 m/s	< 0.30%	Limited Risk
	C	15 m/s	>= 0.30%	Dangerous

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The area directly around the Phase 1 buildings is shaded in blue, meaning there is no risk from high wind speeds of 15 m/s or more. This suggests that the Proposed Development is very safe for pedestrians regarding wind risk.

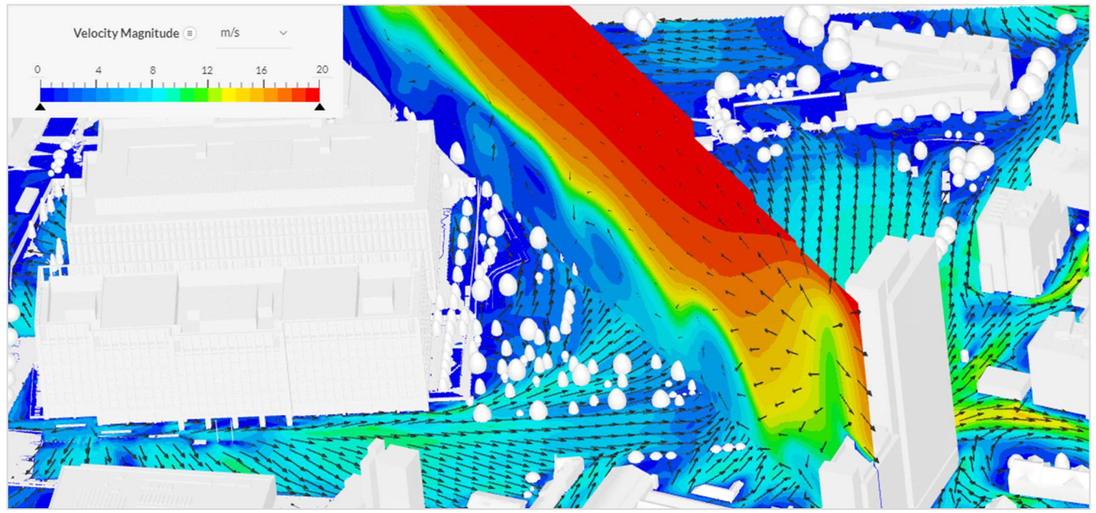


Figure 18-8 – Wind movement around the proposed trees in worst case scenario

Figure 18-8 demonstrates that areas directly behind or within clusters of trees exhibit significantly reduced wind speeds, providing shelter from strong winds Tree canopies create turbulence, which helps to dissipate wind energy and reduce wind speed beneath and around the trees. Trees act as natural barriers, reducing wind speed in their immediate vicinity by absorbing and deflecting wind energy, enhancing pedestrian comfort.

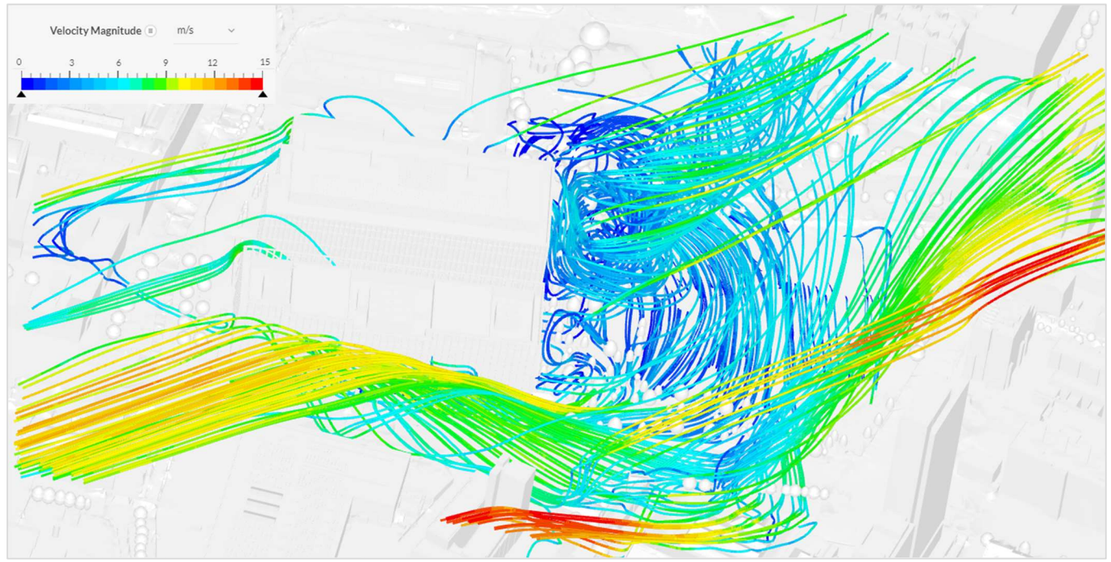


Figure 18-9 – Particle trace movement around the proposed trees

Figure 18-9 shows complex wind flow patterns as wind interacts with trees, significantly affecting wind speed and direction.

The graphic effectively visualises wind flow patterns and speed variations around trees using particle traces and colour coding. High wind speed areas are identified by red and yellow traces, while moderate and low wind speeds are shown by green and blue traces, respectively. Trees act as natural windbreaks, reducing wind speeds and creating sheltered zones that enhance pedestrian comfort and environmental quality.

Within the context of the surrounding area, the Proposed Development is helping to improve the pedestrian wind comfort for the buildings next to the Proposed Development as per Figure 18-6 and the areas is suitable for pedestrian sitting. The open space in on the Proposed Development is comfortable for pedestrian sitting.

18.9 Mitigation Measures

Based on the analysis of wind flow patterns around trees and buildings, no significant effects are anticipated. Therefore, no additional mitigation is required.

18.10 Summary and Conclusion

The analysis of wind flow patterns around trees in the Proposed Development reveals that no significant effects are anticipated during the construction and operational phases. The vegetation and tree planting within the design of the Proposed Development is shown to be sufficient in offsetting any adverse effects on pedestrian comfort.

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