Stag Brewery, Mortlake

Air Quality EIA Report

For Reselton Properties

February 2018

Waterman

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This document has been prepared and checked in accordance with
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Comments

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1. Introduction

This Air quality EIA report has been prepared by Waterman Infrastructure and Environment Ltd (Waterman IE) on behalf of Reselton Properties Limited ('the Applicant') in relation to three linked planning applications for the comprehensive redevelopment of the former Stag Brewery site in Mortlake and land at Chalkers Corner ('the Site') within the London Borough of Richmond Upon Thames ('LBRuT').

This report presents the assessment of the likely significant effects of potential emissions from the proposed demolition, alteration, refurbishment and construction works ('the Works'), as well as emissions from operational road traffic and the proposed heating plant associated with the completed and operational Development on existing sensitive receptors surrounding the Site, and at receptors within the Development itself (see below for a definition of the Development). This report comprises the Environmental Statement (ES) Chapter and associated figures and appendices.

1.1 Report Context and Approach

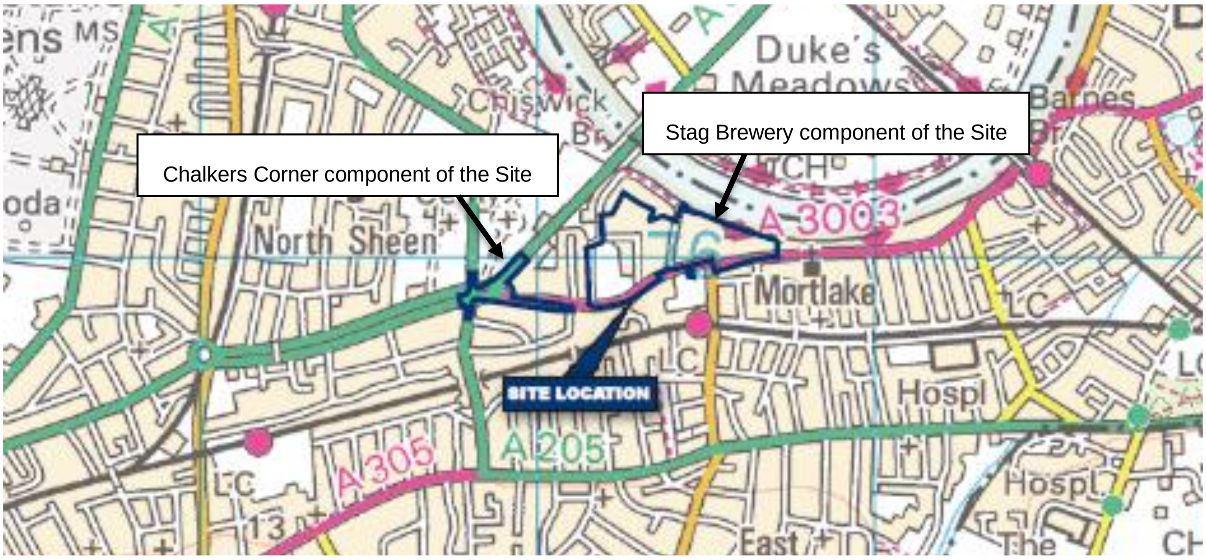
The Development is considered as EIA Development under Schedule 2, Category 10(b) (urban development projects) of the Town and Country Planning (Environmental Impact Assessment) Regulations, 2011 (as amended 2015)[1].

The ES reports the key findings of the EIA process undertaken for the Development and accompanies all three Planning Applications (as described below). At the request of the LBRuT, standalone reports have been provided, but do not differ from those contained within the ES. Justification as to the scope of the ES is summarised in ES Chapter 2: EIA Methodology. Further information on the description of the existing Site and surrounds, the proposed Development, the Works, alternatives and design evolution, and cumulative effects are provided in the ES.

1.2 Site Context and Development Proposals

The location of the Site is shown in Figure 1 below and comprises two components referred to as the 'Stag Brewery component of the Site' and the 'Chalkers Corner component of the Site'.

Figure 1: Site Location



The Stag Brewery component of the Site is bounded by Lower Richmond Road to the south, the river

[1] HMSO (2015) Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (as amended 2015).

Thames and the Thames Bank to the north, Williams Lane to the east and Bulls Alley (off Mortlake High Street) to the west. The Stag Brewery component of the Site is bisected by Ship Lane. The Stag Brewery component of the Site currently comprises a mixture of large scale industrial brewing structures, large areas of hardstanding and playing fields. The Chalkers Corner component of the Site comprises highway and associated landscaping referred to as Chalkers Corner junction which includes the junction with the A316 (Clifford Avenue, A3003 (Lower Richmond Road) and A205 (South Circular). Refer to ES Chapter 3: Existing Site and land uses for further information.

The redevelopment will provide homes (including affordable homes), accommodation for an older population, complementary commercial uses, community facilities, a new secondary school alongside new open and green spaces throughout. Associated highway improvements are also proposed, which include works at Chalkers Corner junction. The proposed floorspace of the Development (made up of the three planning applications) is provided in Table 1 below. Refer to ES Chapter 5: The Proposed Development for further information on the Development. The Works would be carried out over a period of approximately 8 years, anticipated to commence in June 2019 and complete in September 2027 (as set out in ES Chapter 6: Development Programme, Demolition, Alteration, Refurbishment and Construction).

Table 1: Proposed Floorspace of the Development

Land Use and Class	Floorspace Area (m^2)	
	Gross External Area (GEA)	Gross Internal Area (GIA)
Residential (Use Class C3, excluding assisted living)	Up to 84,639 (Up to 667 units)	Up to 75,119 (Up to 667 units)
Office (Use Class B1) (including Site management office)	2,674	2,457
Cinema (Use Class D2)	2,565	2,120
Gym (Use Class D2)	912	740
Flexible Uses - Restaurant / bar / retail / community / boathouse (Use Classes A1 / A2 / A3 / A4 / B1 / D1 / Boathouse)	5,308*	4,664*
Hotel (Use Class C1)	1,858	1,668
Assisted Living (Flexible Use Class C2 / C3)	Up to 16,246	Up to 14,738
Nursing and Care Home (Use Class C2)	Up to 10,293	Up to 9,472
School (Use Class D1)	11,430	9,319
Plant and storage.	Up to 4,536 (+ Plant and storage included in school)	Up to 4,244 (+ 249 included in school)
Car parking spaces.	Up to 708 spaces	Up to 708 spaces
Cycle parking spaces.	Up to 1,611 spaces	Up to 1,611 spaces
Basement residential access / circulation	1,868	1,810
Private amenity space.	Up to 5,912	Not applicable
Public amenity space (including external and internal play space for residents and school play space).	Up to 38,943	Not applicable

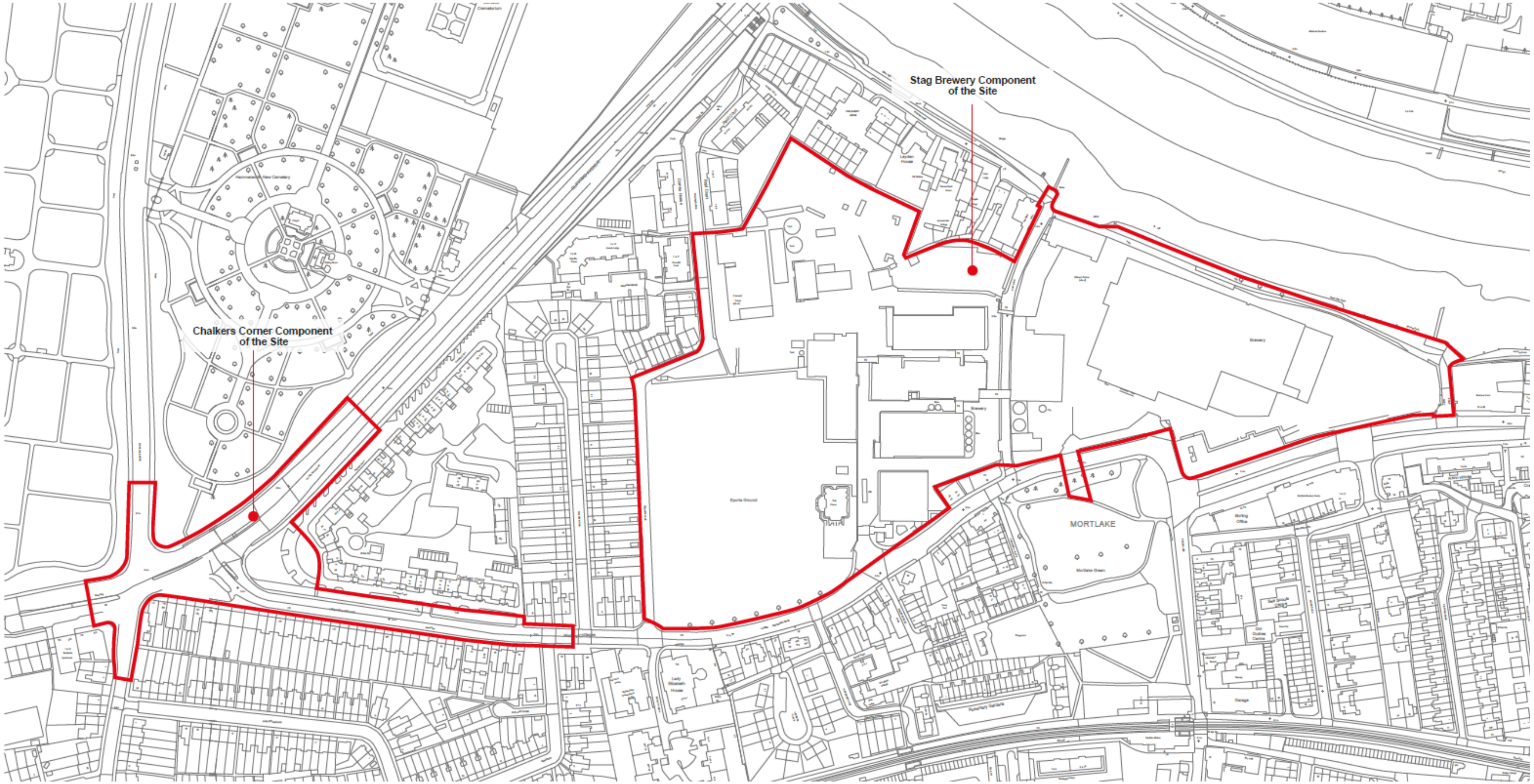
Play space (including external and internal play space for residents and school play space).	Up to 14,353	Not applicable

The three planning applications are as follows:

- Application A – hybrid planning application for comprehensive mixed use redevelopment of the Stag Brewery component of the Site consisting of:
  - Land to the east of Ship Lane applied for in detail (referred to as ‘Development Area 1’ throughout); and
  - Land to the west of Ship Lane (excluding the school) applied for in outline detail (referred to as ‘Development Area 2’ throughout).
- Application B – detailed planning application for the school (on land to the west of Ship Lane within the Stag Brewery component of the Site).
- Application C – detailed planning application for highways and landscape works at Chalkers Corner.

The three Planning Applications are separate applications, but will be linked through a S106 agreement to ensure that the Application B (school) land is handed over at an appropriate time and that the Application C (Chalkers Corner) works are carried out at an appropriate stage in conjunction with either Application A or B. For the purposes of assessment, all three Planning applications are therefore considered together as one comprehensive redevelopment proposal. As such, for the purposes of the EIA and ES, the proposals defined by the Planning Applications are collectively referred to as the ‘Development’. Similarly, the collective parcels of land associated with the Planning Applications are referred to as the ‘Site’, as shown on Figure 2.

Figure 2: The Site for the Purposes of the EIA



2. Assessment

10. Air Quality

Introduction

10.1. This Chapter, prepared by Waterman Infrastructure and Environment (Waterman IE), presents an assessment of the likely significant effects of the Development on local air quality. In particular, consideration is given to the likely effects of potential emissions from the demolition, alteration, refurbishment and construction works (the Works), as well as emissions from operational road traffic and the proposed heating plant associated with the completed and operational Development on existing sensitive receptors surrounding the Site, and at receptors within the Development itself. The assessment includes the potential air quality effect from changes to the Chalkers Corner junction layout, which are being made as part of the Development.

10.2. This Chapter describes the methods used to assess these effects and the baseline conditions currently existing at the Site and in the surrounding area. The likely significant direct and indirect effects of the Development arising from the Works and from the Development once completed and operational.

10.3. Mitigation measures are identified where appropriate to avoid, reduce or offset any likely adverse effects identified and / or enhance likely beneficial effects and the nature and significance of likely residual effects taking account of the mitigation measures are described.

10.4. This Chapter is supported by:

- **Appendix 10.1:** Air Quality Modelling Study;
- **Appendix 10.2:** Air Quality Neutral Assessment;
- **Appendix 10.3**: Modelled Results; and
- **Appendix 10.4:** Chalkers Corner Junction Interim Design Assessment.

Assessment Methodology and Significance

Assessment Methodology

10.5. Specific consultation with the Environmental Health Officer (EHO) at LBRuT was undertaken to agree the following approach for the air quality assessment (refer to Appendix B of **Appendix 2.1** and **Appendix 10.1**):

- identification of potentially sensitive existing and future receptor locations which could be affected by changes in air quality resulting from the Works, as well as the operation of the completed Development;
- review of LBRuT's Air Quality Updating and Screening Assessment and Progress Reports published as part of the Local Air Quality Management (LAQM) regime in order to determine baseline conditions in the area of the Site;
- application of the ADMS-Roads[1] and AMDS 5[2] air quality dispersion models using data from the project Transport Consultant (Peter Brett Associates) and the project Building Services Consultant (Hoare Lea), to assess the likely effects of emissions from traffic generated by the completed and operational Development and emissions from the Energy Centre within the

Development on local air quality. The latest NO_2 from NO_x Calculator available from the LAQM Support website[3] has been applied to derive the road-related NO_2 concentrations from the modelled NO_x concentrations and the Environment Agency[4] conversion of NO_x to ground level NO_2 associated with the emissions from the Energy Centres;

- comparison of the predicted pollutant concentration with the Air Quality Strategy Objectives (UK AQS);
- comparison of the predicted air pollutant concentrations with LBRuT monitored concentrations for the year 2016, and adjustment of modelled results where necessary (model verification details are provided in **Appendix 10.1**);
- determination of the likely significant effects of the Works, and consideration of the environmental management controls likely to be employed during the Works;
- determination of the likely significant effects of the completed and operational Development on air quality, based on the application of the Environmental Protection UK Guidance and Institute of Air Quality Management[5] (EPUK/ IAQM) significance criteria to modelled results;
- consideration of the effect on air quality associated with the changes to Chalkers Corner proposed (details are provided in **Appendix 10.4**);
- identification of mitigation measures where appropriate. This includes inherent measures which would have a beneficial effect on local air quality; and
- establishment of the likely residual effects of the Development upon air quality taking into account mitigation measures.

10.6. The UK AQS identifies the pollutants associated with road traffic emissions and local air quality as:

- nitrogen oxides (NO_x);
- particulate matter (as PM_{10} (particles with a diameter up to 10µm) and $PM_{2.5}$ (particles with a diameter up to 2.5µm));
- carbon monoxide (CO);
- 1, 3-butadiene (C_4H_6); and
- benzene (C_6H_6).

10.7. Emissions of total NO_x from motor vehicle exhausts comprise nitric oxide (NO) and nitrogen dioxide (NO_2). NO oxidises in the atmosphere to form NO_2.

10.8. The most significant pollutants associated with road traffic emissions, in relation to human health, are NO_2 and PM_{10}. LBRuT has declared an Air Quality Management Area (AQMA) for the entire Borough for annual mean NO_2 and 24-hour mean PM_{10}, attributable to road traffic emissions (referred to later in this Chapter). This assessment therefore focuses on NO_2 and particulate matter (PM_{10} and $PM_{2.5}$).

10.9. As agreed via the EIA scoping process (refer to **Chapter 2: EIA Methodology**) no assessment was undertaken (or is, indeed necessary) in relation to odour. Any ventilation extracts associated with the café and restaurant uses within the Development would be designed in accordance with best practice design and appropriate regulations. This would be secured by a suitably worded planning condition. As such, it is not anticipated that odours generated by café and restaurant uses within the Development would give rise to significant environmental effects.

The Works

10.10. The major influences on air quality throughout the Works would most likely be dust generating activities and vehicle emissions from plant and vehicles both on, and accessing / egressing, the Site.

Dust Emissions

10.11. The effects of dust emissions from the Works has been based on the guidance published by the IAQM (2014)[6].

10.12. The approach to the assessment includes:

- consideration of planned construction activities and their phasing; and
- a review of the sensitive uses in the area immediately surrounding the Site in relation to their distance from the Site.

10.13. Following the IAQM Guidance, construction activities can be divided into the following four distinct activities:

- demolition – any activity involved in the removal of an existing building;
- earthworks – the excavation, haulage, tipping and stockpiling of material, but may also involve levelling a site and landscaping;
- construction – any activity involved with the provision of a new structure; and
- trackout – the movement of vehicles from unpaved ground on a site, where they can accumulate mud and dirt, onto the public road network where dust might be deposited.

10.14. The IAQM considers three separate dust effects, with the proximity of sensitive receptors being taken into consideration for:

- annoyance due to dust soiling;
- potential effects on human health due to significant increase in exposure to PM_{10}; and
- harm to ecological receptors.

10.15. A summary of the four-step process which has been undertaken to determine the effect of the Works as set out in the IAQM guidance is presented in **Table 10.1**.

Table 10.1: Summary of the IAQM Guidance for Undertaking a Construction Dust Assessment

Step		Description
1	Screen the Need for a Detailed Assessment	Simple distance based criteria are used to determine the requirement for a detailed dust assessment. An assessment will normally be required where there are 'human receptors' within 350 m of the boundary of the site and / or within 50 m of the route(s) used by construction vehicles on public highway, up to 500 m from the site entrance or 'ecological receptors' within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on public highway, up to 500 m from the site entrance.

Step		Description
2	Assess the Risk of Dust Effects	The risk of dust arising in sufficient quantities to cause annoyance and/or health or ecological effects should be determined using four risk categories: negligible, low, medium and high based on the following factors • the scale and nature of the works, which determines the risk of dust arising (i.e. the magnitude of potential dust emissions) classed as small, medium or large; and • the sensitivity of the area to dust effects, considered separately for ecological and human receptors (i.e. the potential for effects) defined as low, medium or high.
3	Site Specific Mitigation	Determine the site-specific measures to be adopted at the site based on the risk categories determined in Step 2 for the four activities. For the cases where the risk is 'negligible' no mitigation measures beyond those required by legislation are required. Where a local authority has issued guidance on measures to be adopted these should be considered.
4	Determine Significant Effects	Following Steps 2 and 3, the significance of the potential dust effects should be determined, using professional judgement, considering the factors that define the sensitivity of the surrounding area and the overall pattern of potential risks.

Construction Vehicle Exhaust Emissions

10.16. The IAQM guidance on assessing construction impacts states that:

"*Experience of assessing the exhaust emissions from on-site plant and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed*".

10.17. The IAQM guidance states that a detailed air quality assessment should be undertaken where there is a change in Heavy Duty Vehicles (HDV) greater than an annual average daily trip of 25. The Works would result in 57 HDVs during the peak construction period and as such detailed dispersion modelling using ADMS-Roads of the peak construction phase has been undertaken (for the year 2022) to determine the impact of exhaust emissions from construction traffic.

10.18. As discussed later in this report, the Chalkers Corner Junction amendments results in an improvement to individual receptors along Lower Richmond Road as the road is realigned away from these properties and congestion reduces. As a worst-case assessment for properties on Lower Richmond Road, the Chalkers Corner Junction amendments are not considered in this scenario and construction vehicles are expected to use the existing junction layout.

Construction Plant Emissions

10.19. In accordance with the London Plan[7] all plant used during the Works would need to adhere to the emissions standards for NO_2 and PM_{10} set out for Non-Road Mobile Machinery (NRMM). As such it is considered that a quantitative assessment of plant exhaust emissions is not required.

Completed Development

ADMS Models

10.20. The likely effects on local air quality from traffic movements and heating plant emissions generated from the completed and operational Development have been assessed using the atmospheric dispersion model ADMS-Roads and ADMS 5 respectively. **Appendix 10.1** presents the details of the dispersion modelling.

10.21. For the purposes of modelling, traffic data for the relevant local road network, has been provided by PBA. Further details are provided in **Appendix 10.1**. The baseline year of 2016 has been assessed together with the 'without Development' and 'with Development' scenarios for the year 2027, the anticipated first year of operation of the Development (as the Development is anticipated to be completed in December 2026).

10.22. The ADMS-Roads dispersion model predicts how emissions from roads combine with local background pollution levels, taking account of meteorological conditions, to affect local air quality. The model has been run for the completion year, using background data and vehicle emission rates for 2027 as inputs. For the verification assessment (referred to later in this Chapter), background data and vehicle emission rates for 2016 have been used, which would be higher than the 2027 data. Pollutant concentrations have been modelled at a number of locations representative of nearby sensitive receptors.

10.23. Data relating to the proposed heating plant for the Development has been provided by the Applicant's Building Services Engineers (Hoare Lea). As outlined in **Chapter 5: The Proposed Development**, the proposed heating and energy strategy includes two energy centres to serve the eastern and western parts of Application A within the Development, split by Ship Lane, and a separate energy centre would be provided for the school, in Application B (collectively referred to as the 'Energy Centres'). The Energy Centres include a mix of gas-fired Combined Heat and Power (CHP) plants and boilers. The stack parameters provided by Hoare Lea do not represent the final parameters for each plant to be used once the Development is complete and operational but are indicative based on similar plant. As such, with the granting of any planning permission, it is considered that a suitably wording planning condition requesting an air quality assessment of the final plant would be provided by LBRuT.

10.24. Full details of the dispersion modelling study, including the road traffic, and heating plant data used in the assessment, are presented within **Appendix 10.1**.

Nitrogen Dioxide (NO_2) Sensitivity Analysis

10.25. Analyses of historical monitoring data by Defra[8] have identified a disparity between actual measured NO_x and NO_2 concentrations and the expected decline associated with emission forecasts which form the basis of air quality modelling as described above. This disparity is related to the on-road performance of certain vehicles compared to calculations based on Euro emission standards which inform emission forecasts.

10.26. A note on Projecting NO_2 Concentrations[9] published by Defra provides a number of alternative approaches that can be followed in air quality assessments, in relation to the modelling of future NO_2 concentrations, considering that future NO_x / NO_2 road-traffic emissions and background concentrations may not reduce as previously expected. This includes the use of revised background pollution maps, alternative projection factors and revised vehicle emission factors. However, the Defra note does not form part of statutory guidance and no prescriptive method is recommended for use in an air quality assessment.

10.27. This air quality assessment has been based on current guidance, i.e. using existing forecast emission rates and background concentrations to the completion year of 2027, which assumes a progressive reduction compared to the baseline year 2016. However, in addition, a sensitivity analysis has been undertaken on the basis of no future NO_x and NO_2 reductions by 2027 (i.e. considering the likely significant effect of the Development against the baseline 2016 conditions, assuming no reduction in background concentrations or road-traffic emissions rates between 2016 and 2027). The sensitivity approach presented in this air quality assessment has been agreed with the EHO at LBRuT, and provides a clear method to account for the uncertainty in future NO_X and NO_2 concentrations in air quality assessments. The results of this sensitivity analysis, which represent a more conservative assessment scenario, are presented in this Chapter and in **Appendix 10.3**.

10.28. For conservatism, the assessment of construction vehicle exhaust emissions considers NO_x and NO_2 emissions and background concentrations for the year 2016 rather than the year of peak construction works (as 2022).

Background Pollutant Concentrations

10.29. To estimate the total concentrations due to the contribution of any other nearby sources of pollution, background pollutant concentrations need to be added to the modelled concentrations. During consultation, the EHO at LBRuT requested that urban background concentrations from the Wetlands Centre, Barnes are used in this air quality assessment. Full details of the background pollution data used within the air quality assessment are included in **Appendix 10.1**.

Model Verification

10.30. Model verification is the process of comparing monitored and modelled pollutant concentrations and, if necessary, adjusting the modelled results to reflect actual measured concentrations, to improve the accuracy of the modelling results. The model has been verified by comparing the predicted annual mean NO_2 concentrations for the baseline 2016 (the latest year for which LBRuT air quality monitoring data is available), with the monitored annual mean NO_2 concentrations from LBRuT's diffusion tubes located at:

- Site 21 (Lower Richmond Road);
- Site 51 (Sheen Lane); and
- Site 52 (Clifford Avenue).

10.31. These locations are the nearest LBRuT monitors to the Site, and have been identified by the EHO at LBRuT for use in the model verification. It is noted that whilst Site 36 (Upper Richmond Road West (URRW) Sheen Lane); Diffusion Tube 49: URRW War Memorial (Sheen Lane); 50 (URRW, near Clifford Avenue) are located close to the Site, they have not been used as they are located outside of the road domain used in the ADMS-Roads dispersion model. The use of the above diffusion tubes was agreed with the EHO at LBRuT. The approach to the verification and adjustment process is described in detail in **Appendix 10.1**.

Chalkers Corner Junction

10.32. Highway works are proposed at Chalkers Corner to include amendments and reconfiguration to the junction to alleviate the transport and traffic implications associated with the operation of the Development within the Stag Brewery component of the Site. The reconfiguration of the Chalkers Corner junction includes:

- the provision of a short additional left turn lane (flare) from Lower Richmond Road into the junction (26 m long or about 5 car lengths);
- provision of an extended queuing reservoir between the main junction of Lower Richmond Road (this would accommodate about 9 extra cars south westbound) and would also provide extra storage for north east bound vehicles including those waiting to turn right into Lower Richmond Road); and
- provision of a wider pedestrian island within the Lower Richmond Road arm to 4 m wide to sufficiently cater for cyclists crossing as well as pedestrians.

10.33. In addition, an extended, dedicated lane for traffic turning left from Clifford Avenue into Lower Richmond Road would also be provided.

10.34. As discussed in **Chapter 5: The Proposed Development**, the Chalkers Corner Junction forms part of the Development and as such the amendments have been considered within the 'with Development' scenario of this air quality assessment. However, during consultation LBRuT requested additional information on the potential air quality impacts associated with the junction amendments in isolation. As such **Appendix 10.4** considers the following scenarios:

- **Scenario 1**: 2027 Baseline compared against 2027 'with Development but without highway works to Chalkers Corner Junction';
- **Scenario 2**: 2027 'with Development but without highway works to Chalkers Corner Junction' compared against 2027 'with Development and with highway works to Chalkers Corner Junction'; and
- **Scenario 3**: 2027 Baseline compared against 2027 'with Development and with highway works to Chalkers Corner Junction'.

10.35. Whilst the above scenarios have been considered to inform the design and to understand the impacts of the junction highway works in isolation, only Scenario 3 constitutes the assessment of the whole Development which this ES is based on and which is reported in this ES Chapter. Further details on the potential air quality impacts associated with the junction amendments in isolation / other scenarios can be found in **Appendix 10.4**.

UK Air Quality Strategy Objectives and Limit Values

10.36. Air pollutants at high concentrations can give rise to adverse effects on the health of humans and ecosystems. European Union (EU) legislation on air quality forms the basis for UK legislation and policy on air quality. The EU Framework Directive[10] on ambient air quality assessment and management came into force in May 2008 and was implemented by Member States, including the

UK, by June 2010. The Directive aims to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants.

10.37. The current UK AQS, which was published in July 2007[11], sets out objectives for local authorities in undertaking their Local Air Quality Management (LAQM) duties. The 2007 AQS introduced a national level policy framework for exposure reduction for fine particulate matter. Objectives in the AQS are in some cases more onerous than the Limit Values set out within the EU Framework Directive and the Air Quality Standards Regulations 2010[12]. In addition, objectives have been established for a wider range of pollutants. Currently it is a local authority's responsibility to determine the effect of a development against the UK AQS objectives, as such the UK AQS objectives of air pollutants relevant to this assessment are summarised in **Table 10.2**.

Table 10.2: Selected Receptor Locations

Pollutant	Objective		Date by Which Objective is to be Met
	Concentration	Measured as	
Nitrogen Dioxide (NO_2)	200µg/m^3	1-hour mean not to be exceeded more than 18 times per year.	31/12/2005.
	40µg/m^3	Annual Mean.	31/12/2005.
Particulate Matter (PM_{10}) [(a)]	50µg/m^3	24-hour mean not to be exceeded more than 35 times per year.	31/12/2004.
	40µg/m^3	Annual Mean.	31/12/2004.
Particulate Matter ($PM_{2.5}$) [(b)]	Target of 15% reduction in concentrations at urban background locations.	Annual Mean.	Between 2010 and 2020.
	25µg/m^3	Annual Mean.	01/01/2020.

Notes:
(a) Particulate Matter with a mean aerodynamic diameter of less than 10µm (micrometres or microns).
(b) Particulate Matter with a mean aerodynamic diameter of less than 2.5µm.

10.38. With regard to the EU Limit Values, as set by the Air Quality Standards Regulations, whilst the Development has not been assessed against these (as it is the UK Government's responsibility for their implementation), the Limit Values have been considered along with appropriate mitigation in relation to the Development not delaying compliance.

Potentially Sensitive Receptors

10.39. The approach adopted by the UK AQS is to focus on areas at locations at, and close to, ground level where members of the public (in a non-workplace area) are likely to be exposed over the averaging time of the objective in question (i.e. over 1-hour, 24-hour or annual periods). Objective exceedences principally relate to annual mean NO_2 and PM_{10}, and 24-hour mean PM_{10} concentrations, so that associated potentially sensitive locations relate mainly to residential properties and other sensitive locations (such as schools) where the public may be exposed for prolonged periods.

10.40. **Table 10.3** presents existing sensitive receptors selected due to their proximity to the road network likely to be affected by the Development. These existing receptors are located closest to road traffic impacts (i.e. at junctions) and / or the users are highly sensitive to air pollution (such as schools and residential users). **Appendix 10.4** considers the air quality impacts of the Development at an additional 140 selected sensitive receptors located at Chalkers Corner Junction and for receptors within the Air Quality Focus Area (AQFA) (discussed in the Baseline Section below). This includes residential receptors located in Chertsey Court at heights above ground level. The two locations identified in **Appendix 10.4** which are predicted by the air quality modelling to have the largest adverse and beneficial impacts have been presented in this Chapter as well for completeness.

10.41. **Table 10.3** also presents future sensitive receptor locations which are representative of sensitive uses (i.e. residential care homes, school) within the Development itself. The future sensitive receptor locations in **Table 10.3** represent the areas of the Development that would likely be exposed to the worst-case air quality conditions, i.e. the lowest residential / school levels of the Development that would be closest to road and the residential locations closest to the Energy Centre emissions. All other onsite receptors locations, for all other floor level considered, are presented in **Appendix 10.3**.

10.42. To take account of the predicted emissions from the Energy Centres in the local area a 1 km by 1 km grid has been modelled centred on the Development.

10.43. The location of the selected existing and future receptors assessed are presented in **Figure 10.1**.

Table 10.3: Selected Receptor Locations

ID (Refer to Figure 10.1)	Receptor Location	Receptor Type	OS Grid Reference		Height Above Ground (m)
1	1 Varsity Flow	Residential	520212	176221	0
2	6 Watney Cottages	Residential	520078	175845	0
3	1 Watney Cottages	Residential	520122	175846	0
4	1-3 Parliament Mews	Residential	520296	176185	0
5	Ship Lane	Residential	520390	176117	0
6	Lower Richmond Road	Residential	520365	175939	0
7	Lower Richmond Road	Residential	520359	175914	0
8	Lower Richmond Road	Residential	520238	175832	0
9	13 Sheen Lane	Residential	520503	175882	0
10	40 Mortlake High Street	Residential	520582	175939	0
11	Boat Race Court	Residential	520734	175984	0
12	Little Paradise Nursery	Child Care	520300	175870	0

ID (Refer to Figure 10.1)	Receptor Location	Receptor Type	OS Grid Reference		Height Above Ground (m)
13	Thomas House Primary School	School	520510	175816	0
14	Richmond Training and Development Centre	Child Care	520123	175809	0
15	St Mary Magdalen's Catholic Primary School	School	520831	175901	0
16	Proposed Residential Building 10 – Ground Floor Level*		520575	175965	0
17	Proposed School – Ground Floor Level[(a)]		520271	175998	0
18	Proposed Residential Building 3 – Floor Level 5[(b)]		520410	176079	15
19	Proposed School Building – Floor Level 2[(b)]		520271	175998	6
20	Chalkers Corner Junction - Receptor 57 (Chertsey Court)[(c)]		519919	175872	0
21	Chalkers Corner Junction -Receptor 22[(d)] (139 Lower Richmond Road)		519871	175843	0

Note: Ground floor assumed to be 0 m to represent worst-case assessment of exposure as it is the closest location of the receptor to the tailpipe vehicle emissions.
[(a)] Maximum impact within the Development at ground floor.
[(b)] Maximum impact within the Development above ground level because of emissions from the Energy Centre.
[(c)] Receptor identified as having the largest adverse impact in NO_2 concentrations as presented in **Appendix 10.4**.
[(d)] Receptor identified as having the largest beneficial impact in NO_2 concentrations as presented in **Appendix 10.4**
At the proposed buildings, each façade has been modelled and the maximum predicted concentration reported.
See **Appendix 10.4** with regards to impacts at the Chalkers Corner Junction.

Significance Criteria

The Works

Dust Emissions

10.44. The significance of likely effects of the Works on air quality have been assessed based on professional judgement and with reference to the criteria set out in the IAQM guidance. Appropriate Site-specific mitigation measures that would need to be implemented to minimise any adverse effect have also been considered. Details of the assessor's experience and competence to undertake the dust assessment is provided in **Appendix 10.1**.

10.45. The assessment of the risk of dust effects arising from each of the construction activities as part of the Works, as identified by the IAQM guidance, is based on the magnitude of potential dust emission and the sensitivity of the area. The risk category matrix for each of the construction activity types, taken from the IAQM guidance, are presented in **Table 10.4** to **Table 10.7**. Examples of the magnitude of potential dust emissions for each construction activity and factors defining the sensitivity of an area are provided in **Appendix 10.1**.

Table 10.4: Risk Category from Demolition Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 10.5: Risk Category from Earthworks Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 10.6: Risk Category from Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 10.7: Risk Category from Trackout Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

10.46. The risk category determined for each of the likely construction activity types was used to define the appropriate, Site-specific, mitigation measures that should be applied. The IAQM's construction dust guidance recommends that significance is only assigned to the impact after considering mitigation and assumes that all actions to avoid or reduce the impacts are inherent within the design of the Development. Construction mitigation (secured through planning conditions, legal requirements or required by regulations), would ensure that likely significant adverse residual effects will not occur. However, to maintain consistency with the structure of the Environmental Statement (ES), as outlined in **Chapter 2: EIA Approach and Methodology**, pre-mitigation significance criteria based on professional judgement was applied (see **Table 10.8**).

Table 10.8: Pre-Mitigation Significance Criteria for Demolition and Construction Assessment

Significance Criteria	Definition
Adverse effect of major significance.	Receptor is less than 10 m from a major active construction or demolition site.
Adverse effect of moderate significance.	Receptor is 10 m to 100 m from a major active construction or demolition site, or up to 10 m from a minor active construction or demolition site.
Adverse effect of minor significance.	Receptor is between 100 m and 200 m from a major active construction or demolition site or 10 m to 100 m from a minor active construction site or demolition site.
Insignificant.	Receptor is over 100 m from any minor active construction or demolition site or over 200 m from any major active construction or demolition site.

10.47. IAQM outlines that experience of implementing mitigation measures for construction activities demonstrates that total mitigation is normally possible such that likely residual impacts would not be 'significant'.

Construction Vehicle Exhaust Emissions

10.48. The methodology for determining the magnitude and significance of effects associated with vehicle emissions from the peak construction period is the same as the methodology detailed below for the Completed Development.

Construction Plant Emissions

10.49. Given all construction plant used during the Works would need to adhere to the emissions standards for NO_2 and PM_{10} set out for NRMM professional judgment has been used to determine the significance of effects.

Completed Development

10.50. The aforementioned EPUK / IAQM Guidance provides an approach to assigning the magnitude of change as a result of a development as a proportion of a relevant assessment level, followed by examining this change in the context of the new total concentration and its relationship with the assessment criterion to provide a description of the impact at selected receptor locations.

10.51. **Table 10.9** presents the IAQM framework for describing the impacts (the change in concentration of an air pollutant) at individual receptors. The term Air Quality Assessment Level (AQAL) is used to include air quality objectives or limit values, where these exist.

Table 10.9: Impact Descriptors for Individual Receptors

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Note: AQAL may be an air quality objective, EU limit value, or an Environment Agency 'Environmental Assessment Level (EAL)'.
The table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers. Changes of 0% (i.e. less than 0.5%) are described as Negligible.
The table is only to be used with annual mean concentrations.

10.52. The approach set out in the EPUK / IAQM Guidance provides a method for describing the impact magnitude at individual receptors only. The Guidance outlines that this change may have an effect on the receptor depending on the severity if the impact and other factors that may need to be taken into account. The assessment framework for describing impacts can be used as a starting point to make a judgement on significance of effect. However, whilst there may be 'slight', 'moderate' or 'substantial' impacts described at one or more receptors, the overall effect may not necessarily be judged as being significant in some circumstances.

10.53. Following the approach to assessing significance outlined in the EPUK / IAQM Guidance, the significance of likely residual effects of the completed Development on air quality has been established through professional judgement and the consideration of the following factors:

- the geographical extent (local, district or regional) of effects;
- their duration (temporary or long term);
- their reversibility (reversible or permanent);
- the magnitude of changes in pollution concentrations;
- the exceedance of standards (e.g. AQS objectives); and
- changes in pollutant exposure.

Baseline Conditions

London Borough of Richmond upon Thames Review and Assessment Process

10.54. In accordance with the UK Air Quality Strategy[13] and Part IV of the 'Environment Act[14], LBRuT has and will continue to review the ambient air quality within its administrative boundary. In 2000 LBRuT concluded that the Borough-wide levels of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10}) are not expected to meet the Air Quality Strategy Objectives. As such, LBRuT have declared the entire Borough an AQMA attributed to localised vehicle emissions.

10.55. The LBRuT 2015 Updating and Screening Assessment[15] states that the results for NO_2 continue to exceed one or more of the Government's air quality objectives within the Borough, therefore it is necessary to continue to maintain the AQMA. The LBRuT Air Quality Annual Status Reports completed in 2016[16] and 2017[17] show annual mean NO_2 concentrations have remained similar to previous results and findings, and the AQMA should remain.

10.56. In addition to the above declaration of the Borough wide AQMA, the Site is situated adjacent to the GLA Air Quality Focus Area (AQFA). An AQFA is an area identified by a London Borough that is exceeding the annual mean Limit Value for NO_2 coupled with high human exposure. There are four AQFA in LBRuT, which includes the Chalkers Corner AQFA.

London Borough of Richmond upon Thames Air Quality Action Plan

10.57. The currently adopted LBRuT Air Quality Action Plan[18] sets out 33 measures to improve air quality in the Borough through London wide and regional measures; borough wide measures; and local measures. The following measures are relevant to the Development:

- Measure 8 - Continue to pursue land use policies within the saved UDP and Local Development Framework to encourage travel choice with the aim of reducing emissions and to ensure that major new developments are accessible to public transport. The LDF will take such policies forward;
- Measure 8 - Promote Travel Plans to businesses;
- Measure 11 - Promote Travel Plans for schools;
- Measure 14 - To ensure new buildings are energy efficient;
- Measure 16 - To continue to press for and promote travel choice through improvements for pedestrians, cyclists and to public transport in terms of increased capacity, reliability, accessibility and quality;
- Measure 19 - Encourage the use of alternative fuel vehicles in the Borough;
- Measure 22 - Cooperate on implementation of traffic management policies to reduce traffic at the pollution 'hot spots' and improve air quality;
- Measure 23 - Consider use of parking concessions to encourage the use of alternatively fuelled and more fuel-efficient vehicles;
- Measure 29 - Refuse planning consent for activities, which are likely to lead to a significant worsening of air pollution in 'hot spot' areas; and
- Measure 30 - Where practical, undertake changes at congestion hotspots to seek to avoid tailbacks of queuing vehicles.

London Borough of Richmond upon Thames Air Quality Action Plan, 2017-2022 – Consultation Document

10.58. LBRuT has produced an updated Air Quality Action Plan[19] which sets out the actions that LBRuT will deliver for the period 2017-2022 to reduce concentrations of, and exposure to, ambient pollution. Whilst consultation of the report completed in October 2017, and therefore the updated Action Plan is not yet adopted, the draft measures relevant to the Development include:

- Draft Action 2: Adoption of AQ Supplementary Planning Guidance to ensure emissions from new development is minimised and effective mitigation is integrated in scheme design;

- Draft Action 3: Enforcement of Non-Road Mobile Machinery air quality policies;
- Draft Action 4: Low Emission Construction Partnership;
- Draft Action 6: Enforcing CHP and biomass air quality policies;
- Draft Action 7: Enforcing Air Quality Neutral policies;
- Draft Action 20: Detailed assessment of traffic management solutions for GLA Focus Areas and AQ ‘hotspots’; and
- Draft Action 33: Provision of infrastructure to support walking and cycling across the borough.

Local Monitoring

10.59. LBRuT currently undertakes monitoring of NO_2 and PM_{10} at four automatic monitoring locations and NO_2 at 62 locations using diffusion tubes within the Borough.

10.60. The only static roadside automatic monitor within the Borough is located at Castelnau Library, Barnes, approximately 2.4km to the northeast of the Site (OS Grid Reference 522845, 177904). The most recent (2012 to 2015) NO_2 monitored concentrations at this roadside monitor are presented in **Table 10.10**.

Table 10.10: Annual Mean Monitored Concentrations at the LBRuT Castelnau, Library Road Automatic Monitor (µg/m^3)

Pollutant	Averaging Period	AQS Objective	2012	2013	2014	2015	2016
NO_2	Annual Mean (µg/m^3)	40µg/m^3	37	39	37	34	36
	1-Hour Mean (No. of Hours)	200µg/m^3 not to be exceeded more than 18 times a year	0	2	0	0	0
PM_{10}	Annual Mean (µg/m^3)	40µg/m^3	21	22	20	22	20
	24-Hour Mean (No. of Days)	50µg/m^3 not to be exceeded more than 35 times a year	14	10	4	5	7

Notes: Data obtained from 2015 Updating and Screening Assessment for the London Borough of Richmond upon Thames and from LBRuT 2017 Air Quality Annual Status Report
Exceedances of the AQS Objectives shown in **bold** text.

10.61. The monitoring results in **Table 10.10** indicate that the annual mean NO_2 and PM_{10} objectives were met in all years.

10.62. NO_2 is was also measured at 62 locations using diffusion tubes. The results for the 10 NO_2 diffusion tube roadside and kerbside locations within 1 km of the centre of the Site are presented in **Table 10.11**.

Table 10.11: Measured Concentrations at the LBRuT Diffusion Tubes Within 1 km of the Site

Site ID	Location	Distance to Site	Classification	2015	2016
51	Sheen Lane (railway crossing), Sheen	0.3 km	Kerbside	28	32
21	Lower Richmond Road, Mortlake (Nr. Kingsway)	0.4 km	Roadside	37	39
55	Mortlake Rd (adj. to cemetery gates), Kew	0.6 km	Kerbside	**55**	**50**
58	London Road, Twickenham	0.6 km	Kerbside	**46**	**50**
36	Upper Richmond Road West (URRW), Sheen Lane	0.6 km	Kerbside	**49**	**50**
49	URRW War Memorial, Sheen Lane, Sheen	0.6 km	Kerbside	39	44
52	Clifford Avenue, Chalkers Corner	0.7 km	Kerbside	**55**	**57**
50	URRW (Nr. Clifford Avenue, Sheen)	0.8 km	Kerbside	**57**	**55**
54	Mortlake Rd (adj. to West Hill Rd) Kew	0.9 km	Kerbside	**51**	**51**
25	URRW (Nr. Sheen School)	0.9 km	Roadside	**45**	**56**

Notes: Data obtained from directly from LBRuT
Exceedances of the AQS Objectives shown in **bold** text.

10.63. The monitoring results in **Table 10.09** indicate that in 2015 and 2016 the annual mean NO_2 objective of 40µg/m^3 was exceeded at seven of the 10 diffusion tube monitoring locations closest to the Site.

Likely Significant Effects

The Works

Nuisance Dust

10.64. Construction activities in relation to the Development have the potential to affect local air quality through Demolition, Earthworks, Construction and Trackout activities. A description of these activities is presented earlier in this Chapter.

10.65. The surrounding area is mixed-use, including residential and commercial uses. Additionally, the River Thames bounds the north east of the Stag Brewery component of the Site and Mortlake Green is located on the other side of Lower Richmond Road to the south of the Stag Brewery component of the Site. The nearest residential properties to the Site are located on Mortlake High Street, located approximately 10 m to the east of the Site. In addition, St. Mary Magdalen's Catholic Primary School is located approximately 180 m to the south east of the Site.

10.66. In addition to the above, the River Thames and Tidal Tributaries SINC is located adjacent to the north east boundary of the Stag Brewery component of the Site and has the potential to be impacted by dust deposition.

10.67. Should the Development be granted permission, it is likely that there would be air quality sensitive uses associated with occupiers of the early phases whilst other later phases are constructed. As such there is likely to be future receptors in proximity to the Works.

10.68. As there are existing and proposed receptors within 350 m of the boundary of the Site and within 50 m of the routes that would be used by construction vehicles on the public highway, it is therefore considered that a detailed assessment is required to determine the likely dust impacts, as recommended by the IAQM guidance on construction dust. Results of this assessment are provided for each main activity (Demolition, Earthworks, Construction and Trackout) below.

10.69. In addition, given the distance to the River Thames and Tidal Tributaries SINC the detailed qualitative assessment considers potential ecological impacts.

10.70. The qualitative assessment considers the sensitivity of the area to each main set out in Tables A1.2 to A1.5 in **Appendix 10.1**.

Demolition

10.71. As described in **Chapter 6: Development Programme, Demolition, Alteration, Refurbishment and Construction**, Site-wide demolition would be undertaken apart from a small number of key buildings to be retained. Given the details in **Chapter 6: Development Programme, Demolition, Alteration, Refurbishment and Construction**, it was estimated that the total volume of buildings to be demolished could be over 100,000m^3. Based on this, and considering the criteria in Table A1.1 in **Appendix 10.1**, the potential dust emissions during demolition would be of a **large** magnitude.

Earthworks

10.72. As previously noted, the area of the Site is approximately 8.6 hectares (ha), or 86,000m^2. Based on this, and considering the criteria in Table A1.1 in **Appendix 10.1**, the potential dust emissions during earthworks activities would be of **large** magnitude.

Construction

10.73. In the absence of the total volume of buildings to be constructed, it was estimated that the total volume of buildings to be constructed is over 100,000m^3. Based on this, and considering the criteria in Table A1.1 in **Appendix 10.1**, the potential dust emissions during construction activities would be of **large** magnitude.

Trackout

10.74. As detailed in **Chapter 8: Transport and Access**, the number of Heavy Duty Vehicles (HDVs) associated with the Development during the peak construction works is predicted to be 57 trips. Based on this, and considering the criteria in Table A1.1 in **Appendix 10.1**, the potential for dust emissions due to trackout activities would be of **large** magnitude.

10.75. The dust risk categories, based on the potential magnitude of dust emissions and the sensitivity of the area to dust, are presented in **Table 10.12**.

Table 10.12: Summary of Risk from the Works

Potential Effect	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High Risk	High Risk	High Risk	High Risk
Human Health	Medium Risk	Medium Risk	Medium Risk	High Risk
Ecological	High Risk	High Risk	High Risk	High Risk

10.76. As outlined in **Table 10.12**, the Site is considered to be a **medium** to **high risk site** with regard to the Works. In line with the assessment methodology described earlier in this Chapter, no significance criteria is prescribed to pre-mitigation effects. However, such effects would likely be **temporary**, **short to medium term**, **local** and of **adverse significance**. Consequently, mitigation would be required to ensure that adverse effects be minimised, reduced and, where possible, eliminated.

Construction Vehicle Exhaust Emissions

10.77. Likely effects on local air quality associated with construction of the Development would result from changes to traffic flows on the local road network. To present a worst-case assessment of construction, vehicle emission rates and background concentrations for 2016 have been used. The results of the ADMS-Roads modelling of construction traffic at existing sensitive receptors are presented in **Table 10.13**.

Table 10.13: Results of the ADMS-Roads Construction Traffic Modelling at Sensitive Receptors

Receptor ID	NO_2 Annual Mean ($\mu g/m^3$)			PM_{10} Annual Mean ($\mu g/m^3$)			PM_{10} Number of Days >50$\mu g/m^3$			$PM_{2.5}$ Annual Mean ($\mu g/m^3$)		
	Without Construction	With Construction	Change	Without Construction	With Construction	Change	Without Construction	With Construction	Change	Without Construction	With Construction	Change
1	30.4	30.5	0.1	20.8	20.8	0.0	4	4	0	10.8	10.8	0.0
2	37.0	37.4	0.4	21.1	21.1	0.0	4	4	0	12.6	12.6	0.0
3	32.6	32.8	0.2	20.9	20.9	0.0	4	4	0	12.5	12.5	0.0
4	27.1	27.1	0.0	20.3	20.3	0.0	3	3	0	10.5	10.5	0.0
5	26.7	26.7	0.0	20.2	20.2	0.0	3	3	0	12.0	12.0	0.0
6	34.0	34.0	0.0	21.3	21.3	0.0	5	5	0	12.7	12.7	0.0
7	34.0	34.0	0.0	21.3	21.3	0.0	5	5	0	12.7	12.7	0.0
8	33.7	33.9	0.2	21.2	21.2	0.0	5	5	0	12.6	12.7	0.1
9	32.1	32.1	0.0	20.8	20.8	0.0	4	4	0	12.4	12.4	0.0

Receptor ID	NO_2 Annual Mean (µg/m³)			PM_{10} Annual Mean (µg/m³)			PM_{10} Number of Days >50µg/m³			$PM_{2.5}$ Annual Mean (µg/m³)		
	Without Construction	With Construction	Change	Without Construction	With Construction	Change	Without Construction	With Construction	Change	Without Construction	With Construction	Change
10	35.9	35.9	0.0	21.5	21.5	0.0	5	5	0	12.8	12.8	0.0
11	33.3	33.3	0.0	21.1	21.1	0.0	4	4	0	12.6	12.6	0.0
12	34.2	34.2	0.0	21.4	21.4	0.0	5	5	0	12.7	12.7	0.0
13	30.4	30.4	0.0	20.6	20.6	0.0	4	4	0	12.3	12.3	0.0
14	31.9	32.1	0.2	20.8	20.8	0.0	4	4	0	12.4	12.4	0.0
15	26.9	26.9	0.0	20.3	20.3	0.0	3	3	0	12.1	12.1	0.0
20*	41.6	42.3	0.7	21.2	21.3	0.1	5	5	0	12.1	12.1	0.0
21*	48.3	49.1	0.8	21.7	21.8	0.1	5	5	0	12.4	12.5	0.1

Note: For accuracy, the changes arising from the Development have been calculated using the exact output from the ADMS-Road and ADMS model rather than the rounded numbers within Table 10.11. This explains where there may be a slight difference in the calculated change in concentrations from the 'without' and 'with' Development scenarios.
* Results presented for the Receptor with the greatest adverse and beneficial impact of NO_2 during the operational phase, as presented in Appendix 10.4.

10.78. As shown in **Table 10.13**, apart from Receptors 20 and 21 located on Chalkers Corner, for the peak construction period (in 2022) with the Development construction vehicles on the local road network, concentrations are predicted to meet the respective AQS objectives for all pollutants assessed. For the receptors located on Chalkers Corner the annual mean NO_2 AQS Objective of 40µg/m³ is exceeded without the Development construction vehicles.

10.79. Using the impact descriptors outlined in **Table 10.9**, the Development is predicted to result in a 'negligible' impact at all receptors apart from at the Chalkers Corner where a 'moderate adverse' impact is predicted at Receptor 20 and a 'substantial adverse' impact is predicted at Receptor 21. These impacts are predicted mainly due to the existing poor air quality in this area as a result of the poor performance of the junction and congestion.

10.80. As discussed in **Appendix 10.1**, the 1-hour mean AQS objective for NO_2 is unlikely to be exceeded at a roadside location where the annual mean NO_2 concentration is less than 60µg/m³. Given the maximum predicted annual mean NO_2 concentration is 49.1µg/m³ it is considered that with the Development construction vehicles on the local road network there would be a 'negligible' impact on hourly NO_2 concentrations.

10.81. Using the impact descriptors outlined in **Table 10.9** with the Development construction vehicles on the local road network for PM_{10} and $PM_{2.5}$ the predicted impact is 'negligible' at all existing receptors.

10.82. The predicted impacts above are worst-case, as the assessment has used the peak construction trips operating throughout an entire year (which would not occur in reality) and does not consider any improvements in NO_x and NO_2. Nonetheless, using professional judgement, based on the severity of the impact and the concentrations predicted at the sensitive receptors, it is considered that the effect of construction vehicles associated with the Development would be **significant** at Chalkers Corner for annual mean NO_2 of a moderate to substantial effect (based on the predicted impacts at the two receptor locations) but **insignificant** at all other receptors and for all other pollutants assessed.

Construction Plant Emissions

10.83. All construction plant would meet the Emissions Standard set out in the London Plan. As such it is considered the impact from construction plant emissions would be **insignificant**.

10.84. To ensure compliance, as per the guidance in the London Plan, all construction plant would be registered and the emission ratings recorded.

Completed Development

Changes in Local Air Quality from Traffic and Heating Plant

10.85. Likely impacts on local air quality when the Development is completed and operational in 2027 would result from changes to traffic flows on the local road network and emissions from the Energy Centre associated with the Development. The results of the ADMS-Roads modelling of operational traffic (based on current guidance, i.e. with reduced emission rates and background concentration to the completion year of 2027) combined with the ADMS modelling of the emissions from the Energy Centre are presented in **Table 10.14**. Full details are provided within **Appendix 10.1**.

Table 10.14: Results of the Traffic and the Energy Centre Modelling at Select Sensitive Receptors

	NO_2 Annual Mean ($\mu g/m^3$)				PM_{10} Annual Mean ($\mu g/m^3$)				PM_{10} Number of Days >50$\mu g/m^3$				$PM_{2.5}$ Annual Mean ($\mu g/m^3$)			
Receptor ID	2016 Baseline	2027 Without Development	2027 With Development	2027 Change	2016 Baseline	2027 Without Development	2027 With Development	2027 Change	2016 Baseline	2027 Without Development	2027 With Development	2027 Change	2016 Baseline	2027 Without Development	2027 With Development	2027 Change
1	30.1	25.6	25.9	0.3	20.8	19.1	19.1	0.0	4	2	2	0	10.3	9.9	9.9	0.0
2	36.4	28.2	28.5	0.4	21.0	19.2	19.3	01	4	2	2	0	11.9	11.4	11.4	0.0
3	32.2	26.5	26.8	0.3	20.8	19.1	19.1	0.0	4	2	2	0	11.9	11.3	11.4	0.1
4	27.0	24.5	24.7	0.2	20.3	18.5	18.6	0.1	3	1	1	0	10.3	9.6	9.7	0.1
5	26.6	24.3	24.7	0.3	20.2	18.5	18.6	0.1	3	1	1	0	11.9	11.0	11.0	0.0

Receptor ID	NO2 Annual Mean (µg/m³)				PM10 Annual Mean (µg/m³)				PM10 Number of Days >50µg/m³				PM2.5 Annual Mean (µg/m³)			
	2016 Baseline	2027 Without Development	2027 With Development	2027 Change	2016 Baseline	2027 Without Development	2027 With Development	2027 Change	2016 Baseline	2027 Without Development	2027 With Development	2027 Change	2016 Baseline	2027 Without Development	2027 With Development	2027 Change
6	33.5	26.8	27.2	0.4	21.2	19.5	19.6	0.1	5	2	2	0	11.9	11.5	11.6	0.1
7	33.5	26.9	27.2	0.4	21.3	19.5	19.6	0.1	5	2	2	0	11.9	11.6	11.6	0.0
8	33.2	26.9	27.2	0.3	21.2	19.4	19.5	0.1	4	2	2	0	11.9	11.5	11.5	0.0
9	31.7	26.4	26.7	0.3	20.8	19.0	19.0	0.0	4	2	2	0	11.9	11.3	11.3	0.0
10	35.3	27.4	27.7	0.3	21.4	19.6	19.7	0.1	5	2	3	0	11.9	11.6	11.7	0.1
11	32.8	26.5	26.8	0.3	21.1	19.3	19.3	0.0	4	2	2	0	11.9	11.4	11.5	0.1
12	33.7	27.0	27.3	0.3	21.3	19.5	19.6	0.1	5	2	2	0	11.9	11.6	11.6	0.0
13	30.1	26.0	26.3	0.3	20.5	18.8	18.8	0.0	4	2	2	0	11.9	11.2	11.2	0.0
14	31.5	26.3	26.6	0.3	20.8	19.0	19.0	0.0	4	2	2	0	11.9	11.3	11.3	0.0
15	26.8	24.4	24.5	0.2	20.2	18.5	18.5	0.0	3	1	1	0	11.9	11.0	11.0	0.0
16			27.8				19.4				2				11.5	
17			24.9				18.6				1				9.7	
18			25.7				18.8				2				11.1	
19			24.8				18.6				1				9.6	
20*	40.1	31.5	31.7	0.2	21.1	20.9	21.0	0.1	4	4	4	0	12.0	10.8	10.8	0.0
21*	46.3	35.1	35.5	0.4	21.5	21.3	21.4	0.1	5	5	5	0	12.3	11.1	11.1	0.0

Note: For accuracy, the changes arising from the Development have been calculated using the exact output from the ADMS-Road and ADMS model rather than the rounded numbers within Table 10.14. This explains where there may a slight difference in the calculated change in concentrations from the 'without' and 'with' Development scenarios.
* Results presented for the Receptor with the greatest adverse and beneficial impact of NO_2, as presented in Appendix 10.4.

Nitrogen Dioxide (NO_2)

10.86. The results in **Table 10.14** indicate that for 2016 the annual mean NO_2 objective is met all existing receptor locations, apart from the Receptors 20 and 21 located at Chalkers Corner. The predicted concentrations at Receptors 20 and 21 are consistent with the designation of the AQFA. The predicted concentration at all other modelled receptors are in line with the existing LBRuT diffusion tube monitoring results for the two closest diffusion tubes (within 500 m) to the Site as presented in **Table 10.10**.

10.87. The highest concentration is predicted at Receptor 21 (46.3µg/m³). As discussed in **Appendix 10.1**, the 1-hour mean AQS objective for NO_2 is unlikely to be exceeded at a roadside location where the annual mean NO_2 concentration is less than 60µg/m³. As shown in **Table 10.14**, the predicted annual mean NO_2 concentrations in 2016 are below 60µg/m^3 at all receptor locations. Accordingly, the 1-hour mean objective is likely to be met at these locations.

10.88. In 2027, both 'without' and 'with' the Development, concentrations are predicted to meet the NO_2 annual mean objective value at all receptor locations assessed. Therefore, the 1-hour mean objective is also predicted to be met at all existing receptor locations.

10.89. Using the impact descriptors outlined in **Table 10.9**, the Development is predicted to result in an 'negligible' impact at all existing receptors assessed. It is also considered that the Development would have an 'negligible' impact on hourly NO_2 concentrations.

Particulate Matter (PM_{10} and $PM_{2.5}$)

10.90. As shown in **Table 10.14**, the annual mean concentrations of PM_{10} are predicted to be well below the objective of 40µg/m^3 in 2016 and in 2027 both 'without' and 'with' the Development at all the existing receptor locations considered. These 2016 predicted annual mean PM_{10} concentrations are consistent / in line with the existing LBRuT automatic monitor results. The maximum predicted annual mean PM_{10} concentration is 21.5µg/m^3 at Receptor 21 in 2016. Using the impact descriptors outlined in **Table 10.9**, the Development is predicted to result in an 'negligible' impact at all existing receptors assessed.

10.91. The results in **Table 10.14** indicate that in 2016 and in 2027 for both 'without' and 'with' the Development, all existing receptor locations are predicted to be below the 24-hour mean PM_{10} objective value of 35 days exceeding 50µg/m^3. The maximum predicted concentration in all scenarios tested is 5 days at Receptors 6, 7, 10, 12 and 21 in the 2016 scenario.

10.92. The results in **Table 10.14** indicate that in 2016 and in 2027 for both 'without' and 'with' the Development, all existing receptor locations are predicted to be below the annual mean $PM_{2.5}$ objective value of 25µg/m^3.

10.93. Using the impact descriptors outlined in **Table 10.9** the Development is predicted to result in an 'negligible' impact at all existing receptors.

Changes in Local Air Quality at Chalkers Corner

10.94. As discussed in **Chapter 5: The Proposed Development**, the Chalkers Corner Junction forms part of the Development and as such the proposed highway amendments have been considered within the 'with Development' scenario of this air quality assessment and the results for the two receptors with the greatest change have been reported above.

10.95. **Appendix 10.4** presents the results of the potential air quality effect of the Development at the 140 residential properties assessed at the Chalkers Corner Junction, including at height above ground level in Chertsey Court. This is shown as Scenario 3 in **Appendix 10.4 (**see **Tables 1** and **2** of **Appendix 10.4)**.

10.96. In 2027 with the Development (including the highway works), at Chalkers Corner there are two receptors predicted to be above the annual mean NO_2 AQS objective of 40µg/m^3 located at 1 and 2 Lower Richmond Road. These receptors are the closest properties to the centre of the Chalkers Corner Junction. However, the Development (including the highway works) does not result in any new exceedances of the NO_2 AQS objective. Using the impact descriptors outlined in **Table 10.9**, the impact of the Development at the Chalkers Corner Junction is predicted to result in an 'negligible' impact at all existing receptors assessed.

Overall Predicted Effects of the Development (including the highway works)

10.97. Using professional judgement, based on the severity of the impact discussed above and the concentrations predicted at all the sensitive receptors considered in the air quality assessment (including those selected at Chalkers Corner), it is considered that the effect of the Development on local NO_2, PM_{10} and $PM_{2.5}$ concentrations would be **insignificant**.

Conditions within the Development

10.98. As shown by the results in **Table 10.14** and **Appendix 10.3** for other floor levels, the predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations for locations within the Development with relevant exposure are below the relevant objectives in 2027 for all floor levels. As such, it is considered that the effect of introducing future residential and school uses to the Site is **insignificant**.

10.99. **Figure 10.2** presents the predicted dispersion of NO_2 emissions from the Energy Centre across the 1 km by 1 km grid centred on the Development. As noted above, the combined results from the Energy Centre and the predicted road emissions are presented in **Table 10.12**. The maximum contribution from the Energy Centre, as 2.39µg/m^3 of NO_2, is predicted within the Site between Building 17, Building 21 and Building 3.

Nitrogen Dioxide (NO_2) Sensitivity Analysis Results

Changes in Local Air Quality from Traffic and Heating Plant

10.100. The results of the sensitivity analysis in relation to NO_2 (i.e. considering the potential impact of the Development against the current baseline, 2016, conditions) are presented in **Table 10.15**.

Table 10.15: Results of the ADMS-Roads Assessment for 2016 Assuming No Improvement in NOx and NO2

ID	Receptor Location	Without Development	With Development	µg/m^3 Change	Significance
1	1 Varsity Flow	30.6	31.2	0.5	Negligible
2	6 Watney Cottages	37.5	38.2	0.7	Moderate Adverse
3	1 Watney Cottages	33.0	33.6	0.6	Slight Adverse
4	1-3 Parliament Mews	27.2	27.6	0.4	Negligible
5	Ship Lane	26.8	27.2	0.5	Negligible
6	Lower Richmond Road	34.4	35.1	0.8	Slight Adverse
7	Lower Richmond Road	34.4	35.0	0.7	Slight Adverse
8	Lower Richmond Road	34.1	34.7	0.6	Negligible
9	13 Sheen Lane	32.4	33.0	0.6	Negligible

ID	Receptor Location	Without Development	With Development	µg/m³ Change	Significance
10	40 Mortlake High Street	36.3	36.9	0.5	Negligible
11	Boat Race Court	33.6	34.1	0.5	Negligible
12	Little Paradise Nursery	34.6	35.2	0.6	Slight Adverse
13	Thomas House Primary School	30.6	31.1	0.5	Negligible
14	Richmond Training and Development Centre	32.2	32.7	0.5	Negligible
15	St Mary Magdalen's Catholic Primary School	27.0	27.2	0.2	Negligible
16	Proposed Residential Building 10 – Ground Floor Level	-	35.2	-	-
17	Proposed School – Ground Floor Level	-	28.4	-	-
18	Proposed Residential Building 3 – Floor Level 5	-	29.4	-	-
19	Proposed School Building – Floor Level 2	-	28.2	-	-
20	Chalkers Corner Junction - Receptor 57*	41.6	42.6	1.0	Substantial Adverse
21	Chalkers Corner Junction - Receptor 22*	48.3	45.2	-3.1	Substantial Beneficial

Note: For accuracy, the changes arising from the Development have been calculated using the exact output from the ADMS-Road and ADMS model rather than the rounded numbers within Table 10.13. This explains the slight difference in the calculated change in concentrations from the 'without' and 'with' Development scenarios.
* Results presented for the Receptor with the greatest adverse and beneficial impact of NO_2, as presented in Appendix 10.4.

10.101. The overall predicted concentrations in **Table 10.15** are higher than those presented in **Table 10.14** for 2016 due to higher background concentrations and vehicle emissions rates currently occurring in 2016 compared to 2027. The results in **Table 10.15** show that the annual mean concentrations of NO_2 are predicted to be below the annual mean NO_2 AQS objective value of 40 µg/m³ 'without' and 'with' the Development at all receptor locations, when assuming no improvements to NO_x and NO_2, apart from Receptors 20 and 21 located at Chalkers Corner.

10.102. The predicted annual mean NO_2 concentrations are below 60 µg/m³ at all receptor locations both 'without' and 'with' the Development when assuming no improvement to NO_x and NO_2, and as such the 1-hour mean objective is likely to be met at these locations.

10.103. **Table 10.15** shows the impact of the Development using the impact descriptors outlined in **Table 10.7**. Consequently, the Development is predicted to result in:

- a 'substantial adverse' impact at Receptor 20;
- an 'moderate adverse' impact at Receptor 2;
- a 'slight adverse' impact at Receptors 3, 6, 7 and 12;

- a ‘substantial beneficial’ impact at Receptor 21; and
- a ‘negligible’ impact at all other 11 existing receptors.

10.104. Whilst this section presents the greatest adverse and beneficial impact at Chalkers Corner, the section below presents the full range of predicted impacts.

Changes in Local Air Quality at Chalkers Corner

10.105. As above, **Appendix 10.4** presents the results of the potential air quality effect of the Development at 140 residential properties at Chalkers Corner assuming no improvement in NO_x and NO_2 (see the results for Scenario 3 included in **Tables 3** and **4** of **Appendix 10.4**) and the results for the two receptors with the greatest change have been reported above.

10.106. In this scenario, the results show the Development results in a worsening of annual mean NO_2 concentrations at 40 residential locations and has the potential to create eight new exceedances of the annual mean NO_2 AQS objective. However, the junction highway works also result in an improvement of annual mean NO_2 concentrations at 17 locations all of which already exceed the annual mean NO_2 AQS objective.

10.107. When considering the impact of the Development (with junction highway works) against the 2027 baseline (without Development), using the impact descriptors outlined in **Table 10.9**, the impact of the Development at the Chalkers Corner assuming no improvement in NO_x and NO_2 is predicted to result in a:

- ‘substantial’ adverse impact at four receptor locations;
- ‘moderate’ adverse impact at 31 receptor locations;
- ‘slight’ adverse impact at 22 receptor locations,
- ‘moderate’ beneficial’ impact at four receptor locations;
- ‘substantial’ beneficial impact at 13 receptor locations; and
- ‘negligible’ impact at the remaining 66 receptor locations.

10.108. The beneficial impacts are located at properties on Lower Richmond Road and relate to the realignment of the Lower Richmond Road 12m to the north east, resulting in these properties being located further away from vehicle tail pipe emissions. However, adverse impacts are predicted for properties in Chertsey Court as, with the junction highway works, these properties would be located closer to vehicle tail pipe emissions.

10.109. Whilst adverse impacts are predicted at Chalkers Corner, as part of the Development a new wall and new intensive green planting (which includes denser planting and vegetation species selected to filter and capture ambient pollutants) are proposed as part of the landscape strategy outside Chertsey Court. These inherent measures cannot be quantified (in $\mu g/m^3$) by the air quality model but will improve the predicted air quality concentrations at Chertsey Court.

10.110. To understand the impact of the junction highway works at residential receptors at Chalkers Corner, **Appendix 10.4** considers two hypothetical scenarios (discussed above in the Assessment Methodology and Significance Section) as:

- Scenario 1 - assuming the Stag Brewery element was implemented without changes to the Chalkers Corner Junction; and

- Scenario 2 – assessing the Stag Brewery element of the Development without and with changes to the Chalkers Corner Junction in the operational year (of 2027).

10.111. The results are discussed in **Appendix 10.4**, but overall these scenarios show the highways works have a beneficial effect on air quality, and act as mitigation against the impact of the Stag Brewery element of the Development on air quality at Chalkers Corner.

Overall Predicted Effects of the Development (including the highway works) in the NO_2 sensitivity analysis

10.112. As described in the Significance Criteria Section, when using professional judgement to determine the overall impact of the Development consideration is given to the following factors:

- the geographical extent (local, district or regional) of effects;
- their duration (temporary or long term);
- their reversibility (reversible or permanent);
- the magnitude of changes in pollution concentrations;
- the exceedance of standards (e.g. AQS objectives); and
- changes in pollutant exposure.

10.113. Using professional judgement, and considering the above, the overall effect of the Development on local air quality is considered to be **insignificant**, given that:

- whilst 'substantial' adverse impacts are predicted at four receptors at Chalkers Corner, 'substantial' beneficial impacts are also predicted at 13 receptors at Chalkers Corner;
- the majority of receptors experience a 'negligible' impact (as 66 out of 140 receptors at Chalkers Corner and at 10 out of 15 of the selected receptors elsewhere);
- at receptors located away from Chalkers Corner:
  - 'with the Development' predicted annual mean NO_2 concentrations are below the AQS objective at all receptors considered;
  - the Development does not result in any new exceedences of the annual mean NO_2 AQS objective;
  - overall the contribution of NO_2 at all receptors considered is relatively small;
- as found in **Appendix 10.4**, the highways works have a beneficial effect, and act as mitigation against the impact of the Stag Brewery element of the Development on air quality at Chalkers Corner;
- the air quality benefits inherent to the design of the Development cannot be quantified in µg/m^3 (details of the air quality benefits are described below in the Mitigation Section); and
- whilst the amount of filtration or absorption from the new intensive green planting proposed at Chertsey Court cannot be quantified, **Appendix 10.4** has considered the changes in the effective travel distance of air and predicts the 2m wall and 6m trees will have a reduction in the predicted NO_2 concentrations presented in this Chapter.

Conditions within the Development

10.114. During the detailed design stages, the Development has been designed to minimise exposure of future occupants of the Development, including the citing of less air quality sensitive uses (e.g. commercial, retail and leisure facilities) at ground level and in proximity to the roads where air quality concentrations would be the highest. As shown in **Table 10.15** and in **Appendix 10.3**, when assuming no improvements in future NO_X and NO_2 concentrations, the predicted NO_2 concentrations for locations within the Development itself where there is an air quality sensitive use, are below the relevant objectives in 2027. As such, it is considered that the effect of introducing future residential and school uses to the Site is **insignificant**.

Mitigation Measures and Likely Residual Effects

The Works

Nuisance Dust

10.115. The Site is considered to be a medium to high risk site (refer to earlier in this Chapter), and therefore a range of environmental management controls (implemented through a Construction Environmental Mitigation Plan) would be developed with reference to the IAQM guidance for High Risk sites. The management controls would prevent the release of dust entering the atmosphere and / or being deposited on nearby receptors, including the River Thames and Tidal Tributaries SINC. The management controls would include:

- develop and implement a stakeholder communications plan, including community engagement before demolition and construction works commence on the Site;
- record all dust and air quality complaints, identify causes, take appropriate measures to reduce emissions in a timely manner, and record the measures taken, make the log available to the local authority;
- hold regular liaison meetings with other high-risk construction sites within 500 m of the Site boundary to ensure plans are coordinated and emissions minimised;
- plan the Site layout so that machinery and dust causing activities are located away from receptors, as far as possible;
- erect barriers around dusty activities that are at least as high as any stockpiles;
- fully enclose specific operations where there is a high potential for dust production and the area is active for an extensive period;
- avoid Site runoff of water or mud;
- keep hoarding, barriers and scaffolding clean using wet methods;
- remove materials that have a potential to produce dust from Site as soon as possible, unless being re-used on the Site;
- cover, seed or fence stockpiles to prevent wind whipping, where practicable;
- ensure all vehicles switch off engines when stationary – no idling vehicles;
- avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment, where practicable;

- impose and signpost a maximum speed limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas;
- produce a Construction Traffic Management Plan to manage the sustainable delivery of goods and materials and that supports and encourages sustainable travel;
- use cutting, grinding or sawing equipment fitted, or in conjunction, with suitable dust suppression techniques such as water sprays or local extraction;
- ensure adequate water supply on the Site for effective dust/particulate matter suppression / mitigation, using non-potable water, where possible and appropriate;
- used enclosed chutes and conveyors and covered skips;
- minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate;
- ensure equipment is readily available on the Site to clean any dry spillages. Clean up spillages as soon as reasonably practicable after the event using wet cleaning methods;
- use water -assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the Site;
- avoid dry sweeping of large areas;
- ensure vehicles entering and leaving the Site are covered to prevent escape of materials during transport;
- inspect on-Site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable;
- record all inspections of haul routes and any subsequent action in a Site log book;
- implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the Site where reasonably practicable);
- ensure there is an adequate area of hard surfaced road between the wheel wash facility and the Site exit, wherever possible; and
- access gates to be located at least 10 m from sensitive receptors, where possible.

10.116. Such measures are routinely and successfully applied to major construction projects throughout the UK, and are proven to reduce significantly the potential for adverse nuisance dust effects associated with the various stages of demolition and construction work. Therefore, it is considered that the likely residual effects during the demolition and construction works due to fugitive emissions on all sensitive receptors (human and ecological) would be **insignificant**.

Construction Vehicle Exhaust Emissions

10.117. The effect of construction vehicles has been assessed using ADMS-Roads and the impacts predicted as being **significant** at Chalkers Corner for annual mean NO_2 of a moderate to substantial effect (based on the predicted impacts at the two receptor locations) but **insignificant** at all other receptors and for all other pollutants assessed. To reduce impacts, as part of the CEMP and as a matter of good practice, measures to control construction traffic are proposed. Such measures would include:

- establishment of the most suitable construction traffic routes;

- limiting the use of 'sensitive' roads (to include residential roads, congested roads etc.); and
- timing large-scale vehicle movements outside of peak hours.

10.118. Taking account of the above CEMP measures, the likely residual effect of construction traffic on local air quality would be **insignificant**.

Construction Plant Emissions

10.119. As described above, all construction plant would meet the Emissions Standard set out in the London Plan. On this basis, it is considered that the likely residual effect from construction plant emissions on local air quality would be **insignificant**.

Completed Development

10.120. As identified earlier in this Chapter the effect of operational traffic and emissions from the Energy Centre for the Development is predicted to have an **insignificant** potential effect on local air quality at relevant receptors surrounding the Site, and therefore the residual effect would remain **insignificant**.

10.121. **Table 10.16** presents the measures inherent to the Development and additional mitigation measures to be included during the construction and operational phases of the Development which are likely to benefit local air quality. However, there is no standard or recognised methodology to enable the reduction in pollutant concentrations that these measures would result in to be quantified within an air quality assessment. However, these measures are consistent with those identified by LBRuT within their Air Quality Action Plan.

Table 10.16: Summary of Air Quality Mitigation Measures

	Mitigation Measures
1.Demolition and Construction Phase	• Environmental management controls developed and set out in the Framework Construction Management Plan and subsequent Construction Environmental Management Plans this would include dust suppression, hoarding, monitoring etc. • All construction plant would adhere to the emissions standards for NO_2 and PM_{10} set out for Non Road Mobile Machinery (NRMM) in the London Plan. • Avoidance, or limited use, of traffic routes in proximity to sensitive routes (i.e. residential roads etc.). All construction traffic logistics would be agreed with LBRuT. • Avoidance, or limited use, of roads during peak hours, where practicable. • Provision of a Construction Worker Travel Plan and a Construction Transport Management Plan. • Dust monitoring and dust controls to be agreed with LBRuT.
2. Inherent – Measures included in the design of the Development	• Detailed dispersion modelling completed (using ADMS) and results used to ensure that the Energy Centre flues are designed and located for adequate dispersion of flue gases to avoid adverse impacts at existing receptor locations and receptors within the Development. A carefully worded planning condition would ensure that an air quality assessment is undertaken for the final plant; • Energy centre to use low NOx technology and to meet the London Plan Emission Standards;

	Mitigation Measures

	• School set back from Lower Richmond Road and interim dispersion modelling completed (using ADMS-Roads) and results to ensure this location is acceptable;
	• Up to 1,611 spaces cycle spaces in accordance with London Plan requirements.
	• Reduction of the ratio indicated by the Planning Brief of 1 car parking space per residential unit to 0.75 of a space per residential unit.
	• The amount of Electric Vehicle Charging Points on the Stag Brewery component of the Site, both active and passive, is still to be agreed but would as a minimum be provided in accordance with London Plan standards.
	• Provision of new pedestrian and cycle paths aimed to promote walking, cycling and the use of public transport.
	• Extensive public and private realm and landscaping including:
	– Up to 39,430m^2 GEA of public amenity space including playscape would be provided throughout the Development;
	– Up to 5,912m^2 GEA of private amenity space is proposed.
	– Green link between Mortlake Green via the Site to the riverside;
	– Public park; and
	– Pedestrianised High Street.
	• Reconfiguration to the Chalkers Corner junction to alleviate the transport and traffic implications associated with the operation of the Development including the alignment of the Lower Richmond Road arm to be moved approximately 12 m to the north east to allow:
	– the provision of a short additional left turn lane (flare) from Lower Richmond Road into the junction (26 m long or about 5 car lengths);
	– provision of an extended queuing reservoir between the main junction of Lower Richmond Road (this would accommodate about 9 extra cars south westbound), which would also provide extra storage for north east bound vehicles including those waiting to turn right into Lower Richmond Road;
	– provision of a wider pedestrian island within the Lower Richmond Road arm to 4 m wide to sufficiently cater for cyclists crossing as well as pedestrians;
	– an extended, dedicated lane for traffic turning left from Clifford Avenue into Lower Richmond Road;
	– retaining 28 trees and the removal of 22 trees along Lower Richmond Road, Clifford Avenue and within Chertsey Gardens. It is proposed to add a total of 33 new trees, resulting in an overall increase in 10 trees at Chalkers Corner to assist in air pollution. A new 2 m high wall would also replace the existing wall and fence to screen the vehicles at the junction;
	– A new cycle lane would be provided as part of Application C (Chalkers Corner). The highway improvements at Chalkers Corner would benefit cyclists and help Transport for London (TfL) to achieve their “Quietway” proposals for the A316 corridor by creating:
	  • advance cycle stop lines at the main junction;
	  • wider islands to make them suitable for cycle use; and
	  • improved cycle links into Lower Richmond Road.
	• Preparation and implementation of a Delivery and Servicing Plan that will set out how all types of freight vehicle movements to and from the Development will be managed;
	• Framework, School and Residential Travel Plan setting out how all Site users can access the Development by sustainable forms of transport.

	Mitigation Measures
	• Provision of new car club spaces, as part of the Residential Travel Plan; • Introduction of stop idling / switch engine off' signs at the Williams Lane and Ship Lane junctions with Lower Richmond Road and introduction of a traffic congestion / air quality information board.
3.Additional future measures that could be included / to be secured through s278 agreement.	• Other highways works, secured by S278 works: – Improvements to Ship Lane, which would continue as a public highway but would be enhanced as a pedestrian route through the provision of a wider footway on the west side and a new footway (3 m) on the east side; – A new pelican crossing at the southern end of the Green Link along Lower Richmond Road directly north of Mortlake Green. The existing signalised crossing point adjacent to Ship Lane would be relocated to align better with the Green Link; and – A new crossing provided just to the west of the new access road to the school to improve access for pupils needing to cross Lower Richmond Road. This is currently shown as a zebra crossing but could potentially be upgraded to a pelican crossing. • Enhancement of existing bus services. Based on the current service pattern, an increased frequency for the 419 service would be the preferred solution together with provision of special buses to meet the peak demands associated with the school. • Safeguarding of land at the corner of Lower Richmond Road/Williams Lane to allow TfL to provide in the future bus stands, driver facilities and a bus turn facility, • Safeguarding of land close to the Green Link to allow the future provision of a cycle hire facility • A New 20mph speed limit enforced between Williams Lane and Bulls Alley including Sheen Lane, between the Mortlake High Street / Lower Richmond Road junction and the Sheen Lane level crossing. A number of physical measures are proposed to help manage speeds including junction entry treatments, carriageway narrowing and provision of a textured tarmac resin to differentiate the area of speed restraint. Potentially, table tops to comply with TfL requirements for buses could be installed at pedestrian crossing points by the school and on the Green Link. • Potential funding for a new controlled parking zone and/or modification to existing parking zones to help manage potential overspill parking associated with the proposed development onto surrounding roads

Summary

10.122. **Table 10.17** summarises the likely significant effects, mitigation measures, and likely residual effects identified within this Chapter. Refer to **Table 10.16** above for a full list of air quality mitigation measures.

Table 10.17: Summary of Likely Significant Effects, Mitigation Measures and Likely Residual Effects

Description of Effect	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
The Works			
Dust emissions on surrounding existing receptors and early occupiers of the Development.	**Temporary**, **short to medium term**, **local** and of **adverse significance.**	Implementation of CEMP and Framework Construction Management Plan.	**Insignificant**.
Exhaust emissions from construction traffic on surrounding existing receptors and early occupiers of the Development.	**Significant** at Chalkers Corner for annual mean NO_2 of a moderate to substantial effect (based on the predicted impacts at the two receptor locations) but insignificant at all other receptors and for all other pollutants assessed	None required, a Construction Traffic Management Plan would also be implemented.	**Insignificant**.
Emissions from construction plant on surrounding existing receptors and early occupiers of the Development.	**Insignificant**.	None required, all construction plant would meet the Emissions Standard set out in the London Plan.	**Insignificant**.
Completed Development			
Traffic related exhaust emissions on existing sensitive locations surrounding the Site and future residential and school users of the Development.	**Insignificant**.	None required, refer to **Table 10.16** above.	**Insignificant**.
Changes in local air quality from the proposed Energy Centre plant on existing sensitive locations surrounding the Site and future residential and school users of the Development.	**Insignificant**.	None required, refer to **Table 10.16** above.	**Insignificant**.
Introduction of future residential and school uses to the Site.	**Insignificant**.	None required, refer to **Table 10.16** above.	**Insignificant**.

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FIGURES

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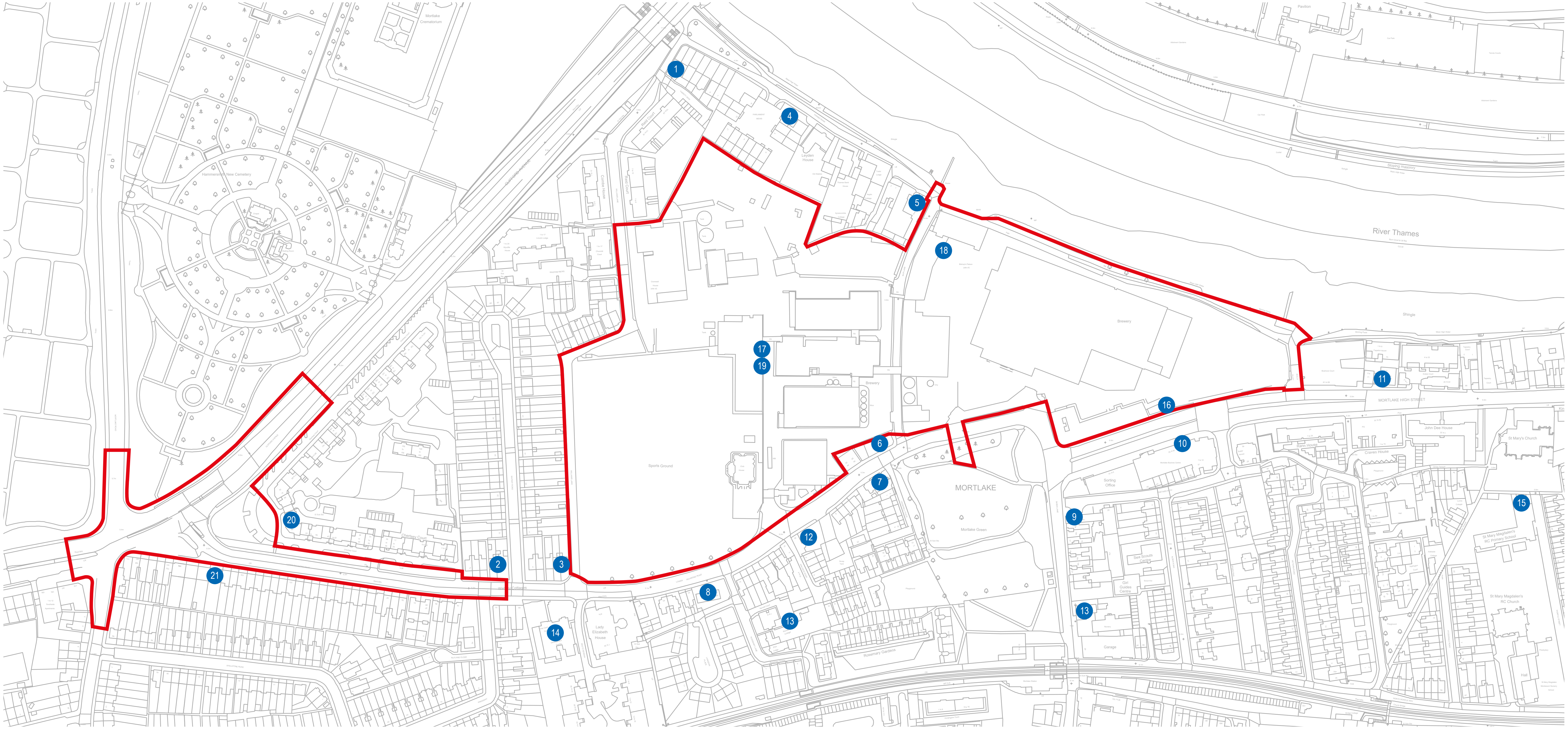

Receptor Locations

Site Boundary

1	1 Varsity Flow
2	6 Watney Cottages
3	1 Watney Cottages
4	1-3 Parliament Mews
5	Ship Lane
6	Lower Richmond Road
7	Lower Richmond Road
8	Lower Richmond Road
9	13 Sheen Lane
10	40 Mortlake High Street
11	Boat Race Court
12	Little Paradise Nursery
13	Thomas House Primary School
14	Richmond Training and Development Centre
15	St Mary Magdalen's Catholic Primary School
16	Plot 10
17	Proposed School
18	Plot 3
19	Proposed School
20	Chertsey Court
21	139 Lower Richmond Road

Project Details	WIE10667-101: Stag Brewery, Mortlake
Figure Title	Figure 10.1: Air Quality Modelled Receptor Locations
Figure Ref	WIE10667-101_GR_ES_10.1A
Date	2018
File Location	\\s-lncs\wiel\projects\wie10667\101\graphics\es\issued figures

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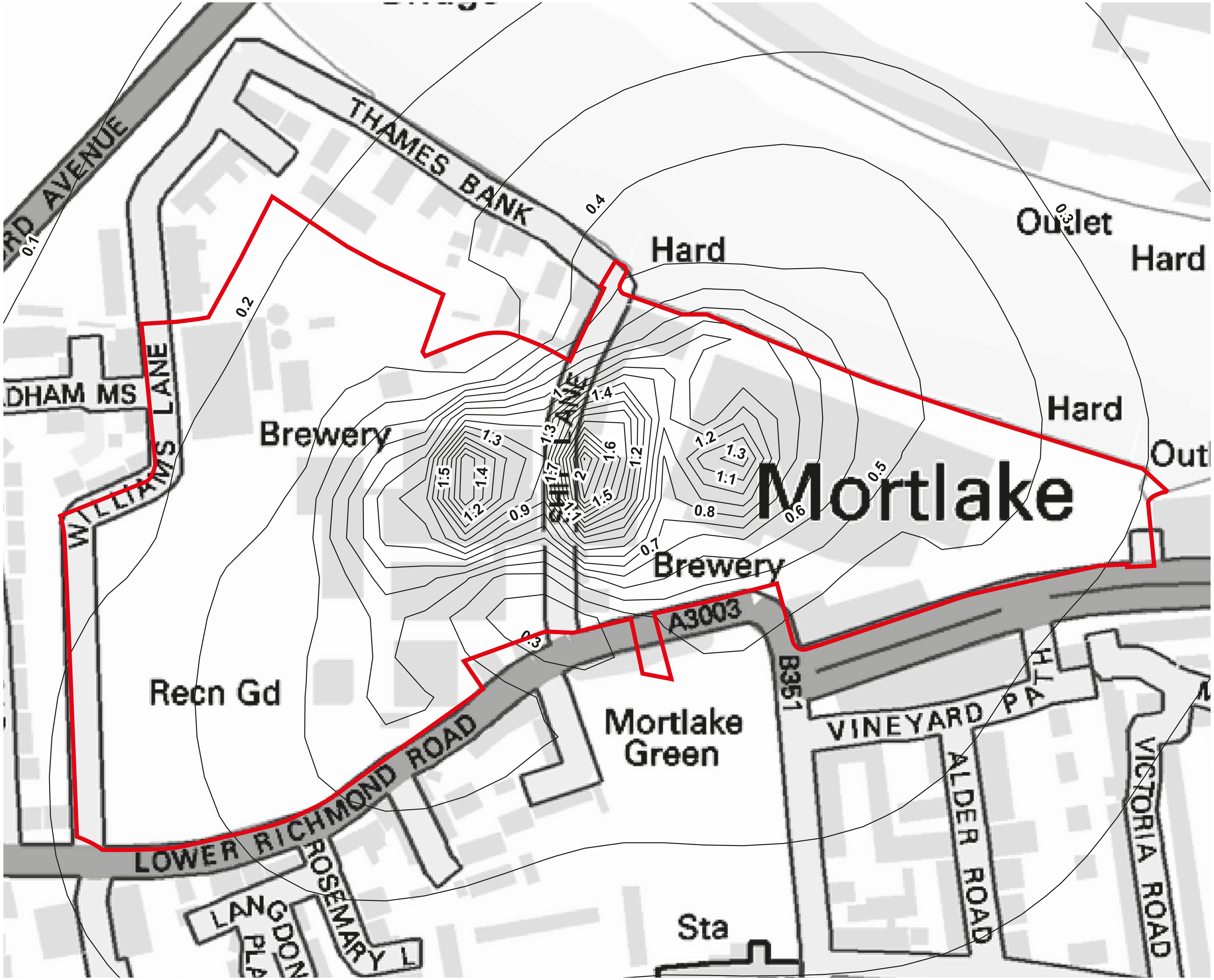

Site Boundary

Project Details	WIE10667-101: Stag Brewery, Mortlake
Figure Title	Figure 10.2: Energy Centre NO2
Figure Ref	WIE10667-101_GR_ES_10.2A
Date	2018
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APPENDICES

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A. Appendix 10.1: Air Quality Modelling Study

APPENDIX 10.1
AIR QUALITY MODELLING STUDY

Appendix 10.1: Air Quality Modelling Study

Introduction

10.1.1 This Appendix presents the technical information and data upon which the air quality assessment is based.

Construction Dust Assessment

10.1.2 **Table A1** provides examples of the potential dust emissions classes for each of the construction activities, as provided in 'The Control of Dust and Emissions during Construction and Demolition' Supplementary Planning Guidance[1] (based on the evaluation process set out in the IAQM 2014 'Guidance on the Assessment of Dust from Demolition and Construction[2]). Noted not all the criteria need to be met for a particular class. Once the class has been determined, the risk category can be determined from the matrices presented in Tables 10.4 to 10.7 in **Chapter 10: Air Quality**.

Table A1: Criteria for the Potential Dust Emissions Class

Activity	Class	Example Criteria
Demolition	Large	Total Building volume >50,000m^3, potentially dusty construction material (e.g. concrete), on site crushing and screening, demolition activities >20m above ground level.
	Medium	Total Building volume 20,000-50,000m^3, potentially dusty construction material, demolition activities 10-20m above ground level.
	Small	Total Building volume <20,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.
Earthworks	Large	Total site area >10,000m^2, potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of stockpile enclosures >8m in height, total material moved >100,000 tonnes.
	Medium	Total site area 2,500m^2 - 10,000m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of stockpile enclosures 4m-8m in height, total material moved 20,000 tonnes – 100,000 tonnes (where known).
	Small	Total site area <2,500m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of stockpile enclosures <4m in height, total material moved <10,000 tonnes, earthworks during wetter months.
Construction	Large	Total Building volume >100,000m^3, piling, on site concrete batching, sand blasting.
	Medium	Total building volume 25,000 m^3 - 100,000m^3, potentially dusty construction material (e.g. concrete), on site concrete batching.
	Small	Total building volume <25,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
Trackout	Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay/silt content), unpaved road length >100m.
	Medium	10-50 HDV (>3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50-100m (high clay content).
	Small	<10 HDV (>3.5t) trips in any one day, surface material low potential for dust release, unpaved road length <50m.

10.1.3 Once the risk category has been defined, the significance of the likely dust effects can be determined, taking into account the factors that define the sensitivity of the surrounding area. Examples of the factors defining the sensitivity of the area, as set out in the IAQM guidance, are presented in Table A2.

Table A2: Examples of Factors Defining Sensitivity of the Area

Type of Effect	Sensitivity of Receptor	Examples
Sensitivities of People to Dust Soiling Effects	High	Users can reasonably expect a enjoyment of a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected[1] to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks[2] and car showrooms.
	Medium	Users would expect[1] to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property would not reasonably be expected[1] to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Indicative examples include parks and places of work.
	Low	The enjoyment of amenity would not reasonably be expected[1]; or Property would not reasonably be expected[1] to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks[2] and roads.
Sensitivities of People to Health Effects of PM_{10}	High	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, relevant location would be one where individuals may be exposed for eight hours or more in a day).[3] Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.
	Medium	Locations where the people exposed are workers[4], and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.
	Low	Locations where human exposure is transient.[5] Indicative examples include public footpaths, playing fields, parks and shopping streets.

Type of Effect	Sensitivity of Receptor	Examples
Sensitivities of Receptors to Ecological Effects	High	Locations with an international or national designation and the designated features may be affected by dust soiling; or Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain[6]. Indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
	Medium	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or Locations with a national designation where the features may be affected by dust deposition. Indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.
	Low	Locations with a local designation where the features may be affected by dust deposition. Indicative example is a local Nature Reserve with dust sensitive features.

1 People's expectations will vary depending on the existing dust deposition in the area.

2 Car parks can have a range of sensitivities depending on the duration and frequency that people would be expected to park their cars there, and the level of amenity they could reasonably expect whilst doing so. Car parks associated with work place or residential parking might have a high level of sensitivity compared to car parks used less frequently and for shorter durations, such as those associated with shopping. Cases should be examined on their own merits.

3 This follows Defra guidance as set out in LAQM.TG(16)[3].

4 Notwithstanding the fact that the air quality objectives and limit values do not apply to people in the workplace, such people can be affected to exposure of PM10. However, they are considered to be less sensitive than the general public as a whole because those most sensitive to the effects of air pollution, such as young children are not normally workers. For this reason workers have been included in the medium sensitivity category.

5 There are no standards that apply to short-term exposure, e.g. one or two hours, but there is still a risk of health impacts, albeit less certain.

6 Cheffing C. M. & Farrell L. (Editors) (2005); The Vascular Plant. Red Data List for Great Britain, Joint Nature Conservation Committee.

10.1.4 Table A3, Table A4 and Table A5 show how the sensitivity of the area may be determined for effects related to dust soiling (nuisance), human health and ecosystem respectively. Distances are to the dust source and so a different area may be affected by the on-Site works than by trackout (i.e. along the routes used to access the Site). The IAQM guidance advises that the highest level of sensitivity from each table should be recorded.

Table A3: Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low

Low	>1	Low	Low	Low	Low

Table A4: Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table A5: Sensitivity of the Area to Ecological Impacts

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Operational Phase Air Quality Assessment

Model

10.1.5 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; which requires a range of input data, which can include pollutant emissions rates, meteorological data and local topographical information.

10.1.6 The effect of the Development on local air quality was assessed using the advanced atmospheric dispersion model ADMS-Roads and ADMS 5, taking into account the contribution of emissions from forecast road-traffic on the local road network and from the heating plant by the completion year respectively. The use of these detailed dispersion models was agreed with the air quality Environmental Health Officer (EHO) at London Borough of Richmond upon

Thames (LBRuT) during email consultation (see details at the end of this Appendix), the scoping response (see details in **Chapter 2: EIA Methodology** of the main Environmental Statement) and during a project planning meeting on the 14th November 2017.

ADMS-Roads

10.1.7 The ADMS-Roads model is a comprehensive tool for investigating air pollution in relation to road networks. On review of the Site, and its surroundings, ADMS-Roads was considered appropriate for the assessment of the long and short term effects from road traffic emissions associated with the proposals on air quality. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations. It can predict long-term and short-term concentrations, including percentile concentrations.

10.1.8 ADMS-Roads model is a formally validated model, developed in the United Kingdom (UK) by CERC (Cambridge Environmental Research Consultants). This includes comparisons with data from the UK's air quality Automatic Urban and Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation, and their models were compared favourably against other EU and U.S. EPA systems. Further information in relation to this is available from the CERC website at www.cerc.co.uk.

ADMS 5

10.1.9 ADMS 5 is a Gaussian atmospheric dispersion model widely used for investigating air pollution from controlled or fugitive emissions. The model is used for a wide range of air quality assessments, from small energy centres in urban areas to large industrial facilities. It is also used to model the dispersion of odours to determine the potential for nuisance at sensitive receptors around installations. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and atmospheric stability which improve calculations of air pollutant concentrations. It can predict long-term and short-term concentrations, as well as concentration percentiles.

10.1.10 ADMS 5 is developed in the UK by CERC, and has been extensively validated against field data sets in order to assess various configurations of the model such as flat or complex terrain, line/area/volume sources, buildings, dry deposition, fluctuations and visible plumes. Further information in relation to the model validation is available from the CERC website at www.cerc.co.uk.

Model Scenarios

10.1.11 In order to assess the effect of the Development on local air quality, future 'without Development' and 'with Development' scenarios were assessed. The Development is anticipated to be complete in 2027 and therefore this is the year in which these future scenarios were modelled. The year 2016 was modelled to establish the existing baseline situation because it is the year for which available monitoring data surrounding the Site is available against which the air quality model is verified (discussed further below). Base year traffic data for 2016 and meteorological data for 2016 were also used to be consistent with the verification year.

10.1.12 Taking into account recent analyses by Defra[4] showing that historical NO_x and NO_2 concentrations are not declining in line with emission forecasts, as outlined in the main Chapter, a sensitivity analysis has been undertaken on the basis of no future reductions in NO_x

/ NO_2 concentrations (i.e. considering the potential effects of the Development against the current baseline 2016 conditions by applying the 2027 road traffic data to 2016 background concentrations and road traffic emission rates).

10.1.13 Given the size of the Development (8.6 hectares of land) and the duration of the demolition, alteration, refurbishment and construction works, detailed dispersion modelling using ADMS-Roads of the peak construction phase has been undertaken (for the year 2022) to determine the impact of exhaust emissions from construction traffic. For this modelling scenario, the above approach to the sensitivity in NO_x and NO_2 has been undertaken (i.e. considered the current baseline 2016 conditions by applying the 2022 traffic data to 2016 background concentrations and road traffic emission rates).

Traffic Data

10.1.14 Traffic flow data comprising Annual Average Daily Traffic (AADT) flows, traffic composition (% HDVs – Heavy-Duty Vehicles) and speeds (in kph) were used in the model as provided by Peter Brett Associates (PBA) for the surrounding road network. Table A6 presents the traffic data used within the air quality assessment. Table A7 presents the trips associated with the development for the air quality neutral assessment and Table A8 presents the trips associated with the peak construction phase (in 2022).

10.1.15 The methodology for calculating the expected change in vehicle trips because of the development proposals is set out in detail within the Transport Assessment and covers all of the proposed land uses. The assessment covers all traffic generated by the Site, including servicing and delivery trips.

Table A6: 24 hour AADT Data Used within the Assessment

Link Name	Speed Limit / Monitored Speed (mph)	Base 2016		Without 2027		With 2027	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
A316 Clifford Avenue Northbound Flows	40	15886	10.99%	17786	10.99%	17957	10.92%
A316 Clifford Avenue Southbound Flows	40	13905	9.51%	15569	9.51%	15896	9.40%
A316 Lower Richmond Road Westbound Flows	30	17515	5.22%	19611	5.22%	19916	5.20%
A316 Lower Richmond Road Eastbound Flows	30	19226	5.68%	21526	5.68%	21812	5.66%
South Circular (north of A316) Northbound Flows	30	7777	6.10%	8708	6.10%	8804	6.08%
South Circular (north of A316) Southbound Flows	30	7086	5.60%	7933	5.60%	8077	5.58%
South Circular (south of A316) Northbound Flows	30	11075	3.91%	12400	3.91%	12400	3.91%
South Circular (south of A316) Southbound Flows	30	10089	3.60%	11297	3.60%	11393	3.60%

Link Name	Speed Limit / Monitored Speed (mph)	Base 2016		Without 2027		With 2027	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
A3003 Lower Richmond Road Westbound Flows	27	8175	8.57%	9053	8.57%	9722	8.27%
A3003 Lower Richmond Road Eastbound Flows	30	8765	8.89%	9706	8.89%	10463	8.54%
Williams Lane Northbound Flows	24	8168	8.34%	9045	8.34%	9761	8.03%
Williams Lane Southbound Flows	28	8930	11.19%	9889	11.19%	10639	10.71%
Mortlake High Street Westbound Flows	26	273	6.71%	302	6.71%	678	5.29%
Mortlake High Street Eastbound Flows	26	336	7.43%	372	7.43%	705	5.95%
The Terrace (west of Barnes Bridge Station) Westbound Flows	31	8547	13.39%	9466	13.39%	9957	12.94%
The Terrace (west of Barnes Bridge Station) Eastbound Flows	21	9502	8.48%	10524	8.48%	11044	8.28%
White Hart Lane (south of Mortlake High Street) Northbound Flows	29	8293	8.66%	9184	8.66%	9572	8.48%
White Hart Lane (south of Mortlake High Street) Southbound Flows	29	8930	8.69%	9888	8.69%	10371	8.49%
Sheen Lane (north of Level Crossing) Northbound Flows	24	2168	8.27%	2401	8.27%	2503	8.10%
Sheen Lane (north of Level Crossing) Southbound Flows	26	2657	7.53%	2942	7.53%	2980	7.49%
Sheen Lane (south of Level Crossing) Northbound Flows	30	3106	4.38%	3440	4.38%	3665	4.36%
Sheen Lane (south of Level Crossing) Southbound Flows	30	2729	2.54%	3022	2.54%	3252	2.66%
Sheen Lane (south of South Circular) Northbound Flows	30	2988	1.99%	3343	1.99%	3568	2.13%
Sheen Lane (south of South Circular) Southbound Flows	30	2570	2.98%	2875	2.98%	3105	3.07%
South Circular Road (west of Sheen Lane) Westbound Flows	21	2307	3.32%	2580	3.32%	2723	3.36%

Link Name	Speed Limit / Monitored Speed (mph)	Base 2016		Without 2027		With 2027	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
South Circular Road (west of Sheen Lane) Eastbound Flows	21	2510	5.07%	2808	5.07%	2941	5.03%

Table A7: 24 hour AADT Data Used within the Air Quality Neutral Assessment

Land Use	Annual Trips
Residential	1269
Education	534
Retail	240
Restaurant	173
Hotel	14
Office	235
Cinema	174
Gym	78
Community	8
Assisted Living	135

Table A8: 24 hour AADT Data Used within the Construction Vehicle Emission Assessment

Link Name	Speed Limit / Monitored Speed (mph)	Without 2022		With 2022	
		AADT	%HDV	AADT	%HDV
A316 Clifford Avenue Northbound Flows	40	17044	11.1%	17786	11.0%
A316 Clifford Avenue Southbound Flows	40	14922	9.6%	15569	9.5%
A316 Lower Richmond Road Westbound Flows	30	18780	5.3%	19611	5.2%
A316 Lower Richmond Road Eastbound Flows	30	20612	5.7%	21526	5.7%
South Circular (north of A316) Northbound Flows	30	8338	6.2%	8708	6.1%
South Circular (north of A316) Southbound Flows	30	7597	5.7%	7933	5.6%
South Circular (south of A316) Northbound Flows	30	11880	4.0%	12400	3.9%
South Circular (south of A316) Southbound Flows	30	10825	3.7%	11297	3.6%
A3003 Lower Richmond Road Westbound Flows	27	8744	9.2%	9053	8.6%
A3003 Lower Richmond Road Eastbound Flows	30	9369	9.4%	9706	8.9%
Williams Lane Northbound Flows	24	8671	8.3%	9045	8.3%
Williams Lane	28	357	7.4%	372	7.4%

Link Name	Speed Limit / Monitored Speed (mph)	Without 2022		With 2022	
		AADT	%HDV	AADT	%HDV
Southbound Flows					
Mortlake High Street Westbound Flows	26	9092	13.4%	9466	13.4%
Mortlake High Street Eastbound Flows	26	10106	8.5%	10524	8.5%
The Terrace (west of Barnes Bridge Station) Westbound Flows	31	8821	8.6%	9184	8.7%
The Terrace (west of Barnes Bridge Station) Eastbound Flows	21	9496	8.7%	9888	8.7%
White Hart Lane (south of Mortlake High Street) Northbound Flows	29	2301	8.3%	2401	8.3%
White Hart Lane (south of Mortlake High Street) Southbound Flows	29	2820	7.5%	2942	7.5%
Sheen Lane (north of Level Crossing) Northbound Flows	24	3297	4.4%	3440	4.4%
Sheen Lane (north of Level Crossing) Southbound Flows	26	2897	2.5%	3022	2.5%
Sheen Lane (south of Level Crossing) Northbound Flows	30	3200	2.0%	3343	2.0%
Sheen Lane (south of Level Crossing) Southbound Flows	30	2753	3.0%	2875	3.0%
Sheen Lane (south of South Circular) Northbound Flows	30	2470	3.3%	2580	3.3%
Sheen Lane (south of South Circular) Southbound Flows	30	2688	5.1%	2808	5.1%
South Circular Road (west of Sheen Lane) Westbound Flows	21	9851	8.9%	10272	8.7%
South Circular Road (west of Sheen Lane) Eastbound Flows	21	9514	8.2%	9920	8.1%

Vehicle Speeds

10.1.16 To consider the presence of slow moving traffic near junctions, at roundabouts, the high level of congestion at the Chalkers Corner Junction; and vehicles idling at railway level crossings the following speeds have been used:

- 10kph at road links approaching junctions, Chalkers Corner Junction and the railway level crossings on Sheen Lane and White Hart Lane;

- 5kph at the Chalkers Corner Junction and the railway level crossings on Sheen Lane and White Hart Lane; and
- at all other junction's a reduction of 10kph from the free-flowing speed.

10.1.17 Queue lengths at Chalkers Corner have been provided by PBA to replicate the existing levels of congestion on the road network and to determine when to apply the above speeds.

10.1.18 The approach to the speeds was agreed with LBRuT during the meeting of the 14th November 2017.

Diurnal Profile

10.1.19 The ADMS-Roads model uses an hourly traffic flow based on the daily (AADT) flows. Traffic flows follow a diurnal variation throughout the day and week. Therefore, a diurnal profile was used in the model to replicate how the average hourly traffic flow would vary throughout the day and the week. This was based on traffic counts undertaken in 2017 by PBA on A316 Clifford Avenue; A3003 (at the Sports Ground and Mortlake Green); Williams Lane; Mortlake High Street; The Terrace; White Hart Lane; Sheen Lane; and the South Circular. Figure A1 presents the diurnal variation in traffic flows which has been used within the model.

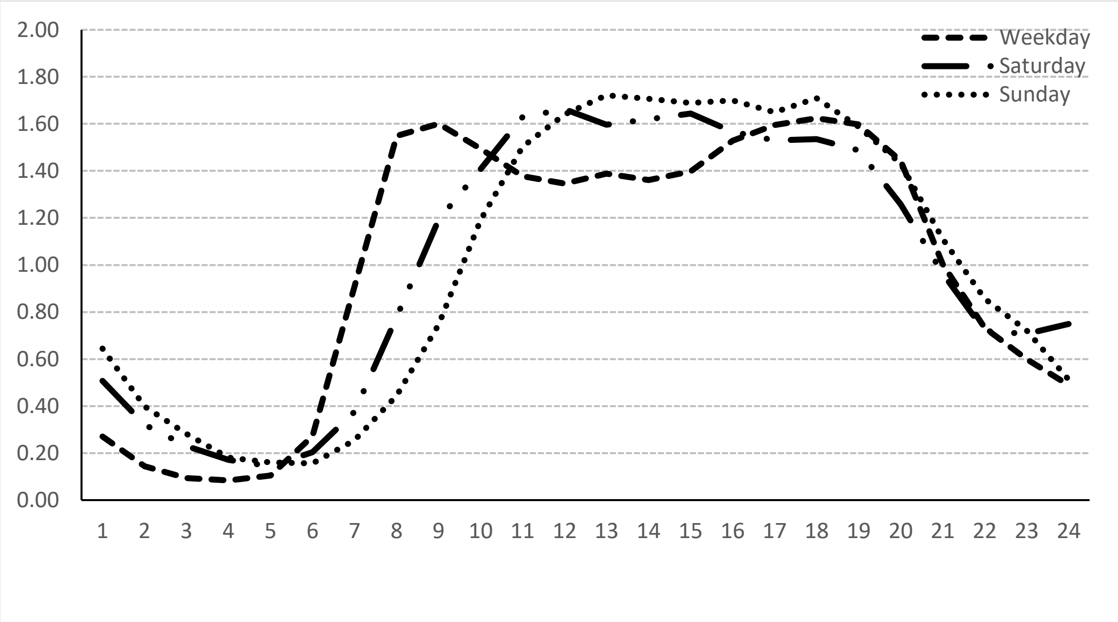

Figure A1: Local Road Network Diurnal Traffic Variation

Street Canyon Effect

10.1.20 Narrow streets with tall buildings on either side have the potential to create a confined space, which can interfere with the dispersion of traffic pollutants and may result in pollutant emissions accumulating in these streets. In an air quality model these narrow streets are described as street canyons.

10.1.21 ADMS-Roads includes a street canyon model to take account of the additional turbulent flow patterns occurring inside such a narrow street with relatively tall buildings on both sides. LAQM.TG(16) identifies a street canyon *"as narrow streets where the height of buildings on both sides of the road is greater than the road width."*

10.1.22 Following a review of the road network to be included within the model, it was considered that modelled roads are relatively wide and the existing buildings along these roads are not considered to be tall.

10.1.23 With the Development, it is considered that a street canyon, with residential exposure (contained within Buildings 13 and 17) would be created along Ship Lane. This street canyon would be created from the construction of Buildings 17, 13, 2 and 1 within the Development. A height of 21m was used in the 'with Development' scenarios to represent the proposed seven floors in Buildings 13 and 17. This is worst case as the opposite buildings are lower including the cinema in Building 1, which is only two floor levels.

10.1.24 Where receptors are located along these roads within the model domain, they have been positioned so as to be located within the street canyon (i.e. the distance from the receptor to the road centreline is less than half the canyon width).

Road Traffic Emission Factors

10.1.25 The latest version of the ADMS-Roads model (version 4.1.0) was used for the assessment. This version of the model does not include the latest vehicle emission factors published by Defra (published in November 2018). As such the latest vehicle emissions as presented in the Emission Factors Toolkit (version 8.0, as above, published in November 2017 and based on the latest COPERT database published by the European Environment Agency) have been externally calculated and added to the model.

10.1.26 The model uses several parameters (traffic flow, percentage of HDV, speed and road type) to calculate road traffic emissions for the selected pollutants.

Chalkers Corner Junction

10.1.27 Highway works are proposed at Chalkers Corner to include amendments and reconfiguration to the junction to alleviate the transport and traffic implications associated with the operation of the Development within the Stag Brewery component of the Site. The reconfiguration of the Chalkers Corner junction includes:

- the provision of a short additional left turn lane (flare) from Lower Richmond Road into the junction (26 m long or about 5 car lengths);
- provision of an extended queuing reservoir between the main junction of Lower Richmond Road (this would accommodate about 9 extra cars south westbound) and would also provide extra storage for north east bound vehicles including those waiting to turn right into Lower Richmond Road); and
- provision of a wider pedestrian island within the Lower Richmond Road arm to 4 m wide to sufficiently cater for cyclists crossing as well as pedestrians.

10.1.28 In addition, an extended, dedicated lane for traffic turning left from Clifford Avenue into Lower Richmond Road would also be provided.

10.1.29 The above reconfigurations have been included in the 'with Development' ADMS-Roads model.

10.1.30 **Appendix 10.4: Chalkers Corner Junction Interim Design Assessment** considers the impact to air quality from the changes made to the junction in isolation from the Development within the Stag Brewery component of the Site.

Car Park Extraction Strategy

10.1.31 The Development includes basement car parking with an extraction system located on Site and away from existing air quality sensitive receptors. The technical specification of the ventilation strategy is indicative at this stage and does not reflect the final system to be used. As such the basement extraction system has not been considered in the air quality assessment and the final extraction system would be designed in accordance with best practice design and appropriate regulations. This would be secured by a suitably worded planning condition. As such, it is anticipated that the car park extraction system uses within the Development would not give rise to significant environmental effects and has not been considered further at this stage.

Heating and Energy Strategy

10.1.32 The Development heating and energy strategy would provide two energy centres to serve the eastern and western parts of the Development (Application A), split by Ship Lane. In addition, a separate energy centre would be provided for the school (Application B). These are collectively referred to as the Energy Centres.

10.1.33 Technical details of indicative plant have been provided by Hoare Lea and the stack parameters used within the ADMS 5 model are presented in Table A9 below. These details do not represent the final plant to be used, however due to the number of plant proposed the air quality assessment has considered the potential impacts to determine the likely significant effect from their operation.

10.1.34 Given Table A9 does not represent the final parameters for each plant to be used once the Development is complete and operational it is considered that a suitably wording planning condition requesting an air quality assessment of the final plant would be provided by LBRuT with the granting of any planning permission.

10.1.35 To take account of the multiple point sources from the boilers and Combined Heat and Power (CHP) at each Energy Centre, ADMS 5 contains the ability to combine multiple point sources into a single stack. The stack parameters for each Energy Centre, as presented in Table A9, have been combined using the additional input file option within ADMS 5.

Table A9: Indicative Plant Stack Parameters

Energy Centre	Unit	No.	Grid Ref.	Flue Diameter (m)	Release Rate (m/s)	Release Height (m)[(a)]	Release Temp (deg ºC)	Total NO_x Emissions (g/s)[(b)(c)]
Building 02	Boiler (2400kW)	5	520430, 176018	0.70	15	35.03	70	0.1300
	CHP (560kW)	2	520430, 176018	0.15	10	35.03	150	0.0204
	CHP (610kW)	1	520430, 176018	0.18	10	35.03	150	0.0111
Building 17	Boiler (2500kW)	4	520354, 176007	0.70	15	29.30	70	0.1027
	CHP (560kW)	2	520354, 176007	0.15	10	29.30	150	0.0204
	CHP (610kW)	1	520354, 176007	0.18	10	29.30	150	0.0111
School	Boiler (750kW)	2	520216, 175982	0.35	15	20.20	70	0.0154
	CHP (226kW)	1	520216, 175982	0.10	10	20.20	150	0.0041

Note:

(a) The stack heights have been determined by the height of the Development (taking account of other factors such as visual impacts). The height of the flues has been calculated by Hoare Lea, this includes a flue of 3.7m above the roof level of Building 02; a flue of 3.3m above the roof level of Building 17; and a flue of 3m above the roof level of the School.

(b) For gas-fired plants emission factors are not provided for PM_{10} because gas-fired plants do not emit any significant level of particulates.

(c) Hoare Lea have provided an estimated seasonal profile for the energy centre, which show the boilers are used during the winter months when heating demand is high. To account of this seasonal profile, the emissions from the boilers presented in Table A1.3 have been halved following modelling as a full year. For the purposes of this assessment this approach is a reasonable assumption.

10.1.36 As shown in Table A9 above, the Development introduces three separate heating plants, located in Building 2, Building 17 and the School. Due to the limitations on the number of sources to be modelled within ADMS 5 within each model run, the heating plant assessment has modelled each Energy Centre separately. Following the model run, the predicted emissions of each heating plant have been added together to determine the total contribution.

10.1.37 The indicative plant stack parameters presented in Table A9 have been modelled in ADMS 5 across a 1km by 1km grid centred on the Development.

Building Parameters

10.1.38 Buildings can have a significant effect on the dispersion of pollutants from sources and can increase the maximum predicted ground level concentrations. ADMS 5 allows buildings to be included in to the model domain as a rectangle or as a circle.

10.1.39 The buildings module is based on experiments in which there was one dominant site building and several smaller surrounding buildings less important for dispersion.

10.1.40 For each of the Energy Centre, the building the flue is located on has been considered to be the main building. These main buildings have been considered as a rectangular building. The parameters are presented in Table A10.

Table A10: Main Building Parameters

Energy Centre	Main building	X	Y	Height (m)	Length (m)	Width (m)	Angle (deg)
Building 02	Plot 02	520430	176035	31.3	76	40	20
Building 17	Plot 17	520348	176023	26.0	57	20	0
School	School	520251	175949	17.2	100	38	0

Background Pollutant Concentrations

10.1.41 Background pollutant concentration data (i.e. concentrations due to the contribution of pollution sources not directly taken into account in the dispersion modelling) have been added to contributions from the modelled pollution sources, for each year of assessment.

10.1.42 The EHO at LBRuT has requested background pollutant concentrations monitored at the Wetlands Centre, Barnes are used within the air quality assessment. The Wetlands Centre automatic monitor is located approximately 2.5km to the north east from Site and is classified as a suburban monitor.

10.1.43 Table A11 presents the most recent monitored concentrations measured at the Wetlands Centre automatic monitor.

Table A11: Measured Concentrations at the Wetlands Centre Suburban Background Automatic Monitor

Pollutant	AQS Objective	2014	2015	2016
NO_2	Annual Mean (40µg/m^3)	25	21	25
	200ug/m^3 as a 1 hour mean, not to be exceeded more than 18 times a year	0	0	0
PM_{10}	Annual Mean (40µg/m^3)	20	22	20
	50ug/m^3 as a 24 hour mean, not to be exceeded more than 35 times a year	4	5	7

Source: LBRuT 2017 Air Quality Annual Status Report
AQS – Air Quality Strategy

10.1.44 Table A11 shows all monitored pollutants at the Wetland Centre Suburban monitor were below their respective objectives in all years.

10.1.45 In addition to the monitoring data, forecast UK background concentrations of NOx, NO2, PM10 and PM2.5 are available from the Defra LAQM Support website5 for 1x1km grid squares for assessment years between 2015 and 2030 (published in November 2017). Table A12 presents the Defra background concentrations for the year 2016, for the grid squares the Site and local receptors considered in the air quality assessment are located within.

Table A12: Defra Background Maps in 2016 for the Grid Square at the Site and the Local Area

Pollutant	Annual Mean Concentration (µg/m^3)		
	520500, 176500[(a)]	519500, 175500[(b)]	520500, 175500[(c)]
NO_x	34.8	37.7	36.8
NO_2	23.4	25.0	24.5
PM_{10}	15.9	17.7	18.9
$PM_{2.5}$	10.3	11.3	11.9

Note: (a) Representative of Receptors: 1, 4 and Proposed Buildings 2-4, 7-9, 11, 12, 17-19, 21, 22
(b) Representative of Receptors located at Chalker's Corner and Diffusion Tube 52
(c) Representative of Receptors: Receptors 2, 3, 5-16 and Proposed Buildings 1, 5, 6. 10, 13- 16, 20 and Diffusion Tubes 21, 51, 49 and 36.

10.1.46 As shown in Table A11 and Table A12, the monitored background concentrations at the Wetlands Centre Suburban monitor in 2016 (as 25µg/m3 for annual mean NO2 and 20µg/m3 for annual mean PM10) are higher than the Defra background maps (as 24.5µg/m3 for annual mean NO2 and 18.9µg/m3 for annual mean PM10).

10.1.47 As requested by LBRuT the background concentrations from the Wetlands Centre monitor have been used within the air quality assessment, however given no data is available for PM2.5 from the automatic monitor, the Defra background maps for PM2.5 have been used. Annual mean NOx concentration for 2016 has been obtained from the London Air Quality Network6.

10.1.48 Background concentrations used in the assessment are presented in Table A13.

Table A13: Background Concentrations (µg/m^3) Used within the Assessment

Pollutant	Source	2016			2027		
NO_x	LBRuT Wetlands Centre Suburban automatic monitor	43			27.5[(a)]		
NO_2		25			23.7[(b)]		
PM_{10}		20			18.3[(c)]		
$PM_{2.5}$	DEFRA Background Map	10.3[(d)]	11.3[(e)]	11.9[(f)]	9.5[(d)]	10.3[(e)]	10.9[(f)]

Notes:

(a) Projected factor of 0.639 used as obtained from Defra Background Maps, taken as an average from the grid squares the Site and surrounding receptors considered in the model are located within.

(b) Projected factor of 0.949 used as obtained from Defra Background Maps, taken as an average from the grid squares the Site and surrounding receptors considered in the model are located within.

(c) Projected factor of 0.914 used as obtained from Defra Background Maps, taken as an average from the grid squares the Site and surrounding receptors considered in the model are located within.

(d) Representative of Defra Background map 520500, 176500.

(e) Representative of Defra Background map 519500, 175500.

(f) Representative of Defra Background map 520500, 175500.

Meteorological Data

10.1.49 Local meteorological conditions strongly influence the dispersal of pollutants. Key meteorological data for dispersion modelling include hourly sequential data for wind direction, wind speed, temperature, precipitation and the extent of cloud cover for each hour of a given year. As a minimum ADMS-Roads and ADMS 5 requires wind speed, wind direction, and cloud cover.

10.1.50 Meteorological data to input into the model were obtained from the London Heathrow Airport Meteorological Station, which is the closest to the Site and considered to be the most representative. The 2016 data were used to be consistent with the base traffic year and model verification year. It was also used for the 2022 and 2027 scenarios for the air quality assessment. Figure A2 presents the wind-rose for the meteorological data.

10.1.51 Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75 m/s. It is recommended in LAQM.TG(16) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(16) recommends that meteorological data should only be used if the percentage of usable hours is greater than 85%. 2016 meteorological data from London Heathrow includes 8,572 lines of usable hourly data out of the total 8,784 for the year, i.e. 100% of usable data. This is above the 97.6% threshold, and is therefore adequate for the dispersion modelling.

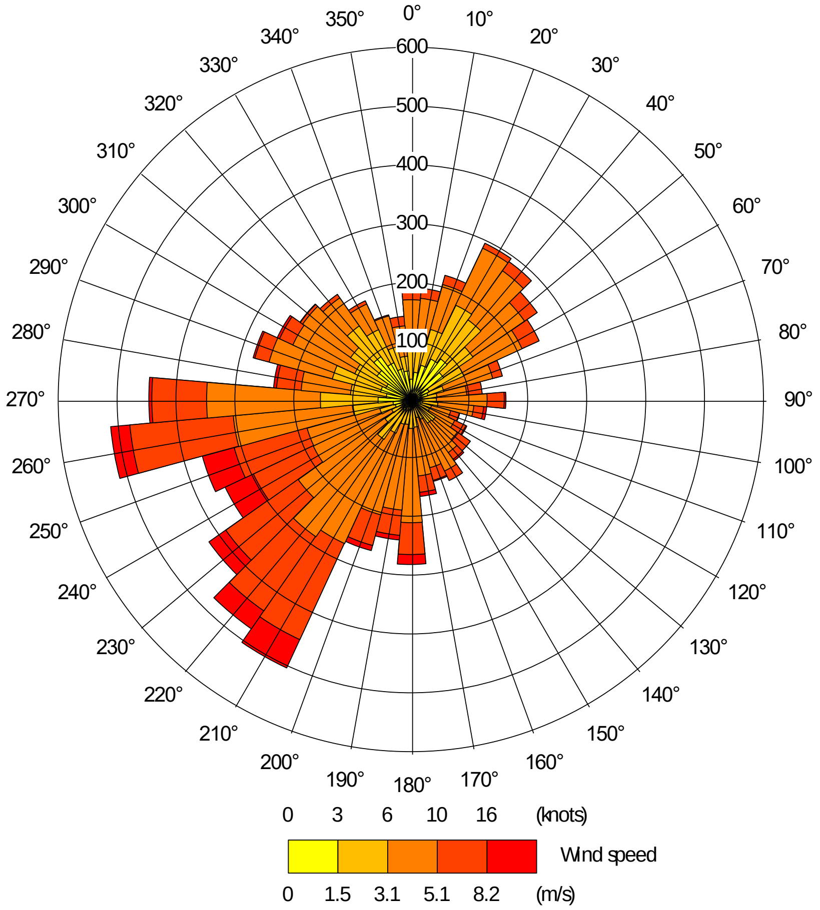

Figure A1: 2016 Wind Rose for the London Heathrow Airport Meteorological Site

10.1.52 Within the air quality models, the surface roughness of 0.2 has been used for the meteorological site, which is representative of large open areas and is considered appropriate given the immediate open surrounding area at the meteorological site.

Model Data Processing

10.1.53 The modelling results were processed to calculate the averaging periods required for comparison with the AQS objectives.

10.1.54 NOx emissions from combustion sources (including vehicle exhausts) comprise principally nitric oxide (NO) and nitrogen dioxide (NO2). The emitted nitric oxide reacts with oxidants in the air (mainly ozone (O3)) to form more NO2. Since only NO2 is associated with effects on human health, the air quality standards for the protection of human health are based on NO2 and not total NOx or NO.

10.1.55 ADMS-Roads was run without the Chemistry Reaction option to allow verification (see below). Therefore, a suitable NOX:NO2 conversion needed to be applied to the modelled NOX concentrations. There are a variety of different approaches to dealing with NOX:NO2 relationships, a number of which are widely recognised as being acceptable. However, the current approach was developed for roadside sites, and is detailed within Technical Guidance LAQM.TG(16).

10.1.56 The LAQM Support website provides a spreadsheet calculator7 to allow the calculation of NO2 from NOx concentrations, accounting for the difference between primary emissions of NOx and background NOx, the concentration of O3, and the different proportions of primary NO2 emissions, in different years. This approach is only applicable to annual mean concentrations.

10.1.57 Research8 undertaken in support of LAQM.TG(16) has indicated that the 1-hour mean AQS objective for NO2 is unlikely to be exceeded at a roadside location where the annual-mean NO2 concentration is less than 60µg/m3. The 1-hour mean objective is, therefore, not considered further within this assessment where the annual mean NO2 concentration is predicted to be less than 60µg/m3.

10.1.58 In order to calculate the number of PM10 24-hour means exceeding 50µg/m3 the relationship between the number of 24-hour mean exceedances and the annual mean PM10 concentration from LAQM.TG (09)1 was applied as follows:

$$\textbf{Number of Exceedances} = -18.5 + 0.00145 \times (\text{annual mean}^3) + \frac{206}{\text{annual mean.}}$$

10.1.59 With regards to the conversion factor for the Energy Centres, the screening approach suggested by the Environment Agency9 for continuously operating plant is to assume that for the annual mean, 70% of the NOx is converted to NO2 at ground level. This approach has been used for the NOx emissions prior to adding to the predicted annual mean NO2 concentrations.

Other Model Parameters

10.1.60 There are a number of other parameters that are used within the ADMS-Roads and ADMS 5 model which are described here for completeness and transparency:

- the model requires a surface roughness value to be inputted. A value of 1 was used at the Site (which is representative of cities and woodland) and a value of 0.2 was used at the location of the London Heathrow Airport Meteorological Station, which is representative of large open areas;

- the model requires the Monin-Obukhov length (a measure of the stability of the atmosphere) to be inputted. A value of 100m (representative of large conurbations >1,000,000) was used for the modelling; and
- the ADMS-Roads model requires the Road Type to be inputted. *'London [Outer]'* was selected and used for the modelling.

Model Verification

10.1.61 Model verification is the process of comparing monitored and modelled pollutant concentrations for the same year, at the same locations, and adjusting modelled concentrations if necessary to be consistent with monitoring data. This increases the robustness of modelling results.

10.1.62 Discrepancies between modelled and measured concentrations can arise for a number of reasons, for example:

- traffic data uncertainties;
- background concentration estimates;
- meteorological data uncertainties;
- sources not explicitly included within the model (e.g. car parks and bus stops);
- overall model limitations (e.g. treatment of roughness and meteorological data, treatment of speeds); and
- uncertainty in monitoring data, particularly diffusion tubes.

10.1.63 Verification is the process by which uncertainties such as those described above are investigated and minimised. Disparities between modelling and monitoring results are likely to arise as result of a combination of all of these aspects.

Nitrogen Dioxide

10.1.64 The dispersion model was run to predict annual mean NOx concentrations at the following LBRuT diffusion tube monitoring locations for use in the model verification:

10.1.65 Diffusion Tube 21: Lower Richmond Road, Mortlake (near Kingsway), a roadside location;

10.1.66 Diffusion Tube 51: Sheen Lane, Sheen (Railway Crossing), a kerbside location; and

10.1.67 Diffusion Tube 52: Clifford Avenue, Chalkers Corner, a kerbside location.

10.1.68 It is noted that whilst the EHO at LBRuT requested the use of Diffusion Tube 36: Upper Richmond Road West; Diffusion Tube 49: URRW War Memorial, Sheen Lane, a kerbside location; and Diffusion Tube 50: Upper Richmond Road near Clifford Avenue these monitors are located outside of the road model domain used in the air quality assessment and therefore cannot be used to check the accuracy of the model. During the meeting of the 14th November 2017 these monitors were discussed further with the EHO at LBRuT and it was agreed that only the above bulleted monitors would be considered in the model verification.

10.1.69 As highlighted above, the NO2 concentrations are a function of NOx concentrations. Therefore, the roadside NOx concentration predicted by the model was converted to NO2 using the NOx to NO2 calculator provided by Defra on the air quality archive. The background data for 2016, as presented in Table A13 were used.

10.1.70 The modelled and equivalent measured roadside NO2 concentrations at the diffusion tube sites were compared as shown in Table A14 following.

Table A14: 2014 Annual Mean NO_2 Modelled and Monitored Concentrations

Site ID	Monitored Annual Mean NO_2 ($\mu g/m^3$)	Modelled Total Annual Mean NO_2 ($\mu g/m^3$)	% Difference (modelled – monitored)
21	39	45.8	17.5
51	32	34.8	8.6
52	57	45.4	-20.4

10.1.71 Table A14 indicates that the model over predicts at Diffusion Tube 21 and Diffusion Tube 51 but under predicts at Diffusion Tube 52. Technical Guidance LAQM.TG(16) suggests that where there is disparity between modelled and monitored results, particularly if this is by more than 25%, appropriate adjustment should be undertaken. Whilst all diffusion tubes considered within the model verification are below a difference of 25% the process to adjust the model results has been undertaken to determine if the relationship between the modelling and monitoring results can be further improved.

10.1.72 LAQM.TG (16) presents a number of methods for approaching model verification and adjustment. Box 7.14 and Box 7.15 in Technical Guidance LAQM.TG(16) indicates a method based on adjusting NO2 road contribution and calculating a single adjustment factor. This method refers to modelling based on road traffic sources and can be applied to either a single diffusion tube location, or where numerous diffusion tube monitoring locations are sited within the modelled area. This requires the roadside NOx contribution to be calculated. In addition, monitored NOx concentrations are required, which were calculated from the annual mean NO2 concentration at the diffusion tube site using the NOx to NO2 spreadsheet calculator as described above. The steps involved in the adjustment process are presented in Table A15.

Table A15: Model Verification Result for Adjustment NO_x Emissions ($\mu g/m^3$)

	Monitored NO_2	Monitored NO_x	Monitored Road NO_2	Monitored Road NO_x	Modelled Road NO_x	Ratio of Monitored Road Contribution NO_x/Modelled Road Contribution NO_x
21	39	74.6	14.0	31.6	49.3	0.64
51	32	58.1	7.0	15.1	21.4	0.71
52	57	125	32.0	82.0	48.0	1.70

10.1.73 Figure A3 shows the mathematical relationship between modelled and monitored roadside NOx (i.e. total NOx minus background NOx) in a scatter graph (data taken from Table A15), with a trendline passing through zero and its derived equation.

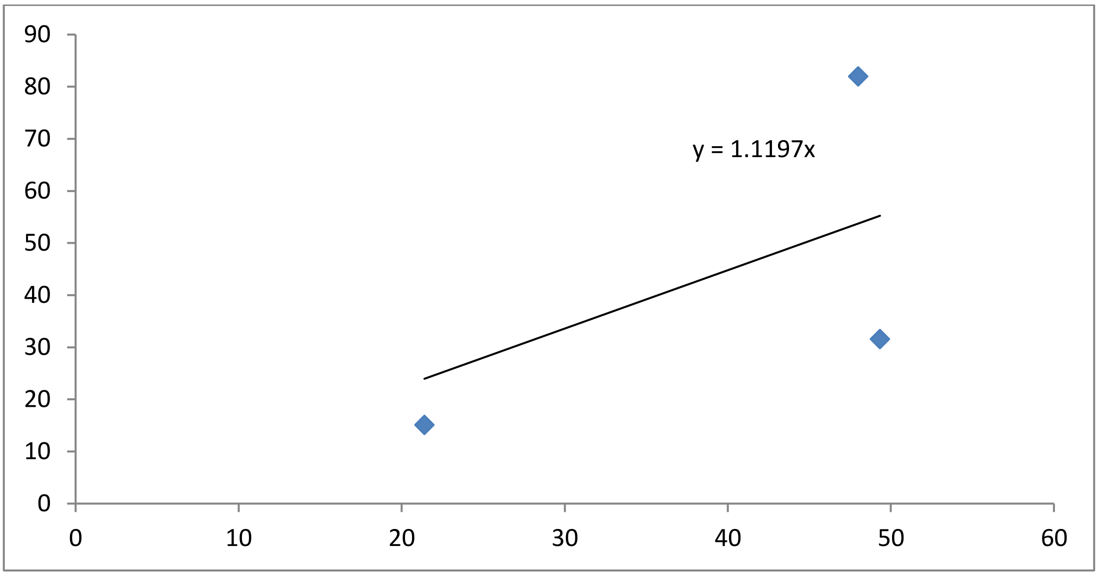

Figure A3: Unadjusted Modelled versus Monitored Annual Mean Roadside NO_x at the Monitoring Sites (µg/m^3)

10.1.74 Consequently, in Table A16 the adjustment factor (1.1197) obtained from Figure A3 is applied to the modelled NOx Roadside concentrations to obtain improved agreement between monitored and modelled annual mean NOx. This has been converted to annual mean NO2 using the NOx:NO2 spreadsheet calculator.

Table A16: Adjusted Annual Average NO_2 Concentrations Compared to Monitored Annual Mean NO_2 Concentrations (µg/m^3)

Site ID	Adjusted Modelled Road NO_x	Adjusted Modelled Total NO_x	Modelled Total NO_2	Monitored Total NO_2	% Difference
21	55.2	98.2	48.0	39.0	23.0
51	24.0	67.0	35.8	32.0	12.0
52	53.7	96.7	47.5	57.0	-16.8

10.1.75 The data in Table A17 shows following the application of the adjustment factor (of 1.1197), whilst the relationship between the monitored and modelled concentrations at Diffusion Tube 52 has slightly improved (from under predicting by 20.4% to under predicting by 16.8%), the adjustment factors lead to a greater over prediction and larger difference at Diffusion Tube 21 (from over predicting by 17.5% to 23%) and Diffusion Tube 51 (from over predicting by 8.6% to 12%).

10.1.76 To ensure the model is performing well a review of the traffic data (including traffic speeds) and monitoring data (including the height and location of Diffusion Tube 52) has been undertaken. Further information on the monitoring locations has also been received from the EHO at LBRuT, who has confirmed:

- Diffusion Tube 21 is set back 226m from Chalkers Junction and is located where traffic is less congested;
- Diffusion Tube 51 is not located on the queuing side of the traffic and as such is close to more freely flowing traffic; and

- Diffusion Tube 52 is 70m from the junction and is also on the opposite side of the road where traffic is less congested.

10.1.77 The above details have been considered in the model. It is considered that no further refinement can be undertaken and all modelling inputs have been included to reflect the known characteristics at the monitored locations.

10.1.78 Given the uncertainty above, to determine if the model verification (of 1.1197) should be used further statistical analysis on the performance of the model verification results have been undertaken using the methodology detailed in LAQM.TG(16) Box 7.17: Methods and Formulae for Description of Model Uncertainty. This additional statistical analysis calculation checks the performance of the model verification used and accuracy of the adjusted results (observed versus predicted).

10.1.79 The methodology for the calculations are presented in LAQM.TG(16) and represented below. The calculations have been undertaken using the formulas available within Microsoft Excel.

- **Correlation Coefficient:** This is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.

$$r = \left[\frac{\sum_{i=1}^{N} (Obs_i - Avg.Obs)(Pred_i - Avg.Pred)}{Stdev.Obs \times Stdev.Pred} \right]$$

- **Fractional Bias:** This is used to identify if the model shows a systematic tendency to over or under predict. Values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.

$$FB = \frac{(Avg.Obs - Avg.Pred)}{0.5(Avg.Obs + Avg.Pred)}$$

- **Root Mean Square Error**: This is used to define the average error or uncertainty of the model. The units of the Root Mean Square Error are the same as the quantities compared.

$$RMSE = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(Obs_i - Pred_i)^2}$$

i = the number of observation compared, 1,2, 3 …. N, *N* = total number of observations compared, *Obs* = observed concentration, *Pred* = predicted concentration, *Avg.Obs* = average of all observed concentrations, *Avg.Pred* = average of all predicted concentrations, *Stdev.Obs* = standard deviation of observed concentrations, *Stdev.pred* = standard deviation of predicted concentrations

10.1.80 The results of the statistical calculation are presented in Table A17 following.

Table A17 – Statistical Calculations to Determine Degree of Error or Modelled Results

Statistical Calculation	Perfect Value[a]	Acceptable Variable Tolerance	Model Verification Source	
			Unadjusted	Adjusted
Correlation Coefficient	1	N/A	0.694	0.691
Fractional Bias	0	Between +2 to -2[a]	0.02	-0.03
Root Mean Square Error	0	Between ±10[b]	4.6	4.5

As detailed in LAQM.TG(16) Box 7.17

As discussed in paragraph 7.541 of LAQM.TG(16)

10.1.81 The results presented in Table A17 show that there is very little difference between the unadjusted (without model verification) and adjusted (with the model verification of 1.1197) results and both sets of data are performing well and within the range of acceptable variable tolerances set out within the guidance. It is observed the correlation coefficient is marginally closer to 1 in the unadjusted scenario and marginally closer to 0 in the fractional bias. However, for the root mean square error the result in the adjusted scenario is closer to 0.

10.1.82 Given there is little difference when looking at the statistical calculations between the results without and with the model verification; the use of the model verification would result in worsening of the modelled results at Diffusion Tube 21 and Diffusion Tube 51; only a slight improvement would occur in the modelled result at Diffusion Tube 52 (which would remain as under predicting); and without the adjustment factor the model is over predicting at two out of the three monitoring sites, it is considered that adjustment is not necessary as the predicted results are already conservative and no further refinement can be undertaken.

Particulate Matter (PM_{10} and $PM_{2.5}$)

10.1.83 PM10 and PM2.5 monitoring data is not available for the Site area. Therefore, given that no model adjustment factor has been applied for the roadside modelled NOx (for the reasons set out above), no adjustment factor has been applied to the roadside PM10 and PM2.5 modelling results.

Verification Summary

10.1.84 Any atmospheric dispersion model study will always have a degree of inaccuracy due to a variety of factors. These include uncertainties in traffic emissions data, the differences between available meteorological data and the specific microclimate at each receptor location, and simplifications made in the model algorithms that describe the atmospheric dispersion and chemical processes. There will also be uncertainty in the comparison of predicted concentrations with monitored data, given the potential for errors and uncertainty in sampling methodology (technique, location, handling, and analysis) as well as processing of any monitoring data.

10.1.85 Whilst systematic under or over prediction can be taken in to account through the model verification / adjustment process, random errors will inevitably occur and a level of uncertainty will still exist in corrected / adjusted data.

10.1.86 While every effort has been made to reduce the uncertainties within the model and thus reduce the verification factor as much as possible, the model verification has been unable to be reduced further and maybe a result of:

- local microclimate experienced at the monitoring locations which the model cannot replicate;

- limited ability to assess the uncertainty of model inputs, for example, the actual emission rates of vehicles on the local road network (particularly in proximity to the monitors used for the verification) compared to the emission rates used within the model;
- the inability to model all contributions in the local area (e.g. all heating plants) due to a lack of available information (including emissions and locations of flues);
- sampling and measurement error associated with the monitoring sites used for the verification. Such as the duration of monitoring (over saturated samples), accuracy of written monitoring duration, collection and transportation errors (if the sample cap has been replaced properly) and errors in analysis; and
- whether the model itself completely describes all the necessary atmospheric and built form processes, such as the local microclimate experienced at the monitoring locations and the real world impact of the street canyon.

10.1.87 Having consideration of the above uncertainty, overall, it is concluded that without the adjustment factor applied to the ADMS-Roads, the model is performing well and modelled results are considered to be suitable to determine the effects of the Development on local air quality.

Assessor Experience

Name: Guido Pellizzaro

Years of Experience: 11

Qualifications:

- BSc (Hons)
- AIEMA (Associate Member of the Institute of Environmental Management and Assessment)
- MIAQM (Member of the Institute of Air Quality Management)
- Part of the All Party Parliamentary Group on Air Pollution

Guido has over eleven years of experience in the assessment of air quality and odour for a variety of environmental impact assessment projects. Guido has knowledge and extensive experience of designing and undertaking ambient air quality monitoring programmes using real time equipment and passive diffusion tubes. This includes devising monitoring programs for dust deposition, typically to monitor levels of dust generated during construction activities in populated areas where there is the potential for nuisance to be caused.

Guido has been responsible for the technical delivery of a wide range of air quality projects for a variety of clients in both the public and private sector. These projects include consideration of emissions from both transportation and industrial sources, through both monitoring and modelling, and therefore he has an in depth understanding of the regulatory requirements for these sources and the published technical guidance for their assessment.

waterman

References

1 Greater London Authority (2014); 'The Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance' July 2014.

2 Institute of Air Quality Management (2014) 'Guidance on the Assessment of Dust from Demolition and Construction'.

3 Defra (2016); 'London Local Air Quality Management (LLAQM) Technical guidance 2016 (LLAQM.TG (16))', DEFRA, London.

4 http://laqm.defra.gov.uk/faqs/faqs.html: Measured nitrogen oxides (NOx) and/or nitrogen dioxide (NO_2) concentrations in my local authority area do not appear to be declining in line with national forecasts.

5 http://laqm.defra.gov.uk/

6 www.londonair.org.uk

7 AEA (2017); NO_X to NO_2 Calculator, http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php Version 6.1, November 2017

8 AEA (2008); 'Analysis of the relationship between annual-mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective', 2008.

9 Environment Agency. Air Quality Modelling and Assessment Unit. 'Conversion Ratios for NOx and NO2'.

B. Appendix 10.2: Air Quality Neutral Assessment

APPENDIX 10.2
AIR QUALITY NEUTRAL ASSESSMENT

Appendix 10.2: Air Quality Neutral Calculations

Introduction

10.2.1 This Appendix presents the calculations undertaken by Waterman Infrastructure and Environment (WIE) to demonstrate how the Development performs against relevant 'air quality neutral' benchmarks.

Description of the Development

10.2.2 The Development is located within the Outer London Activity Zone and would provide a mixed-use scheme (see **Table 1**).

10.2.3 The total amount of floorspace proposed by the Development, relevant to the Air Quality Neutral Assessment criteria is set out below in **Table 1**.

Table 1: 'Air Quality Neutral' Emissions Benchmarks for Buildings

Land Use (Use Class)	Proposed Floorspace Areas (GIA) (m^2)
Residential (Use Class C3, excluding assisted living)	75,119
Office (Use Class B1)	2,424
Cinema (Use Class D2)	2,120
Gym (Use Class D2)	740
Flexible Uses - Restaurant / bar / retail / community / leisure (Use Classes A1 / A2 / A3 / A4 / B1 / D1 / Boathouse)	4,664
Hotel (Use Class C1)	1,668
Assisted Living (Use Class C2)	14,738
Nursing and Care Home (Use Class C2)	9,472
School (Use Class D1)	9,070
Management (Use Class B1)	33
Total	**120,081**

Note: Table 1 is not the Total Floor Space provided within the Development and excludes non-habitable uses such as plant and storage areas, play space, private amenity space, car park space, which are not used within the Air Quality Neutral Assessment calculations.

The AQNA assessment requires the comparison of Development against relevant benchmarks for each use class and therefore it is necessary for them to be included in Table 1.

10.2.4 It is noted the proposed land uses of Assisted Living are submitted as flexible use and have the potential to become residential. For the purposes of the Air Quality Neutral Assessment Assisted Living have been calculated separately as either Use Class C2 or Use Class C3.

Planning Policy

Draft New London Plan, 2017

10.2.5 Policy SI1 'Improving air quality' of the Draft London Plan[1] states that:

"…the development of large-scale redevelopment areas, such as Opportunity Areas and those subject to an Environmental Impact Assessment should propose methods of achieving an Air Quality Positive approach through the new development. All other developments should be at least Air Quality Neutral..."

The London Plan - The Spatial Development Strategy for Greater London; consolidated with alterations since 2011, March 2015

10.2.6 Policy 7.14 'Improving air quality' of the London Plan[2] states that development proposals should:

"…be at least 'air quality neutral' and not lead to further deterioration of existing poor air quality (such as areas designated as AQMAs);…"

The Mayor's Air Quality Strategy 'Clearing the Air' 2010

10.2.7 The Mayor's Air Quality Strategy states that:

"New developments in London shall as a minimum be 'air quality neutral' through the adoption of best practice in the management and mitigation of emissions".

Sustainable Design and Construction - Supplementary Planning Guidance, 2014

10.2.8 To enable the implementation of the London Plan the GLA have produced a Sustainable Design and Construction Supplementary Planning Guidance (SPG). Section 4.3 focusses on air pollution and the effects from the operation of new developments to ensure that they are 'air quality neutral'.

10.2.9 Paragraph 4.3.17 and Appendix 5 of the SPG note that Building Emission Benchmarks (BEBs) have been defined for a series of land-use classes for both NO_x and PM_{10}. **Table 2** outlines the relevant emissions benchmarks for the Development. It is considered that where a Development does not exceed these benchmarks then they are considered to be 'air quality neutral' and would not increase NO_x and PM_{10} emissions across London as a whole.

Table 2: 'Air Quality Neutral' Emissions Benchmarks for Buildings

Land Use Class	NO_x (g/m^2)	PM_{10} (g/m^2)
Class A1	22.6	1.29
Class A3 - A5	75.2	4.32
Class A2 and Class B1	30.8	1.77
Class B2 – B7	36.6	2.95
Class B8	23.6	1.90
Class C1	70.9	4.07
Class C2	68.5	5.97
Class C3	26.2	2.28
Class D1(a)	43.0	2.47
Class D1(b)	75.0	4.30
Class D1(c-h)	31.0	1.78
Class D2(a-d)	90.3	5.18
Class D2(e)	284	16.3

10.2.10 As well as defining a series of benchmarks for a buildings' operation, Appendix 6 of the SPG also defines benchmarks for the transport emissions related to the Development. **Table 3** details the emissions benchmarks for transport relevant to the Development. Section 4.3.18 of the SPG notes that the design of a development should encourage and facilitate walking, cycling and the use of public transport, thereby minimising the generation of air pollutants.

Table 3: 'Air Quality Neutral' Emissions Benchmarks for Transport

Land Use	London Central Activity Zone	Inner	Outer
NO_x (g/m²/annum)			
Retail (A1)	169	219	249
Office (B1)	1.27	11.4	68.5
NO_x (g/dwelling/annum)			
Residential (C3)	234	558	1553
PM_{10} (g/m²/annum)			
Retail (A1)	29.3	39.3	42.9
Office (B1)	0.22	2.05	11.8
PM_{10} (g/dwelling/annum)			
Residential (C3, C4)	40.7	100	267

10.2.11 For both the Building and Transport Emissions Benchmarks, where a development does not exceed these benchmarks then the development is considered to be 'air quality neutral' and would not increase NO_x and PM_{10} emissions across London as a whole.

10.2.12 As well as providing benchmarks the SPG also recommends emission standards for combustion plant to comply with, in addition to meeting the overall 'air quality neutral' benchmark.

Air Quality Neutral Planning Support: GLA 80371, April 2014

10.2.13 In April 2014, the GLA published a report to provide support to the development of the Mayor's policy related to 'air quality neutral' developments. The report provides a method to enable a development to be assessed against the air quality neutral benchmarks set out in the Sustainable Design and Construction SPG.

10.2.14 The report provides a methodology required to apply the air quality neutral policy. It requires the transport and building emissions for the development to be identified and then compared to the benchmark emissions. The report notes that the building and transport emissions should be calculated separately and not combined.

Calculation of the Emissions Benchmarks

Building Emissions

10.2.15 The Development heating and energy strategy would provide two Energy Centres to serve the eastern and western parts of Development, split by Ship Lane. In addition, a separate heating and energy strategy would be provided for the school. The details of the Energy Centres are presented in **Table 4**.

Table 4: Calculation of the Total Building Emission

Energy Centre	Unit	Number	Release Rate (m/s)	Total NO_x Emissions (g/s)	Hours of Operation (hrs./annum)	Total NO_x (kg/annum)
Building 02	Boiler (2400kW)	5	15	0.1300	4380	2049.8
	CHP (560kW)	2	10	0.0204	8760	643.3
	CHP (610kW)	1	10	0.0111	8760	350.0
Building 17	Boiler (2500kW)	4	15	0.1027	4380	1619.4
	CHP (560kW)	2	10	0.0204	8760	643.3
	CHP (610kW)	1	10	0.0111	8760	350.0
School	Boiler (750kW)	2	15	0.0154	4380	242.8
	CHP (226kW)	1	10	0.0041	8760	129.3
	Total Building NO_x Emission					**6028.1**

Note: For gas-fired plants PM_{10} emission factors are not provided because gas-fired plants do not emit any significant level of particulates

10.2.16 The Building Emission Benchmarks (BEB) for each land use category are presented in **Table 5** (as Assisted Living being Use Class C2) and **Table 6** (as Assisted Living being Use Class C3). These are calculated by multiplying the floor area for each land use category with the Building Emission Benchmark presented in **Table 2**.

Table 5: Calculation of the Benchmarked NO_x Building Emissions for each Land-Use Category (Assisted Living being Use Class C2)

Land Use	GIA	Building Emissions Benchmark ($gNO_x/m^2/annum$)	Benchmarked Emissions ($kgNO_x/annum$)
C3	75,119	26.2	1968.1
B1	2,457	30.8	75.7
D2*	2,860	187.15	535.2
A1	4,664	22.6	105.4
C1	1,668	70.9	118.3
D1*	33	49.7	1.6
C2	33,280	68.5	2279.7
Total Benchmarked Building Emissions			**5084.0**

Note: *The average benchmark of these use-class has been taken as presented in Table A2.

Table 6: Calculation of the Benchmarked NO_x Building Emissions for each Land-Use Category (Assisted Living Use Class C3)

Land Use	GIA	Building Emissions Benchmark ($gNO_x/m^2/annum$)	Benchmarked Emissions ($kgNO_x/annum$)
C3	89,857	26.2	2354.3
B1	2,457	30.8	75.7
D2*	2,860	187.15	535.2
A1	4,663	22.6	105.4
C1	1,668	70.9	118.3
D1*	9,319	49.7	1.6
C2	18,542	68.5	1270.1
Total Benchmarked Building Emissions			**4460.6**

Note: *The average benchmark of these use-class has been taken as presented in Table A2.

10.2.17 As shown in **Table 4**, the Total Building NOx Emission of 6,028.1kg/annum are above the benchmarks calculated in **Table 5** (Assisted Living Use Class C2) of 5,084.0kg/annum and **Table 6** (Assisted Living being Use Class C3) of 4,460.6kg/annum and the Development is therefore not considered to be 'Air Quality Neutral', with respect to building emissions.

10.2.18 However, **Table 4** does not represent the final parameters for each plant to be used once the Development is complete and operational. As such it is considered that a suitably wording planning condition requesting an air quality neutral assessment of the final plant would be provided by LBRuT with the granting of any planning permission.

Transport Emissions

10.2.19 Details of the trip generation per day for each land-use class have been provided by Peter Brett Associates (the Applicant's transport consultant).

Assisted Living being Use Class C2

10.2.20 The calculation of the Transport Emission for each component of the Development, assuming Assisted Living and Care Home being Use Class C2 is presented in **Table 7**.

Table 7: Calculation of the Benchmarked Transport Emissions for each Land-Use Category (Assisted Living Use Class C2)

Land Use	Trips per annum	Average Distance per trip*	Distance travelled km/annum	Emission Factors (g/vehicle-km)	Transport Emission (kg/annum)	
					NO_x	PM_{10}
C3	442,782	11.4	5,047,715	NO_x: 0.353 PM_{10}: 0.0606	1781.8	108.0
B1	81,997	10.8	885,567.6		312.6	18.9
D2	87,928	10.8	949,622.4		335.2	20.3
A1	144,105	5.4	778,167		274.7	16.6
C1	4,885	10.8	52,758		18.6	1.1

D1	186,324	10.8	2,012,299.2		710.3	43.0
C2	61,758	10.8	666,986.4		235.4	14.3
Total Transport Emissions					**3,668.8**	**222.3**

Note: * Average distance travelled by car per trip for sites within Outer London Activity Zone

10.2.21 The Transport Benchmark for the Development, as shown in **Table 8**, can be calculated by multiplying the benchmark in **Table 3** by the number of properties within the Development.

Table 8: Calculation of the Benchmarked Transport Emissions for each Land-Use Category (Assisted Living Use Class C2)

Land Use	Units	GIA	Transport Emission Benchmark		Benchmarked Emissions	
			gNO_x/m^2/annum or gNO_x/dwelling/ annum	gPM_{10}/m^2/annum or gPM_{10}/dwelling/ annum	$kgNO_x$/ annum)	$kgPM_{10}$/ annum
C3	687	-	1553	267	1066.9	183.4
B1	-	2,457	68.5	11.8	168.3	29.0
D2	-	2,860	68.5	11.8	195.9	33.7
A1	-	4,664	249	42.9	1161.3	200.1
C1	-	1,668	68.5	11.8	114.3	19.7
D1	-	33	68.5	11.8	2.3	0.4
C2	-	33,280	68.5	11.8	2279.7	392.7
Total Transport Emissions					**4988.7**	**859.0**

10.2.22 Assuming the Assisted Living is Use Class C2, the Total Transport NOx Emission of 3,668.8kg/annum (as shown in **Table 7**) is below the benchmark of 4,988.7kg/annum (as shown in **Table 8**) and the Total Transport PM_{10} Emission of 222.3kg/annum (as shown in **Table 7**) is below the benchmark of 859.0kg/annum (as shown in **Table 8**).

10.2.23 The Development is therefore considered to be 'Air Quality Neutral', with respect to transport emissions and no further mitigation measures are required.

Assisted Living being Use Class C3

10.2.24 The calculation of the Transport Emission for each component of the Development, assuming Assisted Living being Use Class C3 is presented in **Table 9**.

Table 9: Calculation of the Benchmarked Transport Emissions for each Land-Use Category (Assisted Living being Use Class C3)

Land Use	Trips per annum	Average Distance per trip*	Distance travelled km/annum	Emission Factors (g/vehicle-km)	Transport Emission (kg/annum)	
					NO_x	PM_{10}
C3	454,645	11.4	5,182,953	NO_x: 0.353 PM_{10}: 0.0606	1829.6	110.9
B1	81,997	10.8	885,567.6		312.6	18.9
D2	87,928	10.8	949,622.4		335.2	20.3
A1	144,105	5.4	778,167		274.7	16.6

C1	4,885	10.8	52,758		18.6	1.1
D1	186,324	10.8	2,012,299.2		710.3	43.0
C2	49,895	10.8	538,866		190.2	11.5
Total Transport Emissions					**3671.3**	**222.5**

Note: * Average distance travelled by car per trip for sites within Outer London Activity Zone

10.2.25 The Transport Benchmark for the Development, as shown in **Table 10**, can be calculated by multiplying the benchmark in **Table 3** by the number of properties within the Development.

Table 10: Calculation of the Benchmarked Transport Emissions for each Land-Use Category (Assisted Living Use Class C3)

Land Use	Units	GIA	Transport Emission Benchmark		Benchmarked Emissions	
			gNO_x/m^2/annum or gNO_x/dwelling/ annum	gPM_{10}/m^2/annum or gPM_{10}/dwelling/ annum	$kgNO_x$/ annum)	$kgPM_{10}$/ annum
C3	997	-	1553	267	1548.3	266.2
B1	-	2,457	68.5	11.8	168.3	29.0
D2	-	2,860	68.5	11.8	195.9	33.7
A1	-	4,663	249	42.9	1161.1	200.0
C1	-	1,668	68.5	11.8	114.3	19.7
D1	-	9,319	68.5	11.8	638.4	110.0
C2	-	18,542	68.5	11.8	1270.1	218.8
Total Transport Emissions					**5096.4**	**877.4**

10.2.26 Assuming the Assisted Living and Care Home elements are Use Class C3, the Total Transport NOx Emission of 3,671.3kg/annum (as shown in **Table 9**) is below the benchmark of 5,096.4kg/annum (as shown in **Table 10**) and the Total Transport PM_{10} Emission of 222.5kg/annum (as shown in **Table 9**) is below the benchmark of 877.4kg/annum (as shown in **Table 10**).

10.2.27 The Development is therefore considered to be 'Air Quality Neutral', with respect to transport emissions and no further mitigation measures are required.

References

[1] Greater London Authority (2017); 'Draft New London Plan', Draft for Public Consultation, GLA, London.
[2] Greater London Authority (2015); 'The London Plan -– The Spatial Development Strategy for London consolidated with alterations since 2011', GLA, London.

C. Appendix 10.3: Air Quality Modelling Results

APPENDIX 10.3
AIR QUALITY MODELLING RESULTS

Appendix 10.3: Air Quality Modelling Results

Table A1: Predicted Annual Mean NO_2 Concentrations ($\mu g/m^3$) for Floors Levels within the Development

Floor	Building																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	School	Playing field
G	26.6	26.0	25.8	24.9	29.8	26.7	25.0	24.9	26.8	27.2	24.9	25.1	25.5	26.0	24.8	24.7	25.2	25.3	25.0	25.0	24.9	25.4	25.7
1	26.1	25.7	25.6	24.7	28.1	26.2	24.9	24.9	26.1	26.4	24.9	25.0	25.3	25.7	24.8	24.7	25.0	25.2	24.9	24.9	24.7	25.3	
2	25.3	25.5	25.4	24.5	25.8	25.4	24.8	24.8	25.2	25.3	24.7	24.8	25.0	25.2	24.8	24.6	24.7	25.1	24.9	24.9	24.6	25.1	
3	24.8	25.4	25.3	24.4		24.9	24.7	24.7	24.7	24.8	24.6	24.6	24.8	24.9	24.7	24.6	24.6	24.9	24.8	24.8	24.5		
4		25.3	25.2	24.4			24.5	24.5	24.3	24.5	24.5	24.5	24.6	24.7	24.6	24.6	24.5	24.8					
5		25.3	25.2	24.3			24.4	24.4			24.4	24.4	24.5	24.6	24.5	24.5	24.5	24.7					
6		25.2		24.3			24.3	24.3			24.3	24.3			24.5		24.4	24.6					
7		25.2		24.3			24.3	24.3									24.4						
8		24.3		24.2																			
9				24.2																			

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Table A2: Predicted Annual Mean NO_2 Concentrations (µg/m³) for Floors Levels within the Development Assuming No Improvement in NO_x and NO_2

Floor	Building																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	School	Playing field
G	33.4	29.8	29.6	27.4	**42.2**	33.6	28.4	28.3	34.0	35.4	28.2	28.9	29.8	31.5	27.9	27.4	28.2	29.1	28.3	28.3	27.4	29.6	30.1
1	31.8	29.7	29.5	27.2	37.4	32.2	28.2	28.2	32.1	32.8	28.1	28.6	29.4	30.6	27.8	27.4	27.9	28.9	28.2	28.2	27.3	29.3	
2	29.3	29.6	29.3	26.9	30.8	29.7	27.9	27.9	29.1	29.4	27.8	28.0	28.5	29.1	27.6	27.3	27.5	28.6	28.1	28.1	27.0	28.7	
3	27.9	29.3	29.1	26.7		28.1	27.5	27.5	27.6	27.9	27.4	27.4	27.7	28.0	27.4	27.2	27.2	28.2	27.8	27.8	26.9		
4		29.1	29.0	26.6			27.1	27.1	26.8	27.1	27.0	26.9	27.2	27.4	27.2	27.0	27.0	27.9					
5		29.1	28.8	26.5			26.7	26.7			26.7	26.6	26.9	27.0	27.0	26.9	26.8	27.5					
6		28.9		26.4			26.5	26.5			26.4	26.4			26.8		26.6	27.2					
7		28.8		26.3			26.3	26.3									26.5						
8		26.4		26.2																			
9				26.1																			

Note: Exceedance of the AQS Objective shown in Bold. Building 5 includes a hotel, gym and office and as such the annual mean NO_2 concentration does not apply in this location.

Table A3: Predicted Annual Mean PM_{10} Concentrations (µg/m^3) for Floors Levels within the Development

Floor	Building																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	School	Playing field
G	19.3	19.0	19.0	18.6	20.3	19.3	18.6	18.6	19.2	19.4	18.6	18.7	18.8	19.1	18.6	18.5	18.7	18.7	18.6	18.6	18.6	18.8	18.7
1	19.1	19.0	18.9	18.6	19.7	19.1	18.6	18.6	19.0	19.1	18.6	18.7	18.8	18.9	18.6	18.5	18.7	18.7	18.6	18.6	18.6	18.7	
2	18.8	18.9	18.8	18.5	18.9	18.8	18.6	18.6	18.7	18.7	18.6	18.6	18.7	18.7	18.5	18.5	18.6	18.6	18.6	18.6	18.5	18.7	
3	18.6	18.8	18.8	18.5		18.6	18.5	18.5	18.6	18.6	18.5	18.5	18.6	18.6	18.5	18.5	18.5	18.6	18.5	18.6	18.5		
4		18.8	18.8	18.4			18.5	18.5	3.0	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5					
5		18.8	18.8	18.4			18.5	18.5			18.5	18.4	18.5	18.5	18.5	18.5	18.5	18.5					
6		18.8		18.4			18.4	18.4			18.4	18.4			18.4		18.4	18.5					
7		18.7		18.4			18.4	18.4									18.4						
8		18.4		18.4																			
9				18.4																			

Table A4: Predicted Annual Mean PM_{10} Number of Days >50µg/m^3 for Floors Levels within the Development

Floor	Building																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	School	Playing field
G	1	1	2	2	2	2	1	1	1	3	1	1	1	1	1	1	2	2	1	1	1	2	1
1	1	1	2	2	2	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	
2	1	2	2	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	
3	1	2	2	2		2	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1		
4		2	2	1			1	1	3	2	1	1	2	2	1	1	2	1					
5		2	2	1			1	1			1	1	2	2	1	1	1	1					
6		2		1			1	1			1	1			1		1	1					
7		2		1			1	1									1						
8		2		1																			
9				1																			

Table A5: Predicted Annual Mean $PM_{2.5}$ Concentrations (µg/m³) for Floors Levels within the Development

Floor	Building																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	School	Playing field
G	11.4	11.3	11.3	11.1	12.0	11.4	11.1	11.1	11.4	11.5	11.1	11.1	11.2	11.3	11.1	11.0	11.1	11.1	11.1	11.1	11.1	11.2	9.7
1	11.3	11.3	11.2	11.1	11.7	11.3	11.1	11.1	11.3	11.3	11.1	11.1	11.2	11.3	11.0	11.0	11.1	11.1	11.1	11.1	11.0	11.1	
2	11.2	11.2	11.2	11.0	11.2	11.2	11.1	11.1	11.1	11.1	11.0	11.1	11.1	11.1	11.0	11.0	11.0	11.1	11.1	11.1	11.0	11.1	
3	11.1	11.2	11.2	11.0		11.1	11.0	11.0	11.0	11.1	11.0	11.0	11.0	11.1	11.0	11.0	11.0	11.0	11.0	11.0	11.0		
4		11.2	11.2	11.0			11.0	11.0	3.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0					
5		11.2	11.1	11.0			11.0	11.0			11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0					
6		11.2		11.0			11.0	11.0			11.0	11.0			11.0		11.0	11.0					
7		11.1		11.0			11.0	11.0									11.0						
8		11.0		11.0																			
9				10.9																			

D. Appendix 10.4: Interim Junction Design Assessment

APPENDIX 10.4
INTERIM JUNCTION DESIGN ASSESSMENT

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Stag Brewery – Interim Junction Design Assessment
Technical Note

Date: February 2018

Client Name: Reselton Properties Limited

Document Reference: WIE10667-100-TN-1-1-1

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS OHSAS 18001:2007)

Issue	Prepared by	Checked & Approved by
	Chris Brownlie	Guido Pellizzaro
Final	Principal Consultant	Associate Director

1. Introduction

1.1. Stag Brewery (the 'Site') is in the London Borough of Richmond upon Thames (LBRuT) borough-wide Air Quality Management Area (AQMA). The AQMA has been designated due to exceedances of the Air Quality Strategy (AQS) objectives for annual mean nitrogen dioxide (NO_2) and annual mean and 24-hour mean particulate matter (PM_{10}). These exceedances are attributed to existing vehicle emissions. In addition, the Site is situated adjacent to the Greater London Authority Air Quality Focus Area (AQFA). An AQFA is an area identified by a London Borough that is exceeding the annual mean Limit Value for NO_2 coupled with high human exposure. The Chalkers Corner component of the Development is located in the AQFA.

1.2. As part of the Stag Brewery Development, highways works are proposed at the Chalkers Corner Junction to alleviate the transport and traffic implications associated with the operation of the Development. The reconfiguration of the Chalkers Corner Junction includes:

- the provision of a short additional left turn lane (flare) from Lower Richmond Road into the junction (26m long or about 5 car lengths);
- provision of an extended queuing reservoir between the main junction of Lower Richmond Road (this would accommodate about 9 extra cars southwest bound) and would also provide extra storage for northeast bound vehicles including those waiting to turn right into Lower Richmond Road); and
- provision of a wider pedestrian island within the Lower Richmond Road arm to 4m wide to sufficiently cater for cyclists crossing as well as pedestrians.

1.3. In addition, an extended, dedicated lane for traffic turning left from Clifford Avenue into Lower Richmond Road would also be provided.

1.4. As discussed in **Chapter 5: The Proposed Development** of the Environmental Statement (ES), the Chalkers Corner Junction forms part of the Development and as such the highway works have been considered within the 'with Development' scenario of **Chapter 10: Air Quality** of the ES. During consultation LBRuT requested additional information is presented on the potential air quality impacts associated with the junction highway works in isolation.

1.5. This Technical Note presents additional modelling information on the Chalkers Corner Junction highways works. The Technical Note presents a comparison of scenarios not presented in the ES to determine the impact of the junction highway works on air quality in isolation and therefore determine the significance of effect of the highways works in isolation. It is noted that the scenarios assessed here are hypothetical only as the Chalkers Corner Junction highways works forms part of the wider Stag Brewery Development and would not be implemented in isolation. Given that the Chalkers Corner Junction is located in the AQFA this assessment has only focussed on NO_2.

2. Methodology

2.1. The same general methodology has been undertaken with regards to this air quality assessment as the air quality modelling completed for the air quality assessment presented in **Chapter 10: Air Quality** of the ES and the technical details set out in **Appendix 10.1** of the ES as part of the planning application. A general overview of the detailed modelling is provided below.

Model

2.2. The effect of the junction on local air quality was assessed using the advanced atmospheric dispersion model ADMS-Roads, considering the contribution of emissions from forecast road-traffic on the local road for the model scenarios discussed below.

Model Scenarios

2.3. To assess the effect of the junction on local air quality the following traffic data scenarios have been provided:

- 2016 Baseline (no Development and no highways works) – traffic data for the existing baseline year and the current existing situation;'
- 2027 Baseline (no Development and no highways works) - traffic data for the assessment year 2027, the data excludes any traffic flows relating to the Development and no highways works to the Chalkers Corner Junction;
- 2027 'with Development but without highway works to Chalkers Corner Junction' (with Development and no highways works) - traffic data for the assessment year 2027, the data includes any traffic flows relating to the Development at the time of opening in 2027 but does not include the highways works to the Chalkers Corner Junction; and
- 2027 'with Development and with highways work to Chalker's Corner Junction' (with Development and with highways works) - traffic data for the assessment year 2027, the data includes any traffic flows relating to the Development at the time of opening in 2027 and the highways works to the Chalkers Corner Junction.

2.4. The above traffic scenarios have been modelled assuming that there is no future NO_x to NO_2 reductions by 2027 (i.e. considering the potential impacts of the junction highway works against the baseline 2016 conditions, assuming no reduction in background concentrations or road-traffic emissions between 2016 and 2027)[1].

[1] Defra (2012) Local Air Quality Management: Note on Projecting NO2 Concentrations.

2.5. Given that the highways works and the Development are to be completed in 2027, it is very likely that concentrations will be lower than those considered in the air quality assessment, as Euro 6 emissions standards will have fully been implemented by then and there is an expected increase in electric vehicles. However, the sensitivity approach provides a clear method to account for the uncertainty in future NO_x and NO_2 concentrations and ensures the results presented in this Technical Note are conservative.

2.6. The highway works to the Chalkers Corner Junction forms part of the Development and have therefore been considered within the 'with Development' scenario within **Chapter 10: Air Quality** of the ES.

2.7. This Technical Note presents a comparison of the following scenarios:

- **Scenario 1:** 2016 Baseline compared against 2027 Baseline;

  This scenario shows the likely change in air quality conditions from 2016 to 2027 assuming the existing junction layout remains and there is no Development and no highways improvements .

- **Scenario 2:** 2027 Baseline compared against 2027 'with Development but without highway works to Chalkers Corner Junction'.

  This scenario shows the impact of the Development on the existing Chalkers Corner Junction layout. It is noted this scenario would not happen, as the highway works to Chalkers Corner Junction form part of the Development, and as set out in **Chapter 6: Development Programme, Demolition, Alteration, Refurbishment and Construction** the highway works are to be brought forward at the start of the Development construction programme.

- **Scenario 3**: 2027 'with Development but without highway works to Chalkers Corner Junction' compared against 2027 'with Development and with highway works to Chalkers Corner Junction'.

  This scenario shows the change in pollutant concentrations resulting from the highway works to Chalkers Corner Junction alone assuming the Development is already in place.

- **Scenario 4:** 2027 Baseline compared against 2027 'with Development and with highway works to Chalkers Corner Junction'.

  This scenario is presented to show the change in concentrations resulting from the Development and the highway works together and is the scenario considered in **Chapter 10: Air Quality** of the ES.

Traffic Data and Speeds

2.8. Traffic data was provided by Peter Brett Associates (PBA) and is presented in Table A6 of **Appendix 10.1** of the ES. To consider the presence of slow moving traffic near junction, the high level of congestion at the Chalkers Corner Junction traffic speeds have been reduced as per the criteria set out in **Appendix 10.1**. The queue lengths at Chalkers Corner have been provided by PBA to replicate the existing levels of congestion on the road network and to determine when to apply the speeds and the approach was agreed with LBRuT during the meeting on the 14th November 2017.

Diurnal Profile

2.9. Traffic flows follow a diurnal variation throughout the day and week. Therefore, a diurnal profile was used in the model to replicate how the average hourly traffic flow would vary throughout the day and the week. This was based on traffic counts undertaken in 2017 by PBA and the diurnal profile is presented in **Figure A1** in **Appendix 10.1** of the ES.

Road Traffic Emission Factors

2.10. The latest version of the ADMS-Roads model (version 4.1.1.0) was used for the assessment. The model does not include the latest vehicle emission factors published by Defra in the Emission Factors Toolkit (version 8.0 published in November 2017, and based on the latest COPERT database published by the European Environment Agency). Therefore, these have been input manually into the model from the EFT spreadsheet, for use in the assessment.

2.11. The EFT uses several parameters (traffic flow, percentage of HDV, speed and road type) to calculate road traffic emissions for the selected pollutants.

Background Pollutant Concentrations

2.12. Background pollutant concentration data (i.e. concentrations due to sources not directly considered in the dispersion model) have been added to the modelled concentrations, which only account for contributions from the local road traffic.

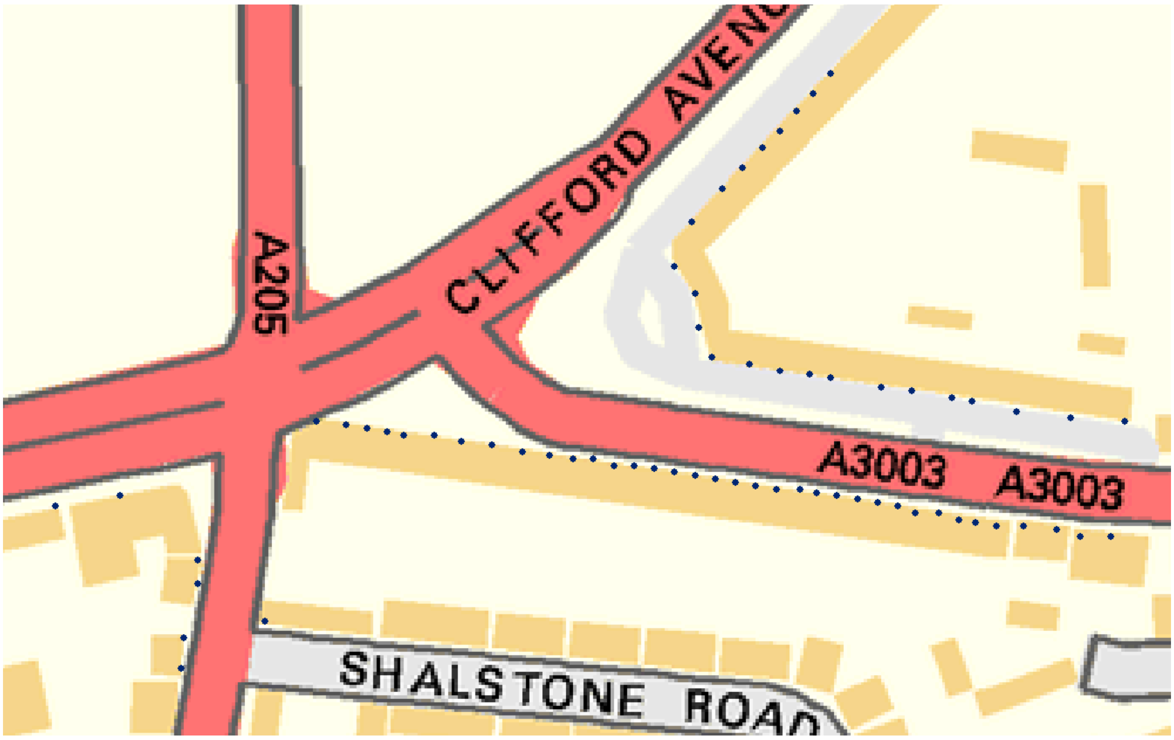
2.13. The EHO at LBRuT has requested background pollutant concentrations monitored at the Wetlands Centre, Barnes are used within the air quality assessment. Background concentrations used in the assessment and are presented in **Table A12** in **Appendix 10.1** of the ES.

Sensitive Receptors

2.14. The approach adopted by the UK Air Quality Strategy (AQS) is to focus on areas at locations at, and close to, ground level where members of the public (in a non-workplace area) are likely to be exposed over the averaging time of the objective in question (i.e. over 1-hour, 24-hour or annual periods). Exceedances of the AQS objectives principally relate to annual mean NO_2 and PM_{10}, and 24-hour mean PM_{10} concentrations, so that associated potentially sensitive locations relate mainly to residential properties and other sensitive locations (such as schools) where the public may be exposed for prolonged periods.

2.15. In total 140 receptors have been assessed, the sensitive receptors are representative of all existing properties at the Chalkers Corner Junction affected by the junction highway works, they include receptors at each floor within the buildings. The location of the selected existing receptors assessed are presented in Figure 1.

Figure 1: Receptor Locations



Note: Each dot represents the ground floor location of a receptor considered within the assessment.

Meteorological Data

2.16. Meteorological data to input into the model were obtained from the London Heathrow Airport Meteorological Station, which is the closest to the Site and considered to be the most representative. The 2016 data were used to be consistent with the base traffic year and model verification year.

Model Verification

2.17. Model verification is the process of comparing monitored and modelled pollutant concentrations and, if necessary, adjusting the modelled results to reflect actual measured concentrations, to improve the accuracy of the modelling results. The approach to the model verification is discussed in **Appendix 10.1** of the ES and compares the predicted annual mean NO_2 concentrations for the baseline 2016 (the latest year for which LBRuT air quality monitoring data is available), with the monitored annual mean NO_2 concentrations from LBRuT's diffusion tubes located at Site 21 (Lower Richmond Road), Site 51 (Sheen Lane) and Site 52 (Clifford Avenue). The results from the model verification showed that the model was over-performing at two diffusions and under-performing at one diffusion tube. Further review of the model was undertaken and no further refinement was considered necessary. An advanced statistical analysis was completed to determine the appropriateness of using the model verification and it was concluded that the unadjusted results were suitable for use in the air quality assessment. The verification and adjustment process is described in detail in **Appendix 10.1**.

Determining Significance

2.18. The EPUK / IAQM guidance provides an approach to assigning the magnitude of change because of a development as a proportion of a relevant assessment level, followed by examining this change in the context of the new total concentration and its relationship with the assessment criterion to provide a description of the impact at selected receptor locations. The criteria are presented in **Table 10.9** of **Chapter 10: Air Quality** of the ES.

3. Results of the Modelling

3.1. As above, the modelled scenarios assume that there is no future NO_x to NO_2 reductions by 2027 (i.e. considering the potential impacts of the junction highway works against the baseline 2016 conditions, assuming no reduction in background concentrations or road-traffic emissions between 2016 and 2027). As such the modelled results are considered conservative as they do not take account of any vehicle improvements between 2016 and 2027.

Scenario 1: Future Air Quality Change Assuming No Development and No Highway Works (Current Situation)

3.2. **Table 1** presents the number of receptors at Chalkers Corner above and below the annual mean AQS Objective of 40µg/m^3 for Scenario 1, which considers the change in annual mean NO_2 from the '2016 Baseline' to the '2027 Baseline' scenarios (i.e. the Chalkers Corner junction layout remains as it currently is and the Development does not come forward).

3.3. The results at each of the modelled receptors are presented in **Table A1 of Annex A** of this note.

Table 1: Scenario 1 - Summary of the Results of the ADMS-Roads Modelling at Residential Properties Located at Chalker's Corner Junction (NO_2)

	2016 Baseline		2027 Baseline	
	Above Annual Mean NO_2 Objective	Below Annual Mean NO_2 Objective	Above Annual Mean NO_2 Objective	Below Annual Mean NO_2 Objective
No. of Receptors	49	91	64 (+15)	76 (-15)

Note: Figures in brackets show the change in annual mean NO_2 concentrations between the period 2016 to 2027.

3.4. As shown in **Table 1,** between 2016 and 2027 assuming there is no Development and no highways works at Chalkers Corner Junction, annual mean NO_2 concentrations are predicted to increase and worsen at Chalkers Corner.

3.5. Between 2016 and 2027, without any changes to Chalkers Corner Junction an additional 15 residential receptors will exceed the annual mean NO_2 AQS objective of 40µg/m^3. This increase is related to the growth in transport trips for the local area, as set out in the traffic data.

3.6. As shown in **Table A1 of Annex A** all modelled receptors experience an increase in annual mean NO_2 concentrations between 2016 and 2027. The increase in annual mean NO_2 concentration ranges between 0.5µg/m^3 and 2.7µg/m^3. The greatest increase of 2.7µg/m^3 is at Receptor J1 (located at the ground floor on Lower Richmond Road). The maximum increase in Chertsey Court is 1.7µg/m^3 located at Receptors J83 to J87. There are no predicted reductions in annual mean NO_2 between these years for this Scenario.

3.7. **Table 2** summarises those receptor locations which experience a change in concentration greater than 0.2µg/m^3 (i.e. a change that would not be considered negligible by the IAQM criteria) where concentrations exceed the NO_2 AQS objective.

Table 2: Scenario 1 - Summary of Change in Concentrations at those Receptors which Exceed the Annual Mean NO_2 AQS Objective

	2016 Baseline Compared Against 2027 Baseline (no Development and no highways works)	
	Worsening of air quality objective already above objective or creation of a new exceedance	**Improvement of an air quality objective already above objective or the removal of an existing exceedance**
>4µg/m^3	-	-
>2-4µg/m^3	-	-
>0.2-2µg/m^3	64 (15)	-

Note: Figures in brackets indicate number of receptors where an exceedance is either created or an existing exceedance is removed.

3.8. As above, when considering the change in annual mean NO_2 concentrations between 2016 to 2027 without the Development and no highways works to Chalkers Corner Junction, there is a worsening in annual mean NO_2 concentrations at all locations. It is predicted 64 locations will exceed the annual mean NO_2 AQS objective in 2027, with potential new exceedances at 15 of those locations. In Scenario 1, between 2016 to 2027 no locations are predicted to experience an improvement in concentrations at locations which already exceed the annual mean NO_2 AQS objective.

3.9. The results in **Table A1 of Annex A** shows that in Scenario 1 there is a 100% increase in relative exposure and no reduction in relative exposure to annual mean NO_2 concentrations at properties located at Chalkers Corner.

3.10. **Table 3** presents the significance of change in annual mean NO_2 concentrations at Chalker Corner for Scenario 1.

Table 3: Scenario 1 - Summary of Impact Significance for NO_2 Annual Mean at Sensitive Receptors

Significance of Impact (NO_2 Annual Mean)	**2016 Base - 2027 Base (without Development and without highway works)**
Substantial Adverse	34
Moderate Adverse	46
Slight Adverse	60
Negligible	-
Total	**140**

3.11. As shown in **Table 3** assuming there is no Development and no highways works at Chalkers Corner Junction, substantial adverse to slight adverse impacts on annual mean NO_2 concentrations are predicted as a result of natural traffic growth in the area between 2016 and 2027. The majority of residential properties at Chalkers Corner will have a worsening in annual mean NO_2 concentration of a slight adverse impact.

3.12. To date, we are unaware of any junction improvement plans proposed by TfL or LBRuT for the Chalker Corner Junction that would improve the predicted impacts as presented in **Tables 1 to 3,** and as such a 2016 to 2027 mitigation scenario has not been modelled.

Scenario 2: With Stag Brewery Element but Without Highway Works to Chalkers Corner Junction

3.13. **Table 4** presents the number of receptors at Chalkers Corner above and below the annual mean AQS Objective of 40μg/m^3 for Scenario 2, which considers the change in annual mean NO_2 from the '2027 Baseline' to the 2027 'with Development but without highway works to Chalkers Corner Junction' scenarios (i.e. the impact of the Stag Brewery element of the Development only with the existing Chalkers Corner junction layout).

3.14. The results at each of the modelled receptors are presented in **Table A1 of Annex A** of this note.

Table 4: Scenario 2 - Summary of the Results of the ADMS-Roads Modelling at Residential Properties Located at Chalker's Corner Junction (NO_2)

	2027 Baseline		2027 With Development (without highways works)	
	Above Annual Mean NO_2 Objective	Below Annual Mean NO_2 Objective	Above Annual Mean NO_2 Objective	Below Annual Mean NO_2 Objective
No. of Receptors	64	76	76 (+12)	64 (-12)

Note: Figures in brackets show the change in annual mean NO_2 concentrations between the 2027 Baseline and the 2027 'With Development but without highways works' scenarios.

3.15. In 2027, without any changes to the Chalkers Corner Junction but taking account of transport trips associated with the Development, an additional 12 residential receptors will exceed the annual mean NO_2 AQS objective of 40μg/m^3.

3.16. As shown in **Table A1 of Annex A** in Scenario 2 all modelled receptors experience an increase in annual mean NO_2 concentrations. The increase in annual mean NO_2 concentration ranges between 0.2μg/m^3 and 4.4μg/m^3. The greatest increase of 4.4μg/m^3 is at Receptor J36 (located at the ground floor on Lower Richmond Road). The maximum increase in Chertsey Court is 1.9μg/m^3 located at Receptors J52. There are no predicted reductions in annual mean NO_2 in this Scenario.

3.17. **Table 5** summarises those receptor locations which experience a change in concentration greater than 0.2μg/m^3 (i.e. a change that would not be considered negligible by the IAQM criteria) where concentrations exceed the NO_2 AQS objective.

Table 5: Scenario 2 - Summary of Change in Concentrations at those Receptors which Exceed the Annual Mean NO_2 AQS Objective

	2027 Base - 2027 With Development (without highway works)	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
>4µg/m^3	9 (6)	-
>2-4µg/m^3	6 (0)	-
>0.2-2µg/m^3	61 (6)	-

Note: Figures in brackets indicate number of receptors where an exceedance is either created or an existing exceedance is removed.

3.18. As above, when considering the change in annual mean NO_2 concentrations with the Development in 2027 (without the junction highway works) against the 2027 baseline, the Development results in a worsening in concentrations at 76 locations which already exceed the annual mean NO_2 AQS objective, with potential new exceedances at 12 of those locations. In this scenario, no locations are predicted to experience an improvement in concentrations at locations which already exceed the annual mean NO_2 AQS objective.

3.19. The results in **Table A1 of Annex A** shows that in Scenario 2 there is a 100% increase in relative exposure and no reduction in relative exposure to annual mean NO_2 concentrations at properties located at Chalkers Corner

3.20. **Table 6** presents the significance of change in annual mean NO_2 concentrations at Chalker Corner for Scenario 2.

Table 6: Scenario 2 - Summary of Impact Significance for NO_2 Annual Mean at Sensitive Receptors

Significance of Impact (NO_2 Annual Mean)	2027 Base - 2027 With Development (without highway works)
Substantial Adverse	29
Moderate Adverse	41
Slight Adverse	45
Negligible	25
Total	**140**

3.21. As shown in **Table 6** assuming the Development is operational in 2027 without the junction highway works, substantial adverse to slight adverse impacts on annual mean NO_2 concentrations are predicted. The majority of residential properties at Chalkers Corner will have a worsening in annual mean NO_2 concentration of a slight adverse impact.

Scenario 3: With Stag Brewery Element With and Without Highway Works to Chalkers Corner Junction

3.22. **Table 7** presents the number of receptors at Chalkers Corner above and below the annual mean AQS Objective of 40µg/m^3 for Scenario 3 which considers the change in annual mean NO_2 from the 'with Development but without highway works to Chalkers Corner Junction' scenario compared to the 'with Development but with highway works to Chalkers Corner Junction' scenario (i.e. the impact of the highways works to Chalkers Corner Junction, assuming the Stag Brewery element of the Development is in place).

3.23. The results at each of the modelled receptors are presented in **Table A1 of Annex A** of this note.

Table 7: Scenario 3 - Summary of the Results of the ADMS-Roads Modelling at Residential Properties Located at Chalker's Corner Junction (NO_2)

	2027 With Development (without highways works)		2027 With Development (with highways works)	
	Above Annual Mean NO_2 Objective	Below Annual Mean NO_2 Objective	Above Annual Mean NO_2 Objective	Below Annual Mean NO_2 Objective
No. of Receptors	76	64	72 (-4)	68 (+4)

Note: Figures in brackets show the change in annual mean NO_2 concentrations between 2027 'with Development but without highway works' and 2027 'with Development but with highways works' scenarios.

3.24. In 2027 assuming the transport trips associated with the Development are operating at Chalkers Corner and then including the highways works to Chalker Corner Junction, four residential receptors are expected to have a decrease such that they would then be below the annual mean NO_2 AQS objective of 40µg/m^3.

3.25. As shown in **Table A1 of Annex A** in Scenario 3 modelled receptors experience both an increase and reduction in annual mean NO_2 concentrations. The increase in annual mean NO_2 concentration ranges between 0.1µg/m^3 and 0.5µg/m^3 and the reduction ranges between 0.1µg/m^3 to 3.9µg/m^3. The greatest increase of 0.5µg/m^3 is at Receptor J60 (located at the ground floor in Chersey Court) and the greatest reduction of 3.9µg/m^3 is at Receptors J21 and J22 (located at ground floor on Lower Richmond Road). The decreases are related to the realignment of the realignment of Lower Richmond Road 12m to the north east Chalkers Corner Junction.

3.26. **Table 8** summarises those receptor locations which experience a change in concentration greater than 0.2µg/m^3 (i.e. a change that would not be considered negligible by the IAQM criteria) where concentrations exceed the NO_2 AQS objective.

Table 8: Scenario 3 - Summary of Change in Concentrations at those Receptors which Exceed the Annual Mean NO_2 AQS Objective

	2027 With Development (without highway works) – 2027 With Development (with highway works)	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
>4µg/m^3	-	-
>2-4µg/m^3	-	23 (2)
>0.2-2µg/m^3	10 (0)	19 (2)

Note: Figures in brackets indicate number of receptors where an exceedance is either created or an existing exceedance is removed.

3.27. As above, when considering the change in annual mean NO_2 concentrations assuming the transport trips associated with the Development are operating at Chalkers Corner and then including the highways works to Chalker Corner Junction, the Development results in a worsening in concentrations at 10 locations which already exceed the annual mean NO_2 AQS objective. No new exceedances are predicted in this scenario. In addition, the Development results in a reduction in concentrations at 42 locations which already exceed the annual mean NO_2 AQS objective, with a potential reduction at 4 of those locations so that they are no longer exceeding the NO_2 AQS objective.

3.28. The results in **Table A1 of Annex A** shows that in Scenario 3 there is a 12% increase in relative exposure and a 88% reduction in relative exposure to annual mean NO_2 concentrations at properties located at Chalkers Corner.

3.29. **Table 9** presents the significance of change in annual mean NO_2 concentrations at Chalker Corner for Scenario 3.

Table 9: Scenario 3 - Summary of Impact Significance for NO_2 Annual Mean at Sensitive Receptors

Significance of Impact (NO_2 Annual Mean)	2027 With Development (without highway works) – 2027 With Development (with highway works)
Substantial Adverse	0
Moderate Adverse	7
Slight Adverse	2
Negligible	65
Slight Beneficial	21
Moderate Beneficial	17
Substantial Beneficial	28
Total	**140**

3.30. As shown in **Table 9** assuming the transport trips associated with the Development are operating at Chalkers Corner and then including the highways works to Chalker Corner Junction moderate adverse to substantial beneficial impacts on annual mean NO_2 concentrations are predicted. The majority of residential properties at Chalkers Corner will have an improvement in annual mean NO_2 concentration of a substantial beneficial impact.

Scenario 4: Future Change Assuming Development and Highway Works Against the Future Baseline

3.31. **Table 10** presents the number of receptors at Chalkers Corner above and below the annual mean AQS Objective of 40µg/m^3 for Scenario 4 which considers the change in annual mean NO_2 from the 2027 'Baseline' to the 2027 'with Development and with highways work to Chalker's Corner Junction' scenarios.

3.32. The results at each of the modelled receptors are presented in **Table A1 of Annex A** of this note.

Table 10: Scenario 4 - Summary of the Results of the ADMS-Roads Modelling at Residential Properties Located at Chalker's Corner Junction (NO_2)

	2027 Baseline		2027 With Development (with highways works)	
	Above Annual Mean NO_2 Objective	Below Annual Mean NO_2 Objective	Above Annual Mean NO_2 Objective	Below Annual Mean NO_2 Objective
No. of Receptors	64	76	72 (+8)	68 (-8)

Note: Figures in brackets show the change in annual mean NO_2 concentrations between 2027 'Baseline' and 'with Development but with highways works' scenarios.

3.33. In 2027, with the Development and including the highways works, an additional eight residential receptors will exceed the annual mean NO_2 AQS objective of 40µg/m^3.

3.34. As shown in **Table A1 of Annex A** in Scenario 4 modelled receptors experience both an increase and reduction in annual mean NO_2 concentrations. The increase in annual mean NO_2 concentration ranges between 0.1µg/m^3 and 1.0µg/m^3 and the reduction ranges between 0.1µg/m^3 to 3.2µg/m^3. The greatest increase of 1.0µg/m^3 is at Receptors J58 and J57 (located at the ground floor in Chersey Court) and the greatest reduction of 3.2µg/m^3 is at Receptors J21 (located at ground floor on Lower Richmond Road). The decreases are related to a reduction in congestion predicted at Chalkers Corner Junction.

3.35. **Table 11** summarises those receptor locations which experience a change in concentration greater than 0.2µg/m^3 (i.e. a change that would not be considered negligible by the IAQM criteria) where concentrations exceed the NO_2 AQS objective.

Table 11: Scenario 4 - Summary of Change in Concentrations at those Receptors which Exceed the Annual Mean NO_2 AQS Objective

	2027 Base -2027 With Development (with highway works)	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
>4µg/m^3	-	-
>2-4µg/m^3	-	6 (0)
>0.2-2µg/m^3	40 (8)	12 (0)

Note: Figures in brackets indicate number of receptors where an exceedance is either created or an existing exceedance is removed.

3.36. As above, when considering the change in annual mean NO_2 concentrations with the Development and including the highways works, the Development results in a worsening in concentrations at 40 locations which already exceed the annual mean NO_2 AQS objective. There are predicted to be eight new exceedances are predicted in this scenario. In addition, the Development results in a reduction in concentrations at 18 locations which already exceed the annual mean NO_2 AQS objective.

3.37. The results in **Table A1 of Annex A** shows that in Scenario 4 there is a 86% increase in relative exposure and a 14% reduction in relative exposure to annual mean NO_2 concentrations at properties located at Chalkers Corner.

3.38. **Table 12** presents the significance of change in annual mean NO_2 concentrations at Chalker Corner for Scenario 4.

Table 12: Scenario 4 - Summary of Impact Significance for NO_2 Annual Mean at Sensitive Receptors

Significance of Impact (NO_2 Annual Mean)	2027 Base -2027 With Development (with highway works)
Substantial Adverse	4
Moderate Adverse	31
Slight Adverse	22
Negligible	66
Slight Beneficial	0
Moderate Beneficial	4
Substantial Beneficial	13
Total	**140**

3.39. As shown in **Table 12** when considering the change in annual mean NO_2 concentrations with the Development and including the highways work, substantial adverse to substantial beneficial impacts on annual mean NO_2 concentrations are predicted. The majority of residential properties at Chalkers Corner will have a negligible impact.

Summary of Predicted Scenario Impacts

3.40. Table 13 presents a summary of the predicted impacts for each of the Scenarios above and shows that:

- Between 2016 and 2027 assuming no Development and no highways works to Chalkers Corner Junction (Scenario1) annual mean NO_2 concentrations are predicted to increase at all modelled receptors in Chalkers Corner, associated with an increase in local traffic between these years. There would be a 100% increase in relative exposure to annual mean NO_2 at all receptors;
- If the Stag Brewery element of the Development was operational without highways works to Chalkers Corner Junction (Scenario 2), annual mean NO_2 concentrations are predicted to increase at all modelled receptors in Chalkers Corner. This is associated with an increase in local traffic generated by the Development and increased congestion. There would be a 100% increase in relative exposure to annual mean NO_2 at all receptors;
- Considering the change in annual mean NO_2 as a result of the highways works to Chalkers Corner Junction (Scenario 3) with the Stag Brewery element of the Development operational, annual mean NO_2 concentrations are predicted to decrease on Lower Richmond Road but increase at Chertsey Court. This is associated with the realignment of Lower Richmond Road 12m to the north east. This realignment would improve annual mean NO_2 concentrations at properties at Lower Richmond Road as these properties are further distanced from vehicle tail pipe emissions, but the realignment would worsen concentrations at Chertsey Court as the road (and vehicle tail pipe emissions) moves closer to these properties. There would be an 80.8% increase in relative exposure to annual mean NO_2 at properties in Chertsey Court and an 100% decrease in relative exposure to annual mean NO_2 at properties at properties on Lower Richmond Road; and
- Comparing the Development (including the Stag Brewery element and highways works) to the future baseline (Scenario 4), as above annual mean NO_2 concentrations are predicted to decrease on Lower Richmond Road but increase at Chertsey Court, associated with the realignment of Lower Richmond Road. In addition, in this scenario there is an increase in traffic at Chalkers Corner related to the Development, resulting in an increase in annual mean NO_2 concentrations on Lower Richmond Road. Overall there would be a 100% increase in relative exposure to annual mean NO_2 at properties in Chertsey Court and a 41.3% increase in relative exposure to annual mean NO_2 at properties at properties on Lower Richmond Road; and
- Overall, based on the results in Table 13 it is considered that when compared to the without junction works scenario, the junction highway works have a beneficial effect on air quality.

Table 13: Summary of Change in Annual Mean NO_2 for the Scenarios Considered

Scenario	Scenario Description	Max Increase (NO_2) µg/m³		Max Decrease (NO_2) µg/m³		% Relative Exposure to annual mean NO_2 AQS objective					
						All Receptors		Lower Richmond Road		Chertsey Court	
		Lower Richmond Road	Chertsey Court	Lower Richmond Road	Chertsey Court	Increase	Decrease	Increase	Decrease	Increase	Decrease
1	Future Change Assuming No Development and No Highway Works (Current Situation)	2.7µg/m³	1.7µg/m³	-	-	100%	0	100%	0	100%	0
2	With Stag Brewery Element but Without Highway Works to Chalkers Corner Junction	4.4µg/m³	1.9µg/m³	-	-	100%	0	100%	0	100%	0
3	With Stag Brewery Element but With and Without Highway Works to Chalkers Corner Junction	-	0.5µg/m³	3.9µg/m³	2.7µg/m³	12%	88%	0	100%	80.8%	19.2%
4	Future Change Assuming Development and Highway Works Against the Future Baseline (The Development)	0.7µg/m³	1.0µg/m³	3.2µg/m³	-	86%	14%	41.3%	58.7%	100%	0%

4. Changes in Effective Travel Distance of Air (Chalkers Corner Mitigation)

4.1. As part of the Development and realignment of Chalkers Corner Junction some of the existing trees are proposed to be removed outside Chertsey Court and as shown in **Figure 2**, will be replaced with a 2 metres high wall and two landscaping areas of new mature planting. Both landscaping areas include 6 metres high mature trees outside Chertsey Court.

Figure 2: Chalkers Corner Proposed Landscaping

4.2. Compared to the existing landscaping outside Chertsey Court the proposed planting within the landscaping is denser; includes species which are evergreen so can capture pollutants throughout the year; and includes vegetation species selected to filter ambient pollutants.

4.3. Whilst green walls and green screens can have beneficial impacts to air quality by reducing the pathway of air flow and by capturing and filtering ambient pollutants, the benefits of green planting cannot be quantified (in $\mu g/m^3$) in air quality assessments due to the variability in the behaviour of plants related to local specific site conditions; local climatic conditions; and individual characteristics of plants.

4.4. The air quality modelling has identified the maximum increase in annual mean NO_2 with the Development at Chertsey Court is $1\mu g/m^3$ at Receptors J58 and J57 which are located on the corner of Lower Richmond Road at ground level. For these receptor locations, the proposed landscape mitigation will reduce the effective pathway of air, as air flow would travel up and over the new 2 metre wall and up and over the 6 metre trees (in both landscape areas), prior to reaching Chertsey Court.

4.5. Defra has produced a calculator that allows for the change in air quality concentrations due to effective/actual distance that the air travels to be calculated[2]. Whilst this calculator is generally used to understand the change in monitored air pollutant concentrations linearly away from a road, it is also considered appropriate to use to determine the likely change in annual mean NO_2 concentrations associated with a change in vertical distance as a result of the proposed landscaping.

4.6. Receptors J58 and J57 were predicted to have the greatest impact at Chertsey Court with the Development (see Scenario 4 above). To quantify the change in the effective travel distance of air from the road to Chertsey Corner, the ADMS-Roads model has been re-run for the With Development Scenario (which includes the Development and highways works to Chalker's Corner Junction) for a location on the roadside closest to Receptors J58 and J57 (modelled at National Grid Reference 519897, 175859). For this modelled roadside location, the annual mean NO_2 concentration has been derived using the methodology detailed in **Appendix 10.2** (as 41.3μg/m^3)**.**

4.7. Without landscaping the effective distance from the road to the façade of Chertsey Court has been measured as approximately 25 metres.

4.8. With the landscaping the effective distance from the road to the façade of Chertsey Court is approximately 37 metres. This has been calculated as 25 metres from the road to the façade of Chertsey Court (as mentioned above) plus 12 meters to take account of the air flowing up and down the 6 metres trees contained within the first landscaping area. The 2 metres new wall has been ignored as the new mature trees are located immediately behind this. In addition given that the second set of landscaping is smaller and provides protection at the corner of Chertsey Court only, this landscaping has also been ignored. The results are therefore conservative.

4.9. **Tables 14 and 15** present the calculations for Chertsey Corner without the landscaping and with the landscaping, taken directly from the Defra calculator. As above, it is noted the results in **Table 14 and Table 15** are not comparable to the modelled results for Receptors J58 and J57 as these concentrations have been derived from the Defra calculator which are based on the change in air quality concentrations due to effective/actual distance that the air travels rather than concentrations directly taken from the dispersion model.

[2] NO_2 Fall-off with Distance Calculator (Version 4.1)

Table 14: Effective Travel Distance of Annual Mean NO_2 at Chalkers Corner Without Landscape Mitigation

Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	2	metres
Step 2	How far from the KERB is your receptor (in metres)?	25	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	25	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	41.3	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	31.7	µg/m^3

Table 15: Effective Travel Distance of Annual Mean NO_2 at Chalkers Corner With Landscape Mitigation

Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	2	metres
Step 2	How far from the KERB is your receptor (in metres)?	37	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	25	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	41.3	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	30.2	µg/m^3

4.10. As shown in **Table 14** and in **Table 15**, the difference in annual mean NO_2 without and with the landscaping at Chertsey Court is 1.5µg/m^3. It is therefore considered that the proposed landscaping has the potential to reduce annual mean NO_2 concentrations within Chertsey Court by approximately 1.5µg/m^3 by reducing the effective travel distance of air.

5. Summary

5.1. Computer modelling has been carried out to predict the effect on local air quality from traffic related exhaust emissions and the highway works to the Chalkers Corner Junction following the completion of the Development. The impact of the Development on local air quality has been predicted for sensitive locations surrounding the junction. Following completion of the Development, and considering the likely beneficial impact of the landscaping (due to an increase in the effective travel distance to air) the highway works to Chalkers Corner Junction is predicted to have an **insignificant** impact on annual mean NO_2.

Annex A: Air Quality Modelled Results

Table A1: Results of the Modelling at Selected Receptors at the Chalkers Corner Junction

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development (with Junction Amendment)	Change: Base - With Development (with Junction Amendment)
J1	179 Lower Richmond Rd	**46.0**	**48.1**	**48.4**	**48.2**	2.1	0.3	-0.1	0.2
J2	179 Lower Richmond Rd	**43.4**	**45.3**	**45.6**	**45.4**	1.9	0.3	-0.1	0.1
J3	179 Lower Richmond Rd	**38.3**	39.7	39.9	39.8	1.4	0.2	-0.1	0.1
J4	179 Lower Richmond Rd	**33.9**	34.9	35.0	34.9	0.9	0.2	-0.1	0.1
J5	189 Lower Richmond Rd	**42.9**	**44.7**	**45.0**	**44.9**	1.8	0.3	-0.1	0.2
J6	2 South Circular	**45.4**	**47.4**	**47.7**	**47.5**	2.1	0.2	-0.1	0.1
J7	2a South Circular	**42.4**	**44.2**	**44.4**	**44.3**	1.8	0.2	-0.2	0.0
J8	4 South Circular	**45.5**	**47.6**	**47.8**	**47.6**	2.1	0.2	-0.1	0.1
J9	4a South Circular	**42.1**	**43.9**	**44.1**	**44.0**	1.8	0.2	-0.1	0.1
J10	6 South Circular	**42.9**	**44.7**	**44.9**	**44.8**	1.9	0.2	-0.1	0.1
J11	8 South Circular	**42.8**	**44.6**	**44.8**	**44.7**	1.9	0.2	-0.1	0.1
J12	67 Shalstone Road	**45.9**	**48.0**	**48.3**	**48.1**	2.1	0.2	-0.2	0.0
J13	1 Lower Richmond Road	**54.2**	**56.9**	**57.3**	**56.9**	2.7	0.4	-0.4	-0.1

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development (with Junction Amendment)	Change: Base - With Development (with Junction Amendment)
J14	2 Lower Richmond Road	**53.2**	**55.9**	**56.2**	**55.6**	2.7	0.4	-0.7	-0.3
J15	3 Lower Richmond Road	**49.9**	**52.4**	**52.7**	**51.9**	2.4	0.4	-0.9	-0.5
J16	4 Lower Richmond Road	**47.7**	**49.9**	**50.3**	**49.2**	2.2	0.4	-1.2	-0.8
J17	5 Lower Richmond Road	**46.3**	**48.4**	**48.8**	**47.4**	2.1	0.4	-1.4	-1.0
J18	6 Lower Richmond Road	**45.4**	**47.4**	**47.8**	**45.8**	2.0	0.5	-2.0	-1.6
J19	7 Lower Richmond Road	**44.5**	**46.5**	**47.0**	**44.4**	2.0	0.5	-2.5	-2.0
J20	8 Lower Richmond Road	**45.0**	**46.9**	**47.6**	**44.1**	2.0	0.6	-3.4	-2.8
J21	9 Lower Richmond Road	**45.5**	**47.5**	**48.2**	**44.3**	2.0	0.7	-3.9	-3.2
J22	10 Lower Richmond Road	**46.3**	**48.3**	**49.1**	**45.2**	2.0	0.8	-3.9	-3.1
J23	11 Lower Richmond Road	**46.6**	**48.7**	**49.5**	**46.1**	2.0	0.8	-3.4	-2.6
J24	12 Lower Richmond Road	**47.7**	**49.8**	**50.7**	**47.5**	2.1	0.9	-3.3	-2.4
J25	13 Lower Richmond Road	**46.4**	**48.4**	**49.3**	**46.8**	2.0	0.9	-2.5	-1.6
J26	14 Lower Richmond Road	**47.3**	**49.4**	**50.4**	**47.9**	2.1	1.0	-2.4	-1.5

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development (with Junction Amendment)	Change: Base - With Development (with Junction Amendment)
J27	15 Lower Richmond Road	**47.1**	**49.1**	**50.1**	**48.0**	2.0	1.0	-2.1	-1.1
J28	16 Lower Richmond Road	**46.8**	**48.8**	**49.8**	**48.0**	2.0	1.0	-1.8	-0.8
J29	17 Lower Richmond Road	**46.4**	**48.4**	**49.5**	**47.8**	2.0	1.1	-1.7	-0.6
J30	18 Lower Richmond Road	**46.1**	**48.0**	**49.2**	**47.6**	2.0	1.2	-1.6	-0.4
J31	19 Lower Richmond Road	**45.6**	**47.6**	**48.8**	**47.4**	1.9	1.2	-1.4	-0.2
J32	20 Lower Richmond Road	**45.2**	**47.1**	**48.4**	**47.1**	1.9	1.4	-1.3	0.0
J33	21 Lower Richmond Road	**44.7**	**46.5**	**48.1**	**46.8**	1.8	1.5	-1.3	0.2
J34	22 Lower Richmond Road	**45.3**	**47.1**	**49.1**	**47.7**	1.9	2.0	-1.5	0.5
J35	23 Lower Richmond Road	**44.1**	**45.9**	**48.4**	**46.6**	1.8	2.5	-1.8	0.7
J36	24 Lower Richmond Road	**42.8**	**44.5**	**47.7**	**45.2**	1.7	3.2	-2.5	0.7
J37	25 Lower Richmond Road	**41.9**	**43.6**	**47.2**	**44.2**	1.6	3.6	-3.0	0.7
J38	26 Lower Richmond Road	**41.3**	**42.9**	**46.7**	**43.5**	1.6	3.9	-3.2	0.6
J39	27 Lower Richmond Road	**40.8**	**42.3**	**46.3**	**42.9**	1.5	4.0	-3.4	0.6

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development (with Junction Amendment)	Change: Base - With Development (with Junction Amendment)
J40	28 Lower Richmond Road	39.6	**41.0**	**44.8**	**41.6**	1.4	3.8	-3.2	0.6
J41	29 Lower Richmond Road	39.9	**41.4**	**45.5**	**42.0**	1.4	4.2	-3.6	0.6
J42	30 Lower Richmond Road	38.9	**40.3**	**44.2**	**40.8**	1.4	4.0	-3.4	0.6
J43	31 Lower Richmond Road	38.5	39.9	**43.8**	**40.4**	1.3	4.0	-3.4	0.6
J44	32 Lower Richmond Road	38.2	39.5	**43.5**	**40.1**	1.3	4.0	-3.4	0.6
J45	33 Lower Richmond Road	38.6	**40.0**	**44.2**	**40.6**	1.3	4.2	-3.6	0.6
J46	34 Lower Richmond Road	38.5	39.9	**44.2**	**40.4**	1.3	4.3	-3.7	0.6
J47	35 Lower Richmond Road	37.6	38.9	**43.0**	39.4	1.2	4.1	-3.6	0.6
J48	36 Lower Richmond Road	38.0	39.3	**43.6**	39.9	1.3	4.4	-3.8	0.6
J49	1 Chertsey Court	35.7	36.9	39.5	37.3	1.1	2.6	-2.2	0.4
J50	2 Chertsey Court	35.9	37.0	39.5	37.5	1.1	2.5	-2.1	0.5
J51	3 Chertsey Court	36.3	37.5	39.7	38.0	1.2	2.2	-1.7	0.5
J52	4 Chertsey Court	36.9	38.1	**40.1**	38.7	1.2	1.9	-1.4	0.5
J53	5 Chertsey Court	37.7	39.0	**40.3**	39.7	1.3	1.3	-0.7	0.6
J54	6 Chertsey Court	38.1	39.4	**40.6**	**40.1**	1.4	1.1	-0.4	0.7

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development (with Junction Amendment)	Change: Base - With Development (with Junction Amendment)
J55	7 Chertsey Court	38.8	**40.2**	**41.2**	**41.0**	1.4	1.0	-0.2	0.8
J56	8 Chertsey Court	39.2	**40.7**	**41.5**	**41.6**	1.5	0.8	0.0	0.8
J57	9 Chertsey Court	**40.1**	**41.6**	**42.3**	**42.6**	1.5	0.7	0.3	1.0
J58	10 Chertsey Court	39.3	**40.8**	**41.4**	**41.8**	1.5	0.6	0.4	1.0
J59	11 Chertsey Court	39.3	**40.8**	**41.3**	**41.6**	1.5	0.5	0.3	0.9
J60	12 Chertsey Court	**41.0**	**42.6**	**43.1**	**43.5**	1.7	0.5	0.5	0.9
J61	13 Chertsey Court	**41.8**	**43.5**	**44.0**	**44.2**	1.7	0.4	0.2	0.6
J62	14 Chertsey Court	**41.4**	**43.1**	**43.5**	**43.5**	1.7	0.4	0.1	0.5
J63	15 Chertsey Court	**41.0**	**42.7**	**43.1**	**43.1**	1.7	0.4	0.0	0.4
J64	16 Chertsey Court	**40.7**	**42.3**	**42.7**	**42.7**	1.7	0.4	0.0	0.4
J65	17 Chertsey Court	**40.4**	**42.0**	**42.4**	**42.4**	1.6	0.4	-0.1	0.3
J66	18 Chertsey Court	**40.4**	**42.0**	**42.4**	**42.3**	1.6	0.4	-0.1	0.3
J67	19 Chertsey Court	**40.1**	**41.7**	**42.1**	**42.0**	1.6	0.4	-0.1	0.3
J68	20 Chertsey Court	**40.1**	**41.7**	**42.1**	**42.0**	1.6	0.4	-0.1	0.3
J69	21 Chertsey Court	35.7	36.8	39.8	37.3	1.1	3.0	-2.5	0.4
J70	22 Chertsey Court	35.4	36.4	39.5	36.9	1.1	3.1	-2.7	0.4
J71	23 Chertsey Court	34.8	35.8	39.0	36.3	1.0	3.1	-2.7	0.4
J72	1 Chertsey Court	34.8	35.8	38.0	36.2	1.0	2.2	-1.8	0.4
J73	2 Chertsey Court	34.9	36.0	38.1	36.4	1.1	2.1	-1.7	0.4
J74	3 Chertsey Court	35.3	36.4	38.3	36.8	1.1	1.9	-1.5	0.4
J75	4 Chertsey Court	35.8	37.0	38.6	37.4	1.1	1.6	-1.2	0.5

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development (with Junction Amendment)	Change: Base - With Development (with Junction Amendment)
J76	5 Chertsey Court	36.6	37.8	39.0	38.4	1.2	1.2	-0.6	0.6
J77	6 Chertsey Court	37.0	38.2	39.2	38.8	1.2	1.0	-0.4	0.6
J78	7 Chertsey Court	37.6	38.9	39.8	39.5	1.3	0.9	-0.2	0.6
J79	8 Chertsey Court	38.1	39.4	**40.2**	**40.1**	1.3	0.8	0.0	0.7
J80	9 Chertsey Court	38.9	**40.3**	**40.9**	**41.1**	1.4	0.7	0.2	0.9
J81	10 Chertsey Court	38.4	39.8	**40.4**	**40.7**	1.4	0.6	0.3	0.8
J82	11 Chertsey Court	38.5	39.9	**40.4**	**40.6**	1.4	0.5	0.3	0.8
J83	12 Chertsey Court	39.9	**41.5**	**41.9**	**42.3**	1.6	0.4	0.4	0.8
J84	13 Chertsey Court	**40.5**	**42.1**	**42.5**	**42.7**	1.6	0.4	0.2	0.6
J85	14 Chertsey Court	**40.1**	**41.6**	**42.0**	**42.1**	1.6	0.4	0.0	0.4
J86	15 Chertsey Court	39.7	**41.3**	**41.7**	**41.6**	1.6	0.4	0.0	0.4
J87	16 Chertsey Court	39.4	**40.9**	**41.3**	**41.3**	1.5	0.4	0.0	0.3
J88	17 Chertsey Court	39.2	**40.7**	**41.0**	**41.0**	1.5	0.4	-0.1	0.3
J89	18 Chertsey Court	39.1	**40.6**	**41.0**	**40.9**	1.5	0.4	-0.1	0.3
J90	19 Chertsey Court	38.9	**40.3**	**40.7**	**40.6**	1.5	0.4	-0.1	0.3
J91	20 Chertsey Court	38.8	**40.3**	**40.7**	**40.6**	1.5	0.3	-0.1	0.2
J92	21 Chertsey Court	34.6	35.6	38.1	36.0	1.0	2.5	-2.1	0.4
J93	22 Chertsey Court	34.3	35.2	37.9	35.6	1.0	2.6	-2.2	0.4
J94	23 Chertsey Court	33.8	34.7	37.4	35.1	0.9	2.7	-2.3	0.4
J95	1 Chertsey Court	32.7	33.5	34.9	33.8	0.8	1.4	-1.2	0.3
J96	2 Chertsey Court	32.8	33.7	35.0	34.0	0.8	1.4	-1.1	0.3

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development (with Junction Amendment)	Change: Base - With Development (with Junction Amendment)
J97	3 Chertsey Court	33.2	34.1	35.3	34.4	0.9	1.2	-0.9	0.3
J98	4 Chertsey Court	33.6	34.5	35.6	34.9	0.9	1.1	-0.7	0.3
J99	5 Chertsey Court	34.2	35.2	36.0	35.6	1.0	0.8	-0.4	0.4
J100	6 Chertsey Court	34.5	35.5	36.3	35.9	1.0	0.7	-0.4	0.4
J101	7 Chertsey Court	35.0	36.0	36.7	36.5	1.1	0.7	-0.2	0.4
J102	8 Chertsey Court	35.4	36.5	37.1	37.0	1.1	0.6	-0.1	0.5
J103	9 Chertsey Court	36.1	37.3	37.8	37.8	1.2	0.5	0.0	0.5
J104	10 Chertsey Court	36.2	37.4	37.9	38.0	1.2	0.5	0.1	0.6
J105	11 Chertsey Court	36.4	37.6	38.0	38.1	1.2	0.4	0.1	0.5
J106	12 Chertsey Court	37.3	38.6	39.0	39.2	1.3	0.4	0.2	0.6
J107	13 Chertsey Court	37.5	38.8	39.1	39.2	1.3	0.4	0.1	0.5
J108	14 Chertsey Court	37.0	38.3	38.7	38.7	1.3	0.4	0.0	0.4
J109	15 Chertsey Court	36.8	38.0	38.4	38.3	1.3	0.4	0.0	0.3
J110	16 Chertsey Court	36.5	37.7	38.1	38.0	1.2	0.3	-0.1	0.3
J111	17 Chertsey Court	36.3	37.5	37.8	37.7	1.2	0.3	-0.1	0.3
J112	18 Chertsey Court	36.2	37.4	37.7	37.6	1.2	0.3	-0.1	0.2
J113	19 Chertsey Court	36.0	37.2	37.5	37.4	1.2	0.3	-0.1	0.2
J114	20 Chertsey Court	35.9	37.1	37.4	37.3	1.2	0.3	-0.1	0.2
J115	21 Chertsey Court	32.4	33.2	34.8	33.5	0.8	1.6	-1.3	0.3
J116	22 Chertsey Court	32.0	32.8	34.5	33.1	0.8	1.7	-1.4	0.3
J117	23 Chertsey Court	31.7	32.4	34.2	32.7	0.7	1.8	-1.5	0.3

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development (with Junction Amendment)	Change: Base - With Development (with Junction Amendment)
J118	1 Chertsey Court	30.8	31.4	32.2	31.6	0.6	0.8	-0.6	0.2
J119	2 Chertsey Court	30.9	31.6	32.3	31.7	0.6	0.8	-0.6	0.2
J120	3 Chertsey Court	31.2	31.9	32.6	32.1	0.7	0.7	-0.5	0.2
J121	4 Chertsey Court	31.5	32.2	32.8	32.4	0.7	0.6	-0.4	0.2
J122	5 Chertsey Court	32.0	32.7	33.2	32.9	0.8	0.5	-0.3	0.2
J123	6 Chertsey Court	32.2	32.9	33.4	33.2	0.8	0.5	-0.3	0.2
J124	7 Chertsey Court	32.5	33.3	33.7	33.5	0.8	0.4	-0.2	0.2
J125	8 Chertsey Court	32.8	33.7	34.1	33.9	0.8	0.4	-0.2	0.2
J126	9 Chertsey Court	33.3	34.2	34.6	34.4	0.9	0.4	-0.1	0.3
J127	10 Chertsey Court	33.6	34.6	34.9	34.9	0.9	0.4	-0.1	0.3
J128	11 Chertsey Court	33.9	34.8	35.1	35.1	0.9	0.3	0.0	0.3
J129	12 Chertsey Court	34.3	35.3	35.6	35.6	1.0	0.3	0.0	0.3
J130	13 Chertsey Court	34.2	35.2	35.5	35.5	1.0	0.3	0.0	0.3
J131	14 Chertsey Court	33.9	34.8	35.1	35.1	1.0	0.3	0.0	0.3
J132	15 Chertsey Court	33.7	34.6	34.9	34.8	0.9	0.3	-0.1	0.2
J133	16 Chertsey Court	33.5	34.4	34.7	34.6	0.9	0.3	-0.1	0.2
J134	17 Chertsey Court	33.3	34.2	34.5	34.4	0.9	0.3	-0.1	0.2
J135	18 Chertsey Court	33.2	34.1	34.4	34.3	0.9	0.3	-0.1	0.2
J136	19 Chertsey Court	33.1	33.9	34.2	34.1	0.9	0.3	-0.1	0.2
J137	20 Chertsey Court	32.9	33.8	34.1	34.0	0.9	0.3	-0.1	0.2
J138	21 Chertsey Court	30.5	31.1	31.9	31.3	0.6	0.9	-0.7	0.2

ID	Receptor Name	2016 Baseline	2027 Baseline	2027 With Development (without Junction Amendment)	2027 With Development (with Junction Amendment)	Change: 2016 Baseline – 2027 Baseline	Change: Base- With Development (without Junction Amendment)	Change: With Development (without Junction Amendment) - With Development	Change: Base - With Development (with Junction Amendment)
J139	22 Chertsey Court	30.2	30.7	31.7	30.9	0.6	0.9	-0.8	0.2
J140	23 Chertsey Court	29.9	30.4	31.4	30.6	0.5	1.0	-0.8	0.2

Note: For accuracy, the changes have been calculated using the exact output from the ADMS-Roads model rather than the rounded numbers within Table A2. This explains where there may a slight difference in the calculated change in concentrations between the different scenarios.

waterman

UK and Ireland Office Locations