K8T
KINGSTON APPLIED
TECHNOLOGY & ENGINEERING

Wind Analysis CFD Modelling Report

BRS-0437-0 Union Park (Block 4) Microclimate & Pedestrian Comfort Wind Study

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1.0 Introduction

A high-rise building is proposed for the Union Park development in London, UK. K8T have been appointed to evaluate the impact the building will have on pedestrian comfort and the impact of the local wind micro-climate.

A 3D CFD wind microclimate analysis has been undertaken. The simulated wind microclimate has been used with the Lawson criteria for distress and comfort (Bristol method) to evaluate the proposed site. It is usual to minimise adverse changes to the wind conditions on neighbouring buildings due to a development. The requirement of the study is to demonstrate that the scheme achieves adequate pedestrian wind comfort and safety levels around the proposed development based on the Lawson Criteria (Lawson, 2001) developed by Professor T V Lawson of Bristol University.

Computational Fluid Dynamics (CFD) is an alternative to wind tunnel modelling. Each has its advantages and disadvantages. In wind tunnel testing, there is an issue in the simulation of the real environment. In the CFD approach, the specification of the flow condition is in general not a problem.

2.0 Regulatory and Policy Context

National and local planning policies do not impose specific limits on the wind environment around a new development, but there are guidance and requirements as part of the National Planning Policy Guidance and from the Local authorities to inform the planning process, so that site conditions can be assessed to show that users around the development are not unreasonably affected by the wind microclimate due to a new development. .

2.1 National Planning Policy

National Planning Policy Framework (NPPF) [15]

The National Planning Policy Framework was last revised in December 2024. The NPPF sets out the Government's national approach to planning policies for England and how these should be applied. The document provides a framework within which locally developed plans for housing and other developments can be produced.

The NPPF does not specify any polices relating to wind microclimate however there is a strong emphasis on the high quality of developments. For example, paragraph 8, point C describes environmental objects that "protect and enhance our natural, built and historic environment, including making effective use of land […], and mitigating and adapting to climate change, including moving to a low carbon economy". The NPPF continues paragraph 96 states that developments should "achieve healthy, inclusive and safe places which […] are safe and accessible […] for example through the use of well-designed, clear and legible pedestrian and cycle routes, and high-quality public space, which encourage the active and continual use of public areas".

National Planning Policy Guidance (NPPG) [14]

The NPPG was last revised in February 2024 and is a web-based resource which supports the NPPF. The NPPG does not specifically reference tall buildings or wind microclimate however it directs to the National Design Guide which comments on the subject.

National Design Guide [13]

The NPPG is designed to be read alongside the National Design Guide. Whilst the NPPG does not specifically mention wind microclimates, the National Design Guide has a section on public realm and the built form which identifies Tall Buildings and the considerations of wind. Specifically, paragraph 70 states that "well-designed tall buildings play a positive urban design role in the built form. They act as landmarks, emphasising important places and making a positive contribution to views and the skyline". Paragraph 71 continues that "proposals for tall buildings (and other buildings with a significantly larger scale or bulk than their surroundings) require special consideration. This includes their location and siting; relationship to context; impact on local character, views and sight lines; composition - how they meet the ground and the sky; and environmental impacts, such as sunlight, daylight, overshadowing and wind. These need to be resolved satisfactorily in relation to the context and local character."

2.2 Regional Planning Policy

London Plan: The Spatial Development Strategy for Greater London (2021) [9]

The London Plan, published in March 2021, is created by the greater London Authority (GLA) and the Mayor of London and is the Spatial Development Strategy for Greater London. The London Plan provides the overall strategic plan for London setting out the "integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years"

There are several policies in the London Plan which relate to the Wind Microclimate in "Chapter 3 Design", namely:

- "Policy D3 Optimising site capacity through the design-led approach" paragraph 3.3.8 states that "buildings should be of high quality and enhance, activate and appropriately frame the public realm. Their massing, scale and layout should help make public spaces coherent and should complement the existing streetscape and surrounding area. […]. Creating a comfortable pedestrian environment with regard to levels of sunlight, shade, wind, and shelter from precipitation is important".
- "Policy D8 Public realm" that states that development should "Ensure buildings are of a design that activates and defines the public realm and provides natural surveillance. Consideration should also be given to the local microclimate created by buildings, and the impact of service entrances and facades on the public realm". The policy continues that development should "Ensure that appropriate shade, shelter, seating and, where possible, areas of direct sunlight are provided, with other microclimatic considerations, including temperature and wind, taken into account in order to encourage people to spend time in a place".
- "Policy D9 Tall buildings" environmental impacts states that developments should address "[…] wind, daylight, sunlight penetration and temperature conditions around the building(s) and neighbourhood must be carefully considered and not compromise comfort and the enjoyment of open spaces, including water spaces, around the building". The policy adds that developments should address "air movement affected by the building(s) should support the effective dispersion of pollutants, but not adversely affect street-level conditions".
- "Policy D9 tall buildings" also comments on the cumulative impacts of developments. The policy states that "the cumulative visual, functional and environmental impacts of proposed, consented and planned tall buildings in an area must be considered when assessing tall building proposals and when developing plans for an area. Mitigation measures should be identified and designed into the building as integral features from the outset to avoid retrofitting".

Optimising Site Capacity: A Design-Led Approach LPG (2023) [10]

The London Plan Guidance (LPG) was published in June 2023 and there is design considerations detailed in section 2.3 relating the impact the organisation of a development should consider, namely "the orientation of buildings should be considered as this can affect a building's thermal performance, and quality and use of public open space (e.g. shadow, wind etc)."

2.3 Local Planning Policy

Hillingdon Local Plan: Part 1- Strategic Policies (2012)[8]

The Hillingdon Local Plan Strategic Policies, adopted in November 2012) does not only mentions wind microclimate briefly stating in section 7.12 that "while tall buildings offer the opportunity for intensive use, their siting, design, effect on views, impact on local micro-climate and provision of communal and private amenity spaces should be carefully considered". The subsequent paragraphs continue about tall buildings generally rather than specifically about wind microclimate state that "Tall buildings may be acceptable in a limited number of suitable locations where the Council considers that they will not seriously harm the surrounding area and its heritage assets and will also deliver wider benefits to the proposed Opportunity Area." The local plan directs to other documents from English Heritage, specifically "Guidance on Tall Buildings" and other Local guidance relating the character of the surround areas.

2.4 Other Relevant Standards and Guidance

Guidance on tall buildings (2007)[5]

Guidance on tall buildings has been produced by English Heritage and the Commission for Architecture and the Built Environment (CABE), with the final version was released in July 2007.In section 4 "Criteria on Evaluation", the guidance documents states that "planning permission for tall buildings should ensure therefore that the following criteria are fully addressed: […] the effect on the local environment, including microclimate, overshadowing, night-time appearance, vehicle movements and the environment and amenity of those in the vicinity of the building".

Historic England Advice Note 4: Tall Buildings (2015)[6]

Paragraph 4.10 of the Historic England Advice Note 4 – Tall Buildings, recommends that: "consideration of the impact on the local environment is also important, including microclimate, overshadowing night-time appearance, light pollution, vehicle movements, the environment and amenity of those in the vicinity of the building and the impact on the pedestrian experience".

UK Climate Predictions (2018) [11]

The UK Climate Projections (UKCP18) published by the Met Office provide an overview of climate modelling across a number of different predicted scenarios. The 'Climate Projects Report' published by UKCP18 presents the probable changes in wind speed for until the end of the 21st century in both the summer and winter seasons. The data from the Met office tends to present data on a broader scale than site specific, however the general trends suggest a modest increase of wind speeds during winter months when compared to year-to-year trends. The predictions from the Met Office detail that the current trends in the climate change are not likely to have a significant effect on the predicted wind microclimate conditions in and around the Proposed Development. Therefore, it is not necessary to provide a quantitative analysis of the increase in storm frequency and the impacts this man have on the wind microclimate for the Proposed Development.

3.0 The Development, Site and Surrounding Context

3.1 Existing Site Description

There is an existing building on site, which has a total area of circa 3,500sqm of floorspace and was formerly occupied by Addison Lee for the repair, maintenance, and replacement of private hire vehicles. Addison Lee has vacated the site, and the building is currently used by Ark and their contractors as a construction base whilst the adjacent permitted scheme is being delivered. The building is surrounded by hardstanding which is currently used for car parking and storage. An area of trees is located in the western corner of the site. To the west of the former British Airways parcel of land, which is now the Union Park Blocks 1, 2 and 3 developments, is an office building, car park and service yard for Addison Lee. The site and adjoining Union Park development are as highlighted in figure 1 below, namely:

1. Addison Lee Offices (1)
2. Union Park Blocks 1, 2 and 3 (2)

The office building is approximately three storeys in height and occupies half of the parcel of land. The remaining land is utilised as a service yard and car park, connecting along the canal side of the site to North Hyde Gardens highway. The southern edge of the parcel of land consists of trees and shrubbery, which separates the site from the Grand Canal

Figure 1 Existing site layout satellite image.

3.2 Development Description

3.2.1 Data Centre Building

The proposed fourth block will connect directly onto the western edge of Data Centre Block 3. The intention is for the data centre to have a maximum height of 35m, mirroring that of Data Centre Block 3. The intention for the façade is to draw on the approach for Data Centre Block 2, using cladding panels connected to each other at right angles to create a point that sticks out. Three sets of these will be located vertically above one another with the angle of each set differing to that of the ones above and below it.

3.2.2 Ancillary Block

This is conjoined and immediately west of the Data Centre Building. It provides the required support and office space. It is to be glazed with glazing panels separated with dark vertical fins on the southern elevation to reduce solar glare. It is envisaged that roof space will be used for PV panels and brown / green roofing.

3.2.3 Energy Centre

An energy centre is proposed to be physically connected to the western edge of the ancillary block. The energy centre will have a maximum height of 28m. The intention is to draw upon the design approach of the three already permitted energy centres, using vertical fins with perforations and orientated in a way to allow views through the façade in some areas (with the use of back lighting adding interest). Darker cladding is to be used then for the Data Centre Building, extending the 'light-dark' pattern across all of the data centre buildings and contrasting with the lighter colour.

3.2.4 Security Measures

Clearly ensuring a high level of security is key for the successful operation of a data centre (and designation of data centres at Critical National Infrastructure only increases these requirements) and the intention is that the permitted fence lines will effectively be extended around the proposed development. No visitor reception centre is required to serve this block whilst the permitted western vehicular lock entrance will be used.

3.2.5 Car Parking and Access

The proposal is for the permitted circulation road, which runs around the western edge of Data Centre Block 3, to be extended further westwards to that it continues around the proposed fourth data centre and energy centre before turning back eastwards and re-connecting to the main access and egress into the wider site at North Hyde Gardens Road Bridge.

3.2.6 Landscaping

Conjoining Data Centre Block 4 with Data Centre Block 3 and pushing development as close to the railway line as possible leaves two primary areas of Data Centre Block 4 landscaping. Due to the security requirements of Ark and their future occupier, these areas of land are to be located within the secure fence line.

3.3 Wider Area Description

The Site is located within the Bulls Bridge Industrial Estate, a well-established multi-let industrial estate covering some 1.26ha positioned to the south of Hayes Town and less than 1km from Junction 3 of the M4 motorway. It lies approximately 3.2km to the northeast of the closest part of the northern runway at Heathrow Airport. The Site is triangular in shape, bound along its northern boundary by the Paddington to Swansea railway line, its southwestern boundary by the Grand Union Canal and associated towpath, and to the east by the wider Bulls Bridge Industrial Estate site which Ark is currently redeveloping.

The northern boundary of the site is formed by the GWR London Paddington to Swansea main line, which is situated behind a galvanised steel palisade fence. Hayes and Harlington railway station is located approximately 500m to the west. Land uses on the northern side of the railway line are industrial in nature, with Tarmac operating a large asphalt plant, a cash and carry, and various small industrial and warehouse units.

The west of the application site is bound by mature trees and shrubbery. Beyond that is the Western View Railway Bridge.

The southern and southwestern boundary of the site is formed by the Grand Union Canal. The Grand Union Canal is connected to the Paddington Arm Canal approximately 400m to the east and is maintained by the Canal & River Trust. Further south is National Grid's North Hyde substation and the Former Nestlé site where planning permission for a major redevelopment scheme has been granted. This scheme includes 1,386 new homes focused on a cluster of apartment blocks, a local centre and commercial floorspace (which includes a data centre) (Ref. 1331/APP/2017/1883). This development, referred to as Hayes Village, adjoins the existing suburb of Cranford Park to the south and is currently under construction.

To the east of the site is the Union Park data centre, approved under 75111/APP/2020/1955 and 75111/APP/2022/1007. An overview of the wider area around the development is shown in Figure 2 below.

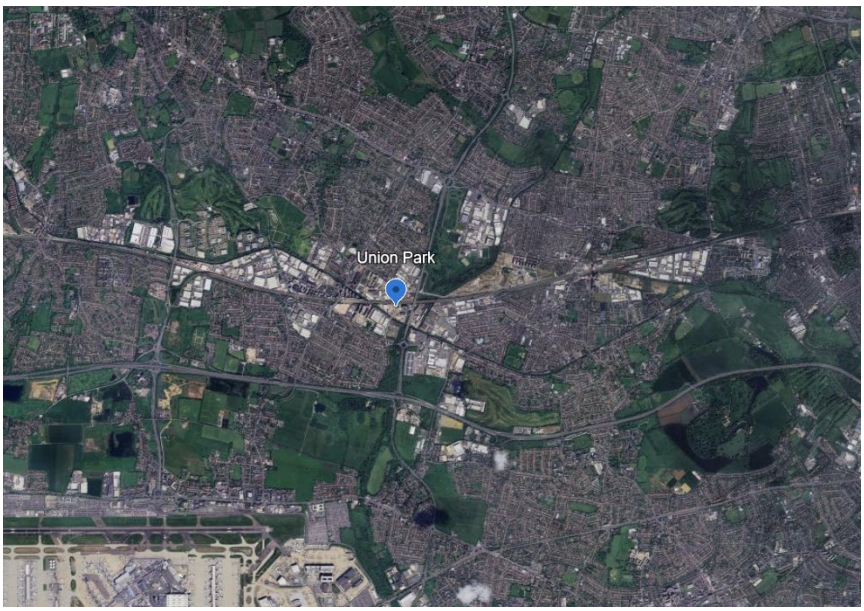

Figure 2 Satellite image of the wider area of the development site.

4.0 Desktop Analysis

4.1 Analysis Methodology

Looking at the site, it is necessary to determine the critical wind direction for the region and then apply this to the location of the site being studied at Union Park. The focus of the assessment was on pedestrian wind safety and the effect the proposed development may have on the local microclimate. Therefore, the identification and evaluation of the conditions associated with strong winds versus consideration of all the wind speeds for the site were considered, with the critical wind directions identified to determine the potential impact of the development on the surround area and on the side.

4.2 Site Topography Category

The proposed site can be found within greater London, in the borough of Hillingdon. The site is located *approximately 57*km from the nearest coast and is inside the area a town area. Based on LIDAR data [4] obtained from 2023 the terrain and level of build up for the area can be established. The terrain is a category 3 with suburban and industrial areas around the development site. An overview of the terrain types can be found in table 1. The coordinates for the site, 51.502075, -0.41046 and is located approximately 34m above sea level.

Figure 3 Site topography analysis at the wider site area, satellite images (left) and LIDAR point cloud (right)

Terrain Category	Description	K_R	Z_0 (m)	Z_{min} (m)
I	Rough open sea: Lake shore with at least 5km fetch up-wind and smooth flat country without obstacles	0.17	0.01	2
II	Farmland with boundary hedges, occasional small farm structures, house or trees	0.19	0.05	4
III	Suburban or industrial areas and permanent forest	0.22	0.3	8
IV	Urban areas in which at least 15% of surface is covered with buildings of average height exceeding 15m	0.24	1	16

Table 1 Terrain categories and related parameters from BS EN 1991-1-1-4 (2005).

4.3 Establishing the Site Meteorological Data

The closest Meteorological Weather data station was determined to be at Hayes which is 1.5km north of the site. An hourly average weather data was used based on 5 years (2020-2024) obtained from the Meteoblue. [12] Meteoblue is a commercial meteorological data provider and provides high resolution simulation data, allowing a full hourly dataset to be analysed without gaps. The simulation data is verified and validated to ensure the integrity of the service. This data has been used to establish the wind conditions for the site due to it being representative of the regional wind frequencies and direction. A 5-year period has been used to provide a balance of the increases in wind speed over the years as well as reducing the occurrence of unusually high years in terms of wind speed, such as storms, within the dataset.

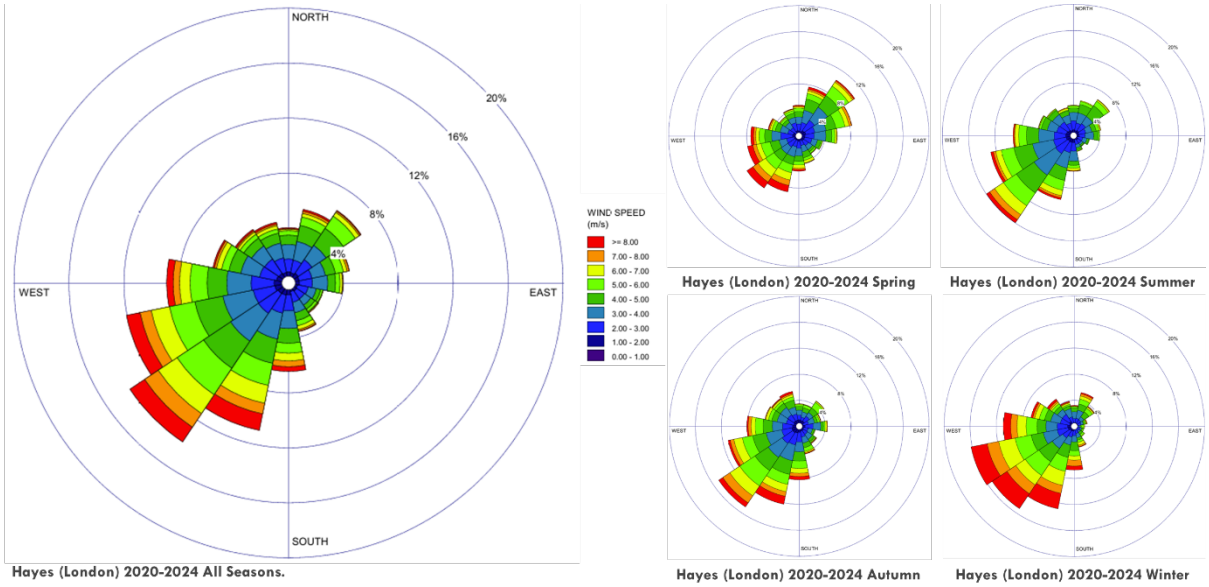

Figure 4 5-year (2020-2024) Wind Rose for Hayes (London)

Through using the 5 years of meteorological data from Hayes (London) it has been establish that the average prevailing winds for the site are predominantly from the Southwest, refer to figure 2. The meteorological data has been analysed to determine the occurrence of the variation of the wind speed during the seasons throughout the year. The season 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 prevailing wind during the seasons are also from predominantly from the southwest, with the winter seasons winds predominantly from the west-southwest, as highlighted in figure 2 above.

The weather data has been adjusted based on the methodology in accordance with BS EN 1991-1-1-4 [3], to account for the variation in weather data based on the located of the site when compared to where the weather data was recorded.

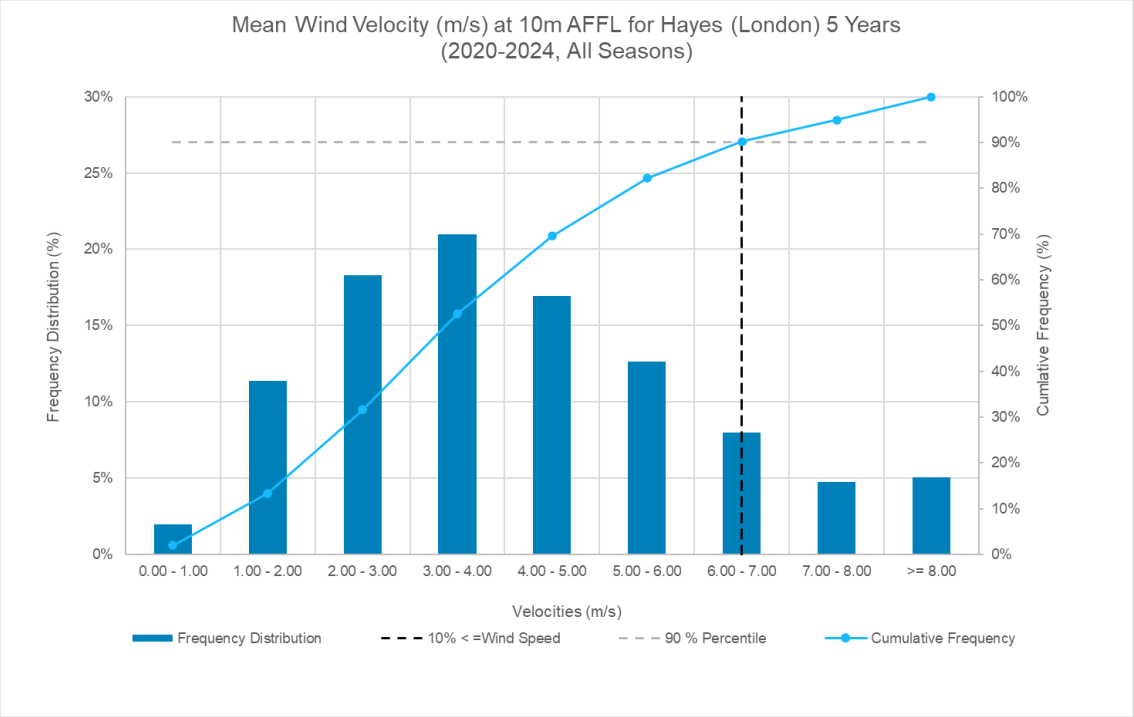

Figure 5 Annual wind speed probability distribution for Hayes (London) 2020-2024.

As well as direction, the magnitude of wind speeds varies from season to season. The general trend is that wind speeds are lower during the summer months and increase during the winter months, this is highlighted in figure 4.

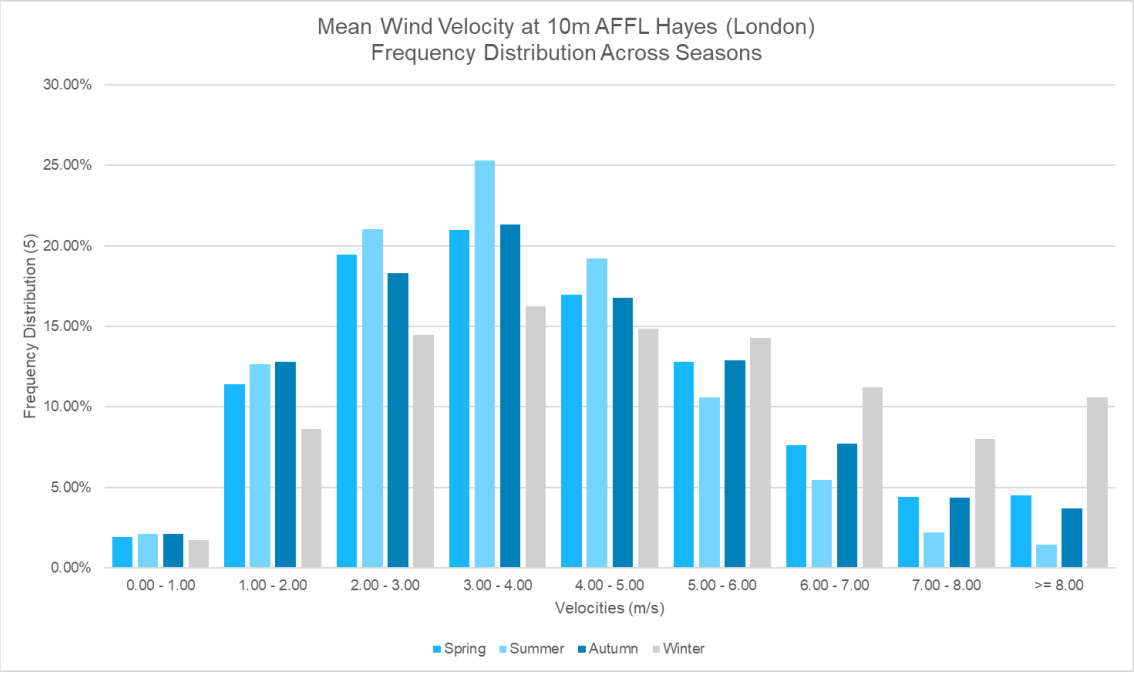

Figure 6 Wind speed probability distribution by seasons for Hayes (London) 2020-2024.

From analysis of the metrological data for Hayes (London) the velocities for the CFD modelling can be selected. The aim of the velocities used in the analysis is to provided analysis of the a wind speed that is the 90th percentile, meaning that the wind speed will equal or be less than the value 90% of the time. The wind frequency distribution for summer and winter months are shown in figure 5 and 6 respectively.

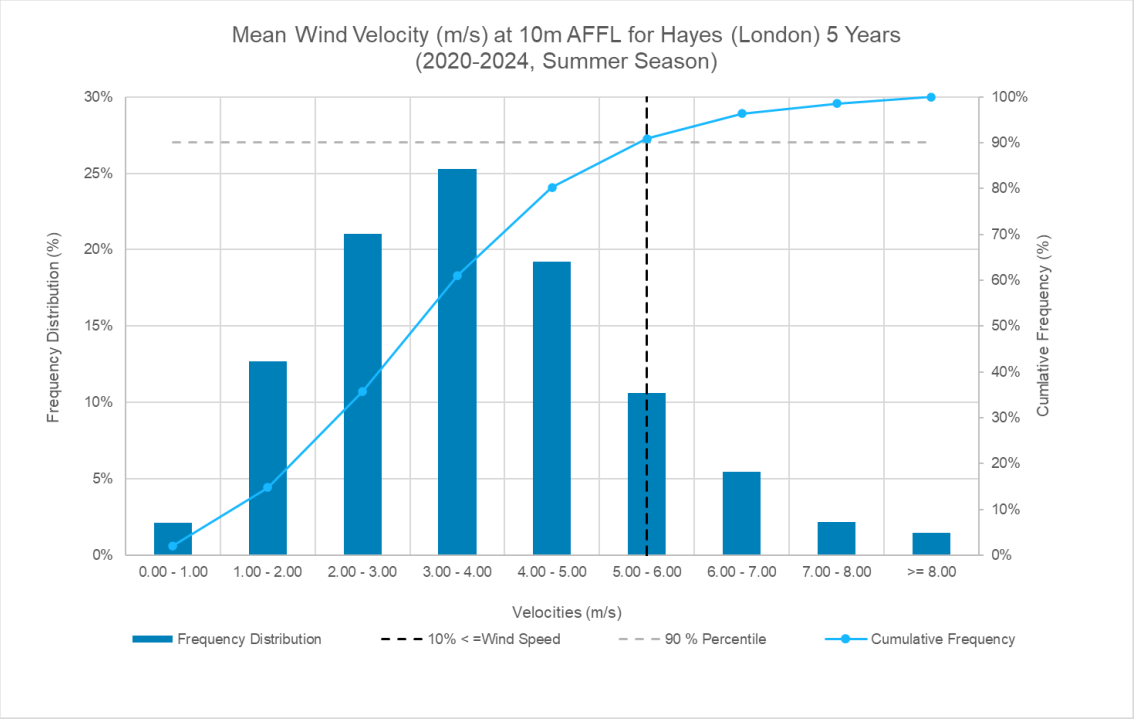

Figure 7 Summer (June, Jully, August) wind speed probability distribution for Hayes (London) 2020-2024.

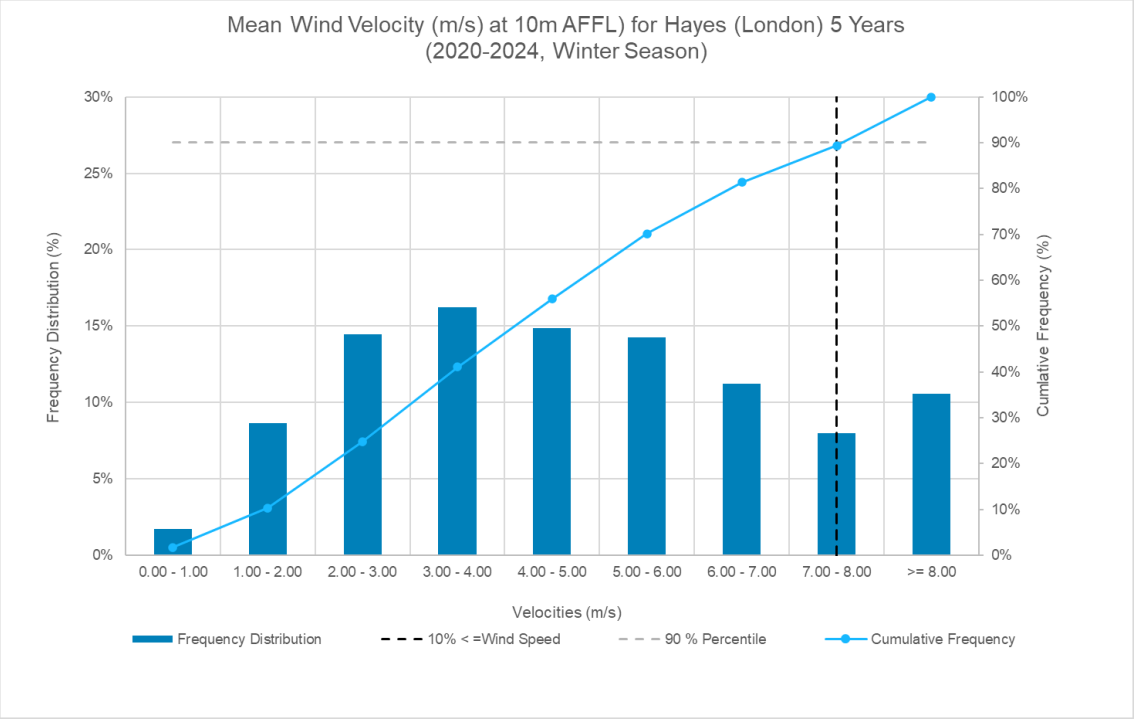

Figure 8 Winter (December, January, February) wind speed probability distribution for Hayes (London) 2020-2024.

4.4 Cumulative Surrounding Buildings

Part of the analysis calls for the modelling to take into account developments within in the modelled radius that are going through the planning process. There are four developments within a 1.5km radius of the site, namely:

1. Hayes Village (Former Nestlé Factory), planning reference 1331/APP/2019/1666.
2. 3 Viveash Close, planning reference 36678/APP/2021/3370.
3. Avondale Drive, planning reference 76551/APP/2024/2653
4. Millington Road, planning reference 76655/APP/2023/779

Figure 9 Loal planning applications to the development site.

It should be noted that:

- The former Nestle site, Hayes Village and associated warehouses, named number (1) which is located to the south of the site has been included as an existing building due to the site being a mix of complete and under construction.
- Developments at Avondale (3) and Millington Road (4) have along not been included due to the distance away from the development site, over 1km, therefore are not within the detailed modelling of the local area and are likely to have a negligible impact on the analysis undertaken.
- There is only one development, 3 Viveash Close (2), within a local area of the proposed development. A cumulative scenario will not be undertaken due to the limited impact that one development may have on the site. It is not neighbouring the site directly, and the Hayes Village (1) development provides a substantial obstruction between the Union Park site and the proposed 3 Viveash Close development.

4.5 Local Vegetation

Local vegetation, such as trees, bushes and plating, has not been included within the simulations due to the difficulty to precisely quantify the effect of an individual tree on the local air flow. There are many factors that may change the airflow through trees by effecting the porosity and resistance of the flow, such as the age, species, season etc. It should be noted that where there is a presence of trees the overall effect on pedestrian comfort will be to reduce the velocities experienced at ground level. Due to this, the omission of tress from the models can be considered a conservative approach due to the possibility of increased airflow being modelled where trees may be present. It is established best practice to ignore landscaping features.

5.0 Design Criteria

5.1 General Context

It is considered good practice to assess proposed buildings with respect to wind at the planning stage of all developments by most local authorities so as to assess the implications on the local wind environment. The impact of proposed developments upon the pedestrian wind environment of the new site and any public realms needs to be evaluated.

5.2 Pedestrian Comfort Methodology

People perceive wind speeds different depending on many factors, such as the activity they are undertaking, the expectation of the within their environment as well as the wind magnitude, therefore criteria has been developed to accommodate these issues. The benchmark for pedestrian wind comfort in the UK is the Lawson Criteria. [7] The Lawson Criteria define wind speeds that are acceptable for different activities and the frequency of occurrence for which they are acceptable.

The acceptability of the wind conditions for activities in table 2 are established using the velocity based on an "R Factor" multiplied by a site temporal velocity, where the R factor = (local velocity + gust velocity) / reference velocity. The study was based upon a simulation of 16 equally spaced directions through North.

	Prescribed Usage Category	Wind Speed Threshold	Wind Speed Exceedance	Description
	Sitting	4 m/s	5%	Desired for outdoor seating areas and restaurants where someone can comfortably sit for long periods.
	Standing	6 m/s	5%	Areas designated for pick-up/drop-off points, bus stops and main building entrances.
	Leisure Walking	8 m/s	5%	Would be considered appropriate for a typical city centre street or park environment with moderate breezes.
	Business Walking/Cycling	10 m/s	5%	Objective to get from point A to point B without lingering by walking, running or cycling.
	Uncomfortable	>10 m/s	5%	Considered a nuisance for most activities, can be acceptable for back of house with infrequent use.

Table 2 Lawson usage Criteria

5.2.1 Strong Winds (Pedestrian Distress Criteria)

The distress criteria will use the Lawson Criteria method outlined within Building Aerodynamics. [7] The criteria, shown in table 4, state that for elderly pedestrians and cyclists the hourly mean wind speed should not exceed 15 m/s for less than 0.025% of the year (2 hours of the course of a year). For able bodied pedestrians the wind speed should not exceed 20 m/s. If the wind exceeds the thresholds, it may indicate the requirement of remedial measures or a careful assessment of the expect use within the specific locations. For example, if the wind exceeds the threshold, is it expected that elderly pedestrians will be present at the specific location at the times where the threshold is exceeded and are there suitable alternative routes that are not deemed distressful.

Category	Letter	Threshold Values of Wind Speed and Exceedance	Description
No Safety Exceedance		<15m/s	No safety threshold has been exceeded.
Pedestrian Distress (Frail)	S15	0.025% > 15m/s	Winds that exceed the threshold will pose distress for vulnerable pedestrians such as the elderly and cyclists
Pedestrian Distress (Able bodied)	S20	0.025% > 20m/s	Winds that exceed the threshold will cause distress for all pedestrians including the able bodied.

Table 3 Lawson pedestrian safety threshold (Lawson, 2001).

Strong winds are usually associated with areas which are classified as being uncomfortable or where direct walking from A to B are acceptable. In an urban environment these conditions would not form an ideal environment and would usually require mitigation due to pedestrian comfort criteria. Through the use of mitigation in these circumstances, the frequency of strong winds would be reduced.

5.2.2 Assessment technique

- Establishment of Meteorological data and adjust, if required, to the site location.
- Determination of the wind environment in and around the Development (using CFD).
- Quantify in terms of pedestrian comfort using Lawson criteria and Gusting Analysis.
- Identification of local effects and possible mitigation routes.
- Enhancements and possible mitigation

6.0 Assessment Methodology

The following section summarises the methodology to enable the pedestrian level wind microclimate at the site to be quantified and classified in accordance with the widely accepted Lawson criteria (Comfort Criteria). [7] The virtual wind tunnel tests deliver a detailed assessment of the wind environment around the proposed development in terms of pedestrian comfort and safety ratings and provide a basis to assess the impact of the site relative to existing site conditions. This assessment is based upon suitability of the site for the planned pedestrian use and residence areas.

6.1 Methodology

The methodology for quantifying the pedestrian level wind environment is outlined below:

Step 1:

Simulate the building induced accelerations and/or decelerations at pedestrian level for a minimum of 16 wind directions.

Step 2:

Combine the local wind speeds with the wind statistics from the meteorological station data and assess how often the various wind speeds will be exceeded.

Step 3:

Compare these data with established criteria (Lawson) for acceptable wind speeds considering peoples activities around the buildings.

Step 4:

Compare the baseline scenario with the proposed development to conclude the impact of the proposed development on the local microclimate. Analyse the results to determine pedestrian comfort levels and based on the results evaluate the introduction of wind speed reduction to improve.

6.2 Assessment Scenarios

In order to assess the pedestrian comfort and understand the impact of the proposed development at Union Park a number of scenarios will be undertaken. The following scenarios have been modelled:

- Scenario 01: Existing Site with the Existing Surrounding Buildings
- Scenario 02: Proposed Development with Existing Surrounding Buildings

For each of the two scenarios outlined above, a summer and winter analysis will be undertaken.

6.3 Scale and Significance

The scale used within the assessment to assess the significance of the effect between the desired microclimate for an area and the predicted (simulated) microclimate. The scale used in this assessment are:

1. Moderate Beneficial
   - Wind conditions are calmer than required for the interested pedestrian route or have improved from the baseline scenario. **Mitigation not required.**
2. Negligible
   - Wind conditions are meet the criteria required and are presented as acceptable in the simulations results. **Mitigation not required.**
3. Moderate Adverse
   - Wind conditions are presented as tolerable in the simulations results. Wind is noticed but not preventing the area being used effectively for the intended purposed. **Some mitigation required.**
4. Major Adverse
   - Wind conditions are presented as unacceptable in the simulation results. Wind conditions in strength and frequency deter people from using the area for its designated purpose. **Mitigation will be required.**

Any adverse effect would require some mitigation depending on the scale of the effect. Subsequently any negligible effect is not considered to be significant therefore would not require mitigation measures.

It should be noted that strong winds which affect pedestrian and cyclist safety levels are not designated under the scale noted above. Any areas which are designated as failing the safety criteria will require mitigation.

7.0 Computational Modelling Approach

7.1 Software

The commercial CFD software Ansys Fluent R20 has been utilised to model the turbulent wind flows through the development area of interest [1].

7.2 Computational Model

The models were solved a 100 million cell meshes with a cell size of 0.15 m at the boundary layer of the pedestrian areas and buildings. A second order numerical scheme was used to solve the Naiver stokes Equations and the Reynolds Averaged RANS KE Realizable turbulence model was used for all of the wind directions.

7.3 Mean and Gust Wind Velocities and Frequency Calculations

A radial disc was modelled for 500 m radius from the proposed site centre. The current buildings were modelled within a 400 m radius to capture the surrounding buildings interaction with the proposed and current site. In terms of analyses a 400m wide area, located at 1.8m height above the ground, was analysed at 0.1m increments.

The mean and gust windspeeds were computed at these heights which represents head height. An urban wind profile with a reference wind speed at 10m was then used as the reference windspeed to evaluate the wind speed ratios i.e. local acceleration / deceleration ratios (r-factor). In calculating the r factor K8T use the Gust velocity as this is considered more onerous than the mean velocity.

Mean Wind speed is calculated a U_{mean} the turbulence in Intensity % I is calculated in the model. The Gust velocity based on $U_{gust} = U_{mean} + K \times (I_{turb} / U_{mean})$

K = 2 by FEIS from (Lawson, 2001)

The local R – Factor (Acceleration / Deceleration) is the evaluated at each head height point in the model using the Gust velocity (worst case).

R- Factor = U_{gust} / U_{10} where 4 m/s is the reference 10m Urban boundary layer reference value used.

The R-factor is calculated for the 16 different wind directions and can be used in to evaluate the local wind speed frequencies. The mean hourly corrected meteorological weather data is then multiplied by the calculated R factor for the relevant wind direction and the frequency analyses is carried out on this basis.

7.4 Model Overview

The development site, Union Park, was modelled along with surrounding buildings and terrain within a 500m radius. The development building and area around the site were constructed using drawings and Revit model provided by the Architect and design team. The surrounding buildings were constructed using LIDAR data obtained from the Environment Agency National LIDAR Program [4] which surveyed the area in 2023 and is accurate to a 1mx1m grid. The buildings to the site around the site being part of the CFD model allow for the local geometric effect of the wind to be modelled. The boundary conditions were applied of surfaces at 1000m radius from the development in a virtual wind tunnel. An overview of the geometry used in the various scenarios are shown in the sections below.

7.4.1 Scenario 01 - Existing Site Model Overview

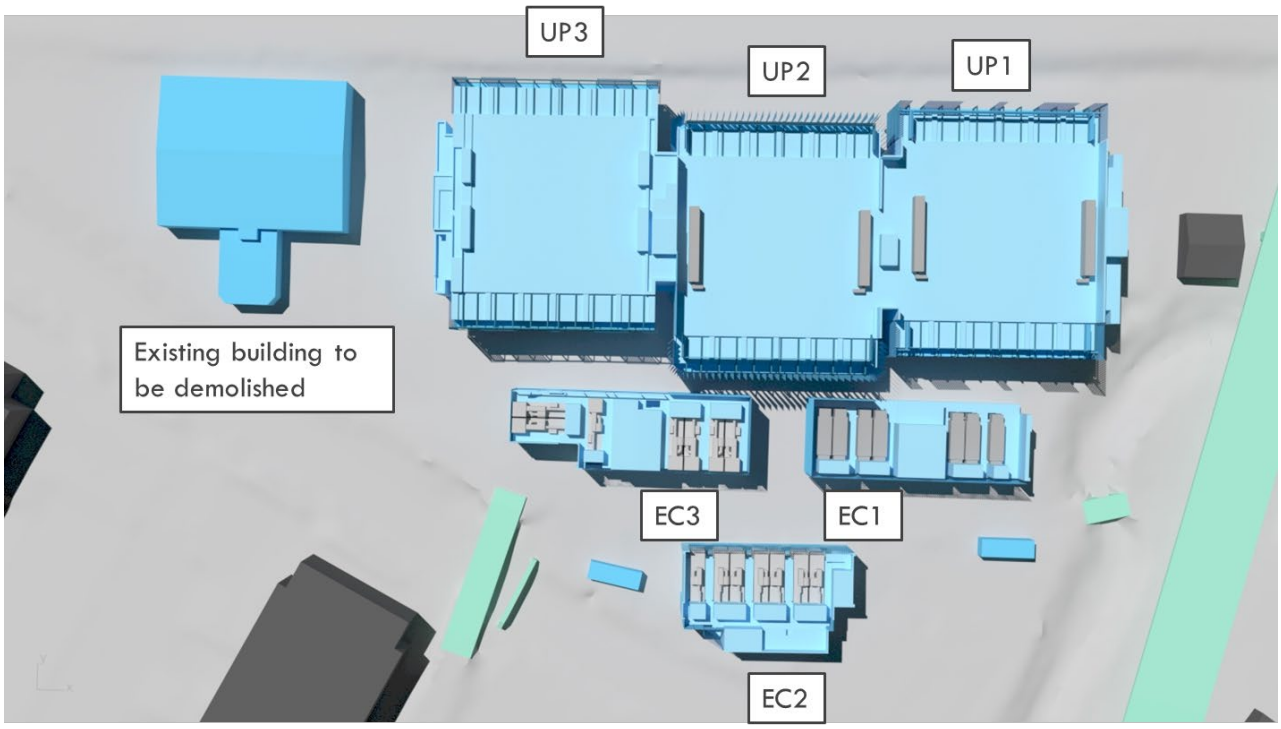

Figure 10 Plan view of existing site.

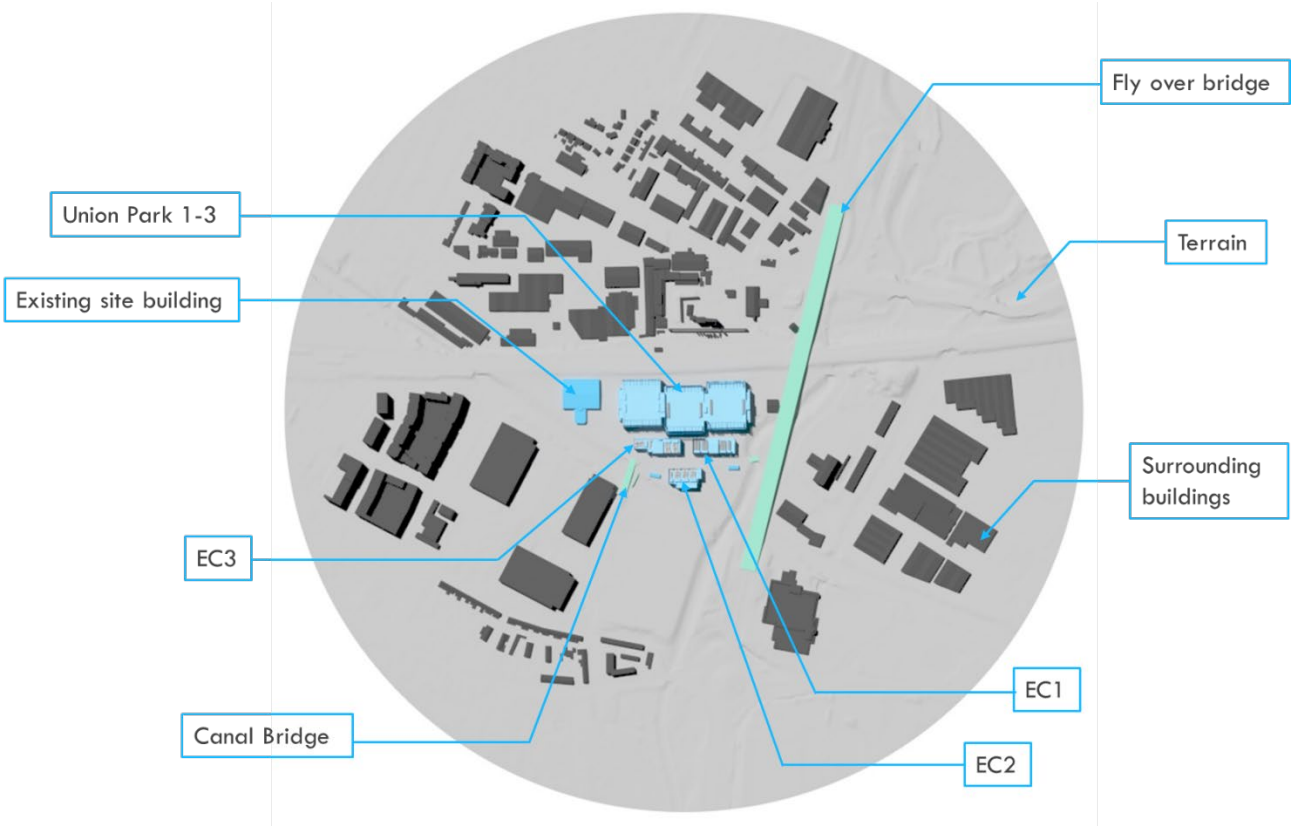

Figure 11 Plan view of the modelled existing site and surrounding buildings.

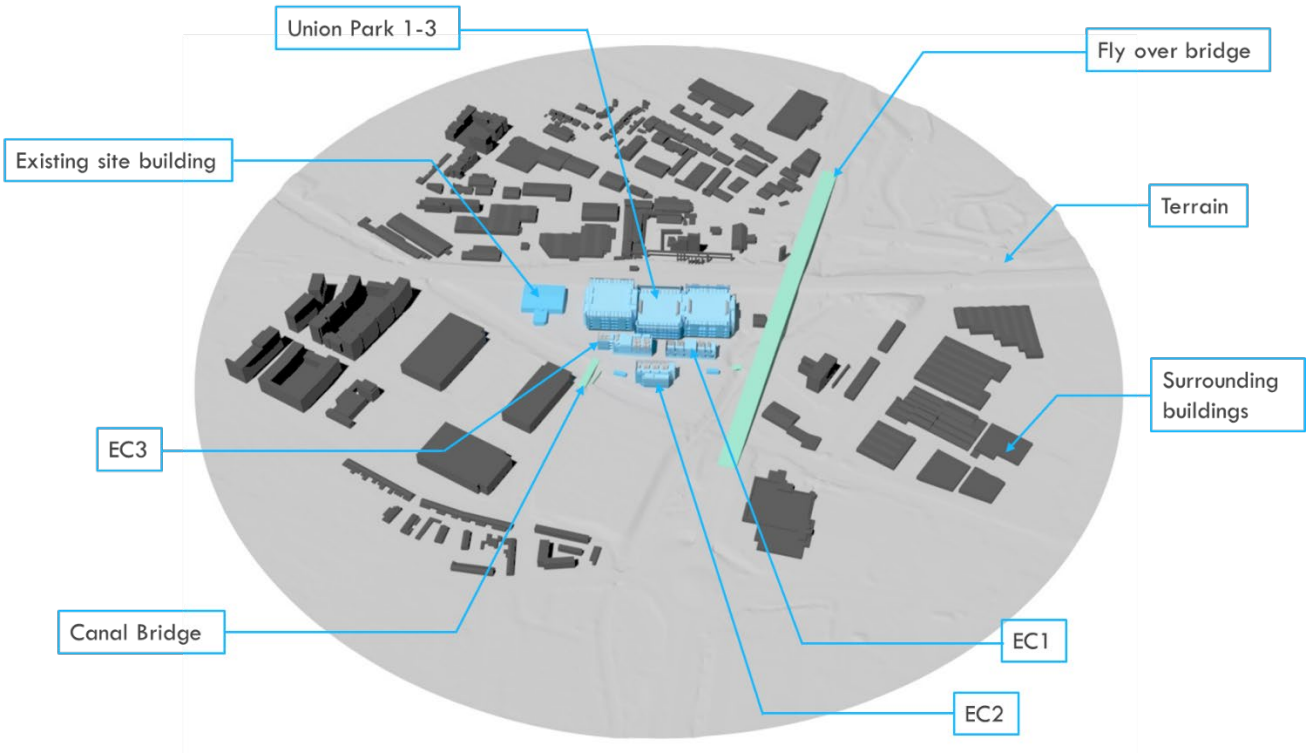

Figure 12 North perspective view of the modelled existing site and surrounding buildings.

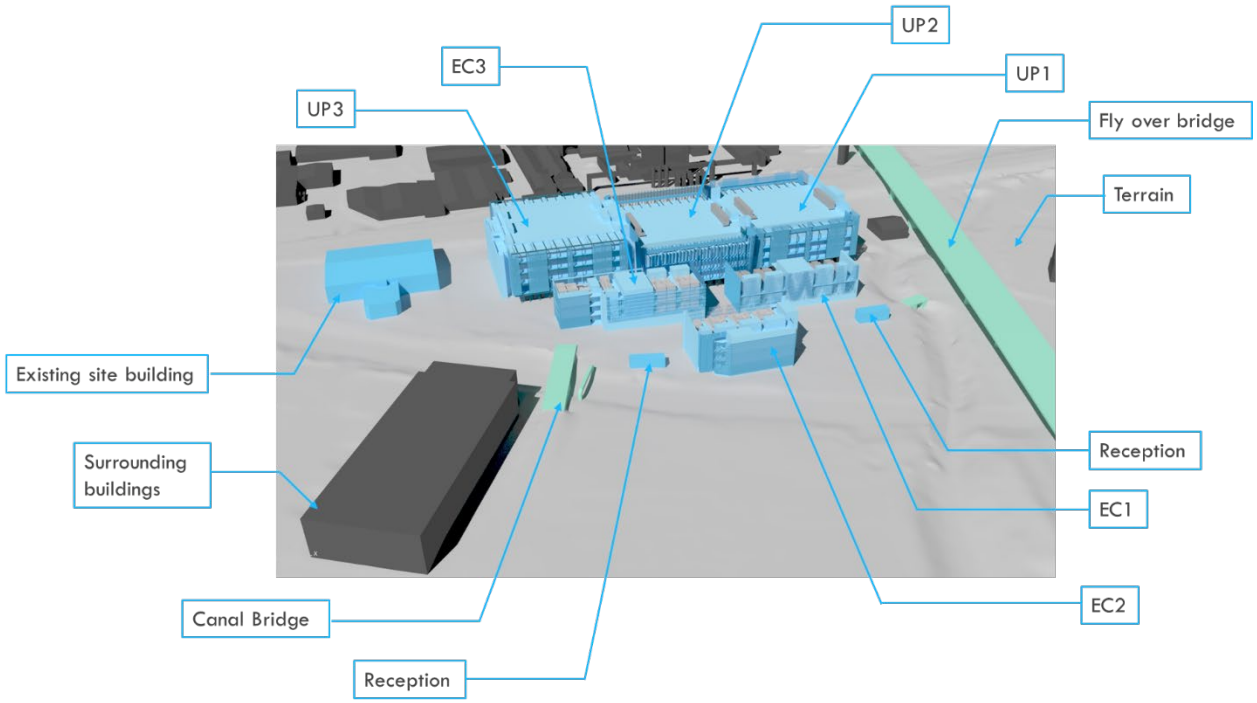

Figure 13 North close-up perspective view of the modelled existing site and surrounding buildings.

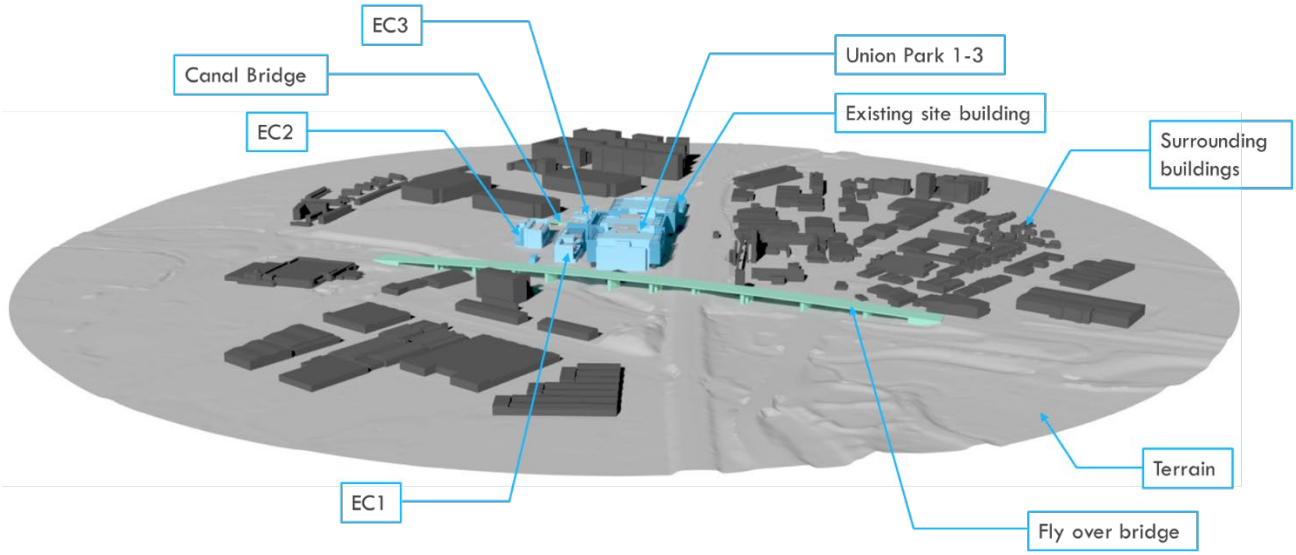

Figure 14 East perspective view of the modelled existing site and surrounding buildings.

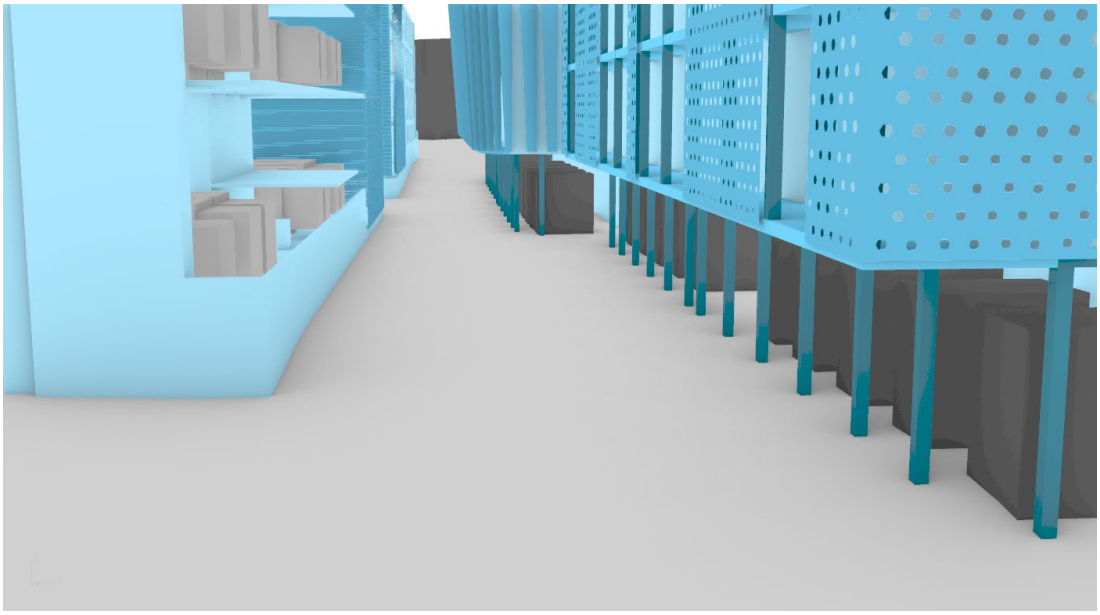

Figure 15 East close-up perspective view of pedestrian area.

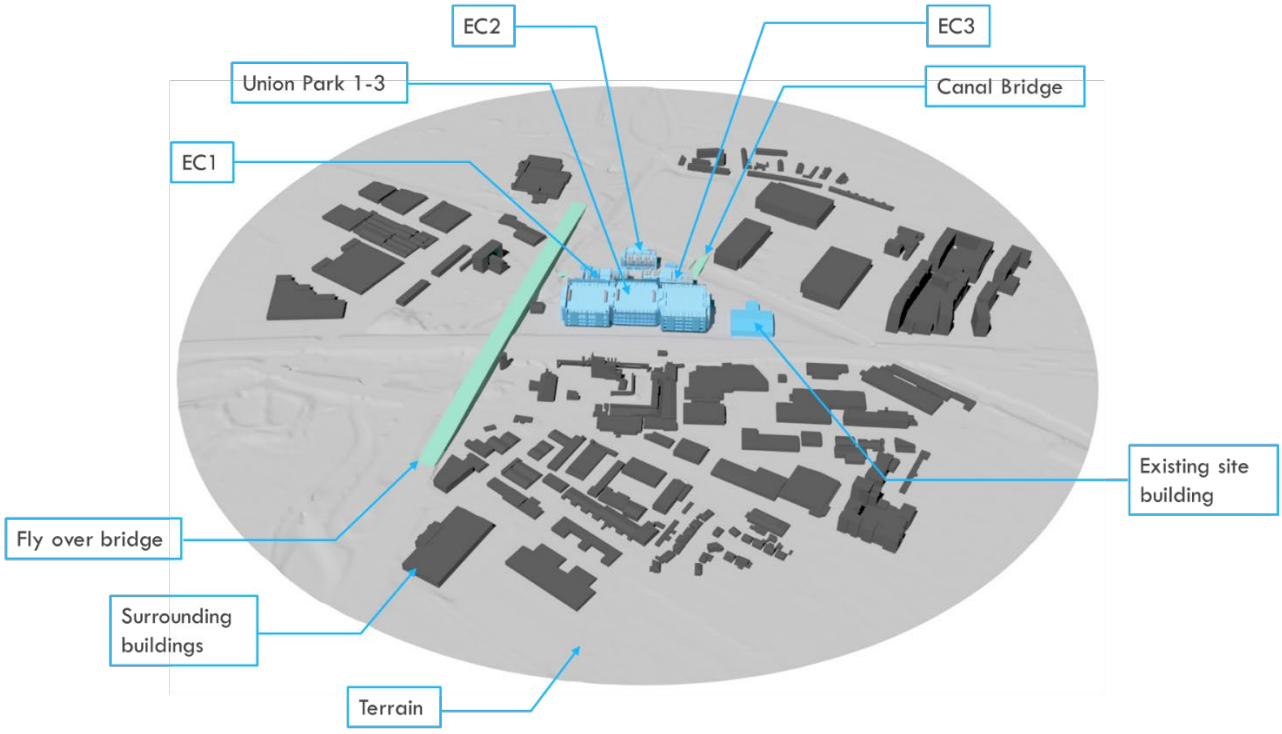

Figure 16 South perspective view of the modelled existing site and surrounding buildings.

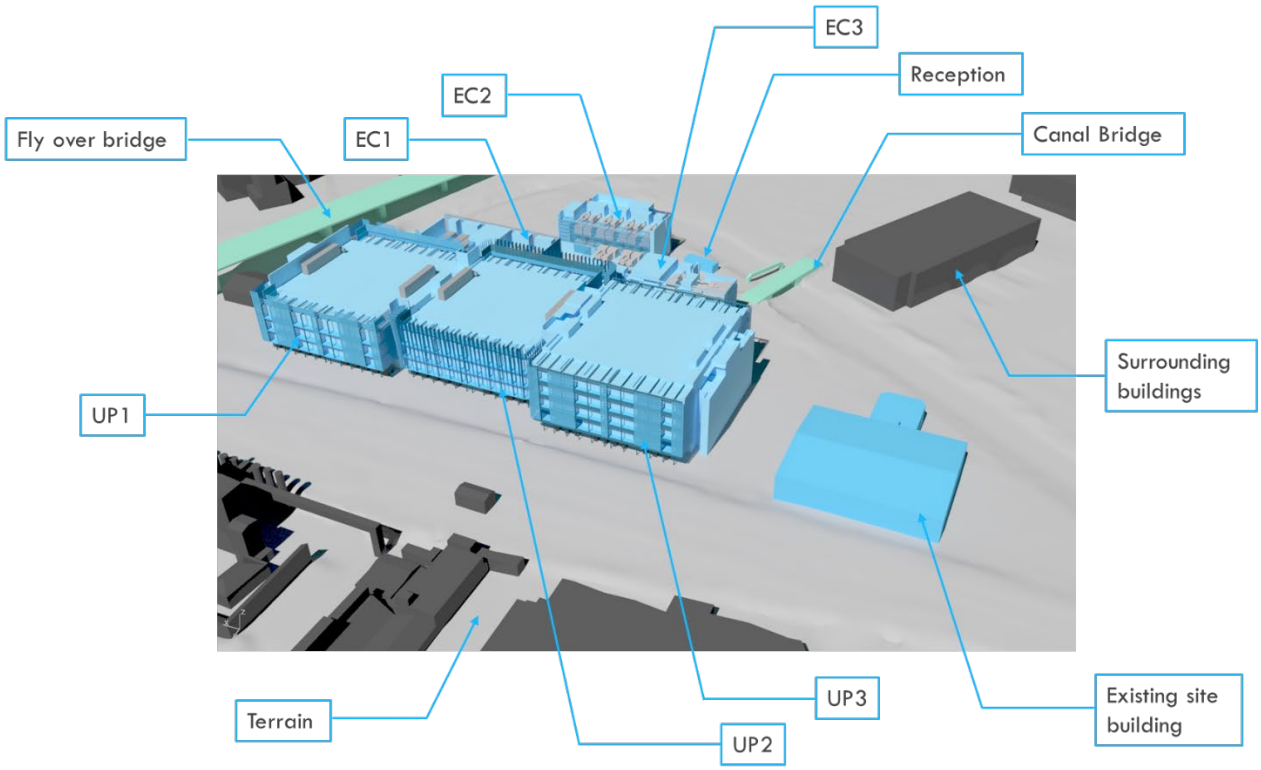

Figure 17 South close-up perspective view of the modelled existing site and surrounding buildings.

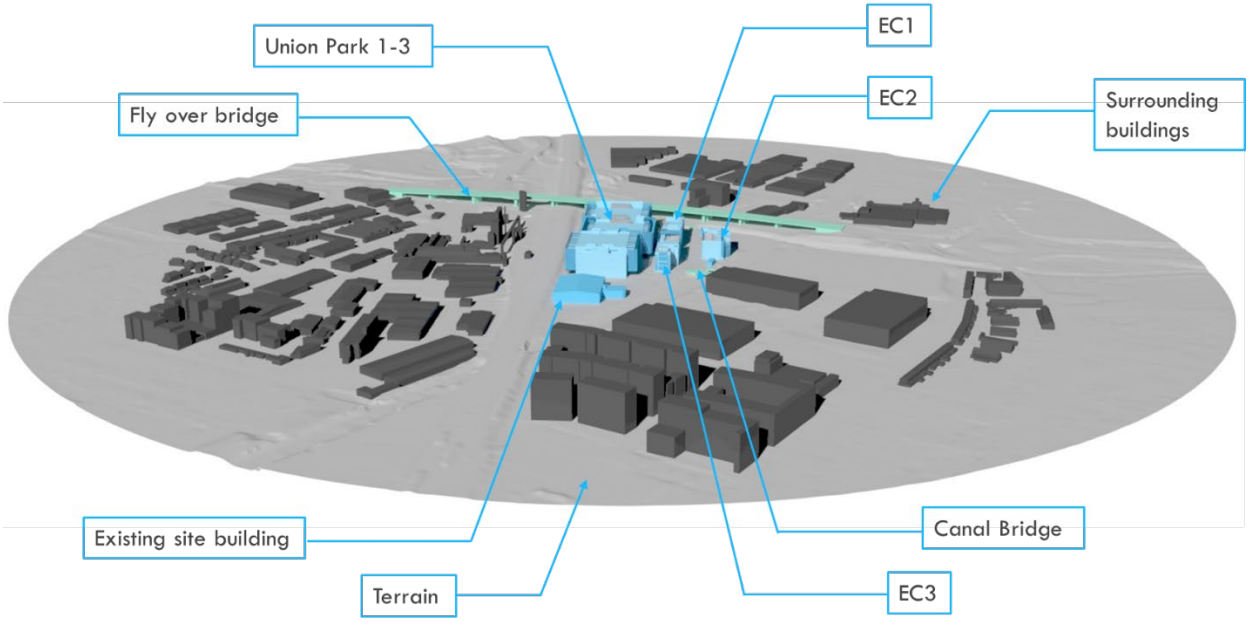

Figure 18 West perspective view of the modelled existing site and surrounding buildings.

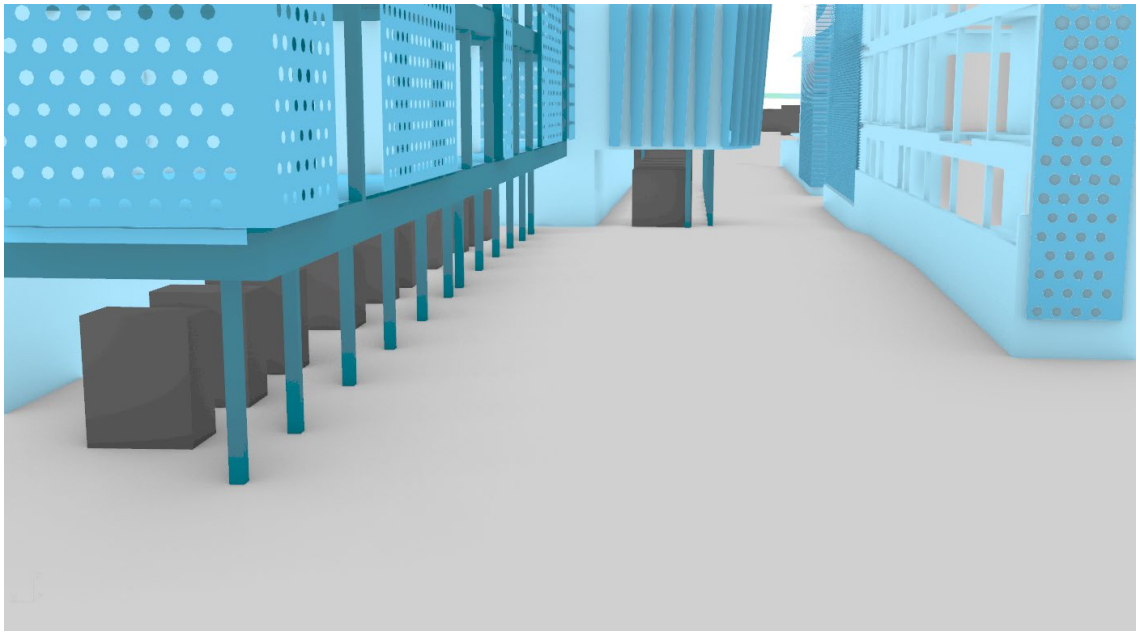

Figure 19 West close-up perspective view of pedestrian area.

7.4.2 Scenario 02 - Proposed Site Model Overview

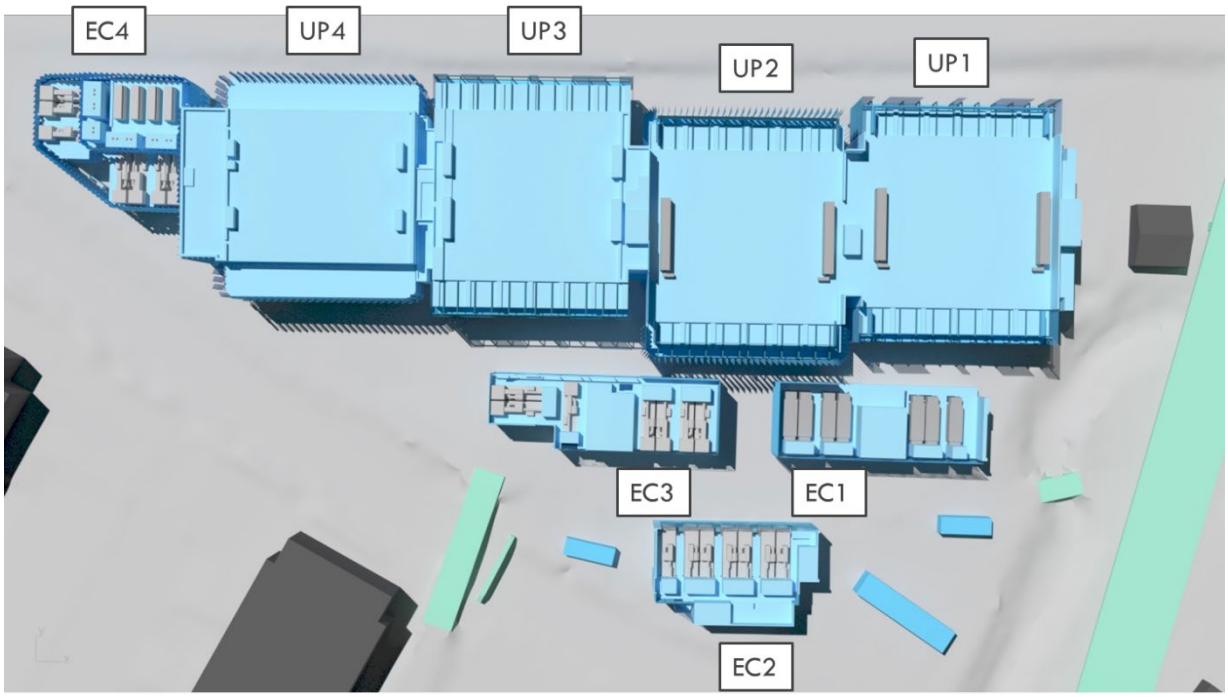

Figure 20 Plan view of proposed Union site.

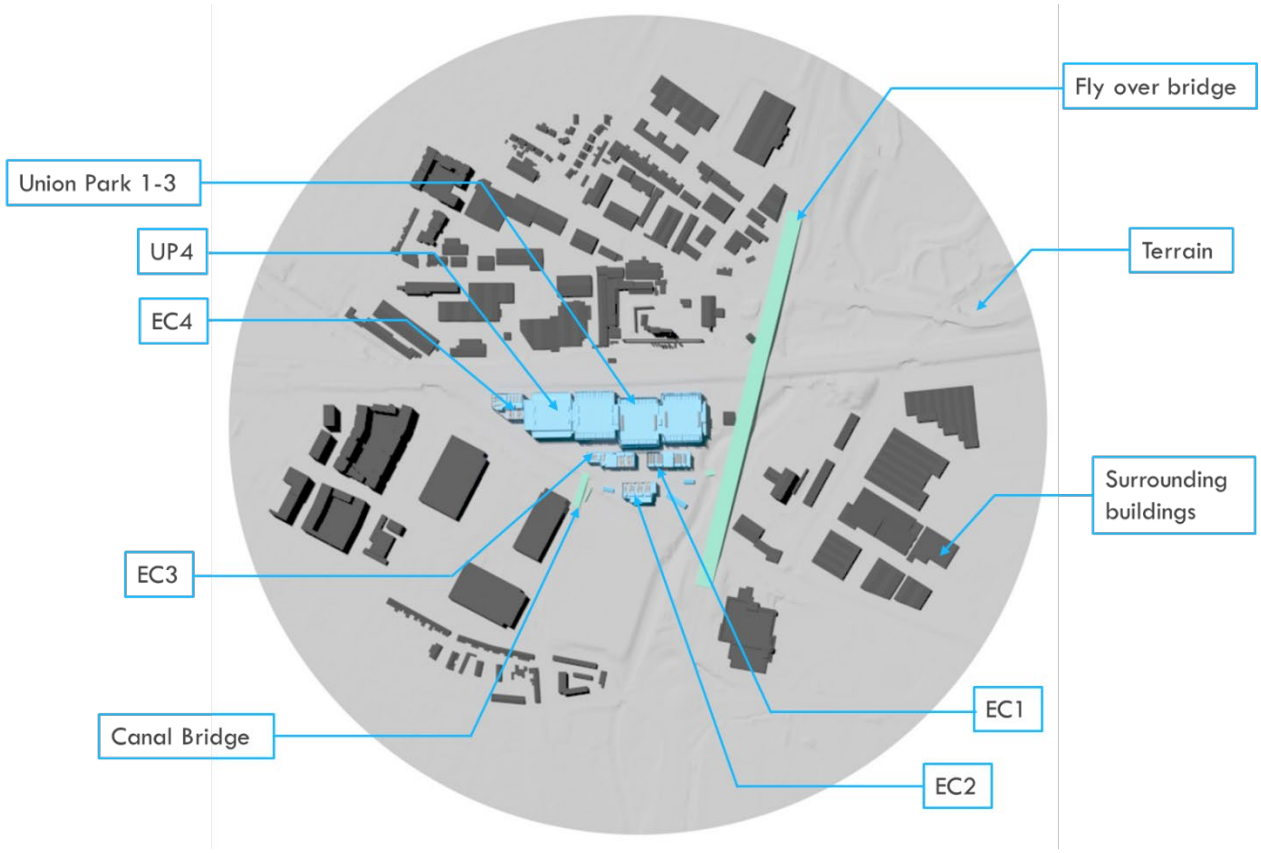

Figure 21 Plan view of the modelled proposed Union site and surrounding buildings.

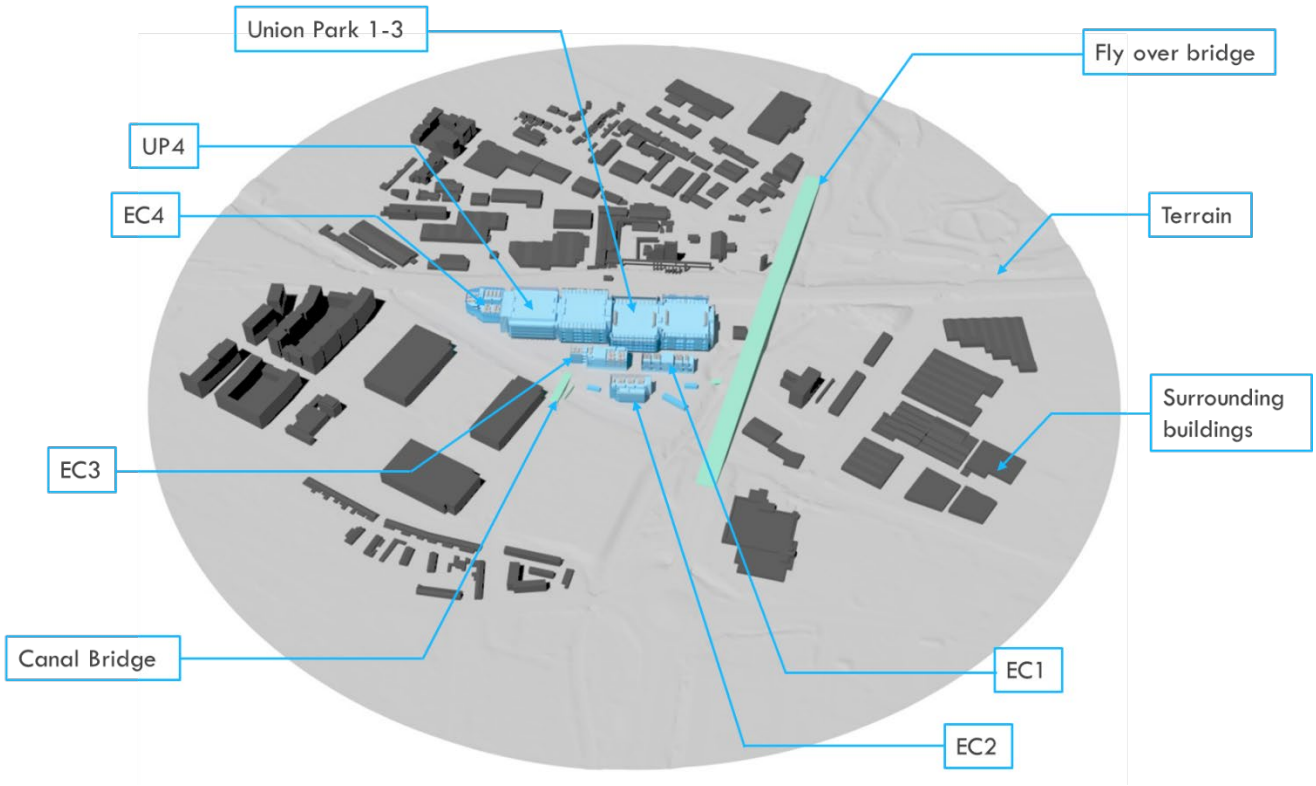

Figure 22 North perspective view of the modelled proposed Union site and surrounding buildings.

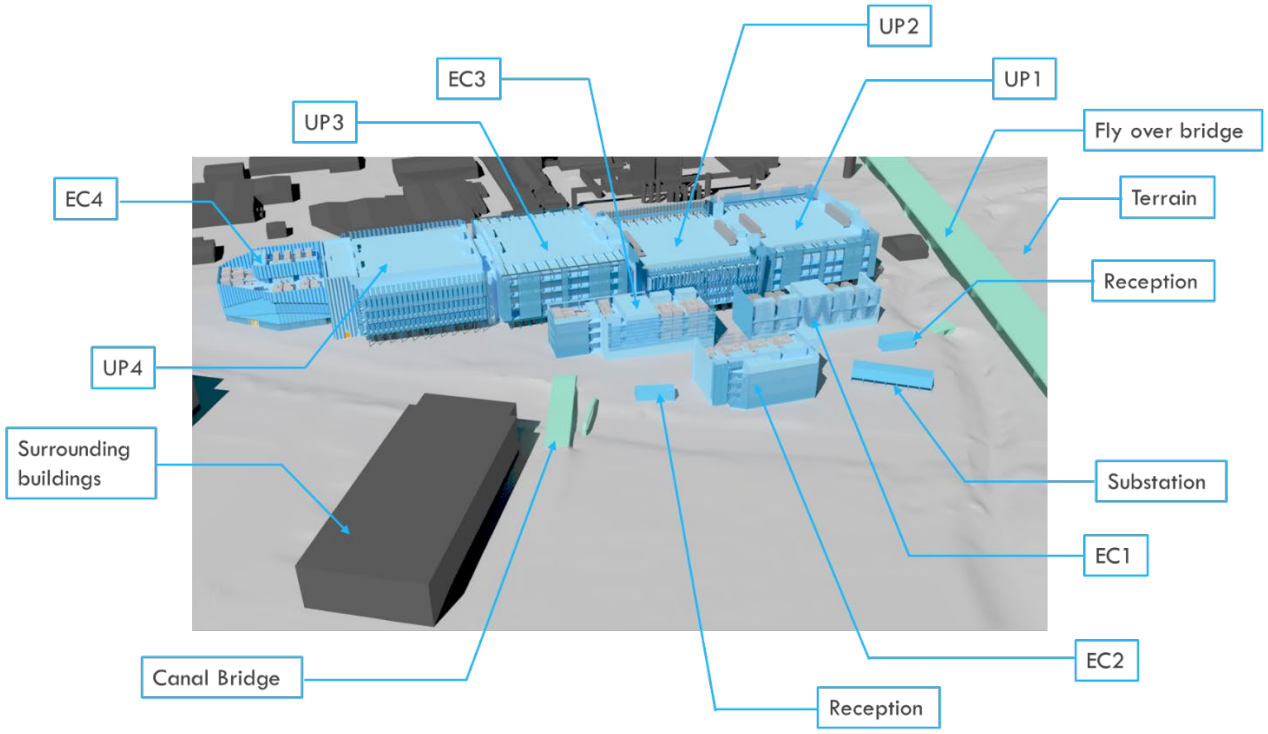

Figure 23 North close-up perspective view of the modelled proposed Union site and surrounding buildings.

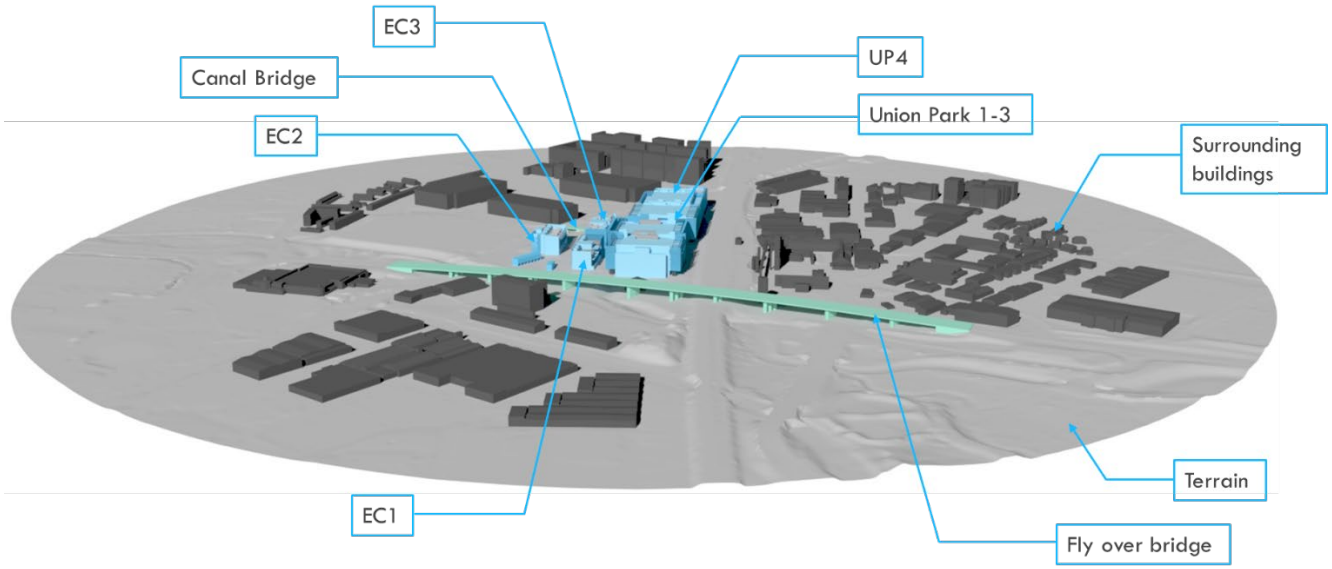

Figure 24 East perspective view of the modelled proposed Union site and surrounding buildings.

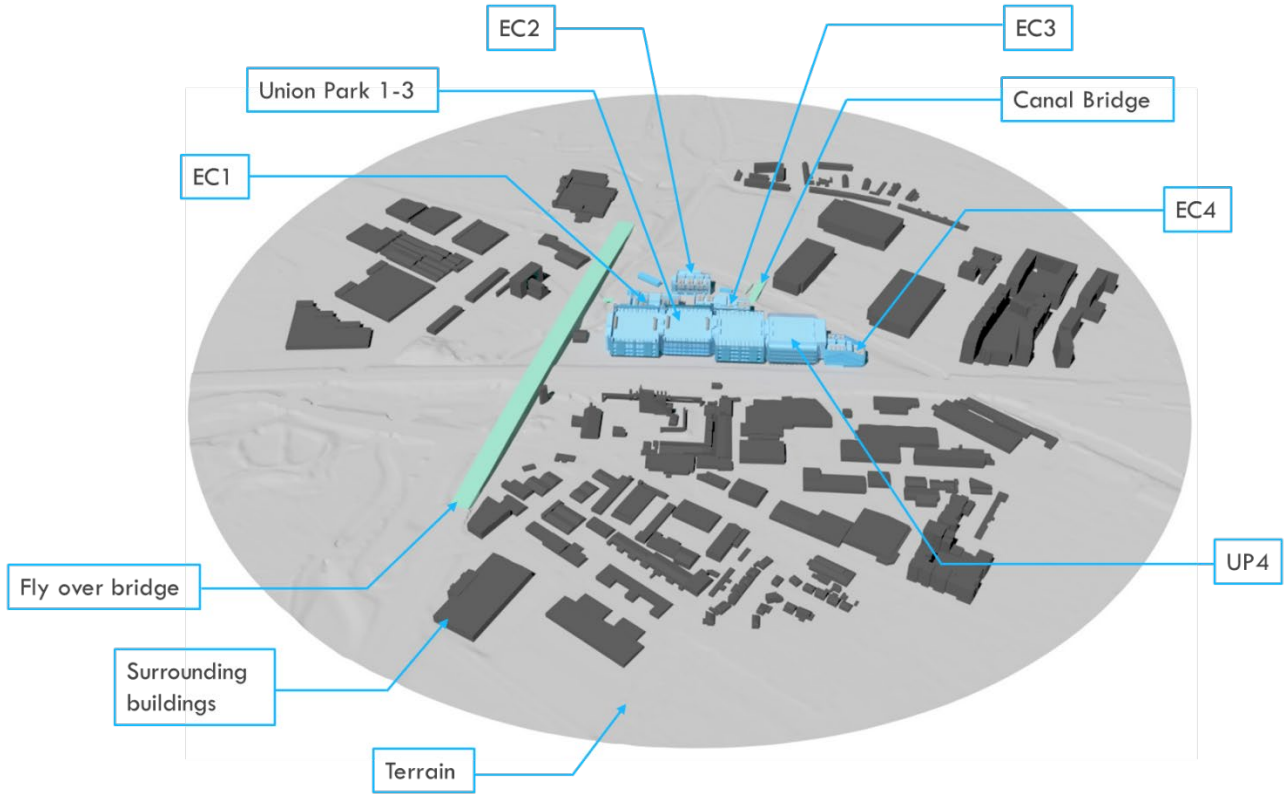

Figure 25 South perspective view of the modelled proposed Union site and surrounding buildings.

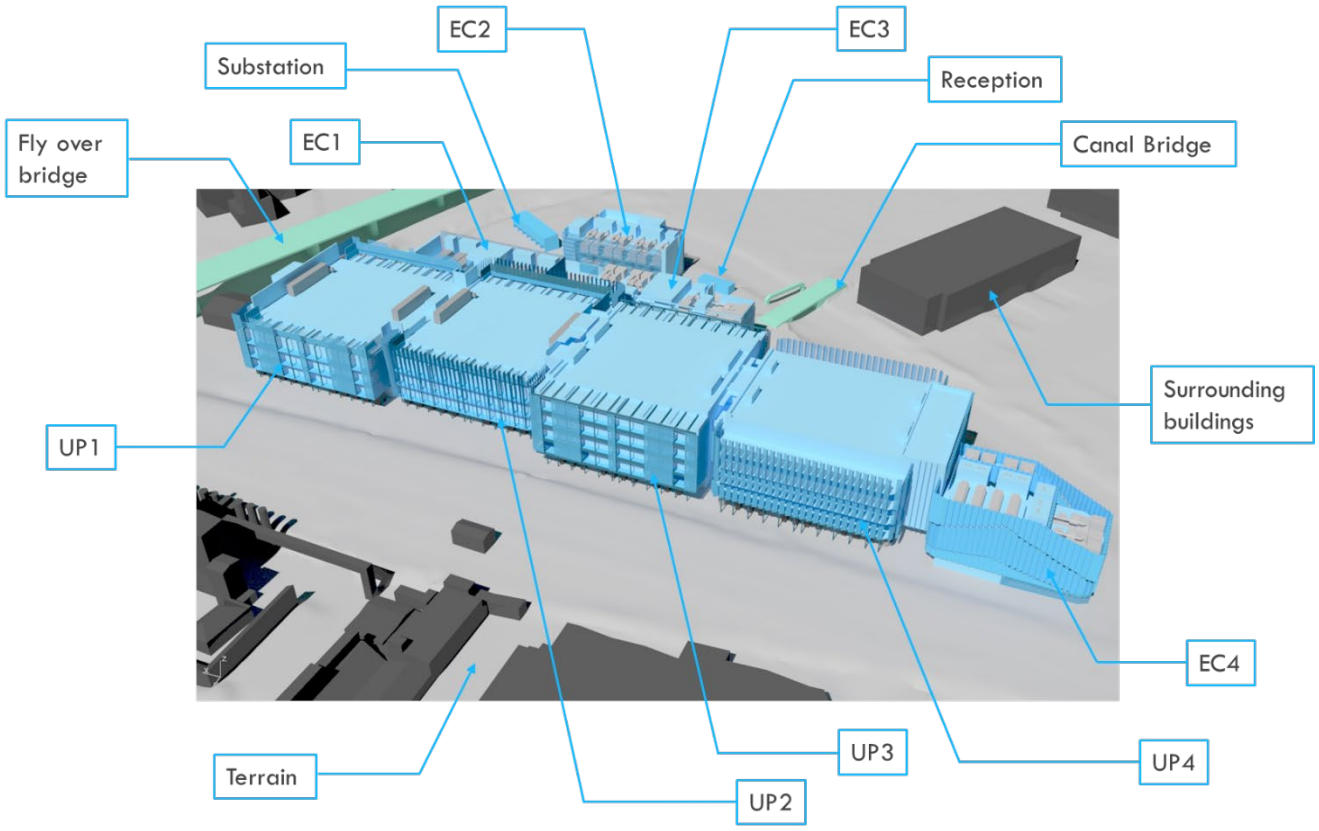

Figure 26 South close-up perspective view of the modelled proposed Union site and surrounding buildings.

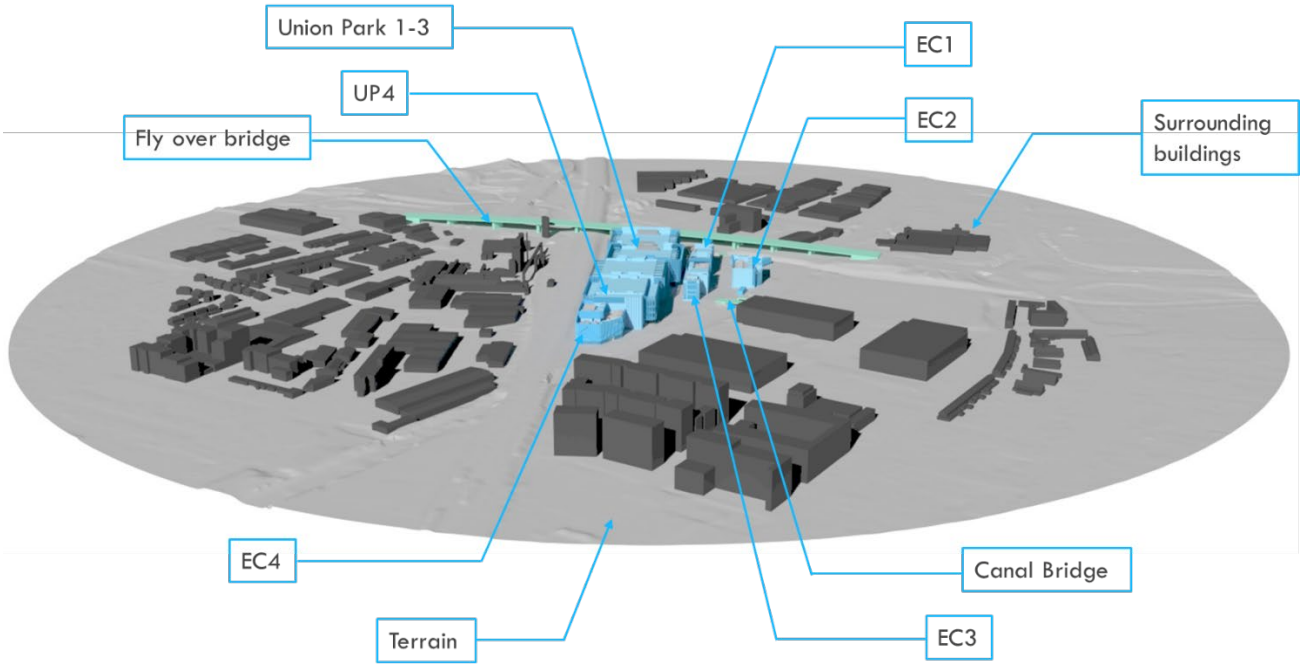

Figure 27 West perspective view of the modelled proposed Union site and surrounding buildings.

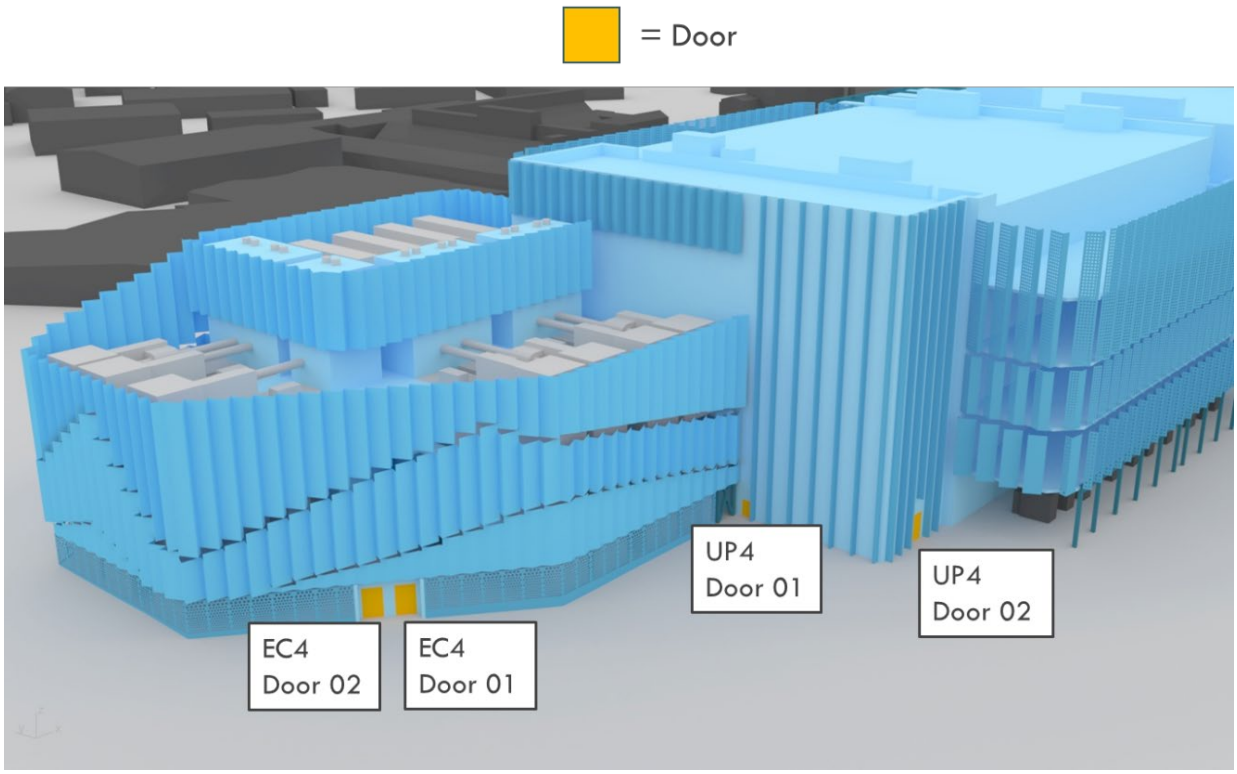

Figure 28 North close-up perspective view of UP4 and EC4 door locations overview.

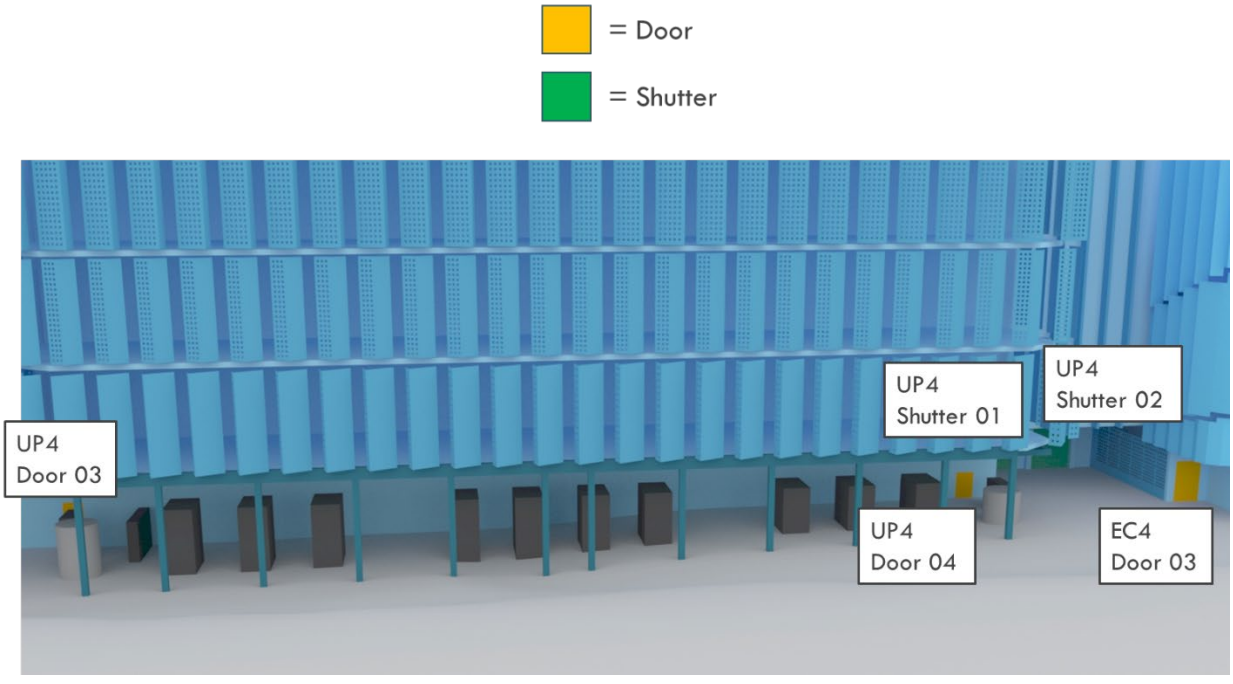

Figure 29 South close-up perspective view of UP4 and EC4 door locations overview.

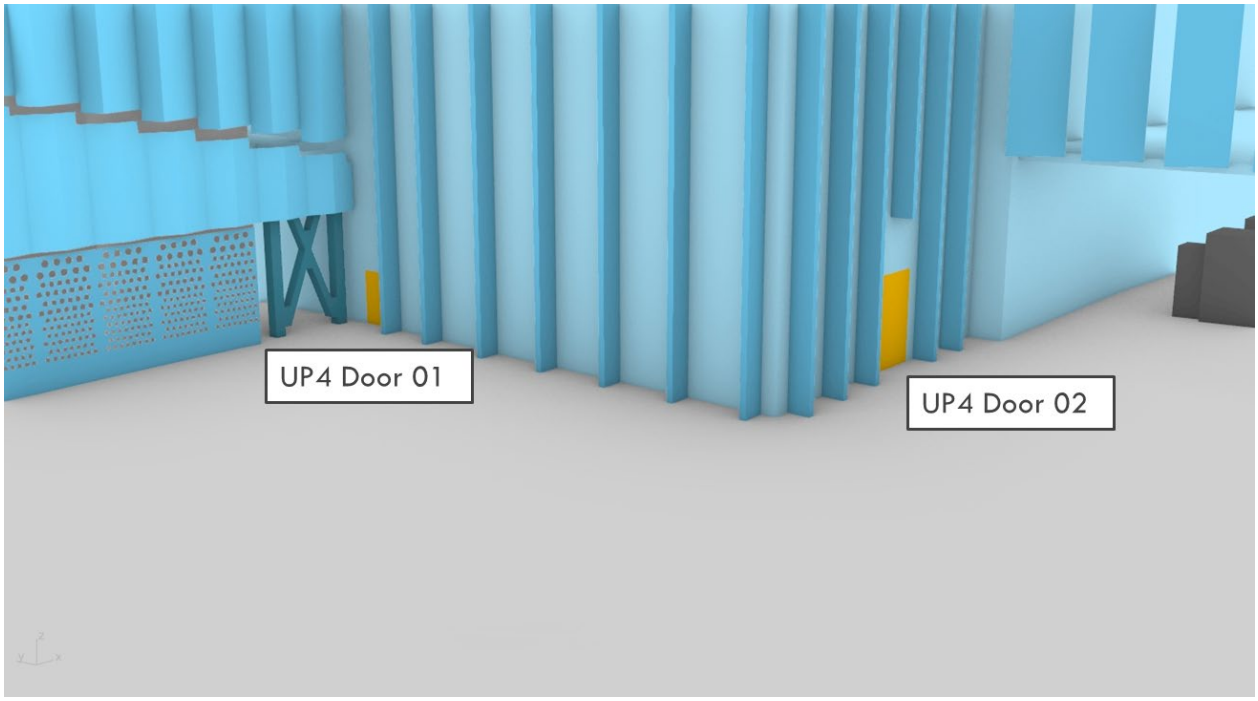

Figure 30 Close-up perspective view UP4 doors 01 and 02.

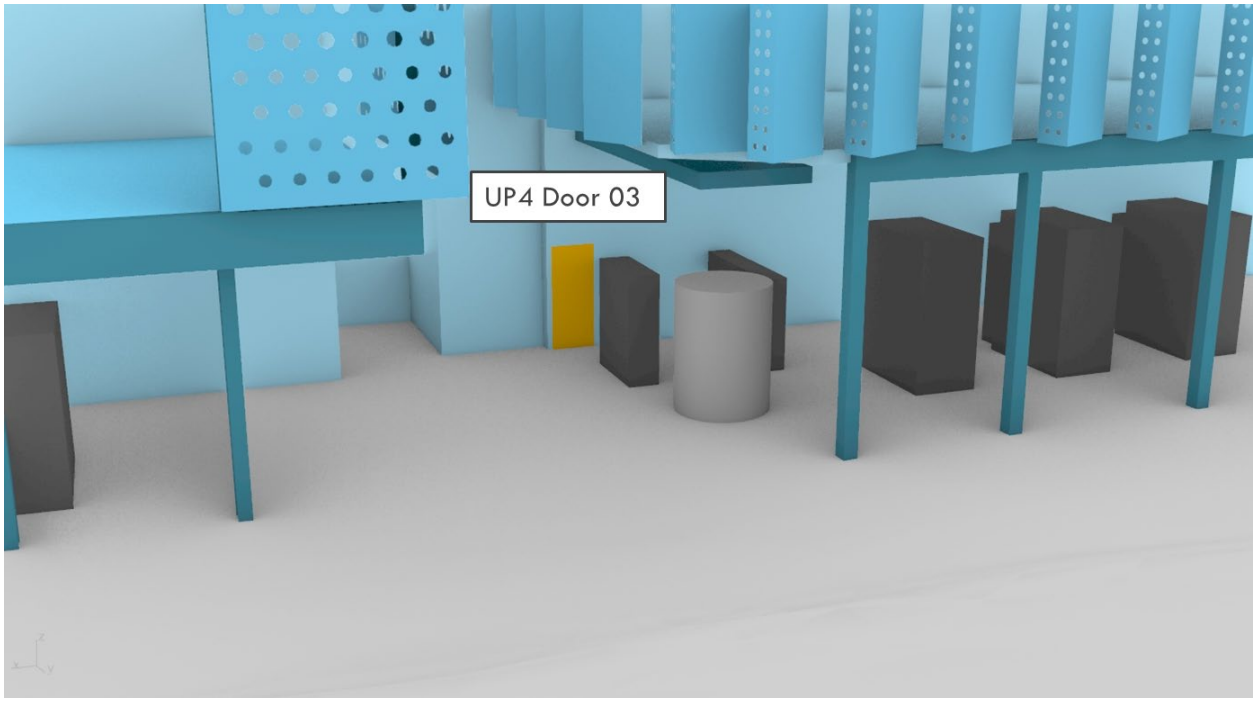

Figure 31 Close-up perspective view UP4 door 03.

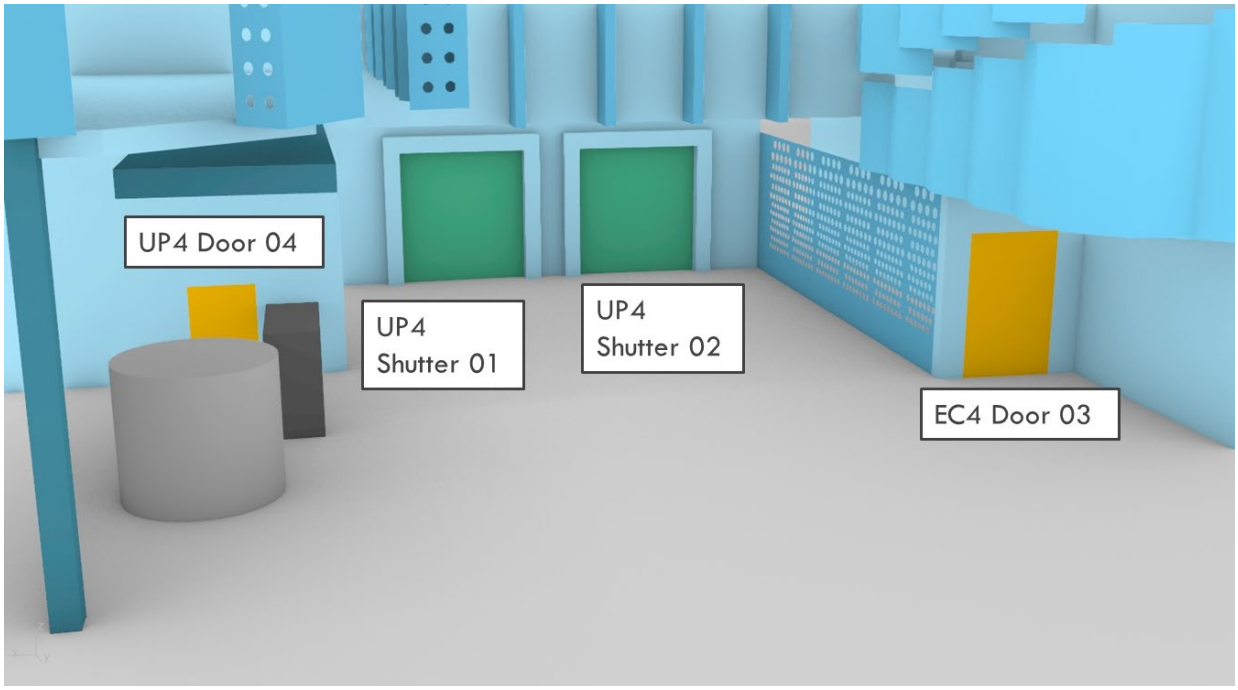

Figure 32 Close-up perspective view UP4 and EC4 doors.

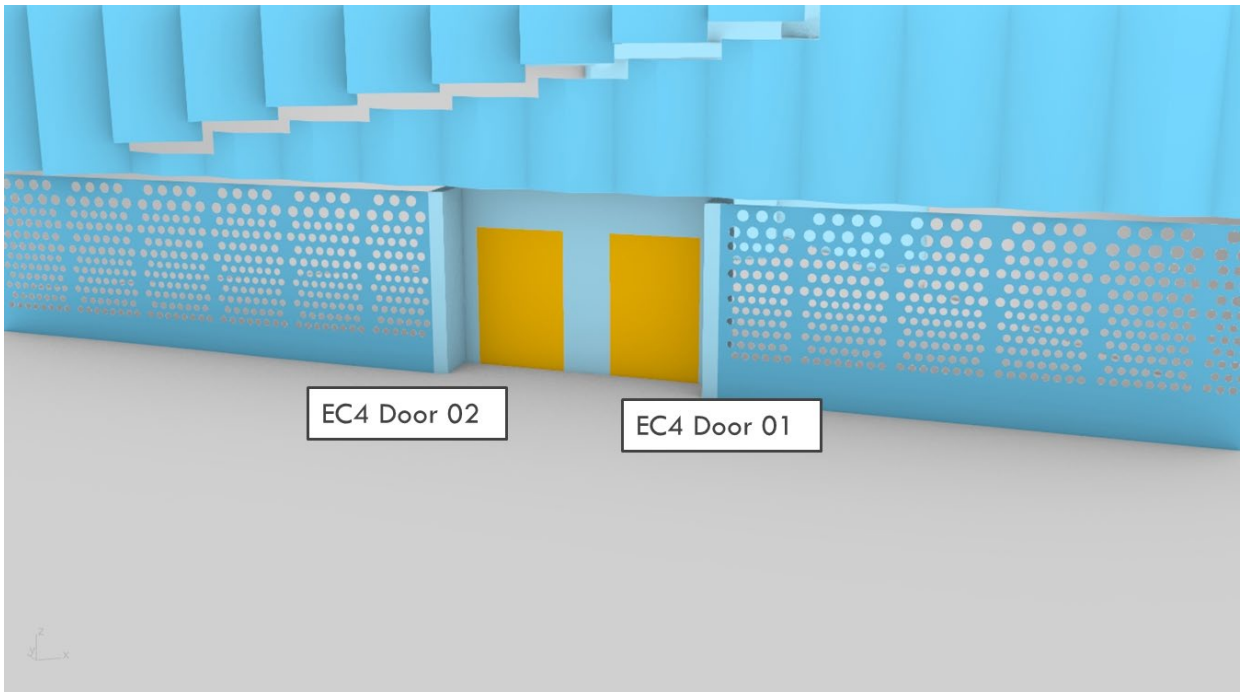

Figure 33 Close-up perspective view EC4 doors 01 and 02.

8.0 Discussion and Results

The acceptability of windiness is subjective and depends on a number of factors, most notably the activities to be performed in the area being assessed. Lawson Criteria describe acceptability for everyday activities in terms of 'comfort' and 'distress' (or safety). Note that the Lawson Criteria are intended for locations that are used on a regular basis. In areas intended for 'good weather use', the Lawson descriptions give an indication of how often wind may interfere, but clearly outdoor use remains possible when wind is calmer.

The wind conditions at each of the measurement positions were assessed for the pedestrian activities of Business Walking, Workers around buildings and leisure walking and entrance doors in accordance with the Lawson comfort criteria.

8.1 Areas of Pedestrian Activity around the Proposed Development

For an urban environment the target conditions around the site are generally:

- Business Walking criteria for direct walking between point A and point B as well as general cycling.
- Pedestrian walking through during the windiest season along pedestrian thoroughfares.
- Pedestrian standing conditions around drop off areas, taxi ranks, bicycle rack and bus stops as well as main building entrances.
- Sitting conditions at outdoor seating, terraces and amenity areas particularly during the summer months when these areas are more likely to be frequently used.

An overview of existing (scenario 01) and proposed (scenario 02) site plans along with identification points for the various locations both on and off site can be found below.

Figure 34 Analysis points for the existing site (scenario 01)

Figure 35 Analysis points for the proposed site (scenario 02)

8.2 Construction Phase

During the construction phase there is likely to be temporary tall structures, such as scaffolding or screening, around the new buildings. Wind conditions during the construction phase, including the demolition phase, would be expected to vary and adjust as the project changes between the various phases of building. As the construction moves phase the phase, the wind conditions would be expected to adjust from the baseline condition (Scenario 01) to the likely wind conditions demonstrated once the development construction is complete (Scenarios 02).

It should be noted that effects during the construction phase will be temporary, impacting the local area in the short term. Effects once the development is constructed and complete are long term.

Pedestrian routes adjacent to any high rising temporary structures on the construction site could suffer from temporary down draughts around the perimeter of the site which may require some mitigation. During construction hoarding or similar measure would be implemented around the areas under construction, and the site as a whole, meaning pedestrian throughfares would have some proactive measures therefore it would represent a negligible effect.

8.3 Scenario 01 Existing Site Acceptability Criteria

8.3.1 Summary

In terms of pedestrian comfort, the baseline analysis demonstrates the conditions across the existing site and surroundings. The majority of the areas analysed either meet or perform better than the requirement for the intended usages however there are a large portion that exceed limits. This is particularly highlighted along North Hyde Gardens (points 18-21) and the southern side of the Grand Union Canal (points 4-6). There is also a safety issue on the corner of North Hyde Gardens and the road bridge of the canal (point 17) where S20 is exceeded meaning winds will cause distress for all pedestrians including the able bodied.

8.3.2 Comfort Criteria

No.	Description	Target Category	Mean Results	GEM Results	Significance
1	Pavement - Sergio Industrial Park (Public)	Leisure Walk	Standing	Standing	Moderate Beneficial
2	Pavement - Sergio Industrial Park (Public)	Leisure Walk	Standing	Standing	Moderate Beneficial
3	Grand Union Canal Walkway (Public)	Sitting	Sitting	Sitting	Negligible
4	Grand Union Canal Walkway (Public)	Sitting	Standing	Leisure Walk	Moderate Adverse
5	Grand Union Canal Walkway (Public)	Sitting	Standing	Standing	Moderate Adverse
6	Grand Union Canal Walkway (Public)	Sitting	Sitting	Standing	Moderate Adverse
7	Grand Union Canal Walkway (Public)	Sitting	Standing	Leisure Walk	Moderate Adverse
8	Grand Union Canal Walkway (Public)	Leisure Walk	Standing	Standing	Moderate Beneficial
9	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
10	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
11	Grand Union Canal Walkway (Public)	Leisure Walk	Standing	Leisure Walk	Negligible
12	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
13	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
14	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
15	Pavement - North Hyde Gardens (Public)	Leisure Walk	Standing	Standing	Moderate Beneficial
16	Pavement - North Hyde Gardens (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
17	Pavement - North Hyde Gardens (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
18	Pavement - North Hyde Gardens (Public)	Standing	Standing	Leisure Walk	Moderate Adverse
19	Pavement - North Hyde Gardens (Public)	Standing	Standing	Leisure Walk	Moderate Adverse

20	Pavement - North Hyde Gardens (Public)	Standing	Standing	Leisure Walk	Moderate Adverse
21	Pavement - North Hyde Gardens (Public)	Leisure Walk	Leisure Walk	Business Walk	Moderate Adverse
22	Roadway - North Hyde Gardens (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
23	Roadway - North Hyde Gardens (Public)	Leisure Walk	Standing	Leisure Walk	Negligible
24	Bicycle Racking - Union Park (Private)	Standing	Sitting	Standing	Negligible
25	Pavement - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
26	Pavement - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
27	Pavement - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
28	Pavement - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
29	Pavement - Union Park (Private)	Leisure Walk	Standing	Standing	Moderate Beneficial
30	Carpark	Leisure Walk	Standing	Leisure Walk	Negligible
31	Roadway - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
32	Roadway - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
33	Roadway - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
34	Pavement - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
35	Pavement - Carpark	Leisure Walk	Sitting	Standing	Moderate Beneficial
36	Office Entrance	Standing	Standing	Leisure Walk	Moderate Adverse
37	Pavement - Carpark	Leisure Walk	Sitting	Standing	Moderate Beneficial
38	Pavement - Carpark	Leisure Walk	Sitting	Standing	Moderate Beneficial
39	Pavement - Carpark	Leisure Walk	Standing	Leisure Walk	Negligible
40	Pavement - Carpark	Leisure Walk	Standing	Leisure Walk	Negligible
41	Carpark	Leisure Walk	Sitting	Sitting	Moderate Beneficial
42	Carpark	Leisure Walk	Sitting	Standing	Moderate Beneficial
43	Pavement - Carpark	Leisure Walk	Standing	Leisure Walk	Negligible
44	Carpark	Leisure Walk	Standing	Leisure Walk	Negligible
45	Carpark	Leisure Walk	Standing	Leisure Walk	Negligible
46	Pavement - Carpark	Leisure Walk	Standing	Standing	Moderate Beneficial

47	Carpark	Leisure Walk	Standing	Standing	Moderate Beneficial
48	Pavement - Carpark	Leisure Walk	Standing	Leisure Walk	Negligible
49	Carpark	Leisure Walk	Sitting	Sitting	Moderate Beneficial
50	Pavement - Union Park (Private)	Leisure Walk	Leisure Walk	Leisure Walk	Negligible

Table 4 Scenario 01 Existing situation comfort criteria results.

8.3.3 Distress Criteria

No.	Description	Mean Distress Results	GEM Distress Results
1	Pavement - Sergio Industrial Park (Public)	No Safety Exceedance	No Safety Exceedance
2	Pavement - Sergio Industrial Park (Public)	No Safety Exceedance	No Safety Exceedance
3	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
4	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
5	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
6	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
7	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
8	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
9	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
10	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
11	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
12	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
13	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
14	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
15	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
16	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
17	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	S20
18	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
19	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
20	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
21	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
22	Roadway - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
23	Roadway - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
24	Bicycle Racking - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
25	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
26	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
27	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
28	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
29	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
30	Carpark	No Safety Exceedance	No Safety Exceedance
31	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
32	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
33	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
34	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
35	Pavement - Carpark	No Safety Exceedance	No Safety Exceedance

36	Entrance	No Safety Exceedance	No Safety Exceedance
37	Pavement - Carpark	No Safety Exceedance	No Safety Exceedance
38	Pavement - Carpark	No Safety Exceedance	No Safety Exceedance
39	Pavement - Carpark	No Safety Exceedance	No Safety Exceedance
40	Pavement - Carpark	No Safety Exceedance	No Safety Exceedance
41	Carpark	No Safety Exceedance	No Safety Exceedance
42	Carpark	No Safety Exceedance	No Safety Exceedance
43	Pavement - Carpark	No Safety Exceedance	No Safety Exceedance
44	Carpark	No Safety Exceedance	No Safety Exceedance
45	Carpark	No Safety Exceedance	No Safety Exceedance
46	Pavement - Carpark	No Safety Exceedance	No Safety Exceedance
47	Carpark	No Safety Exceedance	No Safety Exceedance
48	Pavement - Carpark	No Safety Exceedance	No Safety Exceedance
49	Carpark	No Safety Exceedance	No Safety Exceedance
50	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance

Table 5 Scenario 01 Existing situation distress results

8.4 Scenario 02 Proposed Site Acceptability Criteria

8.4.1 Summary

The proposed development provides a negligible or moderately beneficial affect on pedestrian comfort based on the intended use cases as well as improving the vast majority of the areas analysed compared to the baseline. There are only two points (points 3 and 4) on the southern side of the Grand Union Canal which are shown to have a moderate adverse effect, however these areas are also highlighted in the baseline analysis and are not significant in terms of magnitude. It should be noted that for both the baseline and the proposed analysis that landscaping, such as trees, shrubs and bushes, are not included to provide a worst-case scenario which may improve this area. There is no safety exceedances reported for the proposed analysis, with point 17 from the baseline being improved by the development.

8.4.2 Comfort Criteria

No.	Description	Target Category	Mean Results	GEM Results	Significance
1	Pavement - Sergio Industrial Park (Public)	Leisure Walk	Standing	Standing	Moderate Beneficial
2	Pavement - Sergio Industrial Park (Public)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
3	Grand Union Canal Walkway (Public)	Sitting	Standing	Leisure Walk	Moderate Adverse
4	Grand Union Canal Walkway (Public)	Sitting	Standing	Leisure Walk	Moderate Adverse
5	Grand Union Canal Walkway (Public)	Sitting	Sitting	Sitting	Negligible
6	Grand Union Canal Walkway (Public)	Sitting	Sitting	Standing	Moderate Adverse
7	Grand Union Canal Walkway (Public)	Sitting	Sitting	Sitting	Negligible

8	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
9	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
10	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
11	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
12	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
13	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
14	Grand Union Canal Walkway (Public)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
15	Pavement - North Hyde Gardens (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
16	Pavement - North Hyde Gardens (Public)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
17	Pavement - North Hyde Gardens (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
18	Pavement - North Hyde Gardens (Public)	Standing	Sitting	Sitting	Moderate Beneficial
19	Pavement - North Hyde Gardens (Public)	Standing	Sitting	Sitting	Moderate Beneficial
20	Pavement - North Hyde Gardens (Public)	Standing	Sitting	Standing	Negligible
21	Pavement - North Hyde Gardens (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
22	Roadway - North Hyde Gardens (Public)	Leisure Walk	Sitting	Standing	Moderate Beneficial
23	Roadway - North Hyde Gardens (Public)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
24	Bicycle Racking - Union Park (Private)	Standing	Sitting	Sitting	Moderate Beneficial
25	Pavement - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
26	Pavement - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
27	Pavement - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
28	Pavement - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
29	Pavement - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
30	UP4 Entrance	Standing	Sitting	Sitting	Moderate Beneficial
31	Roadway - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
32	Roadway - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
33	Roadway - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
34	Roadway - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial

35	Roadway - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
36	Roadway - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
37	Carparking - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
38	Pavement - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
39	Garden Walkway (Private)	Sitting	Standing	Standing	Negligible
40	Garden Walkway (Private)	Sitting	Sitting	Sitting	Negligible
41	Garden Walkway (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
42	Garden Walkway (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
43	Pavement - Union Park (Private)	Leisure Walk	Sitting	Standing	Moderate Beneficial
44	EC4 Entrance Door	Standing	Sitting	Sitting	Moderate Beneficial
45	Pavement - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
46	Pavement - Union Park (Private)	Leisure Walk	Sitting	Sitting	Moderate Beneficial
47	UP4 Entrance Door	Standing	Sitting	Sitting	Moderate Beneficial
48	UP4 Roller Shutters	Standing	Sitting	Sitting	Moderate Beneficial
49	UP4 Entrance Door	Standing	Sitting	Standing	Negligible
50	UP4 Entrance Door	Standing	Sitting	Sitting	Moderate Beneficial

Table 6 Scenario 02 Proposed Development comfort criteria results

8.4.3 Distress Criteria

No.	Description	Mean Distress Results	GEM Distress Results
1	Pavement - Sergio Industrial Park (Public)	No Safety Exceedance	No Safety Exceedance
2	Pavement - Sergio Industrial Park (Public)	No Safety Exceedance	No Safety Exceedance
3	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
4	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
5	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
6	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
7	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
8	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
9	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
10	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
11	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
12	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
13	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
14	Grand Union Canal Walkway (Public)	No Safety Exceedance	No Safety Exceedance
15	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance

16	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
17	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
18	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
19	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
20	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
21	Pavement - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
22	Roadway - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
23	Roadway - North Hyde Gardens (Public)	No Safety Exceedance	No Safety Exceedance
24	Bicycle Racking - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
25	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
26	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
27	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
28	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
29	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
30	UP4 Entrance	No Safety Exceedance	No Safety Exceedance
31	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
32	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
33	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
34	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
35	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
36	Roadway - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
37	Carparking - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
38	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
39	Garden Walkway (Private)	No Safety Exceedance	No Safety Exceedance
40	Garden Walkway (Private)	No Safety Exceedance	No Safety Exceedance
41	Garden Walkway (Private)	No Safety Exceedance	No Safety Exceedance
42	Garden Walkway (Private)	No Safety Exceedance	No Safety Exceedance
43	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
44	EC4 Entrance Door	No Safety Exceedance	No Safety Exceedance
45	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
46	Pavement - Union Park (Private)	No Safety Exceedance	No Safety Exceedance
47	UP4 Entrance Door	No Safety Exceedance	No Safety Exceedance
48	UP4 Roller Shutters	No Safety Exceedance	No Safety Exceedance
49	UP4 Entrance Door	No Safety Exceedance	No Safety Exceedance
50	UP4 Entrance Door	No Safety Exceedance	No Safety Exceedance

Table 7 Scenario 02 Proposed Development distress results.

9.0 Proposed Mitigation and Residual Impacts

9.1 Construction Phase

Although the construction phase is determined to have negligible effects on the wind conditions during construction it should be noted that this is on the assumption during construction the site should be screened from roads and pedestrian areas with pedestrian routes covered to ensure pedestrian safety around the perimeter of the site.

9.2 Proposed Development

9.2.1 Building Areas for Mitigation

Figure 36 Proposed building site plan.

Landscape plan from document MWL-0474-SEW-ZZ-DR-L-100003 P14.

Figure 37 Union Park Block 4 Landscape plan.

The analyses have been undertaken without the inclusion of landscaping as this is considered the worst case scenario. With the proposed landscaping as above the environment will improve form a wind shading perspective.

Overall the proposed development adds more shading and does not degrade the local and surrounding public realm spaces.

10.0 Copyrights and Disclaimer

It should be understood that this work reflects the information and detail supplied. Whilst K8T have carried out similar work in the past we cannot guarantee that all the requirements will be met without validation of the models. However, K8T Ltd are confident that they can produce the required information to provide a representative overview of the physics and planning variables in order to achieve the clients' requirements.

The weather data used reflects the most recent data available for the site and does not account for drastic changes in the future due to climate change. The data used is the most recent and reflects the current situation.

Whilst the simulations will be undertaken in good faith using skill and care, K8T Ltd can take no responsibility for natural phenomena or design issues. Any computer model(s) created for this work remain the property of K8T and as do any proprietary codes or software used in the creation of the results data. K8T will provide access to all input data and output results if required by the client. Any tools developed will remain the property of K8T Ltd with a provision to supply a toolkit to the client without any software warranty or support. If required, the client may request support through additional works agreement etc.

Appendix A – References

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Appendix B – Drawings Used

Electronic File Name	Drawing/File No.	Revision	Description
HDR-0474-UP4-ZZ-M3-N-000001.nwd	HDR-0474-UP4-ZZ-M3-N-000001	/	Union Park 4 (UP4) Navisworks model
HDR-0474-EC4-ZZ-M3-N-000001.nwd	HDR-0474-EC4-ZZ-M3-N-000001	/	Energy Centre 4 (EC4) Navisworks model
MWL-0474-SEW-ZZ-DR-L-100003 P8 Block 4 Landscape Masterplan.pdf	MWL-0474-SEW-ZZ-DR-L-100003	P8	Landscaping Masterplan
NWA-0474-SW-ZZ-M3-A-000001.rvt	NWA-0474-SW-ZZ-M3-A-000001	/	Proposed site Revit Model
BRG-0473-UP3-ZZ-M3-A-000001.rvt	BRG-0473-UP3-ZZ-M3-A-000001	/	Union Park 3 (UP3) Revit model
HDR-0474-EC4-ZZ-M3-MEP-000001.rvt	HDR-0474-EC4-ZZ-M3-MEP-000001	/	Energy Centre 4 (EC4) MEP Revit model
HDR-0474-UP4-ZZ-M3-S-000001.rvt	HDR-0474-UP4-ZZ-M3-S-000001	/	Union Park 4 (UP4) Structural Revit model
MWL-0474-SEW-XX-DR-L-100001 P5 Block 4 Landscape Boundary Sections.pdf	MWL-0474-SEW-XX-DR-L-100001	P5	Landscaping boundary section.
HDR-0474-EC4-ZZ-M3-S-000001.rvt	HDR-0474-EC4-ZZ-M3-S-000001	/	Energy Centre 4 (EC4) Structural Revit model
TQ1075_P_12757_20230109_20230315.laz	TQ1075_P_12757_20230109_20230315	/	UK LIDAR data points for the local area.
TQ0575_P_12757_20230109_20230315.laz	TQ0575_P_12757_20230109_20230315	/	UK LIDAR data points for the local area.

Appendix C – Mitigation Examples

Screens incorporated into raised flower beds [2]

Localised landscaping around entrances and terraces

Building height design for cities