

REEDHAM HOUSE

MACHESTER, UK

PEDESTRIAN LEVEL WIND DESK-BASED ASSESSMENT

RWDI #2202699 – REV B

14TH SEPTEMBER 2022

SUBMITTED TO

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VERSION HISTORY

RWDI Project #2202699	Reedham House Manchester, UK		
Engineer	Releases	Dated	Reviewed By
J. Metts	Rev A	04/08/2022	Mazen Hama
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EXECUTIVE SUMMARY

This is a desk-based assessment of the likely wind conditions associated with the proposed Reedham House development in Manchester, UK. The report outlines the overall methodology and the use of the Lawson Comfort Criteria to describe the expected on-Site wind conditions. The assessment is based upon analysis of meteorological conditions for Manchester, adjusted to the Site, a review of the scheme drawings in the context of the surrounding area and in combination with RWDI's extensive experience in wind flow in the urban environment.

The meteorological data indicates that the prevailing winds blow from the south throughout the year and a secondary peak from the north-east and west during spring.

The existing Site is expected to have calm conditions at ground level with no strong winds expected to occur at the existing Site.

With the Proposed Development built, it would be expected that wind conditions on-Site would increase, with windier conditions at ground and upper-level areas. It would be expected that amenity areas at ground level and upper level terraces of the Proposed Development would have windier than desired conditions during the summer season.

Furthermore, it would be expected that there would be occurrences of strong winds with the potential to be a safety concern to more vulnerable pedestrians at upper level amenity areas.

Suggested mitigation measures have been provided to be used to reduce wind speeds at the ground level and upper-level amenity areas with unsuitable wind conditions which have now been incorporated into the proposed landscaping scheme.

Overall, wind conditions at and surrounding the Proposed Development would be expected to be suitable for the intended use, with the landscaping plan and mitigation measures in situ for windier than suitable amenity areas.



1 INTRODUCTION

RWDI was retained by Property Alliance Group to conduct a desk-based assessment of the proposed Reedham House development (hereafter referred to as the 'Proposed Development'), in Manchester, UK. This report presents the background, objectives and results from RWDI's assessment. A summary of the overall recommendations from the study are presented in Section 7, "Concluding Remarks".

2 SITE DESCRIPTION

2.1 Site and Surroundings

The Site is located in the Manchester and is currently occupied by existing buildings of approximately three to four storeys in height. The Site is bounded by Garden Lane to the north, Smithy Lane to the east, King Street West to the south and St Mary's Parsonage to the west. The OS Landranger reference grid for the Site is SJ835983.

The surrounding area consists of a mixture of mid to high-rise developments and is characterised by a 'suburban' terrain; due to the low-rise albeit dense nature of the surrounding developments, which results in a relatively turbulent (i.e. more 'gusty') wind environment with a lower mean wind speed compared to an equivalent site in open terrain. A satellite view of the approximate Site location is highlighted in Figure 1.

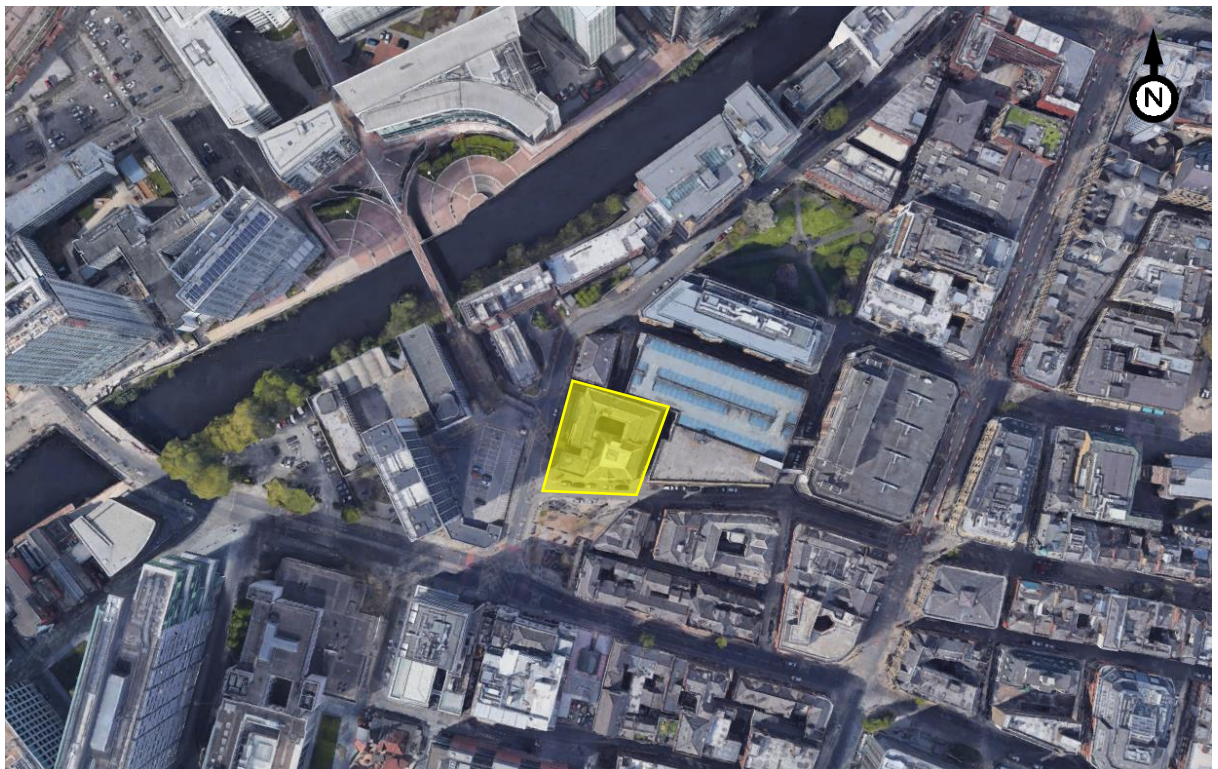


Figure 1: Aerial photograph of the existing Site (approximate extent of the Site highlighted in yellow)

2.2 The Proposed Development

The Proposed Development would retain the existing building to the north, the demolition of the existing building to the south and the construction of a one storey block to the south-west and 14 storey block to the south. A view of the 3D model can be seen in Figure 2.

Entrances would be situated along the northern, eastern and southern elevations of the Proposed Development. Ground level amenity will be located to the north and east of the Proposed Development, with additional outdoor seating areas along the western elevation. Upper level terrace amenity would be situated on level 10 and the rooftop (level 13).

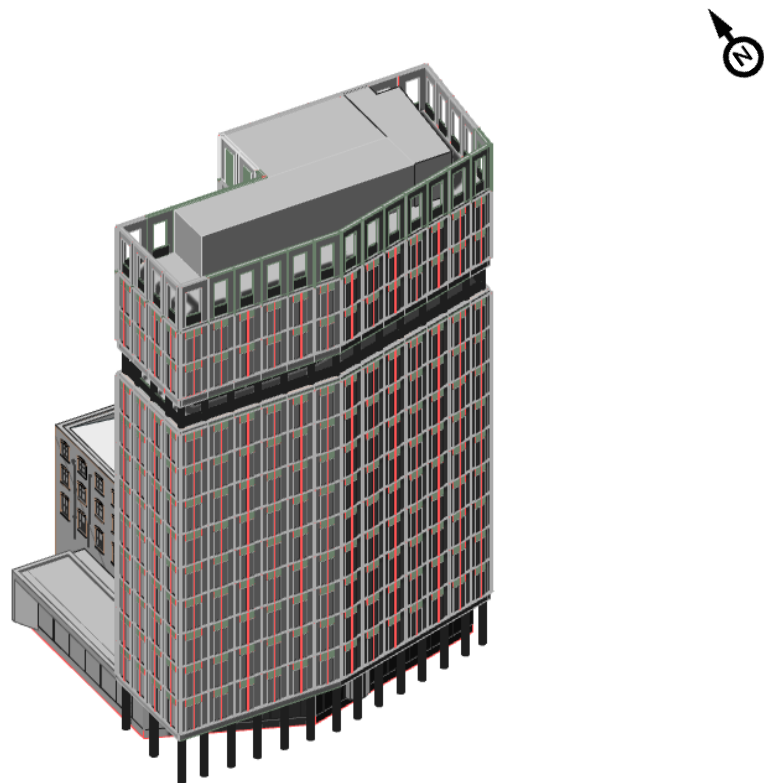


Figure 2: Proposed Development (Isometric view from south-west)

3 METHODOLOGY AND ASSESSMENT CRITERIA

The wind conditions at the Proposed Development have been qualitatively assessed based on the meteorological data for the area, a terrain assessment, and RWDI's extensive experience of wind flow in the urban environment.

Knowledge of the prevailing wind direction focuses attention on the likely impact of these winds on the Site except where the proposed building massing/layout indicates that winds from other directions are likely to be important.

3.1 General Meteorological Data

Approximately 30 years of meteorological data for the Manchester Airport was used in this report and is presented in Figure 3 as wind roses by season, with the wind speed in m/s. The seasons are defined as spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February). The assessment presented in this report focusses on the windiest season (typically the winter months), representing a 'worst-case' season for windy conditions and a summer season (representing a time of the year when amenity spaces are expected to be more frequently used).

The meteorological data indicates that the prevailing winds blow from the south throughout the year with secondary winds approaching the Site from the west and north-east.

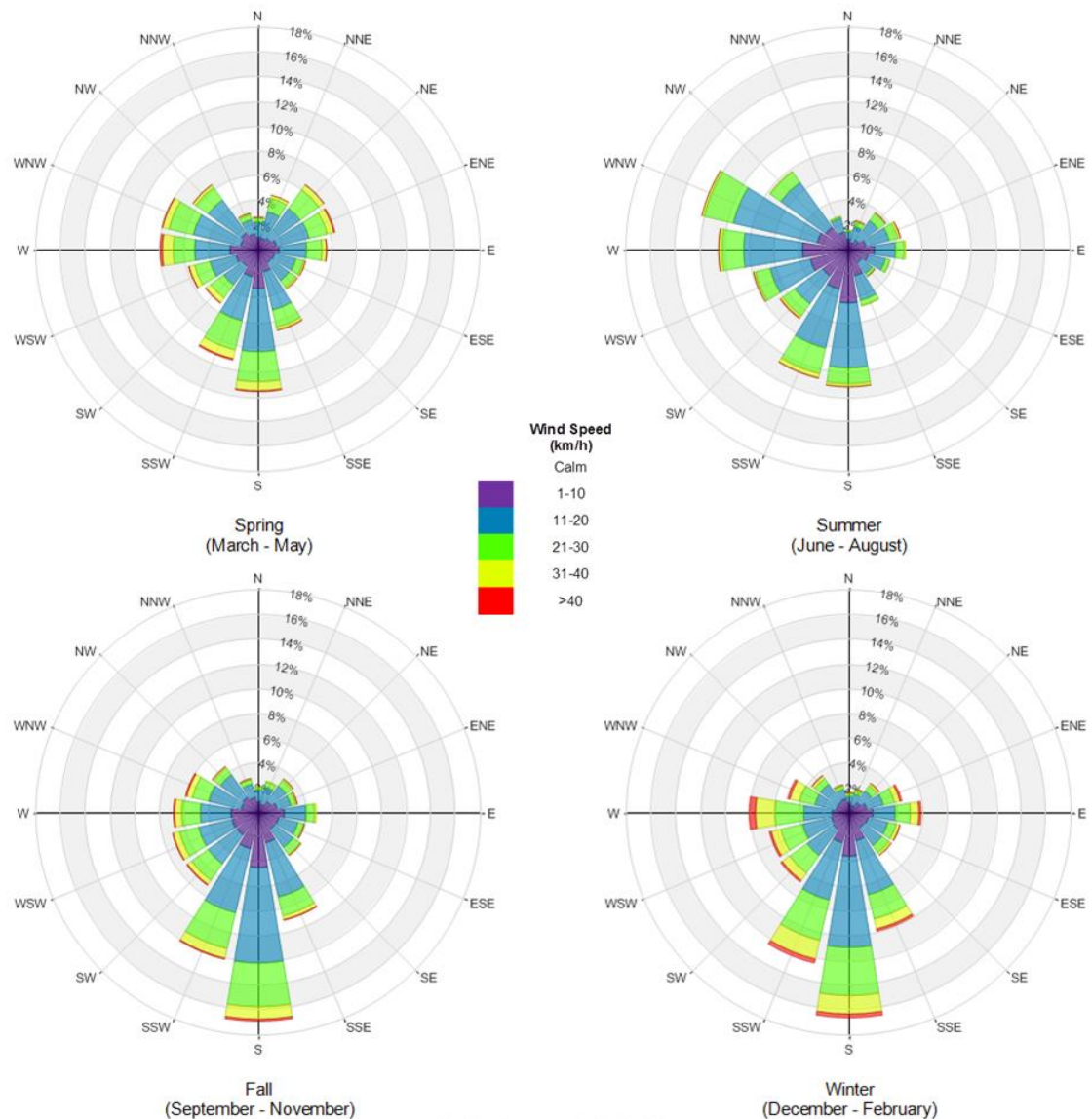


Figure 3: Seasonal wind roses from Manchester Airport (in m/s) - Radial axis indicates the percentage of time for which the stated threshold is exceeded

3.2 Terrain Roughness

Another consideration is the terrain roughness in each wind direction because wide, open spaces permit the wind to flow smoothly at ground level generating conditions similar to those of open countryside even within a built-up area. An assessment of the terrain roughness for the Site was conducted using the methodology implemented in ESDU 01008¹. The assessment of terrain roughness identified a mean factor at both 2m and 10m above ground for each of the 36 wind directions approaching the Site which describes the characteristics of the approaching wind. A higher mean factor indicates that mean winds speeds will be closer to the free stream velocity and less turbulent, and a lower mean factor indicates the opposite. Mean factors for the Site are presented in Table 1.

Table 1: ESDU mean factors at 2m and 10m above ground level

Wind Direction (N°)	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°
Mean Factor at 2m	0.30	0.29	0.29	0.29	0.23	0.23	0.23	0.24	0.23	0.23	0.23	0.23
Mean Factor at 10m	0.65	0.64	0.64	0.64	0.59	0.59	0.59	0.60	0.59	0.59	0.59	0.59
Wind Direction (N°)	120°	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°
Mean Factor at 2m	0.23	0.23	0.23	0.23	0.23	0.29	0.30	0.31	0.30	0.30	0.30	0.30
Mean Factor at 10m	0.60	0.60	0.60	0.60	0.60	0.64	0.65	0.67	0.65	0.65	0.65	0.64
Wind Direction (N°)	240°	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°
Mean Factor at 2m	0.30	0.30	0.30	0.30	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Mean Factor at 10m	0.64	0.64	0.65	0.65	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64

¹ ESDU International, Computer program for wind speeds and turbulence properties; flat or hilly sites in terrain with roughness changes, ESDU 01008, 2001.

3.3 Comfort Criteria

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the Lawson Comfort Criteria, which have been established for over thirty years. The Criteria, which seek to define the reaction of an average pedestrian to the wind, are described in Table 2. If the measured wind conditions exceed the threshold wind speed for more than 5% of the time, then they are unacceptable for the stated pedestrian activity and the expectation is that there may be complaints of nuisance or people will not use the area for its intended purpose.

The Criteria set out four pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The four categories are sitting, standing, strolling and walking, in ascending order of activity level, with a fifth category for conditions that are uncomfortable for all uses. In other words, the wind conditions in an area for sitting need to be calmer than a location that people merely walk past. The distinction between strolling and walking is that in the strolling scenario pedestrians are more likely to take on a more leisurely pace, with the intention of taking time to move through the area, whereas in the walking scenario pedestrians are intending to move through the area quickly and are therefore expected to be more tolerant of windier conditions.

The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. Thermal comfort is discussed with reference to acceptable wind environments but not evaluated as part of the assessment.

Table 2: Lawson Comfort Criteria

Key	Comfort Category	Threshold	Description
	Sitting	0-4 m/s	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or comfortably sit for long periods
	Standing	4-6 m/s	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops
	Strolling	6-8 m/s	Moderate breezes that would be appropriate for window shopping and strolling along a city/town centre street, plaza or park
	Walking	8-10 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
	Uncomfortable	>10 m/s	Winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended

Generally, the target conditions are:

- Strolling use during the windiest season on pedestrian thoroughfares (with walking conditions potentially being tolerated in areas where pedestrians would not linger);
- Standing conditions at main entrances throughout the year (maintenance entrances would tolerate strolling use wind conditions);
- Standing use at private amenity areas where seating is not designated (such as balconies) during the summer season; and



- Sitting use conditions at outdoor seating and amenity areas during the summer season when these areas are more likely to be frequently used by pedestrians. It is noted that in large mixed-use amenity spaces a mixture of sitting use and standing use can be considered acceptable as users can choose to sit in 'calmer' areas, with 'windier' areas acceptable for more active pursuits.

The wind conditions in an area for sitting need to be calmer than a location that people merely walk past and this is reflected in the Comfort Criteria. The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. The criteria address the force of the wind on a person, or activity, they do not take account of thermal factors.

3.4 Strong Winds

Lawson² also specified a strong wind threshold when winds exceed 15m/s for more than 2.2 hours of the year (or 0.025% of the time). Exceedance of this threshold may indicate a need for remedial measures or a careful assessment of the expected use of that location.

Strong winds are generally associated with areas which would be classified as acceptable for walking or as uncomfortable. In a mixed-use urban development scheme, walking and uncomfortable conditions would not usually form part of the 'target' wind environment and would usually require mitigation due to pedestrian comfort considerations. This mitigation would also reduce the frequency of, or even eliminate, any strong winds.

² Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press

3.5 Typical Wind – Building Interactions

Potential wind conditions generated by a new development would be created by typical flow behaviour, common at most suburban/urban developments. Common wind effects which may occur at the Site are discussed below.

Down-washing of the wind occurs when a building is taller than its surrounding buildings. The taller scheme forces high level winds to ground level where they create locally high wind speeds in the pedestrian realm.

Corner acceleration around building corners may occur due to the difference in pressure on the upwind and downwind façades (low pressure zones on the leeward side and zones of higher pressure on the windward side of the building). This effect is particularly pronounced around sharp corners which create localised windy areas in the vicinity of the corner where the flow is accelerated around the building.

Channelling between buildings in close proximity to each other, particularly where the area between is aligned with the prevailing wind direction, “squeezes” the wind through a smaller area resulting in wind acceleration.

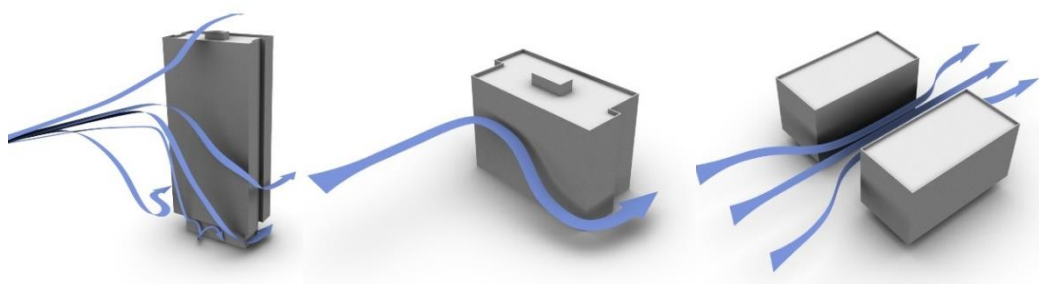


Figure 4: Visual representation of down-washing (left), corner acceleration (centre) and channelling (right).

4 EXISTING SITE WITH EXISTING SURROUNDING BUILDINGS

Often a new development will alter the pedestrian activity (i.e. intended use) on site. Assessment in terms of the desired pedestrian activity on, or around, a Site takes into consideration any change of use and this is where the comfort criteria are particularly helpful.

4.1 Pedestrian Comfort

Based on the terrain roughness analysis discussed in section 3.2, the baseline conditions at 2m above ground level at an idealised “empty” Site would be acceptable for standing use during the windiest season, with strolling use wind conditions 10m above ground level.

The existing Site is currently occupied by existing buildings of approximately three to four storeys in height, relatively shorter than that of the surrounding buildings to the south (the prevailing wind direction). Therefore, stronger, higher-level winds are expected to freely pass over the Site without being brought down to ground level, resulting in relatively calm conditions. Standing wind conditions would be expected in majority of the nearby surrounding area of the Site, with calmer sitting use wind conditions to the north and east of the Site, where immediate surrounding buildings are expected to provide beneficial shelter. During the summer season wind conditions are expected to be generally calmer, with mostly sitting wind conditions in the nearby surrounding area.

4.2 Strong Winds

Strong winds in excess of 15m/s are often concurrent with areas with conditions suitable for walking use or windier. As no conditions windier than suitable for strolling use are likely to occur, strong winds are not expected to occur at the existing Site.

5 PROPOSED DEVELOPMENT WITH EXISTING SURROUNDING BUILDINGS

The expected wind conditions of the Proposed Development at ground level for the windiest season and summer season can be seen in Figures 5 and 6 respectively. During the summer season, wind conditions at the upper-level terraces are shown in Figures 7 and 8. Figures can be found in the “Figures” section of this report.

5.1 Pedestrian Comfort

Due to the increase in height of the Proposed Development, it would be expected that wind conditions in the nearby surrounding area would become windier in comparison to the existing Site, as a result of more wind-building interactions. It should however be noted that taller developments to the south (i.e. 1 Spinningfields, 3 Hardman Street, Sunlight House) would provide beneficial shelter from the stronger, higher-level winds. Visuals of these buildings can be found in Appendix A.

The assessment below is devoid of landscaping measures, to provide a worst case (i.e. windiest) scenario.

Thoroughfares (Figure 5)

As a result of increased wind-building interaction, pedestrian thoroughfare locations on Garden Lane, Smithy Lane, King Street West and St Mary’s Parsonage would become windier, with expected strolling wind conditions during the windiest season. Strolling or calmer wind conditions would be suitable for the intended use and therefore, all pedestrian thoroughfares would be expected to be suitable for the intended use.

Entrances (Figure 5)

Entrances to the Proposed Development would be situated along the northern, eastern and southern elevations. It should be noted that along the southern elevation, there would be a colonnade, providing beneficial shelter underneath. As such, standing use wind conditions would be expected at the entrances to the Proposed Development. Standing or calmer wind conditions would be suitable for the intended use and therefore, entrances to the Proposed Development would be expected to be suitable for the intended use.

Ground Level Amenity (Figure 6)

Ground level amenity would be located to the north and east of the Proposed Development, along Garden Lane and Smithy Lane in the form of benches. There would also be additional outdoor seating areas along the western elevation.

As previously mentioned, there would be a colonnade on the southern side of the Site, which would provide beneficial shelter underneath. As such outdoor seating areas along the western elevation would be expected to have sitting wind conditions during the summer season, suitable for the intended use.



However, ground level amenity on Garden Lane and Smithy Lane would be located where standing wind conditions would be expected during the summer season. Standing use wind conditions would be one category windier than desired for seating amenity. Therefore, mitigation measures would be required, to improve conditions such they are suitable for sitting use during the summer season.

Suggestions for wind mitigation measures for seating areas has been discussed in Section 6 “Mitigation Measures”.

Trinity Square, towards the south of the Site, would be located predominantly upwind of the Proposed Development, therefore, the wind conditions within this area would not be expected to materially change relative to the Baseline conditions, with the Proposed Development in situ.

Upper-Level Terrace Amenity (Figures 7 and 8)

Upper-level terrace amenity would be situated on level 10 and the rooftop (level 13). Due to the height of these terraces in relation to the surrounding terrain, it would be expected that these terraces would be windy, with strolling wind conditions expected during the summer season. Upper-level terraces would desirably have sitting and standing wind conditions during the summer season, with the calmest of conditions at seating areas. Therefore, strolling use wind conditions would be one to two categories windier than desired and therefore, mitigation measures would be required.

Suggestions for wind mitigation measures for seating areas has been discussed in Section 6 “Mitigation Measures”.

5.2 Strong Winds

Strong winds in excess of 15m/s are often concurrent with areas with conditions suitable for walking use (or windier) during the windiest season or strolling use (or windier) during the summer season.

As a result of strolling wind conditions at the upper-level amenity areas at level 10 and the rooftop (level 13) during the summer season, it would further be expected that there would be strong winds with the potential to be a safety concern to more vulnerable pedestrians. Therefore, mitigation measures would be required.

Suggestions for wind mitigation measures for seating areas has been discussed in Section 6 “Mitigation Measures”.

6 MITIGATION MEASURES

Wind conditions across the Site are expected to be mostly suitable for the intended uses. However, it would be expected that amenity areas at ground level and upper-level terraces of the Proposed Development would have windier than desired conditions during the summer season. Furthermore, it would be expected that there would be occurrences of strong winds with the potential to be a safety concern to more vulnerable pedestrians at upper-level amenity areas. Therefore, mitigation measures would be required to improve conditions. Mitigation measures have been recommended below, with examples of similar measures shown in Figure 9 and 10.

6.1 Ground Level Amenity Areas

For ground level amenity areas with unsuitable wind conditions, suggested mitigation measures include:

- Solid or ~50% porous, screening (1.5m tall);
- Planters with planting (1.5m tall);
- Deciduous/evergreen trees (at least 4m tall); or
- Solid or ~50% porous canopy on the southern façade (elevated, at least 2m deep).

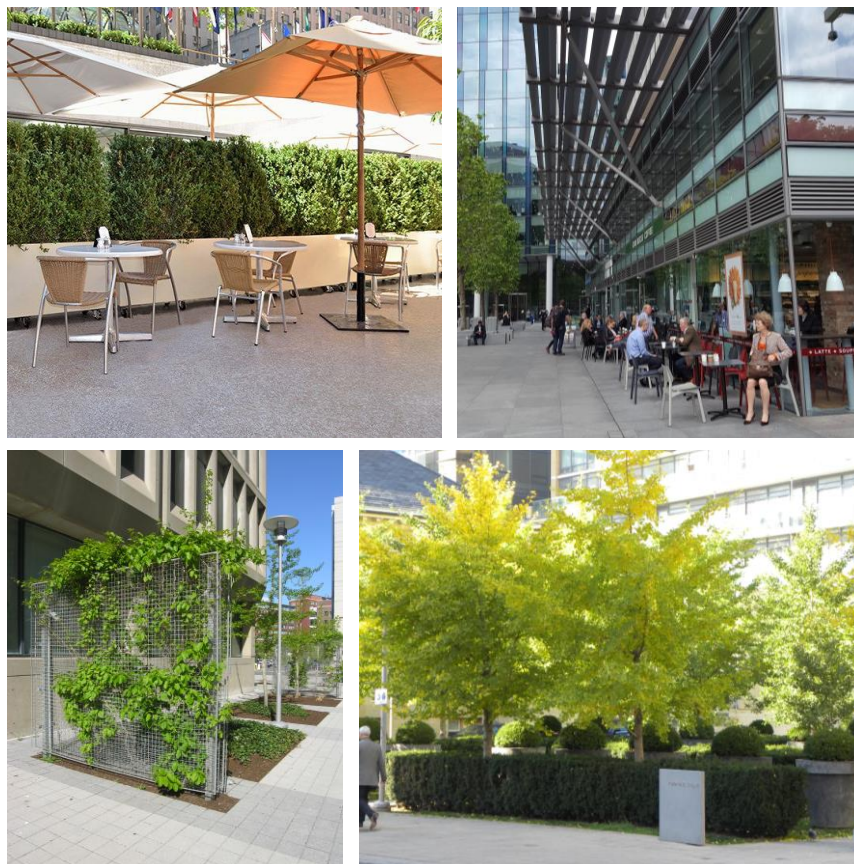


Figure 9: Examples of mitigation measures for ground level amenity areas

6.2 Upper Level Terrace Amenity Areas

For upper level terrace amenity areas with unsuitable wind conditions, suggested mitigation measures include:

- Solid or ~50% porous, balustrade (1.5m tall); and
- Solid or ~50% porous, screening surrounding seating areas (1.5m tall);
- Planters with planting (1.5m tall) surrounding seating areas; or
- Deciduous/evergreen trees (at least 2m tall).



Figure 10: Examples of mitigation measures for upper-level terrace amenity areas

As per the landscaping plans received on 6th September 2022 (see Figures 11-13 within Appendix B), at ground level amenity locations along Garden Lane and Smyth Lane there would be a number of trees around the seating areas. Provided these trees would be at least 4m tall, these would provide beneficial shelter to occupants of these seating areas such that they would be expected to have suitable wind conditions.



Upper-level terraces situated on level 10 and 13 would have solid balustrades (glazed behind metal railings) 1.5m in height which would provide calmer conditions at these terraces. At the rooftop (level 13), seating amenity would be located towards the west of the terrace. The landscaping plan indicates that there would be tree planting adjacent to this seating area. Provided that these would be at least 2m tall, these, combined with the 1.5m high solid balustrade, would be expected to provide adequate shelter to this seating area.

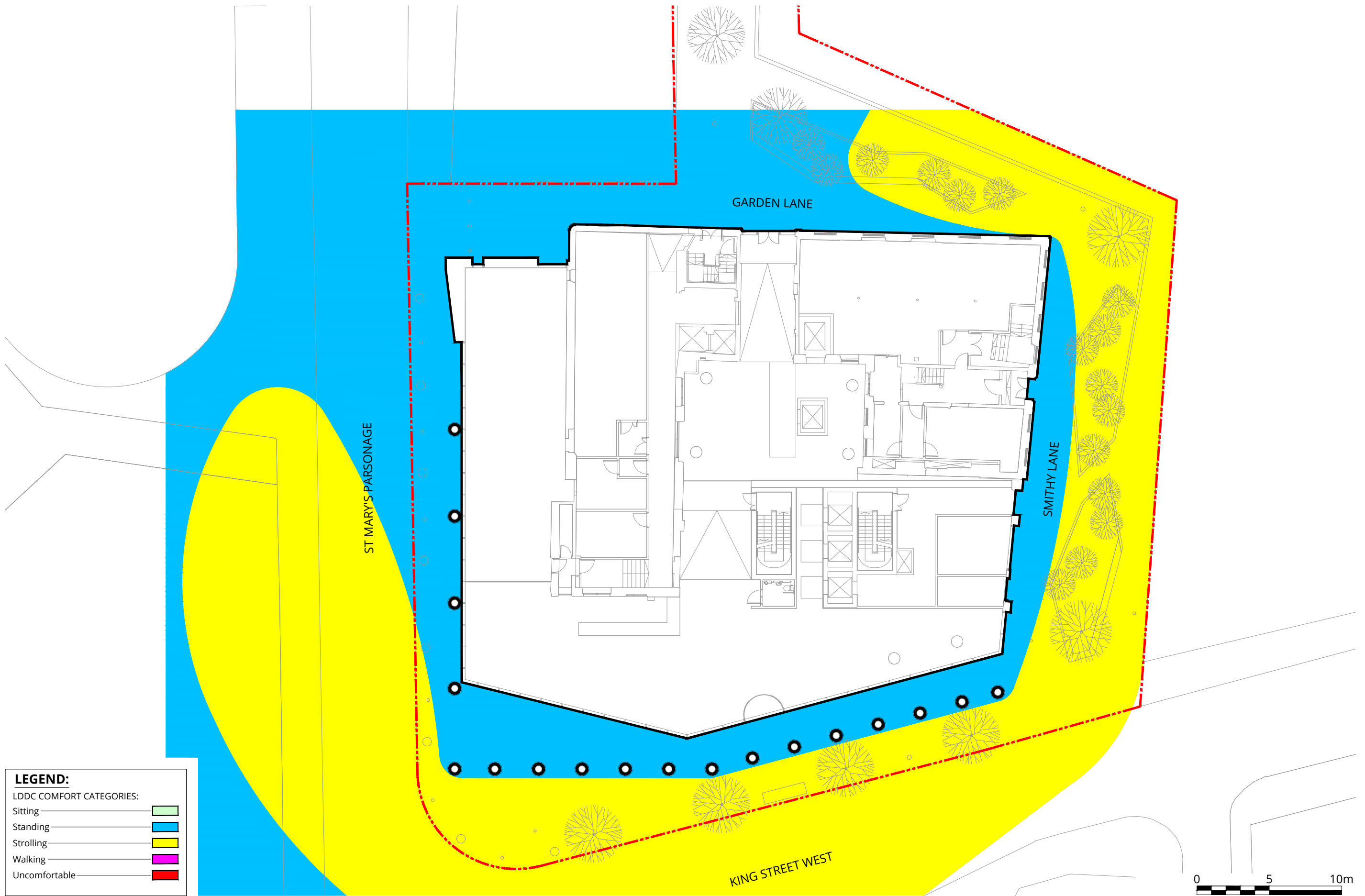
7 CONCLUDING REMARKS

In conclusion:

1. The Site has been qualitatively assessed based on meteorological data, a terrain assessment and professional judgement/experience.
2. The meteorological data indicates that the prevailing winds blow from the south throughout the year with secondary winds approaching from the west and north-east.
3. The existing Site is expected to have calm conditions at ground level, with mostly standing wind conditions during the windiest season and sitting use during the summer season. Strong winds are not expected to occur at the existing Site.
4. With the Proposed Development built, it would be expected that wind conditions on-Site would become windier, with strolling wind conditions at ground level during the windiest season and at upper-level terrace areas during the summer season. It would be expected that amenity areas at ground level and upper-level terraces of the Proposed Development would have windier than desired conditions during the summer season.
5. Furthermore, it would be expected that there would be occurrences of strong winds with the potential to be a safety concern to more vulnerable pedestrians at upper level amenity areas.
6. With the proposed landscaping in situ, ground level and upper-level amenity areas with unsuitable wind conditions would be expected to have suitable wind conditions for the intended use.
7. Overall, wind conditions at and surrounding the Proposed Development would be expected to be suitable for the intended use, with landscape plan and other mitigation measures in situ for windier than suitable amenity areas.

FIGURES







Pedestrian Comfort Desk Study - Expected Wind Conditions - Ground Level

Proposed Development with Existing Surrounding Buildings
Summer Season

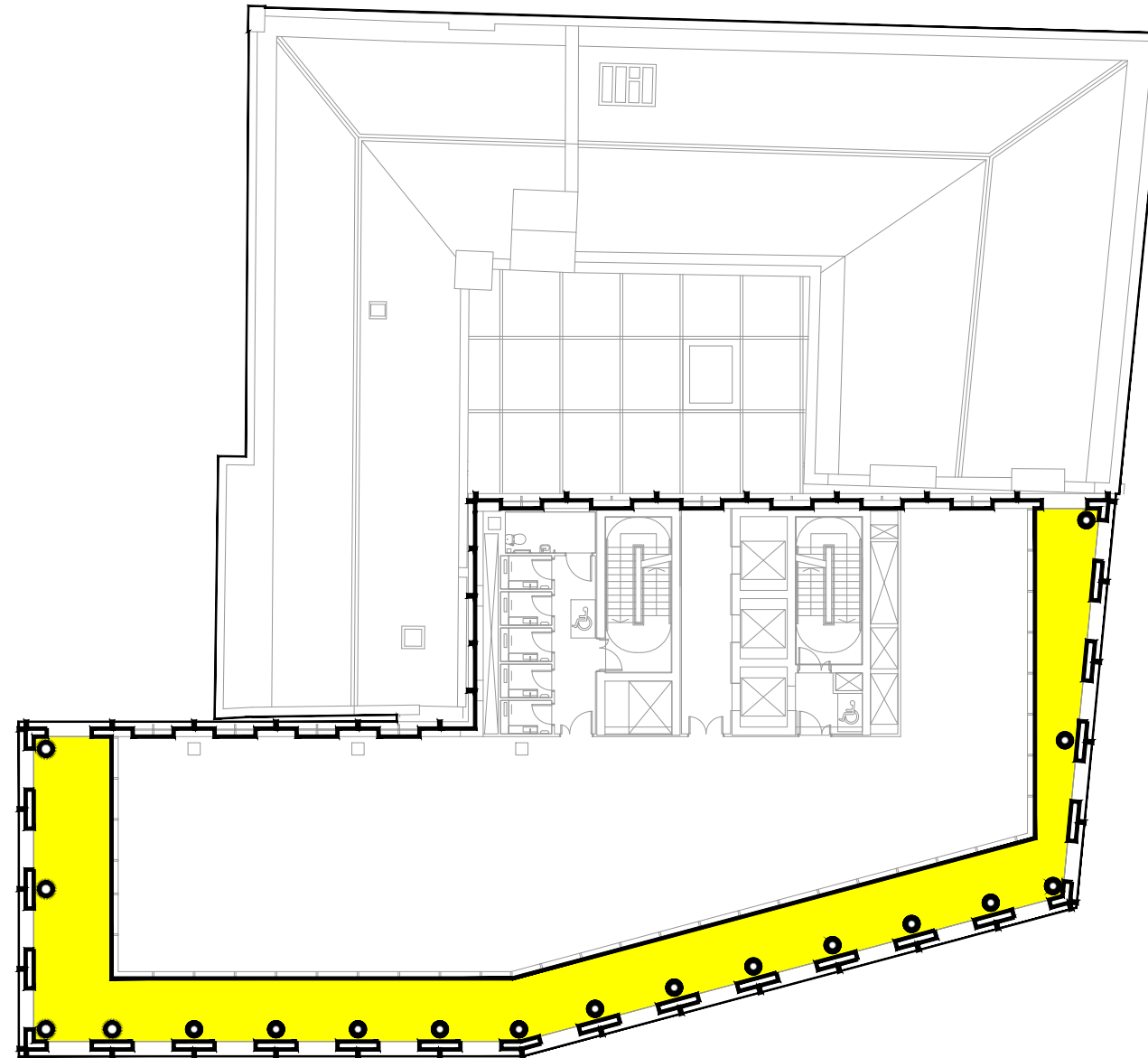
Reedham House - Manchester, UK



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Date Revised: Aug. 2, 2022	



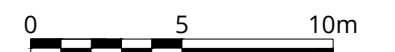
Project #2202699



LEGEND:

LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	



Pedestrian Comfort Desk Study - Expected Wind Conditions - Level 10 Plan
 Proposed Development with Existing Surrounding Buildings
 Summer Season

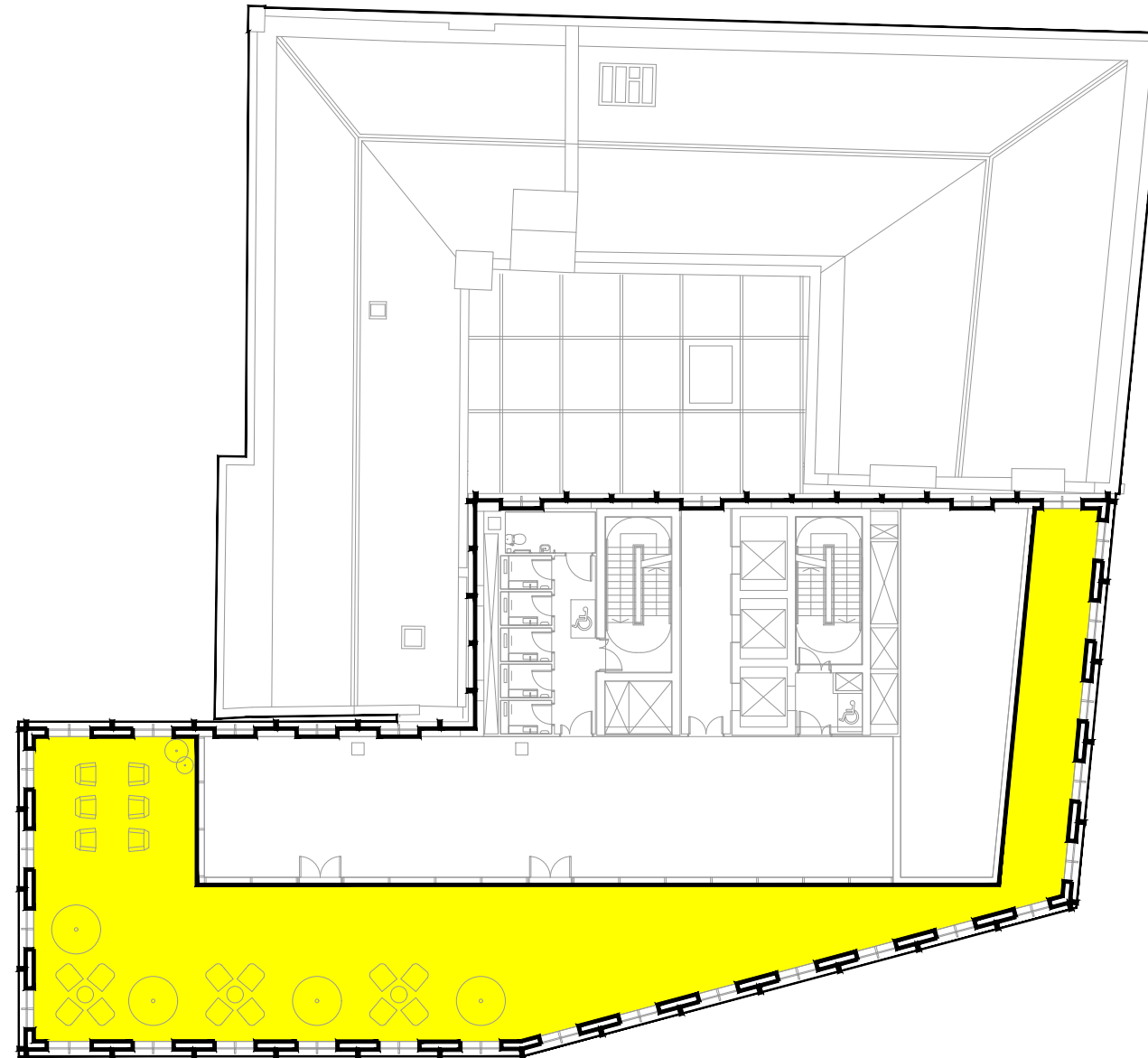
Reedham House - Manchester, UK



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Project #2202699

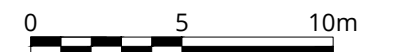




LEGEND:

LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	



Pedestrian Comfort Desk Study - Expected Wind Conditions - Level 13 Plan
Proposed Development with Existing Surrounding Buildings
Summer Season

Reedham House - Manchester, UK



Project #2202699

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APPENDIX A



APPENDIX A: SURROUNDING BUILDINGS

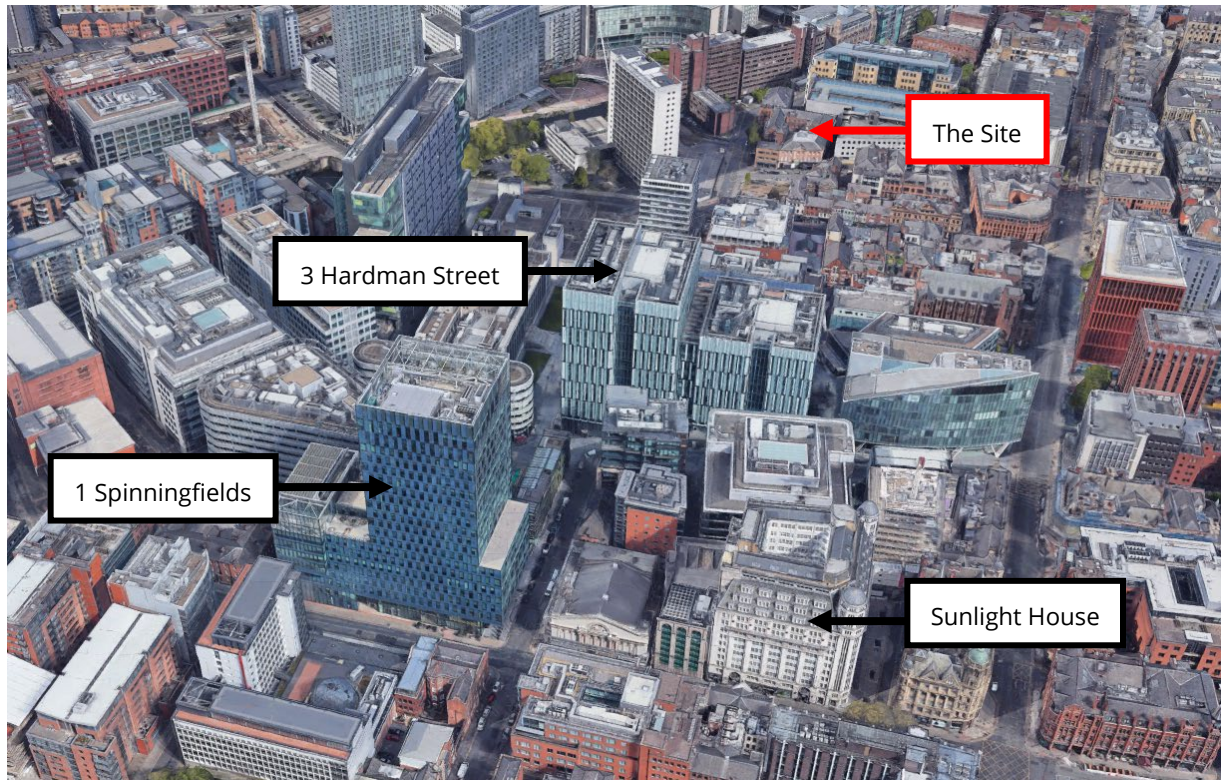


Figure 11: Visuals of the surrounding context (taken from Google Earth)

APPENDIX B



APPENDIX B: LANDSCAPE PLAN

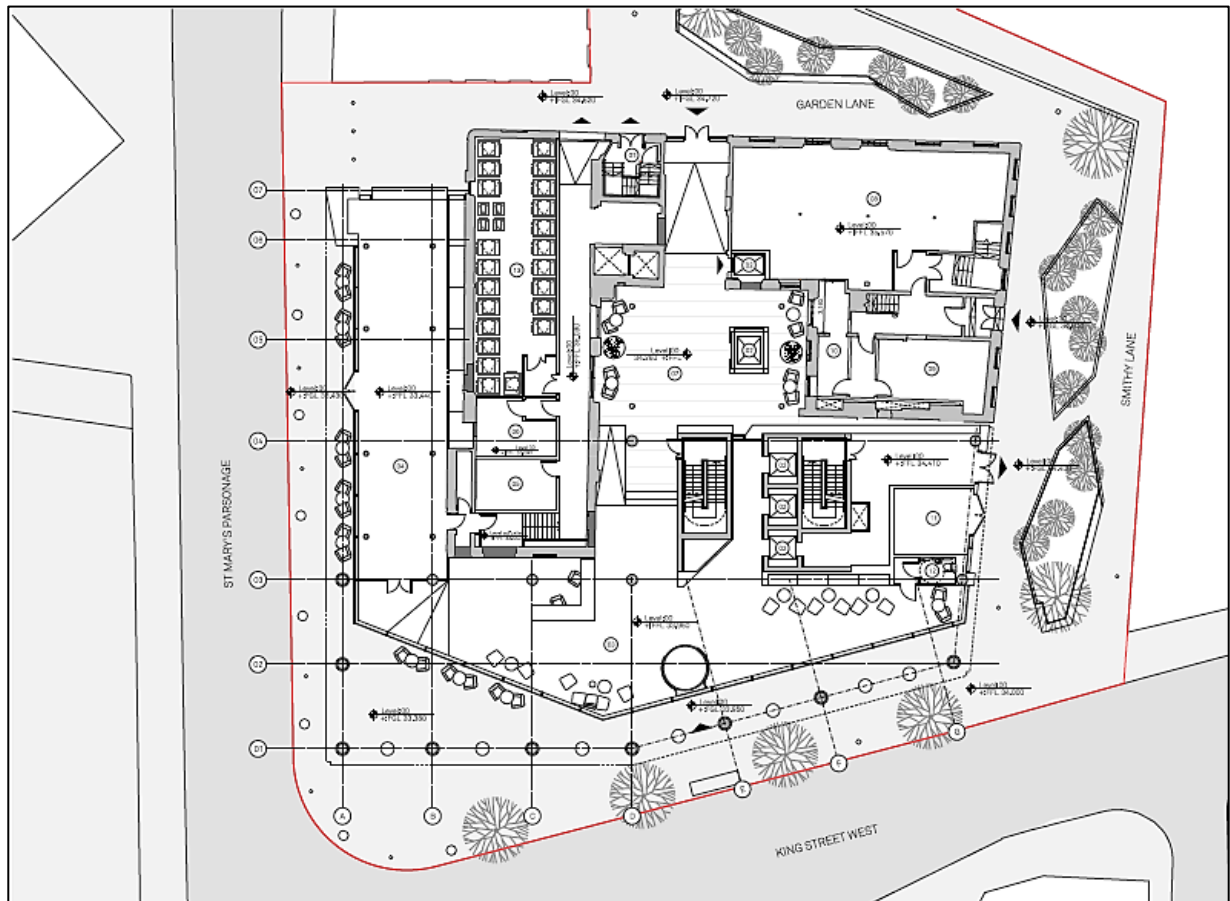
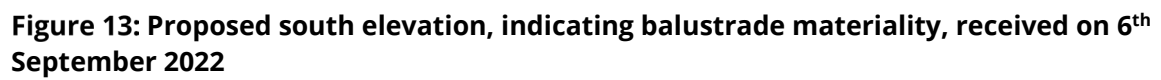


Figure 12: Proposed ground level landscape plan received on 6th September 2022

14th September 2022



**PEDESTRIAN LEVEL WIND - DESK BASED ASSESSMENT
REEDHAM HOUSE - REV B**

RWDI #2202699

14th September 2022

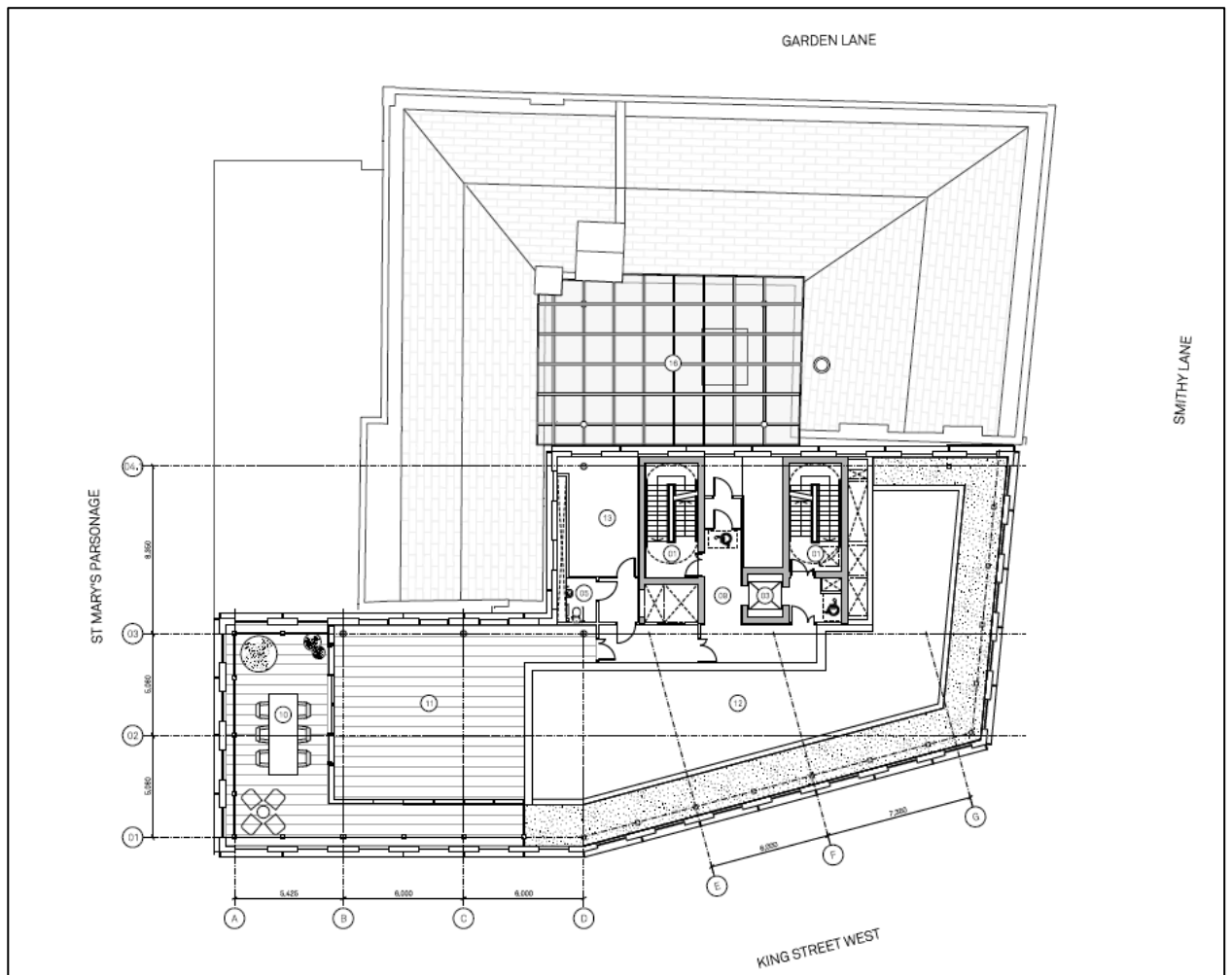


Figure 14: Proposed Level 13 landscape plan received on 6th September 2022