14. Wind

Appendix 14.1

ORIGINAL WIND ES CHAPTER

14 WIND MICROCLIMATE

14.1 INTRODUCTION

14.1.1 Company

RWDI

14.1.2 Author

Matthew Rodwell, MEng

14.1.3 Chapter Purpose

This chapter of the ES assesses the likely significant effects of the proposed development on the environment in terms of wind microclimate. The chapter and it's supporting appendices describe the planning policy context, the assessment methodology; the baseline conditions at the application site and surroundings; the likely significant effects; the mitigation measures required to prevent, reduce or offset any significant adverse effects; the likely residual effects after these measures have been employed; and the cumulative effects. In summary, the objectives of the chapter are to:

- Assess the wind microclimate at the proposed development and in its immediate surrounds; and
- Provide an analysis of mitigation measures that would ensure a safe and comfortable wind microclimate at the proposed development and in its immediate surrounds.

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14.1.5 Appendices

- Appendix 14.1: Pedestrian Level Wind Microclimate Report
- Appendix 14.2: Previous Wind Microclimate Studies
- Appendix 14.3: Minutes of meeting conducted on 25th October regarding wind microclimate

14.2 METHODOLOGY

14.2.1 Guidance

Guidance on tall buildings (1), 2007

English Heritage and the Commission for Architecture and the Built Environment (CABE) produced a revised and updated version of their joint guidance on tall buildings. The final version was released in July 2007 and in section Criteria for evaluation, state that:

- "… planning permission for tall buildings should ensure therefore that the following criteria are fully addressed: […] The effect on the local environment, including microclimate".

A Green Future: Our 25 Year Plan to Improve the Environment (2), 2018

There are no policies pertaining to wind microclimate in this document published by DEFRA in January 2018.

Creating space for beauty (3), 2019

There are no policies pertaining to wind microclimate in this document published by MHCLG in July 2019.

14.2.2 Legislation and Policy

14.2.2.1 Local Policy

The statutory development plan for Liverpool currently comprises the Unitary Development Plan (UDP) which was adopted in 2002; there are no policies within the adopted UDP in relation to wind microclimate.

The World Heritage SPD (4), 2009, which is a material consideration in decision-taking, provides specific design criteria for high-rise buildings and states in the 'design section' that:

"Ensure new tall buildings do not have a negative impact on local microclimate, in particular on key pedestrian routes and public spaces, through […] uncomfortable wind conditions".

The new Liverpool Local Plan (5), 2018 is presently awaiting examination. The following policies therefore have 'weight' in decision taking (as per NPPF paragraph 48 provisions) but are not final:

Policy UD2 Development Layout and Form, states that:

- "Development proposals should demonstrate that the layout and form of the proposal ensures that […] The design has been considered […] with adequate responses to issues of […] scale, relationship to existing structures, function, amenity, and its relationship to the public realm"

Policy UD 5 New Buildings, states that:

- "Design proposals for new buildings must demonstrate that […] Orientation and micro-climate […] issues that may impact on existing structures or neighbouring plots have been considered"

Policy UD6 Tall Buildings, states that:

- "The City Council will expect the submitted proposal to contribute to the sustainability of Liverpool now and in the future […] Ensuring that […] there has been a robust assessment of the proposals impact on its surroundings that demonstrates the building will not result in an adverse impact in terms of microclimate, wind turbulence"

14.2.2.2 National Policy

National Planning Policy Framework (6), 2019

In February 2019, the Government published an updated version of the NPPF. There are no policies pertaining to wind microclimate in the NPPF.

National Planning Practice Guidance (7), 2019

The NPPG was published in November 2016 to support the NPPF and was updated in October 2019. There is no guidance within the NPPG related to tall buildings and wind microclimate issues.

14.2.3 Consultees

The following have been consulted with in regard to this assessment:

- Historic England (HE);
- Liverpool City Council (LCC);

A meeting took place on 25th October 2019 with representatives from Liverpool City Council, Historic England and the Design team present to discuss the wind mitigation strategy for the proposed development. The minutes for this meeting outlining what has been discussed can be found in Appendix 14.3.

14.2.4 Scoping

Section 6.5 of the document 'Environmental Impact Assessment Scoping Report' produced by CBRE on 15/05/2017, sets out the proposed scope of the wind microclimate assessment, including wind tunnel testing:

'Wind tunnel tests will be carried out to quantify conditions around the proposed development. The tests will include the effects of all nearby existing and consented schemes that would affect wind conditions around the site. Likely future surroundings, if any, will also be considered.'

The study conducted by RWDI encompasses all the requirements laid out for the assessment of wind through wind tunnel testing in section 6.5 of the Environmental Impact Assessment Scoping Report. There were no comments from any relevant consultees on the Scoping Report with regards to the proposed wind assessment scope.

14.2.5 Consideration of Climate Change

The "Climate Projects Report" published by UKCP18 (8) presents the probable changes in wind speed for the 2070-2099 (timeframe considered most relevant for urban regeneration projects) in both the summer and winter seasons.

With these predictions, the current trends in the climate change are not likely to result in any significant changes in the predicted wind microclimate conditions in and around the proposed development from those considered in this ES chapter.

14.2.6 Consideration of Human Health

The objective of the pedestrian level wind microclimate assessment is to assess whether the spaces intended for pedestrian activities meet both the safety and comfort criteria that are required. The comfort and safety of pedestrians is therefore considered within this chapter using the widely accepted Lawson Criteria (further discussed in Section 'Pedestrian Wind Comfort' of this report).

14.2.7 Consideration of Risk of Major Accidents and/or Disasters

Severe Weather and Storms have been considered in the pedestrian level wind microclimate assessment. Severe Weather and Storm conditions have been taken into account via the metrological data used in the analysis and the range of wind speeds that have informed the various Lawson Comfort grades, as well as in the assessment of pedestrian safety at the site and the immediate surrounding area.

14.2.8 Alternatives

Over a two-year period between 2017 and 2019, numerous wind tunnel tests and Computation Fluid Dynamics (CFD) tests have been undertaken in relation to the proposals. In response to these tests, the design of the stadium has been adapted numerous times over this period to generate a safer and more comfortable wind microclimate.

The extent of these design changes has included:

- Updates to the façade of the stadium;
- Slight relocation of the stadium;
- Updates to the hard / soft landscaping strategy; and

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- Relocation of the proposed multi-storey car park (MSCP) from the western side of the site (west quay beyond proposed new water channel) to within the proposed west stand of the stadium.

The relocation of the MSCP to the west stand (to become integral to it) effectively provides a canopy over ground floor circulation space to provide shelter to pedestrians from the wind.

Further information on the design evolution of the proposed development is provided in Chapter 4 of the ES. Information on the design and assessment work specific to the consideration of the wind microclimate is provided in the section below.

The future baseline scenario, comprising the approved outline planning permission for the Liverpool Waters scheme (LPA ref. 11RM/1121 – variation of 10O/2424) has also been assessed within this report. The effects on wind conditions around the existing application site (without the proposed stadium scheme) with the Liverpool Waters Masterplan built out to the maximum massing parameters has been assessed and compared to the effects that the proposed development would have on wind conditions around the application site to ensure all relevant alternative scenarios have been analysed.

14.2.9 Previous Wind Assessment Work

The design of the proposed development has been developed over a two-year period (with the results presented in this chapter having been tested on 25/09/2019, 03/10/2019, 10/10/2019, and 19/11/2019) with extensive collaboration between RWDI and the design team in order to ensure that the wind microclimate around the proposed development would be safe and suitable for the intended pedestrian usage. As such over 65 wind tunnel tests have been conducted on multiple designs of the proposed development with four workshops conducted totalling more than 120 hours of wind tunnel work, in order to develop a suitable and sensible stadium design and set of mitigation measures that is expected to produce an appropriate wind microclimate around the proposed development whilst also ensuring that the desires of all stakeholders are met.

Previous wind tunnel testing was undertaken by Buro Happold and was supplemented by CFD testing, also undertaken by Buro Happold. The previous wind assessment work undertaken prior to that reported in this ES chapter, is described in Appendix 14.2.

14.2.10 Technical Assessment Methodology

The following section outlines the methodologies applied to identify and assess the range of potential wind impacts likely to result from the proposed development.

Wind tunnel testing is the most well-established and robust means of assessing the pedestrian wind environment. It enables the pedestrian level wind microclimate at a site to be quantified and classified in accordance with the widely accepted Lawson Comfort Criteria.

The wind tunnel tests deliver a detailed assessment of the mean and gust wind conditions for all wind directions (10° increments) in terms of pedestrian comfort and strong winds are also reported when they occur.

14.2.10.1 Wind Tunnel Testing and Model Details

A 1:300 scale model of the existing buildings at and surrounding the application site within a 360 m radius of the centre of the application site was constructed. Models of the proposed development and the approved Nelson Dock (development block parameters) element of the wider Liverpool Waters scheme (LPA ref. 19NM/1121 - as the most recent variation of the original outline permission ref. 10O/2424) were also built and inserted in the surround model as necessary. Up to 242 locations were instrumented across the tests conducted at ground level, and elevated levels on-site and at ground level off-site.

The study area of 360 m is used as buildings beyond this radius will have no aerodynamic impact on the application site during wind tunnel testing. Additionally, the impact of locations further than 360 m from the application site are taken into account when the terrain roughness of the surrounding area is analysed using the BREVe3.2 software package.

This geographic scale has enabled the testing of off-site receptor locations including United Utilities Wastewater Treatment Works (UU WwTW) to the north of the application site, Regents Road to the east and Nelson Dock (existing and future baseline) to the south. Beyond the western boundary of the application site lies the River Mersey. This is severed from the application site by the River Mersey wall and a further concrete structure sitting immediately to the eastern rear of the River Mersey wall.

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

- Step 1: Measure the building-induced wind speeds at pedestrian level in the wind tunnel;
- Step 2: Adjust standard meteorological data to account for conditions at the application site;
- Step 3: Combine these to obtain the expected frequency and magnitude of wind speeds at pedestrian level; and
- Step 4: Compare the results with the Lawson Comfort Criteria to 'grade' conditions around the application site.

14.2.10.2 Simulation of Atmospheric Winds

Wind is unsteady, or gusty, and this 'gustiness' or turbulence, varies depending upon the application site. Modelling these effects is achieved by a series of spire and floor roughness elements to create a boundary layer that is representative of urban conditions for the application site. The detailed proximity model around the application site is used to fine-tune the flow and create conditions similar to those expected at full scale. These features can be seen in the background of Figure 14.1.

14.2.10.3 Measurement Technique

Wind speed measurements are made using Irwin probes, which measure the wind speed at a scaled 1.5 metres (m) vertical height above the ground. For pedestrian comfort studies, both the mean and peak wind speeds were determined at each measurement location.

The wind speed was measured for all wind directions in equal increments, with 0° representing wind blowing from the north and 90° wind from the east. The locations included potential entrances, amenity spaces and thoroughfares within and around the proposed development, as well as off-site locations surrounding the application site.

The Met Office supply joint frequency tables of wind speeds divided into ranges of the Beaufort scale, and direction on a monthly and annual basis for 30° sectors around the compass. RWDI has an extensive database of meteorological data from a range of meteorological stations around the U.K. The frequency of winds of various strengths for standard reference conditions (10m height in open flat level country terrain at sea level) is shown in Figure 16.2 for spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February). The prevailing westerly winds account for the most frequent winds for this study.

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Figure14.1
Proposed Development Model in the Wind Tunnel