

85 Rochdale Road Wind Microclimate

Client: McGoff Group Projects Limited

Prepared by ArcAero

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Executive Summary

Wind microclimate studies assess how new developments alter local wind conditions. They estimate how often wind speeds at pedestrian level exceed thresholds for safety and comfort, helping to determine whether areas are suitable for their intended use, or if design changes are needed.

The 85 Rochdale Road development was assessed by ArcAero using Computational Fluid Dynamics (CFD) and the Lawson criteria. The study predicts pedestrian wind conditions following the introduction of the proposed buildings and evaluates their suitability for public comfort and safety.

- Within the existing site, there are no exceedances of wind safety and comfort criteria.
- Following the introduction of the proposed development into the existing surrounds, the wind safety and comfort criteria continue to be met.
- Following the introduction of the proposed development into the cumulative surrounds, the wind safety and comfort criteria continue to be met.

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1. Project Introduction

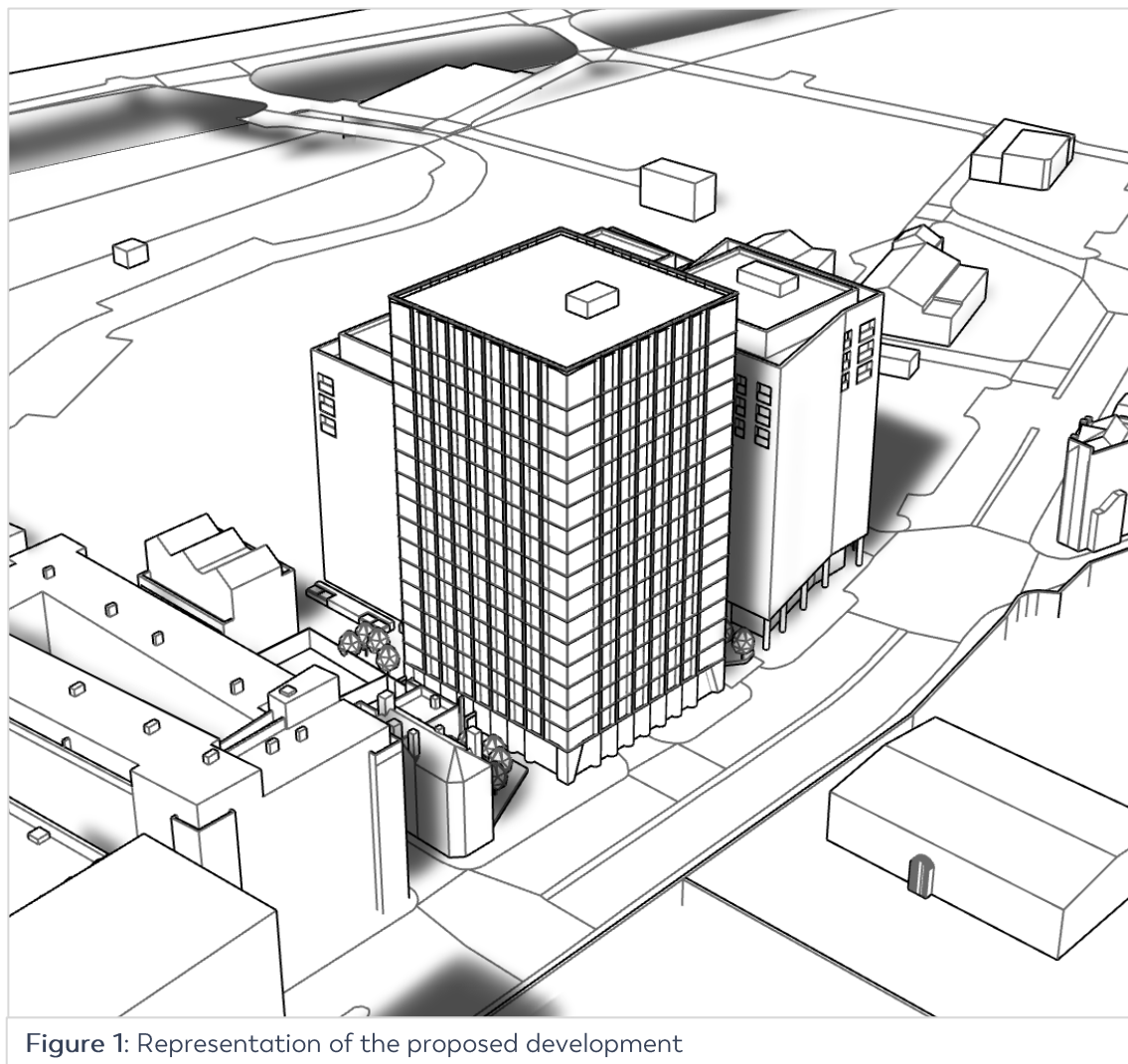


Figure 1: Representation of the proposed development

Overview

This report summarises the results of a CFD study, commissioned by McGoff Group Projects Limited, to assess the wind microclimate for the detailed proposals for the Rochdale Road development in Manchester, UK.

The assessment focuses on pedestrian safety and comfort, with particular attention to entrances, walkways, seating areas, and outdoor amenity spaces, including elevated terraces and balconies.

Predictions have been made using Computational Fluid Dynamics (CFD), based on the Lawson (LDDC) criteria.

The study informs both design refinement and planning compliance, ensuring that wind conditions are appropriate for the intended year-round use of public and private external spaces.

Rochdale Road

The Rochdale Road development is bounded by Gould Street to the west, Rochdale Road to the south, a neighbouring building to the east, and a construction site to the north.

Further afield the area is generally typified by existing and emerging mid-rise developments to the west.

The proposed development consists of the erection of a 17-storey residential apartment building (Use Class C3 (a)), with associated access, amenity, landscaping, public realm, infrastructure and other associated works. Demolition of existing vacant building on site, comprising of ground floor retail and first floor apartment.

Digital models used in this study are based on project-specific drawing information, detailed in Appendix A.

2. Modelling Approach

CFD Methodology

Computational Fluid Dynamics (CFD) modelling was undertaken using a steady-state Reynolds-Averaged Navier-Stokes (RANS) approach. This method employs turbulence models to approximate the effect of wind gusts by predicting fluctuations about the mean wind speed.

Key aspects of the modelling setup include:

- The Shear Stress Transport (SST) $k-\omega$ turbulence model was used for its accuracy in near-wall regions and flow separation.
- All architectural features greater than 0.5 metres in scale were explicitly included in the model geometry.
- A refined mesh resolution was applied in critical areas, with cell sizes as small as 0.2 metres.
- At pedestrian level (1.5 metres height), a minimum of five vertical cell layers were used to accurately resolve ground-level wind conditions.
- 36 wind directions were assessed at 10° increments, capturing a full compass range of prevailing and secondary winds.

Mean wind speeds and gust-equivalent mean wind speeds were derived from the simulations, following accepted industry guidance. Analysis was carried out using the Lawson criteria (LDDC variant)^[1] for wind comfort and safety, in accordance with industry standard practice.

Further technical detail is provided in Appendix B.

Digital Model Domain

A detailed 3D model of the site and its surroundings was used for the CFD simulations. The study domain extended up to 450 m in all directions from the site, incorporating all existing and planned built forms or topographical features likely to influence airflow patterns.

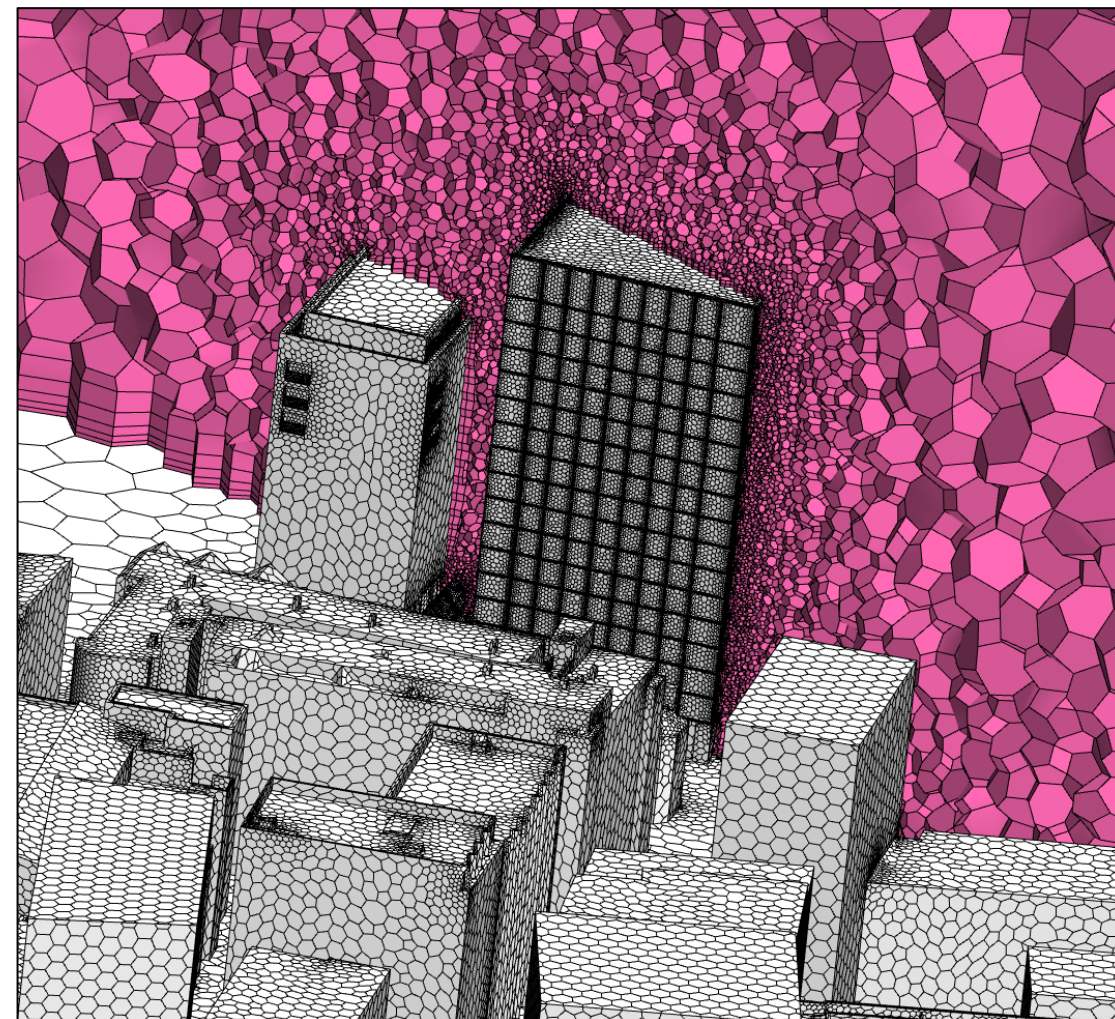


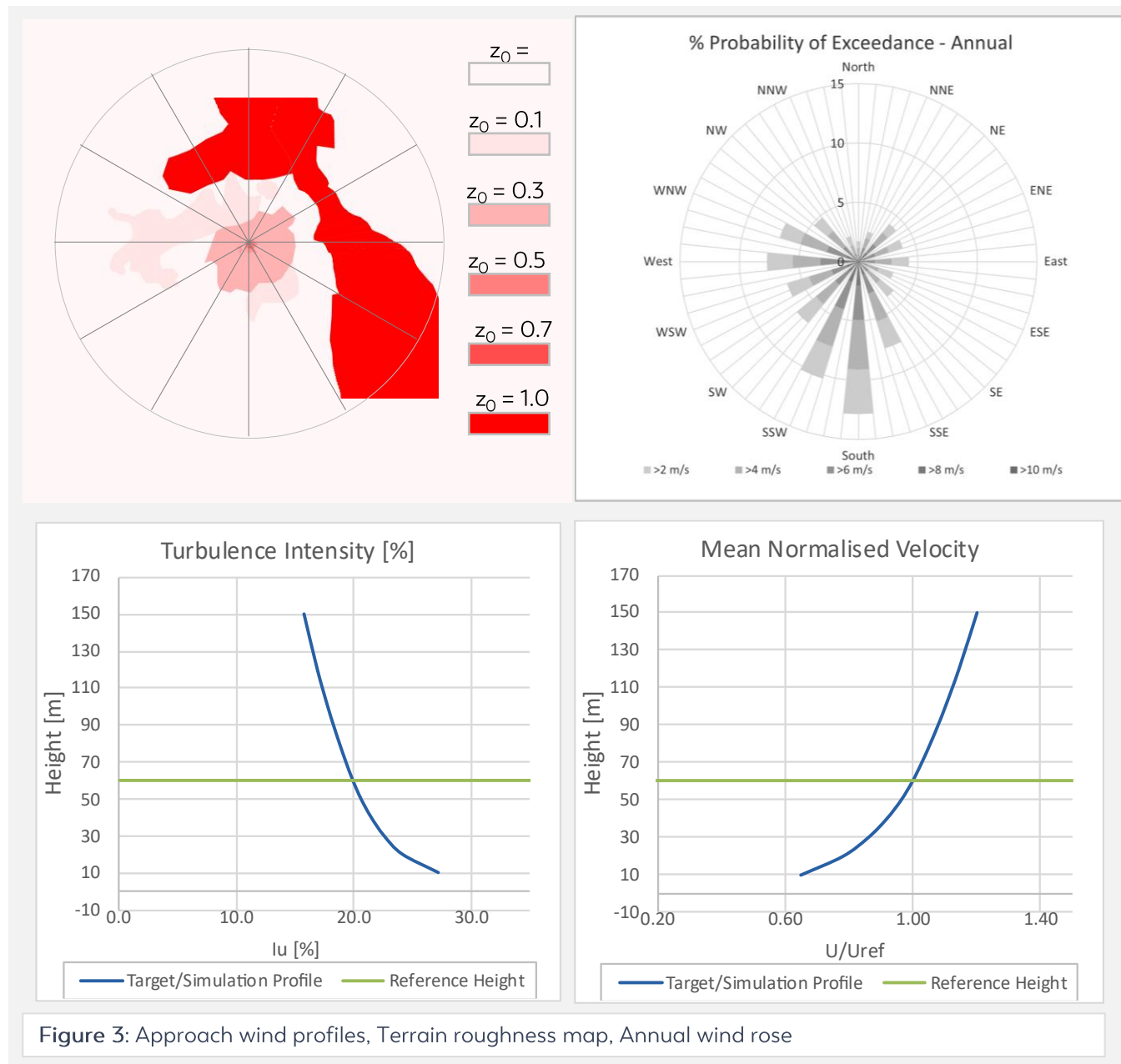
Figure 2: Computational mesh for CFD simulations

ABL & Wind Climate Data

Wind frequency and direction statistics were derived from long-term meteorological data obtained from Manchester Airport.

- Wind data was transposed to the site location and adjusted for local terrain roughness.
- The atmospheric boundary layer (ABL) and wind speed profiles were modelled using methods set out in ESDU Item 01008^[2], consistent with best industry practice for microclimate analysis.
- Seasonal variation in wind intensity and directional frequency was accounted for to distinguish worst-case winter safety conditions and seasonal comfort conditions.

ArcAero's terrain roughness assessment, resulting approach wind profiles and annual wind rose are presented in Figure 3.



3. Understanding Wind Comfort and Safety Criteria

The Lawson Criteria

Pedestrian wind conditions are assessed using the Lawson ‘LDDC’ criteria^[1], which define thresholds for safety, and separate comfort thresholds based on typical outdoor activities. These thresholds are compared against predicted wind speeds using long-term meteorological data.

For safety, a 15 m/s threshold is typically applied. Wind speeds exceeding this level more than once per year (~0.022% ≈ 2 hours per year) may destabilise vulnerable individuals and are considered a risk to pedestrian safety.

For comfort, wind speeds should not exceed activity-specific thresholds more than 5% of the time. Stricter criteria are applied in areas where pedestrians are expected to pause, wait, or linger, such as café seating, waiting areas, entrances, or playparks. In contrast, higher thresholds apply to routes where continuous movement is expected.

Comfort conditions are assessed seasonally:

- Worst-seasonal conditions are used to evaluate spaces with year-round use, such as entrances, footpaths, and through-routes. This ensures windiness is acceptable during the windiest part of the year, which typically occurs in winter, but sometimes in spring, or autumn.
- Summer amenity conditions are typically applied to seasonal-use areas, such as external seating terraces and roof gardens, using climate statistics for June, July and August.

Table 1 sets out the LDDC variant of the Lawson comfort criteria, with Figure 4 providing visual examples of the primary activities reflected.

Figure 4: Visual examples of typical outdoor activities



	Threshold Wind Speed (m/s)	Lawson Classification	Examples
	4	Long-term sitting	Bar / café
	6	Standing / short-term sitting	Bus stop, school pick-up point, playpark, viewing terrace
	8	Strolling	Residential routes, public realm, shopping streets
	10	Walking	Commuter routes, business district
	>10	Uncomfortable	Unsuitable for regular pedestrian use

Table 1: Lawson comfort criteria

4. Assessment Scenarios

The following scenarios have been modelled:

- i. Existing site conditions, Existing surrounding context (EinE)
- ii. Proposed development, Existing surrounding context (PinE)
- iii. Proposed development, Cumulative surrounding context (PinC)

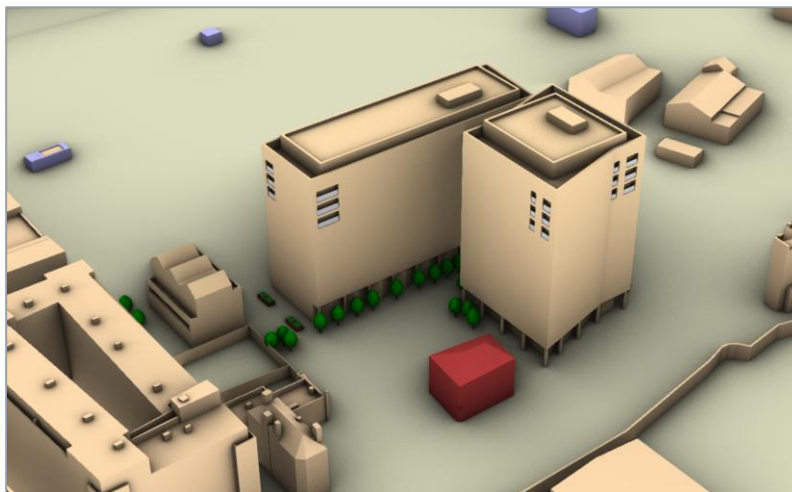


Figure 4.1.1:EinE Closeup from south

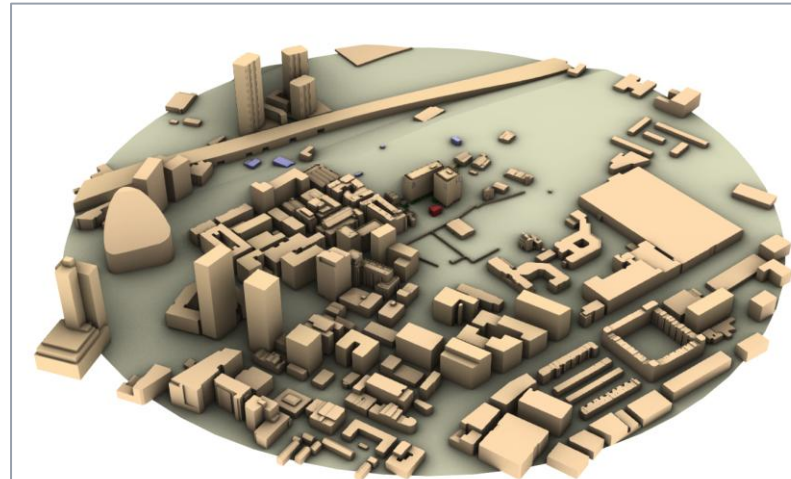


Figure 4.1.2:EinE Surrounds from south

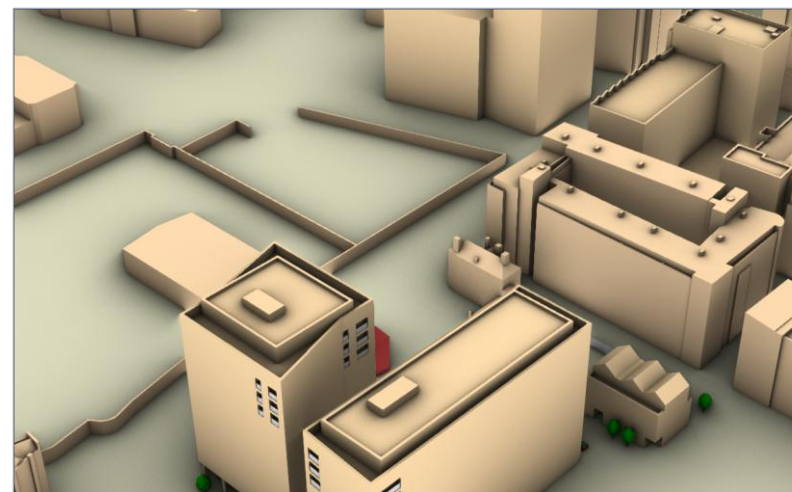


Figure 4.1.3:EinE Closeup from north

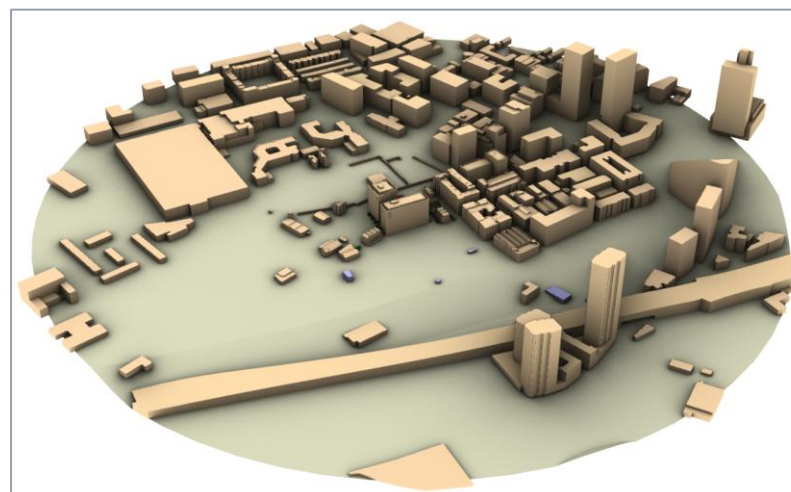


Figure 4.1.4:EinE Surrounds from north

4. Assessment Scenarios

The following scenarios have been modelled:

- i. Existing site conditions, Existing surrounding context (EinE)
- ii. Proposed development, Existing surrounding context (PinE)
- iii. Proposed development, Cumulative surrounding context (PinC)



Figure 4.2.1:PinE Closeup from south

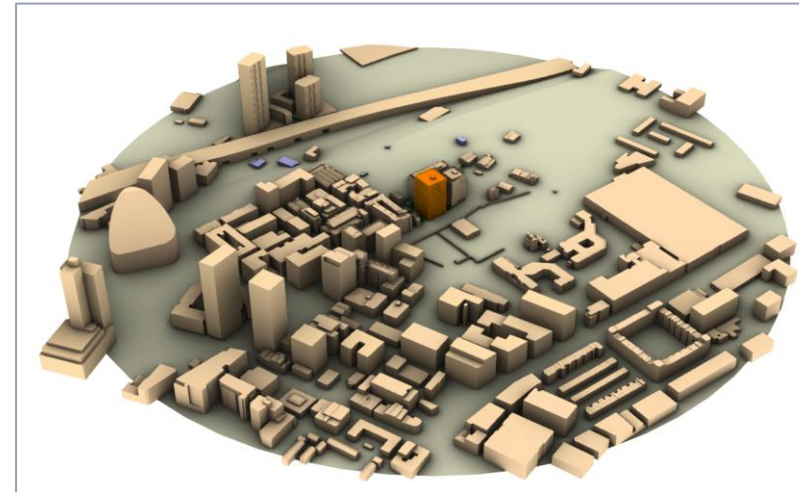


Figure 4.2.2:PinE Surrounds from south

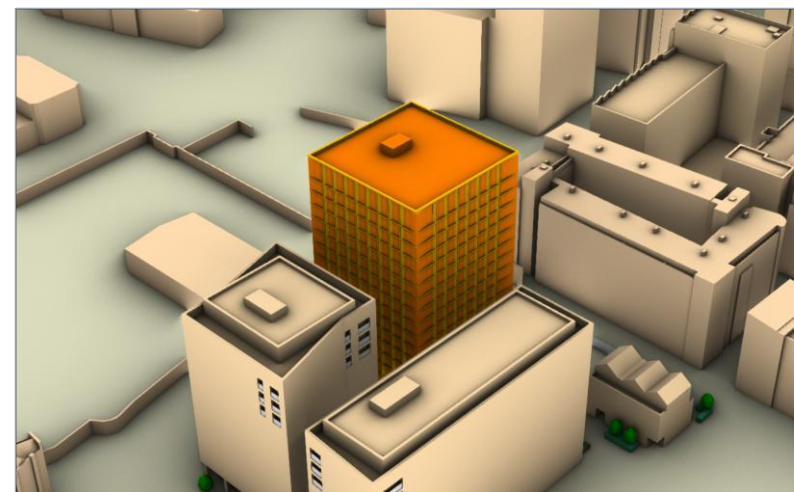


Figure 4.2.3:PinE Closeup from north

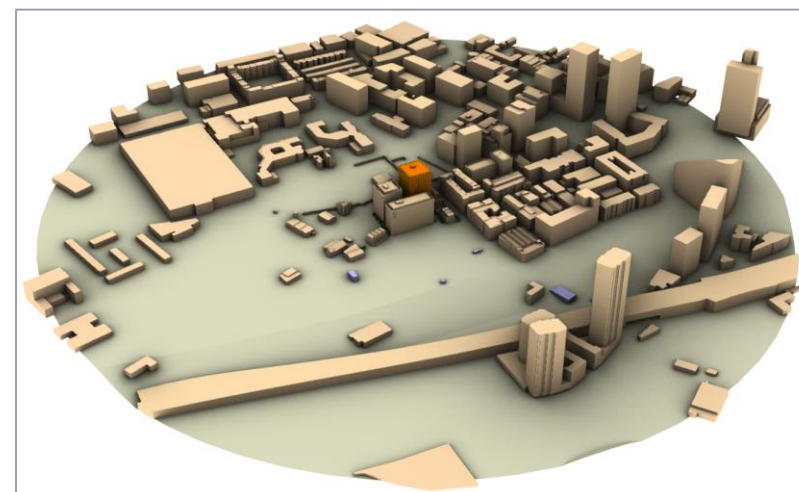


Figure 4.2.4:PinE Surrounds from north

4. Assessment Scenarios

The following scenarios have been modelled:

- i. Existing site conditions, Existing surrounding context (EinE)
- ii. Proposed development, Existing surrounding context (PinE)
- iii. Proposed development, Cumulative surrounding context (PinC)

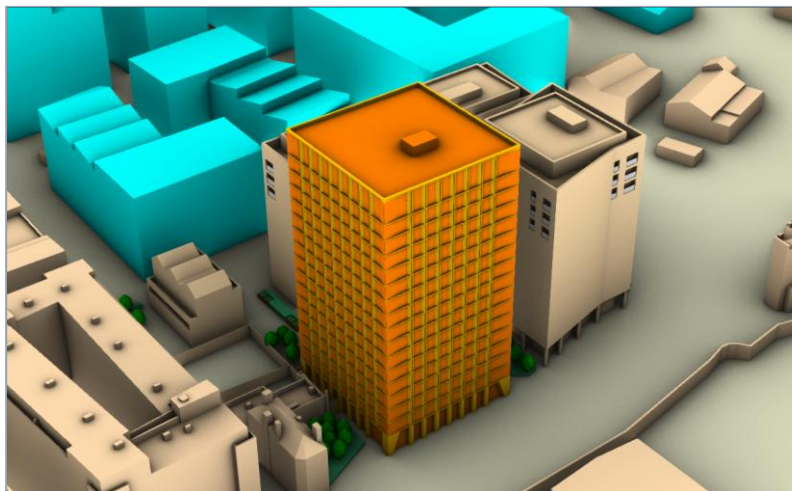


Figure 4.3.1:PinC Closeup from south

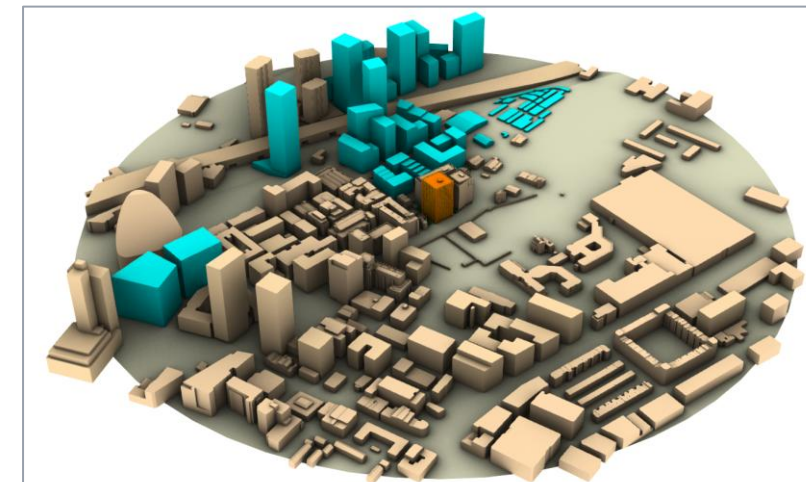


Figure 4.3.2:PinC Surrounds from south

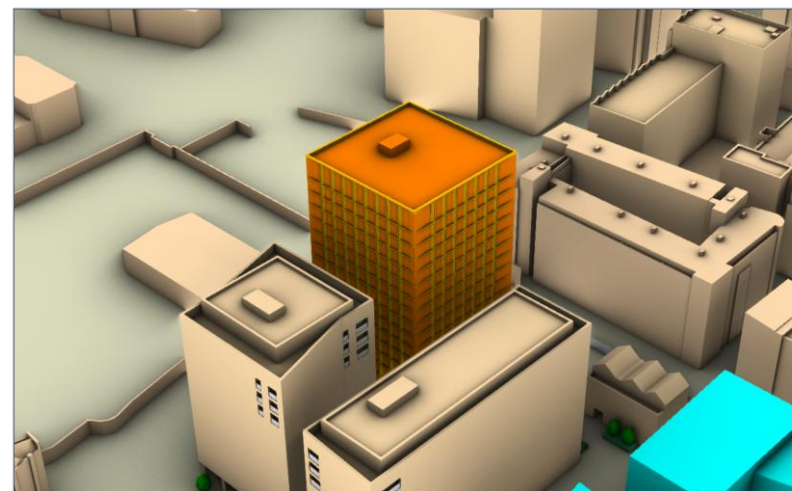


Figure 4.3.3:PinC Closeup from north



Figure 4.3.4:PinC Surrounds from north

Modelling of Nearby Developments With Planning Consent

Several cumulative schemes have been included in the assessment. These are presented visually in Figure 5 and in tabular format in Table 2.

Table 2: Cumulative developments		
List	Development Name	Planning Reference
i	Land Bounded By Dantzic Street & Aspin Lane, Land Bounded By Gould Street & Angel Meadows And Land Bounded By Old Mount Street, School Street, Naples Street & Ludgate Street Manchester	124120/JO/2019
j	Land Bounded By Dantzic Street, Dalton Street And The Railway Line Known As Plots NT02, NT03 And NT04 Manchester	136814/FO/2023
k	Land At Bromley Street Manchester M4 4JS	138695/FO/2023
l	Land Bound By Gould Street, Williamson Street, Bromley Street And Bilbrook Street Manchester M4 4DD The Gasworks	128248/FO/2020
u	Land Bounded By Angel Street, Miller Street And Angel Square Known As Plots M And N Manchester	134307/FO/2022
q	Land at Peary Street	143289/JO/2025

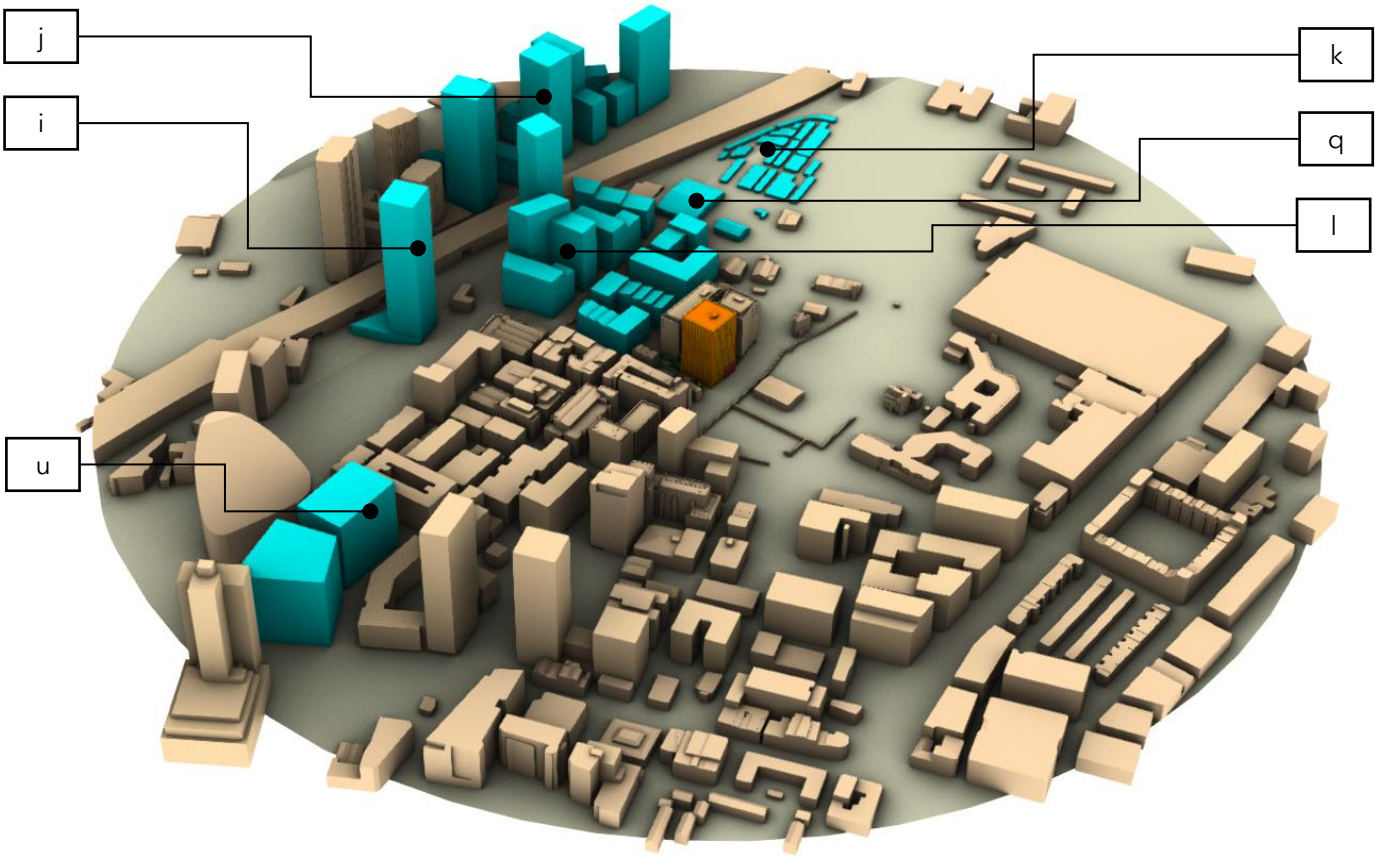


Figure 5: Cumulative developments

Modelling of Nearby Developments With Planning Consent

Developments with planning consent that are substantially under construction have been treated as existing and included within the existing surrounds scenario. These are detailed in Table 4.

Table 4: Built or under-construction cumulative sites treated as existing		
List	Development Name	Planning Reference
a	Land Bounded By Miller Street, Rochdale Road And Angel Street Ancoats Manchester	111347/FO/2016/N1
b	Site Bound By Bendix Street To The North East, Chadderton Street To The South East, Goulden Street To The South West And Cross Keys Street To The North West Manchester	125678/FO/2019
c	Land Bounded By Thompson Street / Mason Street / Bendix Street And Rochdale Road Manchester	118120/FO/2017
d	4 Angel Court Ancoats Manchester M4 4HT	110351/FO/2015/N1
e	25 Rochdale Road Manchester M4 4HT	127537/FO/2020
f	Land Bounded By Sharp Street, Baptist Street, Ludgate Hill And Rochdale Road Ancoats Manchester	111921/FO/2016/N1
g	Land Bounded By Simpson Street, School Street, New Mount Street And Ludgate Street Ancoats Manchester	108455/FO/2015/N1
h	23 New Mount Street Manchester	120881/FO/2018
m	87 Rochdale Road Manchester M4 4JD. PHASE 1.	131708/FO/2021
n	Land Bounded By Oldham Road, Marshall Street, Chadderton Street And Bendix Street Ancoats Manchester M4 5FR	112015/FO/2016/N1
o	Site Bound By Thompson Street To The North East, Oldham Road To The South, Bendix Street To The South West And A Building Occupied By Turning Point To The North West Manchester.	125681/FO/2019
p	Site Bound By Oldham Road To The South East, Marshall Street To The North East, Chadderton Street To The North West, And Addington Street To The South West Manchester	125686/FO/2019
r	8 Cable St	114908/FO/2016
s	Land Bounded By Cable Street, Cross Keys Street, Addington Street And Mason Street Manchester M4 5FT	118057/FO/2017
t	Swan House Swan Street Manchester M4 5DF	121380/FO/2018
v	Land Bound By Dantzic Street, Gould Street, Williamson Street And Bromley Street (Known As Victoria Riverside) Manchester	126944/FO/2020
w	Land Bounded By Bengal Street, Primrose Street, Radium Street And Silk Street Manchester	120893/FO/2018

5. Landscaping & Mitigation

Landscaping Proposals

The wind microclimate for the Proposed Development has been assessed with current soft landscaping proposals and surrounding landscaping. The wind microclimate for the Proposed Development has been assessed with current soft landscaping proposals and surrounding landscaping. Figure 6.1 summarises the landscaping modelled.

Modelling of the soft landscaping has been based on drawings provided by Planit, with all referenced drawing information listed in Appendix A.



Figure 6.1: Soft landscaping proposal tested

6. Results

Pedestrian Uses

Assessments of this nature predict the proportion of time an area will experience wind speeds in excess of threshold values associated with comfortable use once the development is introduced. It is therefore important to have an adequate understanding of the expected uses of the various areas in & around the site.

For the current study, anticipated pedestrian uses are presented graphically in Figure 7.

Results

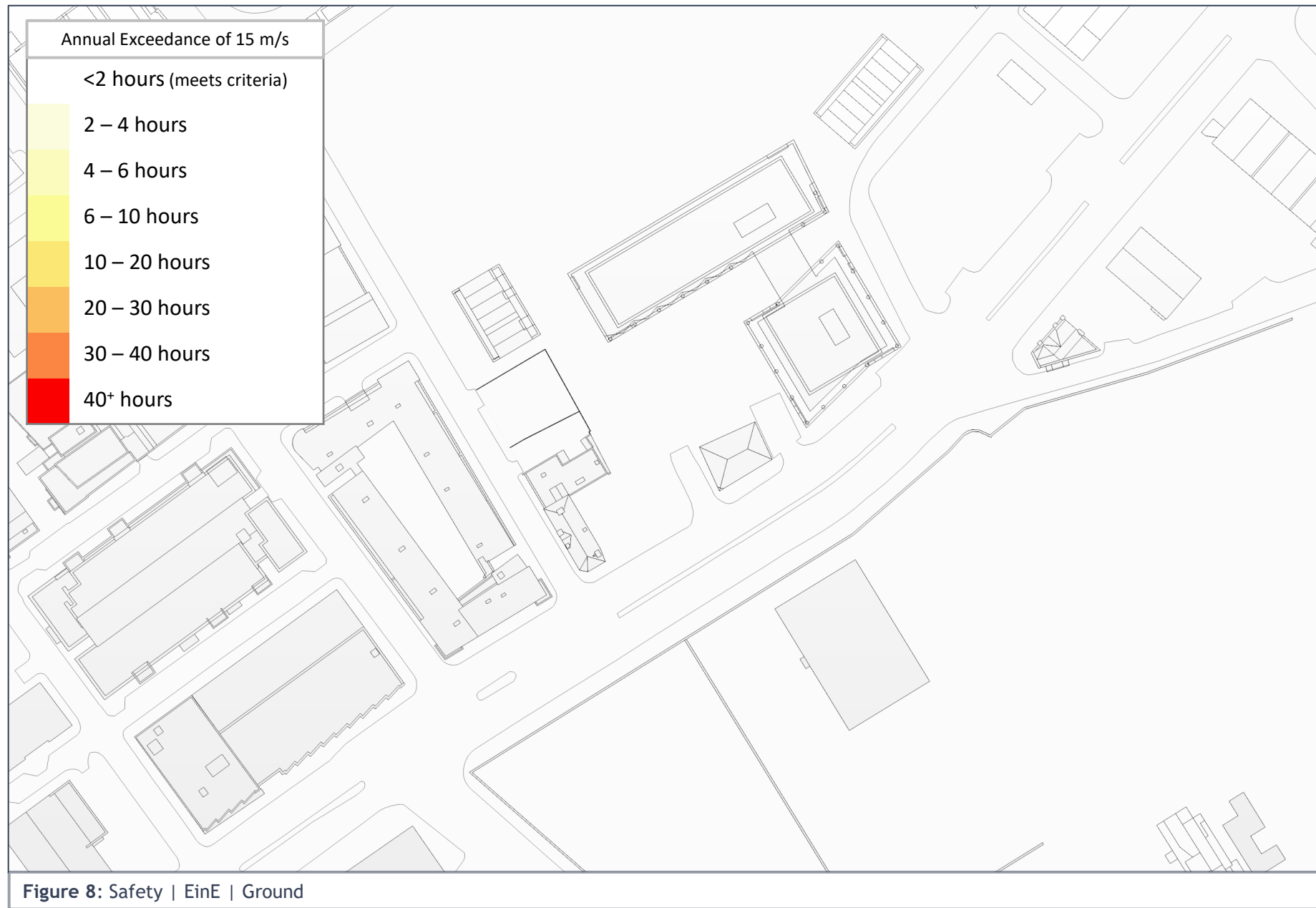
Results are presented as follows, for safety, worst-seasonal comfort and summertime comfort respectively, at ground level, plus summertime comfort above ground:

- Existing site conditions, Existing surrounding context (EinE) - Figures 8-10
- Proposed development, Existing surrounding context (PinE) - Figures 11-13
- Proposed development, Cumulative surrounding context (PinC) - Figures 14-16



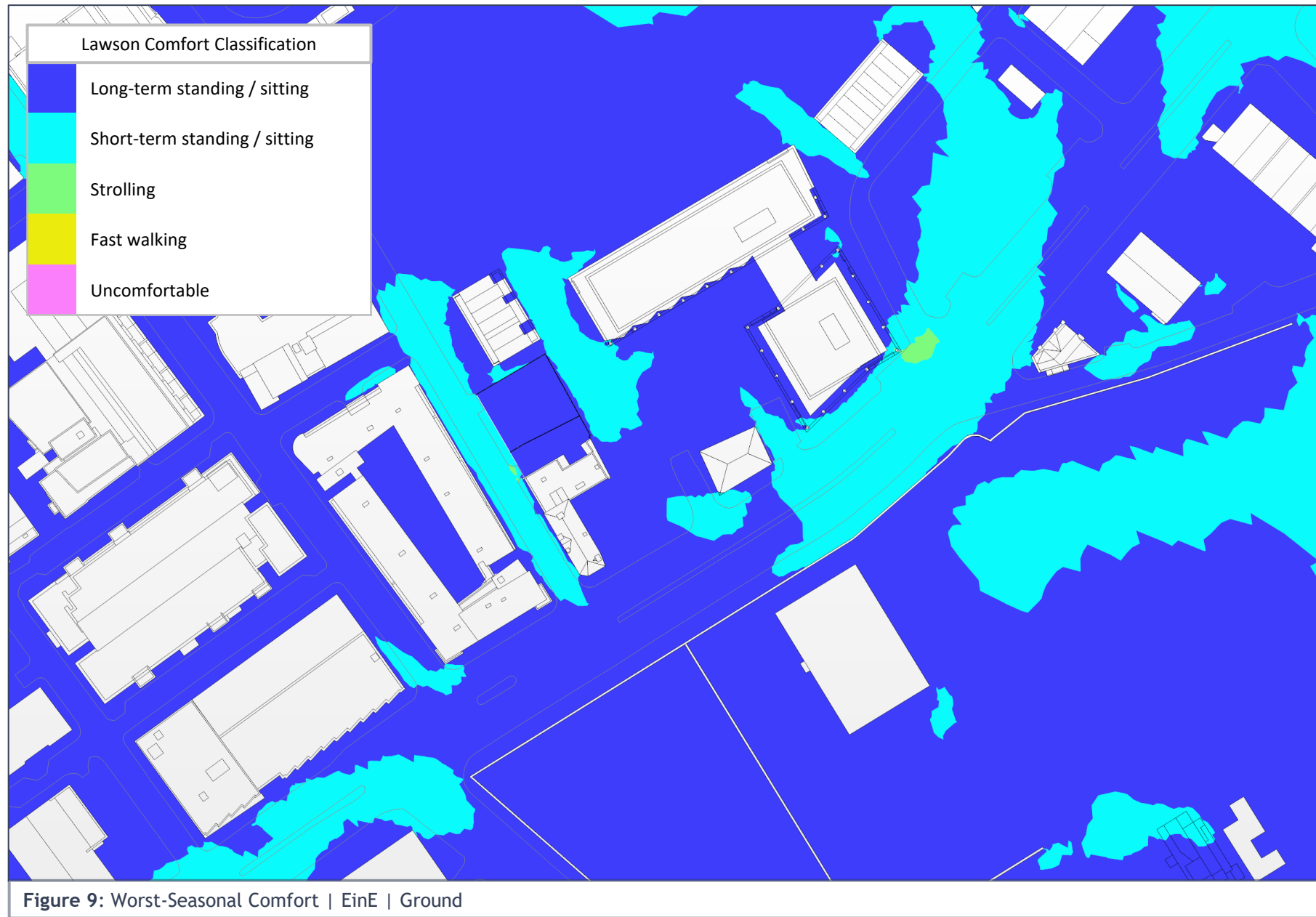
Safety | EinE | Ground

- There are no exceedances of the wind safety criteria within the existing site and surrounding area.



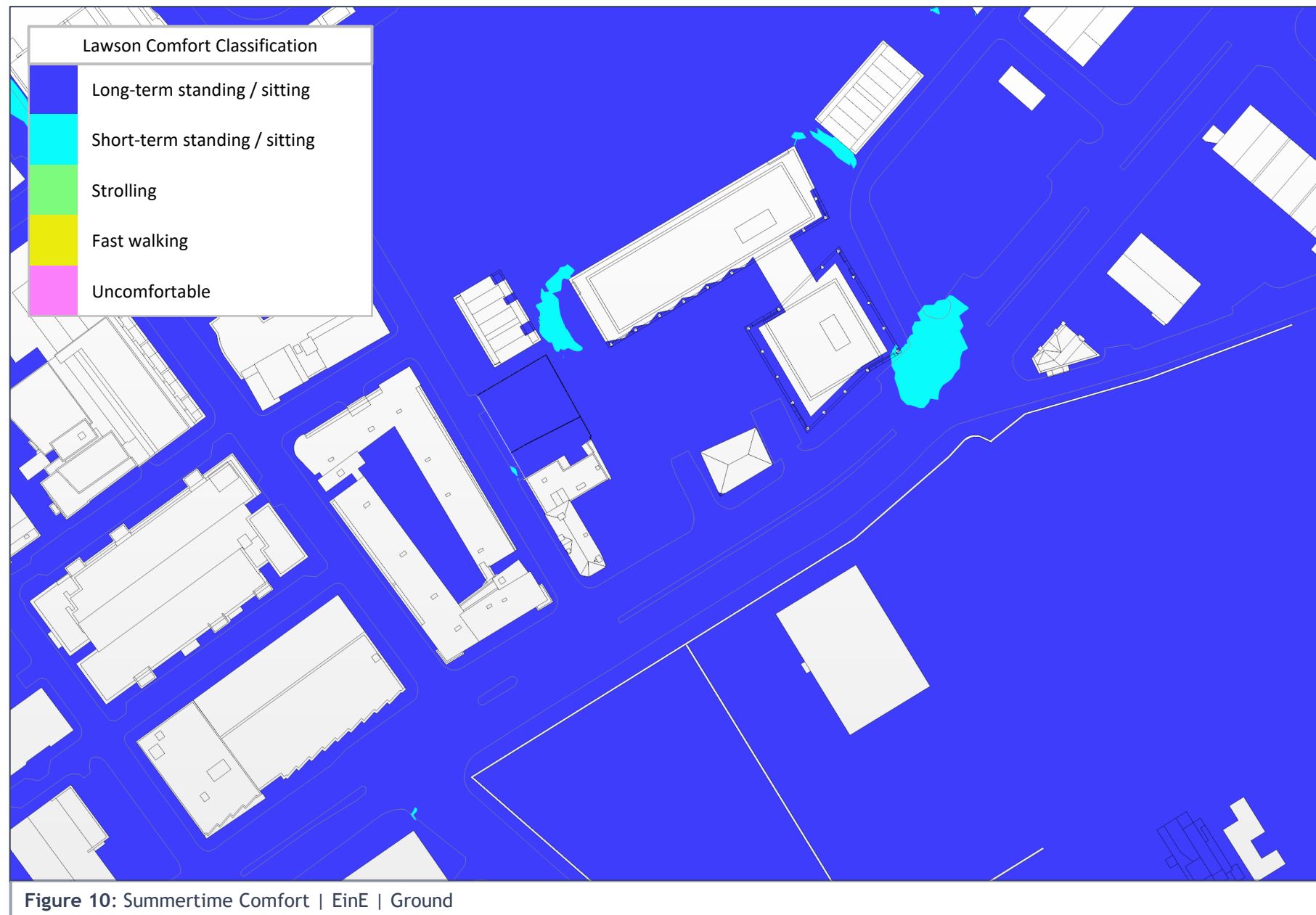
Worst-Seasonal Comfort | EinE | Ground

- All site throughfares are suitable for at least short-term standing throughout the year and thus suitable for pedestrian usage.
- Within the surrounding area, wind comfort conditions are generally suitable for at least short-term standing through the year at thoroughfares thus suitable for pedestrian usage.
- All entrances within the surrounding area are suitable for at least short-term standing through the year thus making them suitable for pedestrian ingress/egress.



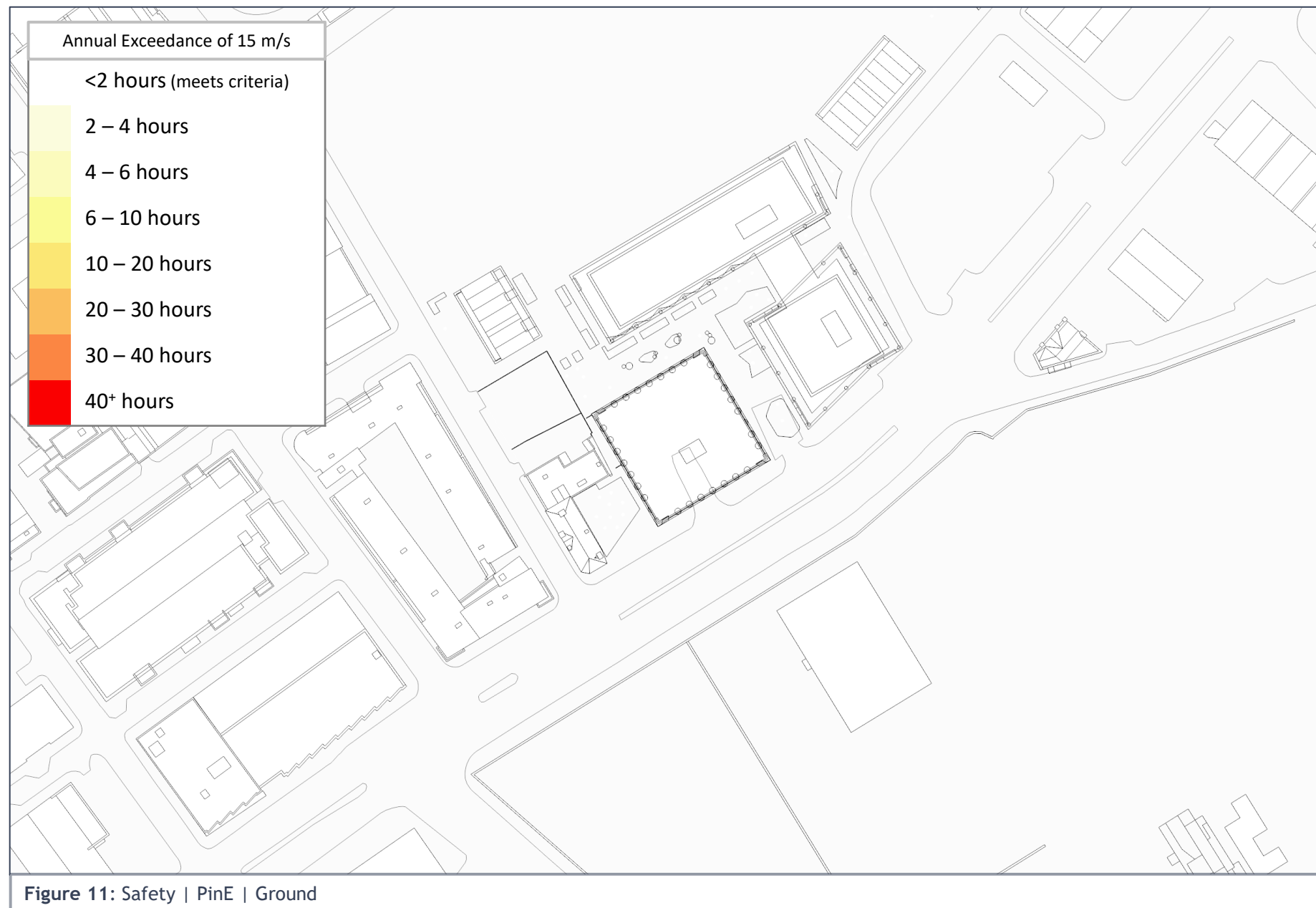
Summertime Comfort | EinE | Ground

- In summer, wind conditions generally improve to long-term standing or sitting thus the conclusions reached in worst-seasonal comfort continue to apply.



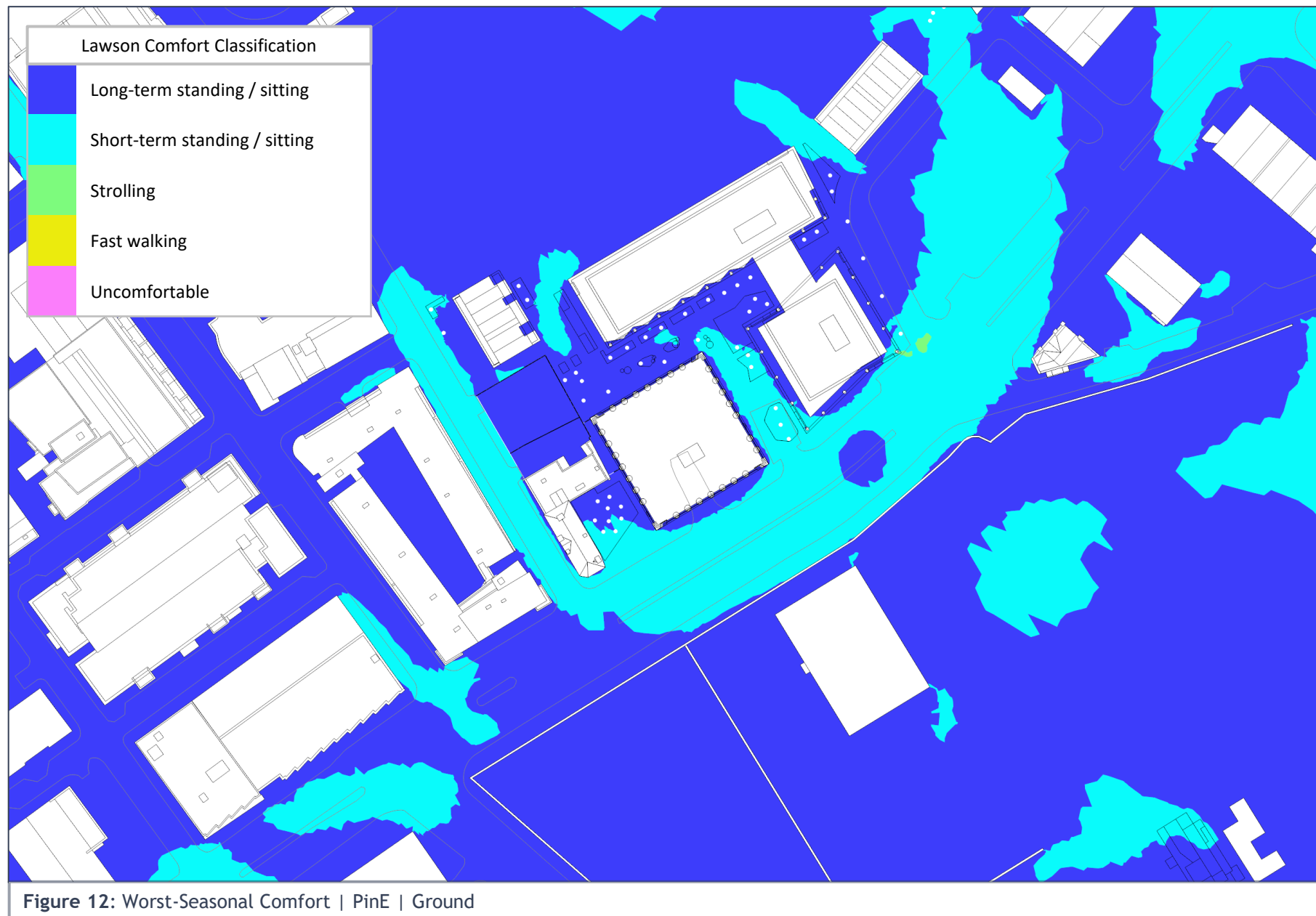
Safety | PinE | Ground

- Following the introduction of the proposed development within the existing surrounds, there continue to be no exceedances of the safety criteria on the ground level of the site and the surrounding area.



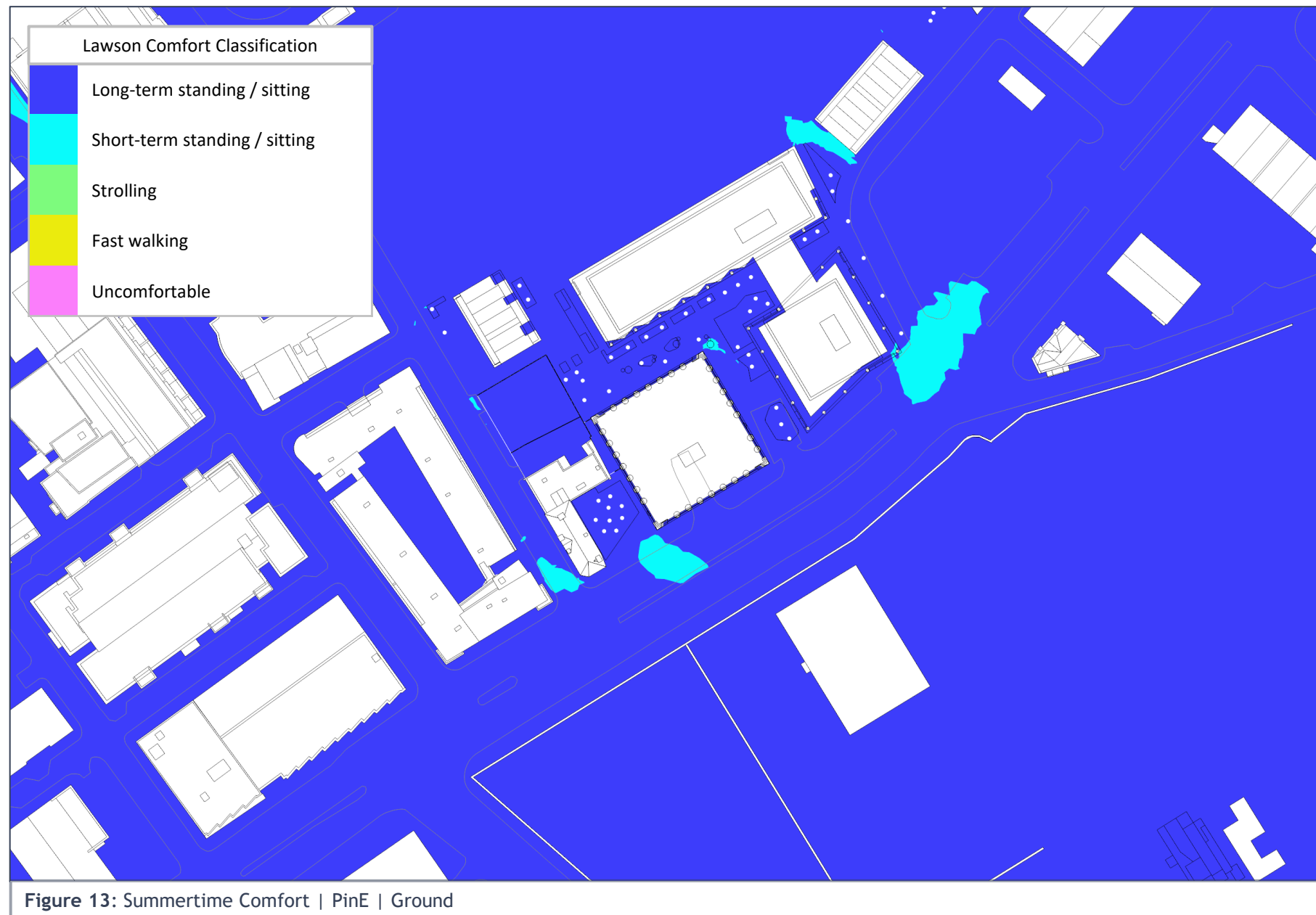
Worst-Seasonal Comfort | PinE | Ground

- Following the introduction of the proposed development into the existing surrounds, all site entrances are suitable for at least short-term standing year-round, thus making them suitable for pedestrian ingress/egress.
- All site throughfares are suitable for at least short-term standing throughout the year and thus suitable for pedestrian usage.
- Within the surrounding area, wind comfort conditions are generally suitable for at least short-term standing through the year at thoroughfares thus being suitable for pedestrian usage.
- All entrances within the surrounding area are suitable at least short-term standing through the year thus making them suitable for pedestrian ingress/egress.



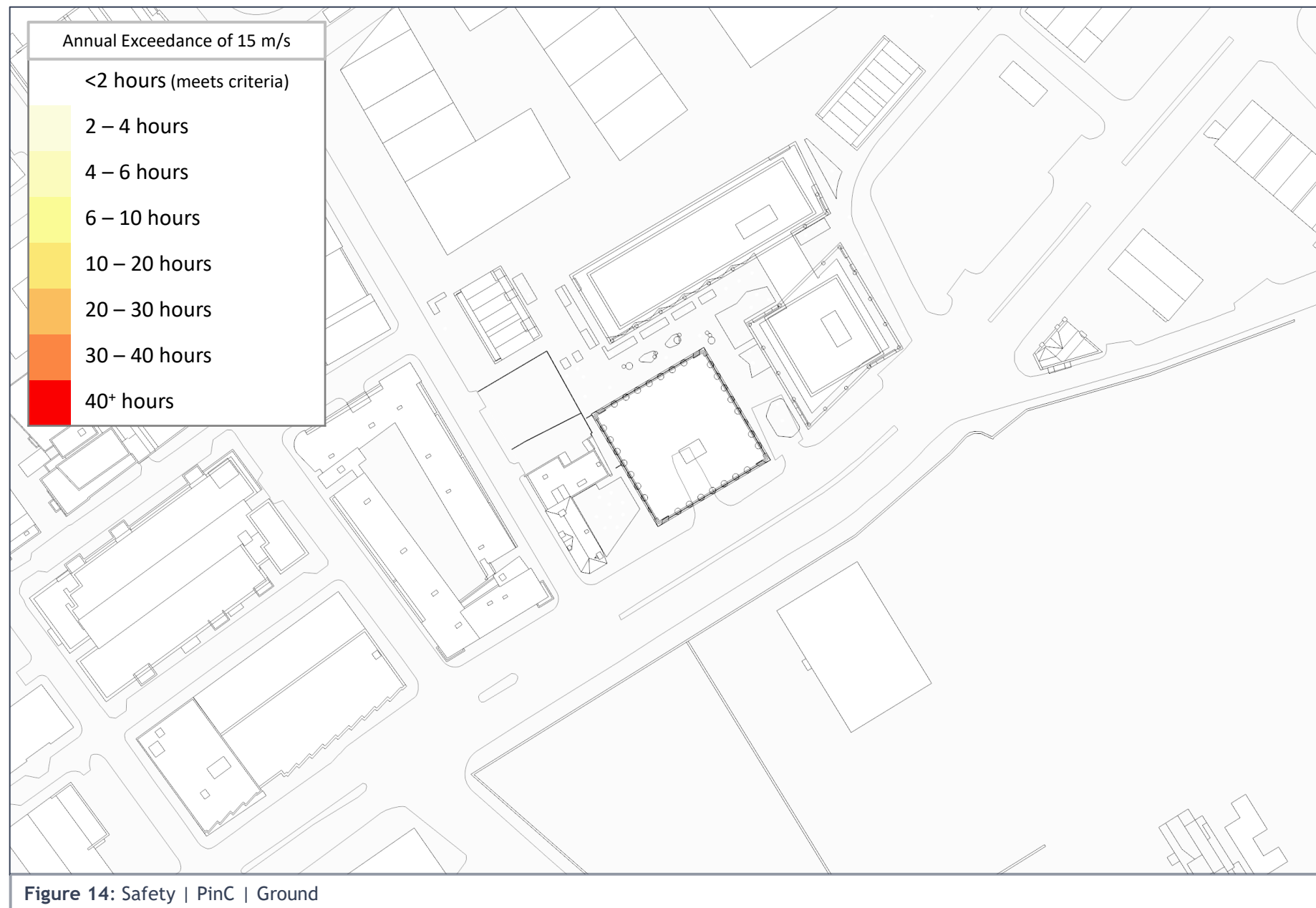
Summertime Comfort | PinE | Ground

- In summer, wind conditions generally improve to long-term standing or sitting thus the conclusions reached in worst-seasonal comfort continue to apply.



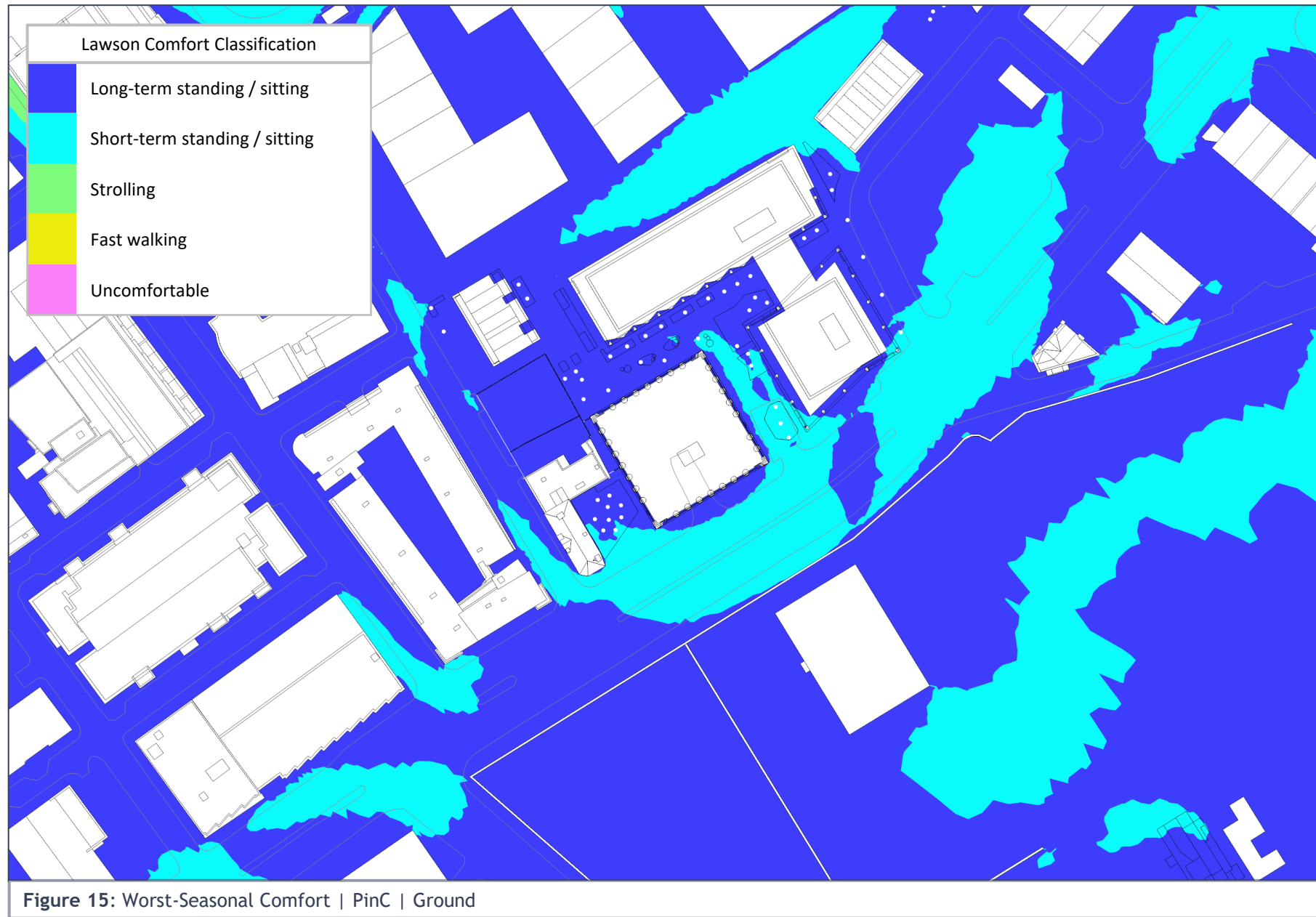
Safety | PinC | Ground

- Following the introduction of the proposed development within the cumulative surrounds, there continue to be no exceedances of the safety criteria on the ground level of the site and the surrounding area.



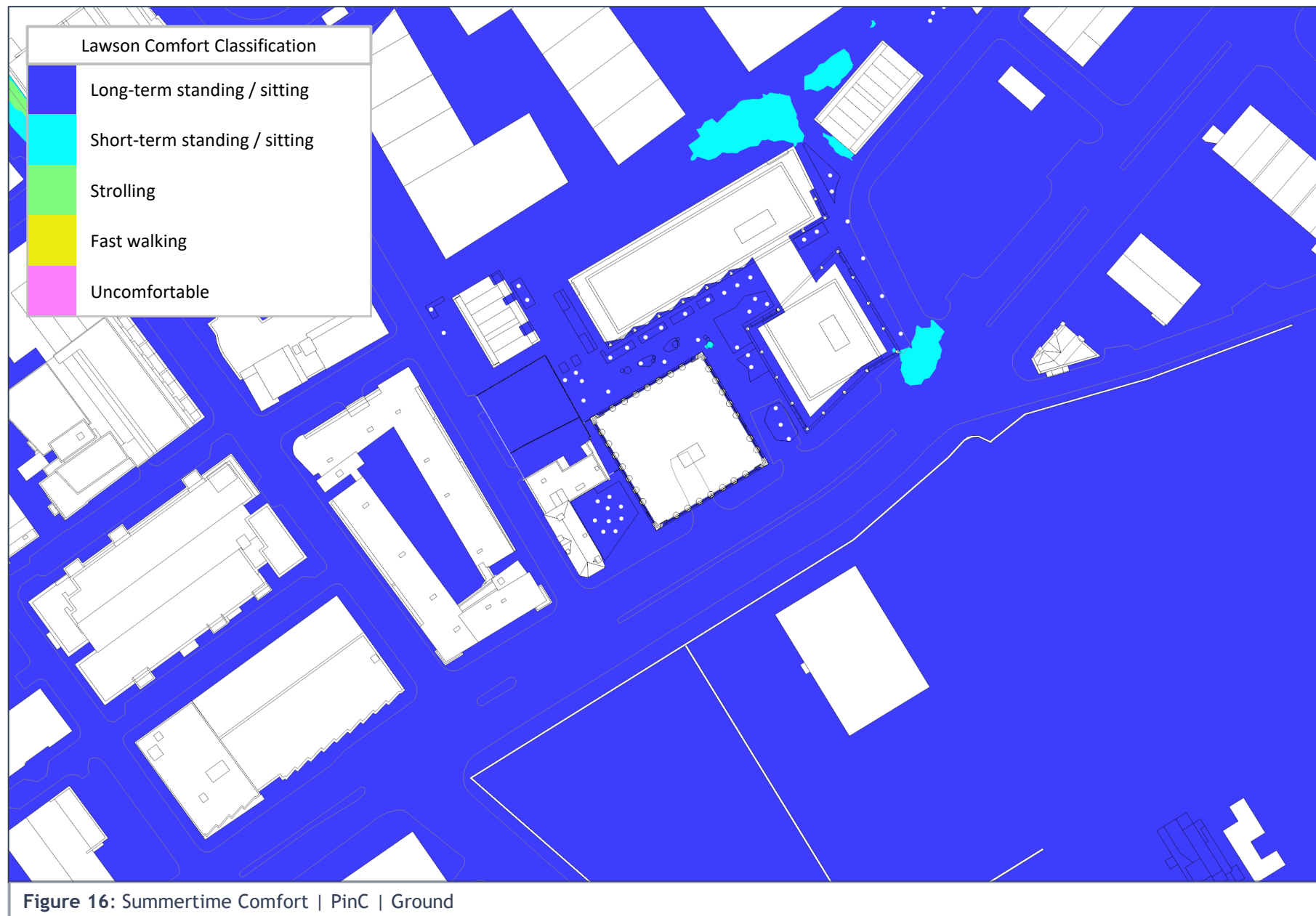
Worst-Seasonal Comfort | PinC | Ground

- Following the introduction of the proposed development into the cumulative surrounds, all site entrances are suitable for at least short-term standing year-round, thus making them suitable for pedestrian ingress/egress.
- All site thoroughfares are suitable for at least short-term standing throughout the year and thus suitable for pedestrian usage.
- Within the surrounding area, wind comfort conditions are suitable for at least short-term standing through the year at thoroughfares thus being suitable for pedestrian usage.
- All entrances within the surrounding area are suitable at least short-term standing through the year thus making them suitable for pedestrian ingress/egress.



Summertime Comfort | PinC | Ground

- In summer, wind conditions generally improve to long-term standing or sitting thus the conclusions reached in worst-seasonal comfort continue to apply.



7. Conclusions

Wind microclimate studies assess how new developments alter local wind conditions. They estimate how often wind speeds at pedestrian level exceed thresholds for safety and comfort, helping to determine whether areas are suitable for their intended use, or if design changes are needed.

The Rochdale Road development was assessed by ArcAero using Computational Fluid Dynamics (CFD) and the Lawson criteria. The study predicts pedestrian wind conditions following the introduction of the proposed buildings and evaluates their suitability for public comfort and safety.

- Within the existing site, there are no exceedances of wind safety and comfort criteria.
- Following the introduction of the proposed development into the existing surrounds, the wind safety and comfort criteria continue to be met.
- Following the introduction of the proposed development into the cumulative surrounds, the wind safety and comfort criteria continue to be met.

8. References

- [1] Lawson, T.V. The determination of the wind environment of a building complex before construction. Bristol : University of Bristol, Department of Aeronautical Engineering, 1990.
- [2] ESDU (Engineering Science Data Unit). Item 01008. Computer Program for wind speeds and turbulence properties: flat or hilly sites in terrain with roughness. 2001.
- [3] F, Menter. Zonal Two Equation $k-\omega$ Turbulence Models for Aerodynamic Flows. 1993. AIAA Paper 93-2906.
- [4] F, Menter. Turbulence Modelling for Engineering Flows. s.l. : ANSYS Inc., 2011.
- [5] Richards, P.J. and Hoxey, R.P. Appropriate boundary conditions for computational wind engineering models using the $k-\epsilon$ turbulence model. s.l. : Journal of Wind Engineering and Industrial Aerodynamics, 1993. vol. 46 & 47, pg. 145 - 153.
- [6] Blocken, B. and Carmeliet, J. Pedestrian wind environment around buildings: Literature review and practical examples. s.l. : Journal of Thermal Envelope and Building Science, 2004.

Appendix A: Preparation of Digital Models



Figure A.1: Proposed Development, close-up

Digital models used in this study were prepared using project-specific drawing information, provided by Jon Matthews Architects on the 4th of March 2026, listed below.

- Rochdale Road Phase 2 - Sketch Model.dwg

Upon the completion of the wind microclimate analysis via CFD, there have been minor updates to the design for the proposed development. This included façade details and column geometry at ground level. An updated digital model was received from Jon Matthews Architects on the 19th of March 2026, listed below:

- 260312 243 Rochdale Road 3D Model.skp

These changes are minor and will not materially impact the wind conditions, hence the conclusions within this report based on the quoted models are still applicable.

Drawings provided by Planit on the 12th of March 2026 used for the modelling of landscaping are:

- 3917.2-PLA-XX-XX-DR-L-0001-General Arrangement.dwg



Figure A.2: Proposed Development, close-up

Appendix B: CFD Modelling

Spatial Discretization

The computational domain was discretised using polyhedral cells for the core mesh and low aspect-ratio prism cells adjacent to solid boundaries, including building walls and the ground surface. Separate computational meshes were constructed for each of the three study configurations.

The domain includes the Proposed Development site along with surrounding buildings and topographical features, explicitly modelled within a 450m radius. The overall domain extends to 1500 m in the along-wind direction, 1100 m across-wind, and 450 m vertically.

To resolve detailed architectural features and flow structures, the Proposed Development and its immediate surroundings were meshed with a minimum cell size of 0.2 m. Pedestrian-level surfaces were meshed with a five-layer prism mesh, which increases in thickness near buildings to reach a total height of 1.5 m above ground level.

Figure B.1 illustrates the computational domain.

Figures B.2 to B.4 provide examples of mesh resolution and distribution.

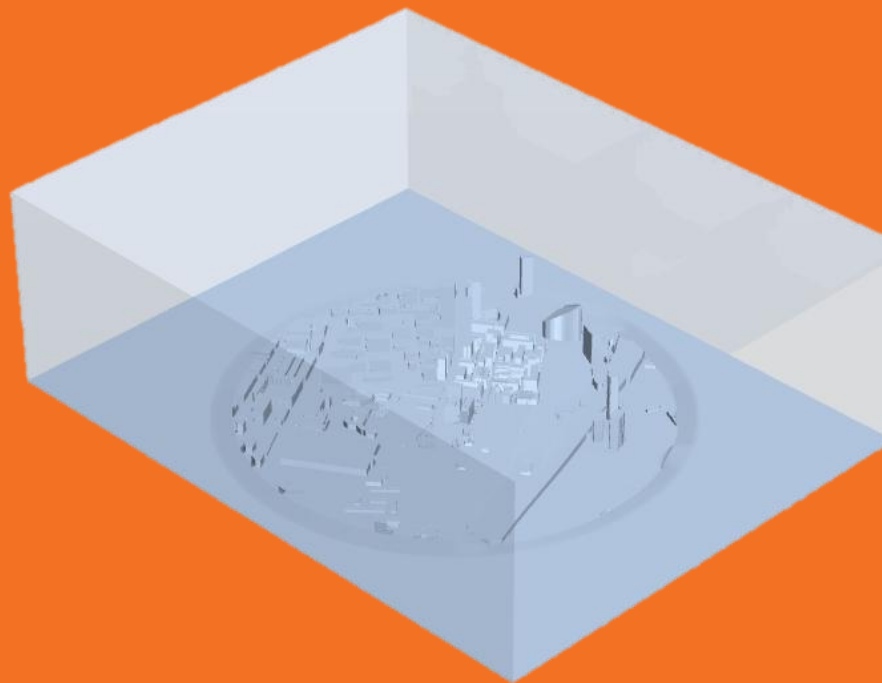
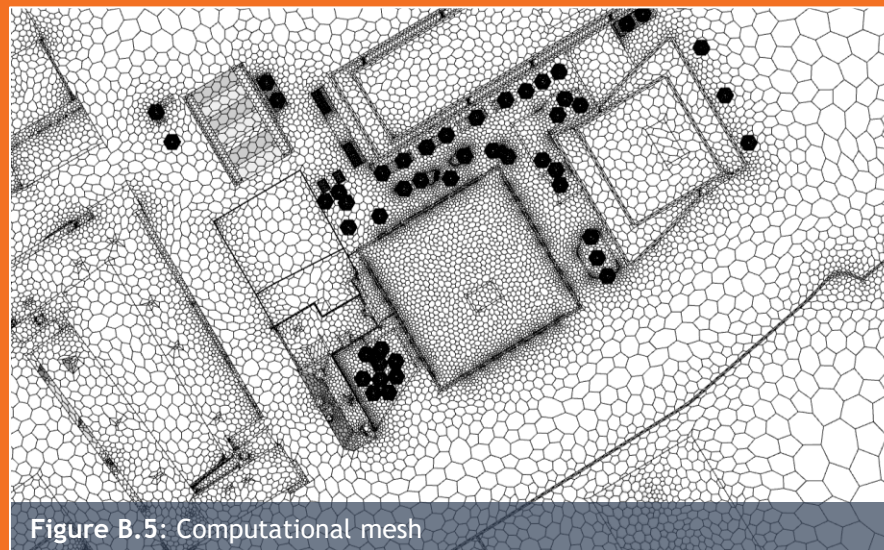
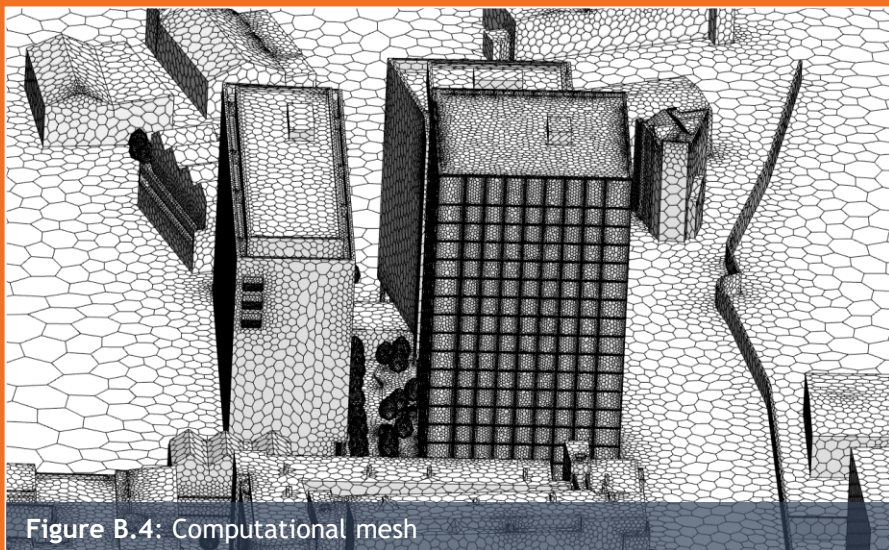
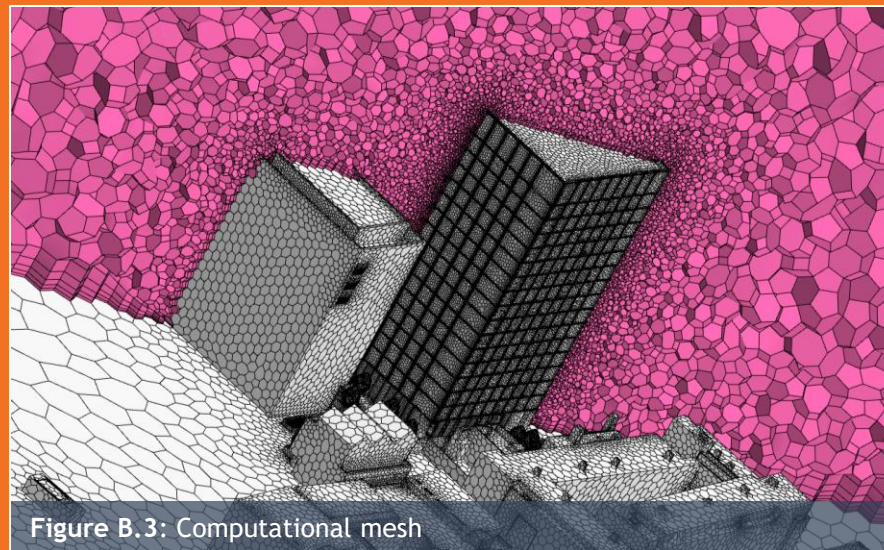
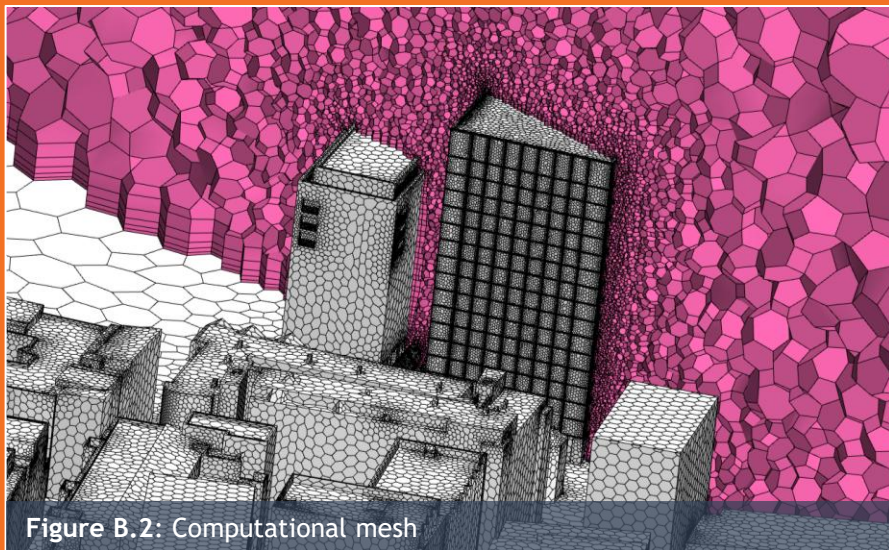


Figure B.1: Computational domain



Solution Method

The modelling of incompressible fluid flow was carried out using variants of the Semi-Implicit Method for Pressure-Linked Equations (SIMPLE) algorithm. Turbulent flow features were simulated using the Shear Stress Transport (SST) k- ω turbulence model.

Originally proposed by Menter^[3], the SST k- ω model is a two-equation eddy-viscosity model that blends the advantages of both the k- ω and k- ϵ formulations. It applies the k- ω model near wall boundaries for accurate resolution of boundary layers, while transitioning to a k- ϵ -like behaviour in the free-stream regions to improve robustness and accuracy in separated flows. Further detail on the formulation and application of the SST k- ω turbulence model can be found in the work of Menter^[3, 4].

Initial and Boundary Conditions

The atmospheric boundary layer flow was simulated by implementing a logarithmic velocity profile model presented by Richards and Hoxey^[5], with the following main assumptions:

- The vertical velocity component at the domain boundary is negligible
- The pressure gradient and shear stress are constant

The model implies the following equation for the mean inlet velocity at the CFD domain:

$$U(z) = \frac{U^*}{\kappa} \cdot \ln\left(\frac{z + z_0}{z_0}\right)$$

where:

- κ - is the von Karman's constant
- z - is the distance from the ground surface in vertical direction
- z_0 - is the ground surface roughness length in metres

The friction velocity U^* is calculated by the following equations:

$$U^* = \kappa \frac{U_{ref}}{\ln\left(\frac{z_{ref} + z_0}{z_0}\right)}$$

where:

- z_{ref} - is the reference height in metres
- U_{ref} - is the reference velocity in m/s measured at z_{ref}

The turbulent velocity fluctuations at the domain inlet are induced by constant shear stress with height, maintained by the turbulent kinetic energy k equation below:

$$k(z) = \frac{U_{ref}^2}{\sqrt{C_\mu}}$$

where:

- $C_\mu = 0.09$ - is a k - ϵ turbulence model constant

All surface boundary conditions were modelled as smooth walls with a no-slip condition. A no-slip wall boundary condition with a varying roughness length height based on the terrain analysis for the site was applied on the ground surface outside the explicit surrounds area of the domain.

Gust Equivalent Mean Calculation

The presence of gusts in the wind flow is a major component that may lead to additional instability and discomfort to that caused by the mean wind flow. Thus, the gust wind speed is accounted for by a calculation of the short-duration gust wind speed, considering the standard deviation of the mean wind speed, and in particular the turbulent kinetic energy, k :

$$\sigma = \sqrt{\frac{2}{3}k}$$

The Gust Equivalent Mean (GEM) is then calculated as:

$$U_{GEM} = \frac{U_{mean} + 3.5\sigma}{k_g}$$

where gust factor, $k_g = 1.85$

The final wind speed ratio (speed-up) used in the Lawson criteria assessment corresponds to the worst-case value derived from both the time-averaged mean wind speed and the gust equivalent mean wind speed. Once known, it is applied in conjunction with the the Weibull cumulative distribution function to calculate the probability of exceedance:

$$P(V > v) = \exp \left[- \left(\frac{v^k}{c} \right) \right]$$

Where v is the wind speed threshold, c is the scale (or dispersion) parameter, and k is the shape parameter. To this formulation, the directional probability of occurrence pp for each wind direction is incorporated. This allows the exceedance probability to be calculated for each wind direction and for each month of the year, providing a directional and temporal profile of wind comfort conditions in accordance with the Lawson criteria.

Rochdale Road- Wind Microclimate Assessment
Version 02 - Issued 25th March 2026

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