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GLADMAN DEVELOPMENTS LTD

LAND OFF HEMPSTED LANE, GLOUCESTER

AIR QUALITY ASSESSMENT

JANUARY 2020

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GLADMAN DEVELOPMENTS LTD

LAND OFF HEMPSTED LANE, GLOUCESTER

AIR QUALITY ASSESSMENT

JANUARY 2020

PREPARED BY:

[redacted]

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EXECUTIVE SUMMARY

A detailed air quality assessment, based on the potential impacts associated with a proposed development on Land off Hempsted Lane, Gloucester, has been conducted using the atmospheric dispersion model, ADMS. The assessment has been based upon a proposed development of up to 300 residential dwellings and associated infrastructure.

The assessment has also considered dust and fine particulate matter during the construction phase, and road traffic emissions during the operational phase. During the construction phase, the risk of dust soiling effects is classed as medium for earthworks and construction, and is classed as low for trackout; the risk of human health effects is classed as low for earthworks, construction and for trackout. Mitigation measures have been proposed to further reduce any potential impacts based on best practice guidance.

For the operational phase, annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations have been modelled at thirteen existing sensitive receptor locations, using the most recent Emission Factor Toolkit available from DEFRA (EFT v9.0). Predicted annual mean concentrations have been compared to the relevant air quality objectives.

The assessment concludes that the operational phase of the development will result in concentrations of NO_2, PM_{10} and $PM_{2.5}$ remaining below the air quality objectives, both without and with the development for the assessed years of 2025 and 2029. A sensitivity analysis has applied 2018 background pollution concentrations and vehicle emission factors to the 2025 opening year and 2029 future year to provide a robust conservative approach. The impact of the development is predicted to be negligible at all thirteen existing sensitive receptors that were assessed. Air quality effects are therefore considered to be not significant.

The assessment demonstrates that the proposed development will not lead to an unacceptable risk from air pollution, or to any breach in national objectives. Therefore, there are no material reasons in relation to air quality why the proposed scheme should not proceed, subject to appropriate planning conditions.

1 INTRODUCTION

1.1 Background

1.1.1 Wardell Armstrong LLP has been commissioned by Gladman Developments Ltd to undertake an air quality assessment for a proposed development at Land off Hempsted Lane, Gloucester.

1.1.2 The proposed development site is located to the south west of Gloucester. To the north, the site is bordered by existing residential dwellings. To the east there is the A430 with an industrial depot beyond. To the south the site is bordered by open land and to the west the site is bordered by Rea Lane with open land beyond.

1.1.3 From the information provided, it is understood that the proposals comprise a residential development and associated infrastructure, with access from Hempsted Lane. For the purposes of this assessment a scheme of up to 300 units has been assumed.

1.1.4 This report details the results of an air quality assessment undertaken to accompany a planning application for the proposed development. The report discusses the potential air quality impacts of the additional road traffic generated by the proposed development. Air pollutant concentrations are considered at existing sensitive receptor locations in the vicinity of the proposed development.

1.1.5 The report has been compiled using the most recent version of the Emission Factor Toolkit (EFT - version 9.0), which was released by DEFRA in May 2019.

2 LEGISLATION AND POLICY CONTEXT

2.1 Relevant Air Quality Legislation and Guidance

2.1.1 The air quality assessment has been undertaken in accordance with the following legislation and guidance:

- EU Ambient Air Quality Directive 2008/50/EC (i.e. the CAFE Directive);
- The Environment Act 1995;
- Department of Environment, Food and Rural Affairs, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, July 2007;
- The Air Quality Standards Regulations 2010;
- Department for Environment, Food and Rural Affairs, Local Air Quality Management Technical Guidance LAQM.TG(16), February 2018;
- Ministry of Housing, Communities and Local Government, National Planning Policy Framework, February 2019; and
- Department for Communities and Local Government, Planning Practice Guidance: Air Quality, March 2014.

2.1.2 Further details of these documents are included in **Appendix A**.

2.2 Assessment Criteria

2.2.1 The relevant air quality objectives and limit values for this assessment are included within Table 1.

Table 1: Air Quality Objectives and Limit Values Relevant to the Assessment*

Pollutant	Objective/Limit Value	Averaging Period	Obligation
Nitrogen Dioxide (NO_2)	200µg/m^3, not to be exceeded more than 18 times a year	1-hour mean	All local authorities
	40µg/m^3	Annual mean	All local authorities
Particulate Matter (PM_{10})	50µg/m^3, not to be exceeded more than 35 times a year	24-hour mean	England, Wales and Northern Ireland
	40µg/m^3	Annual mean	England, Wales and Northern Ireland
	18µg/m^3	Annual mean	Scotland only
Particulate Matter ($PM_{2.5}$)	Limit Value of 25µg/m^3	Annual mean	England, Wales and Northern Ireland
	10µg/m^3	Annual mean	Scotland only

Table 1: Air Quality Objectives and Limit Values Relevant to the Assessment*			
Pollutant	**Objective/Limit Value**	**Averaging Period**	**Obligation**
**In accordance with the Air Quality Standards Regulations 2010*			

2.2.2 Further details of where these objectives and limit values apply are detailed in **Appendix A**.

3 ASSESSMENT METHODOLOGY

3.1 Consultation and Scope of Assessment

3.1.1 The assessment methodology was discussed with Gupti Gosine, Community Wellbeing Manager at Gloucester City Council (GCC), via email correspondence between 14th August 2019 and 16th August 2019.

3.1.2 A summary of the consultation undertaken is provided in Table 2.

Table 2: Summary of Consultation

Assessment Stage	Proposed Method	Response
Construction phase assessment to consider dust and fine particulate matter (PM_{10})	Qualitative assessment in accordance with Institute of Air Quality Management (IAQM) guidance	Please ensure that management/mitigation and complaint considerations are included, also take into account routes to the construction site where schools may be located
Operational phase assessment to consider nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$)	Detailed assessment using the ADMS-Roads atmospheric dispersion model, in accordance with Environmental Protection UK (EPUK)/IAQM guidance, and with all predicted concentrations compared to air quality objectives/limit values	Please consider impacts on any nearby AQMAs likely to be impacted by increased traffic flows
	Meteorological data from Cheltenham/Gloucester recording station	No objection
	Background concentrations from 2017-based DEFRA default maps	No objection
	Model verification to be undertaken using diffusion tubes located in Gloucester	No objection
	Proposed scenarios: • A base year (2018); and • A proposed opening year (2025) and future year (2029), with and without the development in place.	Please look at a trend rather than a single year at least three years

3.1.3 All of the points raised by Gupti Gosine have been addressed;

- The construction phase assessment includes mitigation and complaint considerations, as well as advising the best route for construction traffic;
- Air quality impacts within the Priory Road AQMA have been modelled; and

- A qualitative assessment of the air quality trend has also been included in this report.

3.2 Construction Phase Assessment

3.2.1 To assess the impacts associated with dust and fine particulate matter releases during the construction phase of the development, an assessment has been undertaken in accordance with guidance from the Institute of Air Quality Management (IAQM)[1]. Further details of the construction assessment methodology are provided in **Appendix B**.

3.2.2 The closest sensitive human receptors to where construction phase activities will take place are mostly residential and are detailed in Table 3.

Table 3: Existing Sensitive Receptors Considered in the Construction Phase Assessment

Receptor	Direction from the Site	Approximate Distance from the Site Boundary (m)
Existing Residential Dwellings off High View and Hempsted Lane	North/North East	Approximately 18m at closest point
Existing Industrial Depot off A430	South East	Approximately 50m at closest point
Existing Residential Dwellings off Rea Lane	South West	Approximately 10m at closest point

3.2.3 There are no ecological receptors, or potentially dust sensitive statutory designated habitat sites, within 50m of the site and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s). Ecological effects do not therefore need to be considered within this assessment.

3.2.4 The criteria used to assess the construction impact of the proposed development, and the associated significance of effects at existing sensitive receptors, are included in **Appendix B**.

[1] Institute of Air Quality Management, Guidance on the Assessment of Dust from Demolition and Construction, February 2014

3.3 Operational Phase Assessment

3.3.1 The air dispersion model ADMS-Roads (CERC, Version 4.1) has been used to assess the impacts associated with road traffic emissions during the operational phase assessment. The impacts have been assessed in accordance with guidance from Environmental Protection UK (EPUK) and the IAQM[2]. Further details of the modelling and assessment methodology are provided in **Appendix C**.

3.3.2 NO_2, PM_{10} and $PM_{2.5}$ concentrations have been predicted at existing and proposed sensitive receptors, as these are the pollutants considered most likely to exceed the objectives and limit values.

3.3.3 Air dispersion modelling has been carried out to estimate pollutant concentrations, due to road traffic emissions, for five assessment scenarios as follows:

- **Scenario 1:** 2018 and Base Year, the most recent year for which traffic flow information and meteorological data is available;
- **Scenario 2:** 2025 Opening Year, without the proposed development in place;
- **Scenario 3:** 2025 Opening Year, with the proposed development in place, assuming 100% occupancy;
- **Scenario 4:** 2029 Future Year, without the proposed development in place; and
- **Scenario 5:** 2029 Future Year, with the proposed development in place, assuming 100% occupancy.

3.3.4 Scenario 3 is considered to be conservative and robust, as it is unlikely that the development will be fully built and occupied by 2025.

Existing Sensitive Receptors

3.3.5 A number of representative existing sensitive receptors (identified as ESR 1 to ESR 13) have been selected for consideration in the air quality assessment. These have been chosen based on their proximity to roads which will be affected by development generated traffic. Receptors 1, 2 and 3 have been modelled with the exact same grid coordinates as the three diffusion tubes located within the Priory Road AQMA.

3.3.6 Details of these receptors considered are provided in Table 4, and their locations are shown on drawing GM10710-019.

[2] Moorcroft and Barrowcliffe et al, Land-Use Planning and Development Control: Planning for Air Quality (v1.2), January 2017

Table 4: Existing Sensitive Receptors Considered in Operational Phase Assessment				
Receptor	Address	Grid Reference		Receptor Type
		Easting	Northing	
ESR 1*	St Oswald's Road	382898	219029	Residential
ESR 2*		382921	219034	Residential
ESR 3*		382950	219040	Residential
ESR 4	Wharfside Close	382079	217204	Residential
ESR 5	Soren Larsen Way	382005	216940	Residential
ESR 6		381980	216871	Residential
ESR 7		381973	216844	Residential
ESR 8	The Gallops	381925	216845	Residential
ESR 9	Hempsted Lane	381815	216503	Residential
ESR 10		381856	216459	Residential
ESR 11	Bristol Road	382328	216840	Residential
ESR 12		382410	217013	Residential
ESR 13		382606	217292	Residential
**Located inside the Priory Road AQMA*				

3.3.7 The criteria used to assess the operational impact of the proposed development, and the associated significance of effects at existing sensitive receptors, are included in **Appendix C**.

Proposed Sensitive Receptors

3.3.8 Two proposed sensitive receptors (referred to as PR 1 and PR 2) have been selected within the development site boundary. These receptors are considered to be representative of the proposed residential areas which will be closest to the main existing source(s) of pollution. In this case, the main source is considered to be vehicle emissions from Hempsted Lane and the A430.

3.3.9 Pollutant concentrations at the proposed receptors have been predicted for scenarios 3 and 5 only (as detailed in paragraph 3.3.3). It is only necessary to consider the 'with development' scenarios for the proposed receptors as they will not experience any 'without development' conditions. It is not therefore necessary to consider the changes in pollutant concentrations at the proposed receptors.

3.3.10 Details of the proposed sensitive receptor are provided in Table 5, and the location is shown on drawing GM10710-019.

Table 5: Proposed Sensitive Receptors Considered in the Operational Phase Assessment

Receptor Point	Location	Grid Reference	
		Easting	Northing
PR 1	Location considered to be representative of the closest proposed residential properties to Hempsted Lane and the A430	381778	216468
PR 2	Location considered to be representative of the closest proposed residential properties to Hempsted Lane	381708	216585

3.3.11 The predicted concentrations at the proposed receptors have been assessed against the air quality objectives and limit values detailed in Table 1.

3.4 Limitations and Uncertainties

3.4.1 At present, there is a degree of uncertainty associated with the prediction of future NO_2 concentrations, and consequently the assessment of impacts relating to development generated road traffic emissions.

3.4.2 Air quality assessments make use of official sources of information (i.e. vehicle emission factors and background concentrations) which are increasingly considered to be overly optimistic. Monitoring data collected by the UK Government and local authorities shows that annual mean NO_2 concentrations have remained higher than previously expected (especially in roadside locations). This is widely thought to be due to the lower than expected decline in NO_x emissions from diesel vehicles (even as new Euro standards have been introduced), coupled with an overall increase in the number of diesel vehicles on the road.

3.4.3 The vehicle emission factors used in this assessment are from Defra's Emission Factor Toolkit (EFT v9.0.[3]), which is the most up-to-date version available. Although this is considered to be more realistic than earlier versions, uncertainty remains.

3.4.4 A position statement has recently been produced by the IAQM which deals specifically with the use of EFT v8.0 and the consideration of uncertainties in predicting future air quality[4]. The statement concludes that the approaches for dealing with this uncertainty should be decided on a case-by-case basis, but may include use of a sensitivity test in which it is assumed that NO_x emissions will not reduce as quickly as within the EFT. The statement also highlights the need for careful consideration of the results of any sensitivity test, particularly with regard to assessing impacts and the significance of effects. A precautionary approach is recommended. As yet no IAQM update has been provided for EFTv9, however it is considered that uncertainty still exists.

3.4.5 This assessment has taken into account the uncertainties associated with predicting future air quality with a sensitivity analysis, by applying 2018 background pollution concentrations and vehicle emission factors to the 2025 opening year and 2029 future year, to provide a robust conservative approach. Further details of the methodology are provided in **Appendix C** and the results are detailed in section 5 of this report.

[3] Defra Local Air Quality Management webpages (https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html)
[4] Institute of Air Quality Management, Dealing with Uncertainty in Vehicle NO_x Emissions within Air Quality Assessments v1.1, July 2018

4 BASELINE SITUATION

4.1 Gloucester City Council Local Air Quality Management

4.1.1 The proposed development site is located within the administrative area of Gloucester City Council (GCC), which is responsible for the management of local air quality.

4.1.2 There are currently three AQMAs declared by GCC, as a result of exceedances of the annual mean NO_2 objective.

4.1.3 The nearest AQMA to the proposed development is located approximately 2.6km to the north along St Oswald's Road and Priory Road, Gloucester.

4.1.4 There are a number of roadside NO_2 diffusion tubes located in and around the Priory Road AQMA and along Bristol Road. Monitoring data for 2018, provided by GCC, showed annual mean NO_2 concentrations of between 23.00 and 47.45 µg/m^3 in the vicinity of the proposed development.

4.1.5 Table 6 below analyses the monitored air quality trend over the last five years for the five diffusion tubes that were used for model verification. Diffusion tubes 1 and 2 show a clear year on year reduction in pollution concentrations. The trend is less clear with diffusion tubes 23, 24 and 25, however they are all showing a significant improvement over 2014 concentrations.

Table 6: Qualitative Assessment of the Monitors used for Model Verification Purposes.

Diffusion Tube Reference	Annual Mean Concentrations (µg/m^3)				
	2014	2015	2016	2017	2018
1	27.6	25.9	27.2	25.0	23.0
2	26.9	25.3	26.2	23.9	23.2
23*	60.5	40.3	44.9	42.8	46.3
24*	70.7	43.0	51.1	48.3	47.4
25*	58.5	49.2	52.1	46.7	47.1

**Located inside the Priory Road AQMA*

4.2 Background Air Pollutant Concentrations

4.2.1 The air quality assessment needs to take into account background concentrations upon which the local, traffic derived pollution is superimposed.

4.2.2 As there are currently no representative background NO_2, PM_{10} or $PM_{2.5}$ monitoring locations in the vicinity of the proposed development site, background concentrations have been obtained from the 2017-based Defra default concentration maps, for the appropriate grid squares[5].

4.2.3 The background pollutant concentrations used in this assessment are detailed in Table 7.

Table 7: Background Pollutant Concentrations Used in the Air Quality Assessment.

Pollutant	Annual Mean Concentrations (µg/m³)			
	NOx	NO_2	PM_{10}	$PM_{2.5}$
2018 Base Year				
ESR 1 – ESR 3 (382500, 219500)	20.40	14.51	13.46	8.79
ESR 4, ESR 12 and ESR 13 (382500, 217500)	20.81	14.74	14.16	9.37
ESR 5 and ESR 11 (382500, 216500)	17.18	12.44	13.32	9.16
ESR 6 – ESR 10, PR 1 and PR 2 (381500, 216500)	15.09	11.10	13.36	8.69
2025				
ESR 1 – ESR 3 (382500, 219500)	15.59	11.39	12.58	8.03
ESR 4, ESR 12 and ESR 13 (382500, 217500)	16.40	11.92	13.27	8.62
ESR 5 and ESR 11 (382500, 216500)	13.67	10.12	12.44	8.42
ESR 6 – ESR 10, PR 1 and PR 2 (381500, 216500)	11.75	8.82	12.50	7.96
2029				
ESR 1 – ESR 3 (382500, 219500)	13.90	10.27	12.52	7.97
ESR 4, ESR 12 and ESR 13 (382500, 217500)	15.12	11.05	13.22	8.57

[5] Accessed through the Defra Local Air Quality Management webpages (http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html)

Table 7: Background Pollutant Concentrations Used in the Air Quality Assessment.				
Pollutant	**Annual Mean Concentrations (µg/m^3)**			
	NOx	**NO_2**	**PM_{10}**	**$PM_{2.5}$**
ESR 5 and ESR 11 (382500, 216500)	12.67	9.42	12.38	8.37
ESR 6 – ESR 10, PR 1 and PR 2 (381500, 216500)	10.79	8.14	12.44	7.90
**Obtained from the Defra 2017-based background maps*				

4.3 Modelled Baseline Concentrations at Existing Sensitive Receptors

4.3.1 The baseline assessment (i.e. scenarios 1, 2 and 4) has been carried out for the existing sensitive receptors considered, in accordance with Defra guidance (i.e. using EFT v9.0). The adjusted NO_2 and unadjusted PM_{10} and $PM_{2.5}$ concentrations are detailed in Table 8.

Table 8: Predicted Adjusted NO_2 and Unadjusted PM_{10} and $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 1, 2 and 4									
Receptor	**Calculated Annual Mean Concentrations (µg/m^3)**								
	Scenario 1: 2018 Base Year			**Scenario 2: 2025 Opening Year, Without Development**			**Scenario 4: 2029 Future Year, Without Development**		
	NO_2	**PM_{10}**	**$PM_{2.5}$**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**
ESR 1	52.28	15.06	9.75	35.59	14.16	8.92	28.30	14.15	8.88
ESR 2	50.29	14.94	9.68	34.22	14.04	8.85	27.26	14.02	8.81
ESR 3	53.27	14.84	9.64	35.96	13.92	8.80	28.56	13.90	8.75
ESR 4	25.25	15.75	10.29	18.36	14.88	9.51	15.78	14.87	9.47
ESR 5	19.54	14.29	9.72	14.42	13.41	8.96	12.56	13.38	8.92
ESR 6	21.99	14.59	9.42	15.27	13.71	8.64	12.84	13.68	8.60
ESR 7	22.45	14.60	9.44	15.53	13.72	8.65	13.03	13.69	8.60
ESR 8	17.10	14.03	9.09	12.37	13.16	8.33	10.72	13.12	8.28
ESR 9	17.61	14.14	9.15	12.78	13.29	8.40	11.02	13.25	8.35
ESR 10	17.62	14.12	9.14	12.67	13.25	8.38	10.94	13.21	8.33
ESR 11	19.17	14.23	9.69	13.98	13.35	8.92	12.23	13.32	8.88

Table 8: Predicted Adjusted NO_2 and Unadjusted PM_{10} and $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 1, 2 and 4

Receptor	Calculated Annual Mean Concentrations (µg/m³)								
	Scenario 1: 2018 Base Year			Scenario 2: 2025 Opening Year, Without Development			Scenario 4: 2029 Future Year, Without Development		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
ESR 12	21.74	15.12	9.93	15.94	14.23	9.15	13.99	14.20	9.11
ESR 13	22.09	15.17	9.96	16.14	14.28	9.17	14.14	14.25	9.14

NO_2 concentrations obtained by inputting predicted NO_x concentrations into the NO_x to NO_2 calculator[6] in accordance with LAQM.TG(16)
Underlined concentrations indicate an exceedance of the air quality objective

4.3.2 The results show that for the 2018 base year there is a predicted exceedance of the NO_2 air quality objective at ESR 1, ESR 2 and ESR 3, which are all located inside the Priory Road AQMA.

4.3.3 The results show that all predicted PM_{10} and $PM_{2.5}$ concentrations are below the relevant objectives and limit values.

[6] Defra Local Air Quality Management webpages (http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html)

5 IMPACT ASSESSMENT

5.1 Construction Phase Assessment

Step 2 – Impact Assessment

5.1.1 In accordance with the IAQM guidance, the main activities to be considered during the construction phase of the proposed development are demolition, earthworks, construction and trackout. There are no demolition activities proposed, and so no further consideration is required.

5.1.2 Earthworks covers the processes of soil-stripping, ground-levelling, excavation and landscaping. Construction activities will focus on the proposed buildings, access roads and car parking areas. Trackout is defined as the transport of dust and dirt by vehicles travelling from a construction site on to the public road network. This may occur through the spillage of dusty materials onto road surfaces or through the transportation of dirt by vehicles that have travelled over muddy ground on the site. This dust and dirt can then be deposited and resuspended by other vehicles.

Step 2A

5.1.3 Step 2A of the assessment defines the potential dust emission magnitude from earthworks, construction and trackout in the absence of site-specific mitigation.

5.1.4 Examples of the criteria for the dust emission classes are detailed in **Appendix B**. The results of this step are detailed in Table 9.

Step 2B

5.1.5 Step 2B of the construction phase dust assessment defines the sensitivity of the area, taking into account the significance criteria detailed in **Appendix B**, for earthworks, construction and trackout. The sensitivity of the area to each activity is assessed for potential dust soiling, human health effects and ecological effects.

5.1.6 For earthworks and construction, there are currently between 10 and 100 receptors (mainly residential) within 50m of where these activities may take place, which is assumed to be the site boundary for the purposes of this assessment.

5.1.7 As a result, for trackout, there are between 1 and 10 receptors (mainly residential) within 50m of where trackout may occur for a distance of up to 500m from the site entrance, assuming that construction traffic travels south along the A430.

Step 2C

5.1.8 Step 2C of the construction phase dust assessment defines the risk of impacts from each activity, by combining the dust emission magnitude with the sensitivity of the surrounding area.

5.1.9 The risk of dust impacts from each activity, with no mitigation in place, has been assessed in accordance with the criteria detailed in **Appendix B**. The results of this step are detailed in Table 9.

Summary of Step 2

5.1.10 Table 9 details the results of Step 2 of the construction phase assessment for human receptors.

Table 9: Construction Phase Dust Assessment for Human Receptors

	Activity			
	Demolition	**Earthworks**	**Construction**	**Trackout**
Step 2A				
Dust Emission Magnitude	N/A	Large[a]	Large[b]	Medium[c]
Step 2B				
Sensitivity of Closest Receptors	N/A	High	High	High
Sensitivity of Area to Dust Soiling Effects	N/A	Medium	Medium	Low
Sensitivity of Area to Human Health Effects	N/A	Low[d]	Low[d]	Low[d]
Step 2C				
Dust Risk: Dust Soiling	N/A	Medium Risk	Medium Risk	Low Risk
Dust Risk: Human Health	N/A	Low Risk	Low Risk	Low Risk

a. Total site area estimated to be greater than 10,000m^2
b. Total building volume estimated to be greater than 100,000m^3, with potentially dusty construction materials
c. Number of construction phase vehicles estimated to be between 10-50 movements per day
d. Background annual mean PM_{10} concentration is taken from the LAQM Defra default concentration maps, for the appropriate grid square for 2018

Step 3 – Mitigation

5.1.11 During the construction phase, the implementation of effective mitigation measures will substantially reduce the potential for nuisance dust and particulate matter to be generated.

5.1.12 Step 2C of the assessment has identified that the risk of dust soiling and human health effects is not negligible for all the activities and therefore site-specific mitigation will need to be implemented to ensure dust effects from these activities will be not significant.

Recommendations for Site-Specific Mitigation

5.1.13 Specific mitigation relating to dust control may be in the form of construction best practices or could include a dust management plan. Recommendations for mitigation within the IAQM guidance include:

- Revegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- Protect surfaces and exposed material from winds until disturbed areas are sealed and stable;
- Dampen down exposed stored materials, which are to be stored as far from sensitive receptors as possible;
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place;
- Avoid activities that generate large amounts of dust during windy conditions;
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery;
- Avoid dry sweeping of large areas;
- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use;
- Ensure vehicles entering and leaving the site are covered to prevent escape of materials during transport;

- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable);
- Minimise vehicle movements and limit vehicle speeds – the slower the vehicle speeds, the lower the dust generation;
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever the site size and layout permits; and
- Access gates to be located at least 10m from receptors, where possible.

5.1.14 All dust and air quality complaints should be recorded, and appropriate measures be taken to identify causes and reduce emissions in a timely manner. Exceptional incidents which cause dust and/or emissions, and the action taken to resolve the situation, should be recorded in a logbook and made available to GCC on request.

5.1.15 It is recognised that the final design solutions will be developed with the input of the Contractor to maximise construction efficiencies, to use modern construction techniques and sustainable materials and to incorporate the particular skills and experience offered by the appointed contractor.

Step 4 – Residual Effects

5.1.16 Step 4 of the construction phase dust assessment has been undertaken to determine the significance of the dust effects arising from earthworks, construction and trackout associated with the proposed development.

5.1.17 The implementation of effective mitigation measures during the construction phase, such as those detailed in Step 3, will substantially reduce the potential for nuisance dust and particulate matter to be generated and any residual impact should be **not significant**.

5.2 Operational Phase – Impact Assessment

Existing Sensitive Human Receptors

5.2.1 The impact assessment has been carried out for the representative existing sensitive receptors considered (i.e. ESR 1 to ESR 13).

5.2.2 Table 10 details the predicted NO_2 concentrations for the 2025 Opening Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 10: Predicted Adjusted NO_2 Concentrations at Existing Sensitive Receptors for Scenarios 2 and 3, Assuming 100% Occupancy

Receptor	Calculated Annual Mean NO_2 Concentrations (µg/m^3)[a]				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[b]
		Concentration	Percentage in Relation to AQAL		
ESR 1	35.59	35.65	76-94%	<0.5%	**Negligible**
ESR 2	34.22	34.28	76-94%	<0.5%	**Negligible**
ESR 3	35.96	36.02	76-94%	<0.5%	**Negligible**
ESR 4	18.36	18.53	<75%	<0.5%	**Negligible**
ESR 5	14.42	14.53	<75%	<0.5%	**Negligible**
ESR 6	15.27	15.45	<75%	<0.5%	**Negligible**
ESR 7	15.53	15.72	<75%	<0.5%	**Negligible**
ESR 8	12.37	12.47	<75%	<0.5%	**Negligible**
ESR 9	12.78	13.10	<75%	1%	**Negligible**
ESR 10	12.67	12.79	<75%	<0.5%	**Negligible**
ESR 11	13.98	13.98	<75%	<0.5%	**Negligible**
ESR 12	15.94	15.95	<75%	<0.5%	**Negligible**
ESR 13	16.14	16.15	<75%	<0.5%	**Negligible**

a. NO_2 concentrations obtained by inputting predicted NO_x concentrations into the NO_x to NO_2 calculator, in accordance with LAQM.TG(16)

b. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration

5.2.3 Table 11 details the PM_{10} concentrations for the 2025 Opening Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 11: Predicted Unadjusted PM_{10} Concentrations at Existing Sensitive Receptors for Scenarios 2 and 3, Assuming 100% Occupancy

Receptor	Calculated Annual Mean PM_{10} Concentrations (µg/m³)				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[a]
		Concentration	Percentage in Relation to AQAL		
ESR 1	14.16	14.17	<75%	<0.5%	**Negligible**
ESR 2	14.04	14.04	<75%	<0.5%	**Negligible**
ESR 3	13.92	13.92	<75%	<0.5%	**Negligible**
ESR 4	14.88	14.92	<75%	<0.5%	**Negligible**
ESR 5	13.41	13.44	<75%	<0.5%	**Negligible**
ESR 6	13.71	13.74	<75%	<0.5%	**Negligible**
ESR 7	13.72	13.76	<75%	<0.5%	**Negligible**
ESR 8	13.16	13.18	<75%	<0.5%	**Negligible**
ESR 9	13.29	13.35	<75%	<0.5%	**Negligible**
ESR 10	13.25	13.27	<75%	<0.5%	**Negligible**
ESR 11	13.35	13.35	<75%	<0.5%	**Negligible**
ESR 12	14.23	14.23	<75%	<0.5%	**Negligible**
ESR 13	14.28	14.28	<75%	<0.5%	**Negligible**

a. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration

5.2.4 Table 12 details the $PM_{2.5}$ concentrations for the 2025 Opening Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 12: Predicted Unadjusted $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 2 and 3, Assuming 100% Occupancy

Receptor	Calculated Annual Mean $PM_{2.5}$ Concentrations (µg/m³)				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[a]
		Concentration	Percentage in Relation to AQAL		
ESR 1	8.92	8.92	<75%	<0.5%	**Negligible**

Table 12: Predicted Unadjusted $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 2 and 3, Assuming 100% Occupancy

Receptor	Calculated Annual Mean $PM_{2.5}$ Concentrations (µg/m³)				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[a]
		Concentration	Percentage in Relation to AQAL		
ESR 2	8.85	8.85	<75%	<0.5%	**Negligible**
ESR 3	8.80	8.80	<75%	<0.5%	**Negligible**
ESR 4	9.51	9.53	<75%	<0.5%	**Negligible**
ESR 5	8.96	8.97	<75%	<0.5%	**Negligible**
ESR 6	8.64	8.66	<75%	<0.5%	**Negligible**
ESR 7	8.65	8.67	<75%	<0.5%	**Negligible**
ESR 8	8.33	8.34	<75%	<0.5%	**Negligible**
ESR 9	8.40	8.43	<75%	<0.5%	**Negligible**
ESR 10	8.38	8.39	<75%	<0.5%	**Negligible**
ESR 11	8.92	8.92	<75%	<0.5%	**Negligible**
ESR 12	9.15	9.15	<75%	<0.5%	**Negligible**
ESR 13	9.17	9.17	<75%	<0.5%	**Negligible**

a. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration

5.2.5 Table 13 details the predicted NO_2 concentrations for the 2029 Future Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 13: Predicted Adjusted NO_2 Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy

Receptor	Calculated Annual Mean NO_2 Concentrations (µg/m³)[a]				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[b]
		Concentration	Percentage in Relation to AQAL		
ESR 1	28.30	28.35	<75%	<0.5%	**Negligible**
ESR 2	27.26	27.30	<75%	<0.5%	**Negligible**

Table 13: Predicted Adjusted NO_2 Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy

Receptor	Calculated Annual Mean NO_2 Concentrations (µg/m³)[a]				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[b]
		Concentration	Percentage in Relation to AQAL		
ESR 3	28.56	28.60	<75%	<0.5%	**Negligible**
ESR 4	15.78	15.91	<75%	<0.5%	**Negligible**
ESR 5	12.56	12.65	<75%	<0.5%	**Negligible**
ESR 6	12.84	12.97	<75%	<0.5%	**Negligible**
ESR 7	13.03	13.17	<75%	<0.5%	**Negligible**
ESR 8	10.72	10.79	<75%	<0.5%	**Negligible**
ESR 9	11.02	11.25	<75%	1%	**Negligible**
ESR 10	10.94	11.03	<75%	<0.5%	**Negligible**
ESR 11	12.23	12.24	<75%	<0.5%	**Negligible**
ESR 12	13.99	13.99	<75%	<0.5%	**Negligible**
ESR 13	14.14	14.14	<75%	<0.5%	**Negligible**

a. NO2 concentrations obtained by inputting predicted NOx concentrations into the NOx to NO2 calculator, in accordance with LAQM.TG(16)
b. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration

5.2.6 Table 14 details the PM_{10} concentrations for the 2029 Future Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 14: Predicted Unadjusted PM_{10} Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy

Receptor	Calculated Annual Mean PM_{10} Concentrations (µg/m³)				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[a]
		Concentration	Percentage in Relation to AQAL		
ESR 1	14.15	14.16	<75%	<0.5%	**Negligible**
ESR 2	14.02	14.03	<75%	<0.5%	**Negligible**

Table 14: Predicted Unadjusted PM_{10} Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy					
Receptor	**Calculated Annual Mean PM_{10} Concentrations (µg/m³)**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[a]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 3	13.90	13.90	<75%	<0.5%	**Negligible**
ESR 4	14.87	14.91	<75%	<0.5%	**Negligible**
ESR 5	13.38	13.41	<75%	<0.5%	**Negligible**
ESR 6	13.68	13.72	<75%	<0.5%	**Negligible**
ESR 7	13.69	13.73	<75%	<0.5%	**Negligible**
ESR 8	13.12	13.14	<75%	<0.5%	**Negligible**
ESR 9	13.25	13.31	<75%	<0.5%	**Negligible**
ESR 10	13.21	13.24	<75%	<0.5%	**Negligible**
ESR 11	13.32	13.32	<75%	<0.5%	**Negligible**
ESR 12	14.20	14.20	<75%	<0.5%	**Negligible**
ESR 13	14.25	14.25	<75%	<0.5%	**Negligible**
a. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration					

5.2.7 Table 15 details the $PM_{2.5}$ concentrations for the 2029 Future Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 15: Predicted Unadjusted $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy					
Receptor	**Calculated Annual Mean $PM_{2.5}$ Concentrations (µg/m³)**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[a]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 1	8.88	8.88	<75%	<0.5%	**Negligible**
ESR 2	8.81	8.81	<75%	<0.5%	**Negligible**
ESR 3	8.75	8.75	<75%	<0.5%	**Negligible**

Table 15: Predicted Unadjusted $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy					
Receptor	**Calculated Annual Mean $PM_{2.5}$ Concentrations (µg/m³)**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[a]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 4	9.47	9.50	<75%	<0.5%	**Negligible**
ESR 5	8.92	8.93	<75%	<0.5%	**Negligible**
ESR 6	8.60	8.62	<75%	<0.5%	**Negligible**
ESR 7	8.60	8.63	<75%	<0.5%	**Negligible**
ESR 8	8.28	8.30	<75%	<0.5%	**Negligible**
ESR 9	8.35	8.39	<75%	<0.5%	**Negligible**
ESR 10	8.33	8.35	<75%	<0.5%	**Negligible**
ESR 11	8.88	8.88	<75%	<0.5%	**Negligible**
ESR 12	9.11	9.11	<75%	<0.5%	**Negligible**
ESR 13	9.14	9.14	<75%	<0.5%	**Negligible**
a. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration					

5.2.8 The results of the assessment show that all predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations, in all scenarios considered, are below the relevant objectives and limit values.

Proposed Sensitive Human Receptors

5.2.9 Pollutant concentrations have been modelled for the proposed receptors for the 2025 'With Development' scenario, in accordance with Defra guidance (i.e. using EFT v9.0), as detailed in Table 16.

Table 16: Predicted Adjusted NO_2, and Unadjusted PM_{10} and $PM_{2.5}$ Concentrations at the Proposed Sensitive Receptor for Scenario 3			
Proposed Receptor	**Calculated Annual Mean Concentrations (µg/m³)**		
	NO_2	**PM_{10}**	**$PM_{2.5}$**
PR 1	12.14	13.21	8.35

Table 16: Predicted Adjusted NO_2, and Unadjusted PM_{10} and $PM_{2.5}$ Concentrations at the Proposed Sensitive Receptor for Scenario 3			
Proposed Receptor	**Calculated Annual Mean Concentrations (µg/m³)**		
	NO_2	**PM_{10}**	**$PM_{2.5}$**
PR 2	10.08	12.76	8.10

5.2.10 Pollutant concentrations have been modelled for the proposed receptors for the 2029 'With Development' scenario, in accordance with Defra guidance (i.e. using EFT v9.0), as detailed in Table 17.

Table 17: Predicted Adjusted NO_2, and Unadjusted PM_{10} and $PM_{2.5}$ Concentrations at the Proposed Sensitive Receptor for Scenario 5			
Proposed Receptor	**Calculated Annual Mean Concentrations (µg/m³)**		
	NO_2	**PM_{10}**	**$PM_{2.5}$**
PR 1	10.56	13.17	8.31
PR 2	9.05	12.71	8.05

5.2.11 The results of the assessment show that all predicted proposed receptor NO_2, PM_{10} and $PM_{2.5}$ concentrations are below the relevant objectives and limit values.

5.3 Operational Phase – Sensitivity Analysis

Existing Sensitive Human Receptors

5.3.1 Current evidence suggests that NO_2 background concentrations and emissions are not decreasing in accordance with expected reductions. The air quality assessment has therefore applied 2018 background pollution concentrations and vehicle emission factors to the 2025 opening year and 2029 future year, to provide a robust conservative approach.

5.3.2 The sensitivity analysis has been carried out for the representative existing sensitive receptors considered (i.e. ESR 1 to ESR 13).

5.3.3 Table 18 details the predicted NO_2 concentrations for the 2025 Opening Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 18: Predicted Adjusted NO_2 Concentrations at Existing Sensitive Receptors for Scenarios 2 and 3, Assuming 100% Occupancy – Sensitivity Analysis

Receptor	Calculated Annual Mean NO_2 Concentrations (µg/m³)[a]				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[b]
		Concentration	Percentage in Relation to AQAL		
ESR 1	54.28	54.37	>110%	<0.5%	**Negligible**
ESR 2	52.21	52.30	>110%	<0.5%	**Negligible**
ESR 3	55.34	55.43	>110%	<0.5%	**Negligible**
ESR 4	25.99	26.30	<75%	1%	**Negligible**
ESR 5	20.07	20.27	<75%	1%	**Negligible**
ESR 6	22.80	23.14	<75%	1%	**Negligible**
ESR 7	23.30	23.65	<75%	1%	**Negligible**
ESR 8	17.57	17.76	<75%	<0.5%	**Negligible**
ESR 9	18.29	18.87	<75%	1%	**Negligible**
ESR 10	18.17	18.37	<75%	1%	**Negligible**
ESR 11	19.61	19.62	<75%	<0.5%	**Negligible**
ESR 12	22.19	22.20	<75%	<0.5%	**Negligible**
ESR 13	22.56	22.57	<75%	<0.5%	**Negligible**

a. NO_2 concentrations obtained by inputting predicted NO_x concentrations into the NO_x to NO_2 calculator, in accordance with LAQM.TG(16)
b. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration
Underlined concentrations represent an exceedance of the annual mean NO_2 objective

5.3.4 Table 19 details the PM_{10} concentrations for the 2025 Opening Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 19: Predicted Unadjusted PM_{10} Concentrations at Existing Sensitive Receptors for Scenarios 2 and 3, Assuming 100% Occupancy – Sensitivity Analysis					
Receptor	**Calculated Annual Mean PM_{10} Concentrations (µg/m³)**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[a]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 1	15.17	15.17	<75%	<0.5%	**Negligible**
ESR 2	15.03	15.04	<75%	<0.5%	**Negligible**
ESR 3	14.93	14.93	<75%	<0.5%	**Negligible**
ESR 4	15.86	15.91	<75%	<0.5%	**Negligible**
ESR 5	14.36	14.39	<75%	<0.5%	**Negligible**
ESR 6	14.68	14.72	<75%	<0.5%	**Negligible**
ESR 7	14.70	14.74	<75%	<0.5%	**Negligible**
ESR 8	14.09	14.11	<75%	<0.5%	**Negligible**
ESR 9	14.22	14.29	<75%	<0.5%	**Negligible**
ESR 10	14.18	14.21	<75%	<0.5%	**Negligible**
ESR 11	14.29	14.30	<75%	<0.5%	**Negligible**
ESR 12	15.18	15.18	<75%	<0.5%	**Negligible**
ESR 13	15.23	15.23	<75%	<0.5%	**Negligible**
a. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration					

5.3.5 Table 20 details the $PM_{2.5}$ concentrations for the 2025 Opening Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 20: Predicted Unadjusted $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 2 and 3, Assuming 100% Occupancy – Sensitivity Analysis					
Receptor	**Calculated Annual Mean $PM_{2.5}$ Concentrations (µg/m³)**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[a]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 1	9.81	9.81	<75%	<0.5%	**Negligible**

Table 20: Predicted Unadjusted $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 2 and 3, Assuming 100% Occupancy – Sensitivity Analysis					
Receptor	**Calculated Annual Mean $PM_{2.5}$ Concentrations (µg/m³)**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[a]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 2	9.73	9.74	<75%	<0.5%	**Negligible**
ESR 3	9.69	9.69	<75%	<0.5%	**Negligible**
ESR 4	10.36	10.39	<75%	<0.5%	**Negligible**
ESR 5	9.77	9.78	<75%	<0.5%	**Negligible**
ESR 6	9.48	9.51	<75%	<0.5%	**Negligible**
ESR 7	9.50	9.52	<75%	<0.5%	**Negligible**
ESR 8	9.12	9.14	<75%	<0.5%	**Negligible**
ESR 9	9.20	9.24	<75%	<0.5%	**Negligible**
ESR 10	9.18	9.19	<75%	<0.5%	**Negligible**
ESR 11	9.73	9.73	<75%	<0.5%	**Negligible**
ESR 12	9.97	9.97	<75%	<0.5%	**Negligible**
ESR 13	10.00	10.00	<75%	<0.5%	**Negligible**
a. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration					

5.3.6 Table 21 details the predicted NO_2 concentrations for the 2029 Future Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 21: Predicted Adjusted NO_2 Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy – Sensitivity Analysis					
Receptor	**Calculated Annual Mean NO_2 Concentrations (µg/m³)[a]**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[b]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 1	55.50	55.58	>110%	<0.5%	**Negligible**
ESR 2	53.37	53.45	>110%	<0.5%	**Negligible**

Table 21: Predicted Adjusted NO_2 Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy – Sensitivity Analysis

Receptor	Calculated Annual Mean NO_2 Concentrations (µg/m³)[a]				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[b]
		Concentration	Percentage in Relation to AQAL		
ESR 3	56.56	56.65	>110%	<0.5%	**Negligible**
ESR 4	26.34	26.66	<75%	1%	**Negligible**
ESR 5	20.32	20.52	<75%	1%	**Negligible**
ESR 6	23.18	23.53	<75%	1%	**Negligible**
ESR 7	23.70	24.05	<75%	1%	**Negligible**
ESR 8	17.79	17.98	<75%	<0.5%	**Negligible**
ESR 9	18.50	19.10	<75%	1%	**Negligible**
ESR 10	18.38	18.61	<75%	1%	**Negligible**
ESR 11	19.88	19.89	<75%	<0.5%	**Negligible**
ESR 12	22.48	22.49	<75%	<0.5%	**Negligible**
ESR 13	22.86	22.86	<75%	<0.5%	**Negligible**

a. NO2 concentrations obtained by inputting predicted NOx concentrations into the NOx to NO2 calculator, in accordance with LAQM.TG(16)
b. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration
Underlined concentrations represent an exceedance of the annual mean NO_2 objective

5.3.7 Table 22 details the PM_{10} concentrations for the 2029 Future Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 22: Predicted Unadjusted PM_{10} Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy – Sensitivity Analysis

Receptor	Calculated Annual Mean PM_{10} Concentrations (µg/m³)				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[a]
		Concentration	Percentage in Relation to AQAL		
ESR 1	15.23	15.24	<75%	<0.5%	**Negligible**

Table 22: Predicted Unadjusted PM_{10} Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy – Sensitivity Analysis					
Receptor	**Calculated Annual Mean PM_{10} Concentrations (µg/m³)**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[a]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 2	15.09	15.10	<75%	<0.5%	**Negligible**
ESR 3	14.98	14.99	<75%	<0.5%	**Negligible**
ESR 4	15.92	15.97	<75%	<0.5%	**Negligible**
ESR 5	14.40	14.43	<75%	<0.5%	**Negligible**
ESR 6	14.73	14.77	<75%	<0.5%	**Negligible**
ESR 7	14.75	14.79	<75%	<0.5%	**Negligible**
ESR 8	14.11	14.13	<75%	<0.5%	**Negligible**
ESR 9	14.25	14.31	<75%	<0.5%	**Negligible**
ESR 10	14.21	14.23	<75%	<0.5%	**Negligible**
ESR 11	14.33	14.33	<75%	<0.5%	**Negligible**
ESR 12	15.22	15.22	<75%	<0.5%	**Negligible**
ESR 13	15.27	15.28	<75%	<0.5%	**Negligible**
a. Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration					

5.3.8 Table 23 details the $PM_{2.5}$ concentrations for the 2029 Future Year, for both the 'Without Development' and 'With Development' scenarios. The impact has been assessed in accordance with the descriptors included in **Appendix C**.

Table 23: Predicted Unadjusted $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy – Sensitivity Analysis					
Receptor	**Calculated Annual Mean $PM_{2.5}$ Concentrations (µg/m³)**				
	Without Development	**With Development**		**Concentration Change as Percentage of AQAL**	**Impact[a]**
		Concentration	**Percentage in Relation to AQAL**		
ESR 1	9.85	9.85	<75%	<0.5%	**Negligible**
ESR 2	9.77	9.77	<75%	<0.5%	**Negligible**

Table 23: Predicted Unadjusted $PM_{2.5}$ Concentrations at Existing Sensitive Receptors for Scenarios 4 and 5, Assuming 100% Occupancy – Sensitivity Analysis

Receptor	Calculated Annual Mean $PM_{2.5}$ Concentrations (µg/m³)				
	Without Development	With Development		Concentration Change as Percentage of AQAL	Impact[a]
		Concentration	Percentage in Relation to AQAL		
ESR 3	9.73	9.73	<75%	<0.5%	**Negligible**
ESR 4	10.40	10.42	<75%	<0.5%	**Negligible**
ESR 5	9.79	9.81	<75%	<0.5%	**Negligible**
ESR 6	9.51	9.53	<75%	<0.5%	**Negligible**
ESR 7	9.52	9.55	<75%	<0.5%	**Negligible**
ESR 8	9.14	9.15	<75%	<0.5%	**Negligible**
ESR 9	9.22	9.26	<75%	<0.5%	**Negligible**
ESR 10	9.20	9.21	<75%	<0.5%	**Negligible**
ESR 11	9.75	9.75	<75%	<0.5%	**Negligible**
ESR 12	9.99	9.99	<75%	<0.5%	**Negligible**
ESR 13	10.02	10.02	<75%	<0.5%	**Negligible**

a. *Assessed using the Impact Descriptors from the EPUK/IAQM guidance, included in Appendix C. Changes of less than 0.5% should be described as negligible, however, changes greater than 0.5% can still be classed as negligible depending on the concentration*

5.3.9 The results of the sensitivity analysis show a predicted exceedance of the NO_2 air quality objective at ESR 1, ESR 2 and ESR 3, both with and without the development. All three receptors are located within the Priory Road AQMA, a known area of poor air quality.

5.3.10 The results of the sensitivity analysis show that all predicted PM_{10} and $PM_{2.5}$ concentrations, in all scenarios considered, are below the relevant objectives and limit values.

Proposed Sensitive Human Receptors

5.3.11 Pollutant concentrations have been modelled for the proposed receptors for the 2025 'With Development' scenario, as detailed in Table 24.

Table 24: Predicted Adjusted NO_2, and Unadjusted PM_{10} and $PM_{2.5}$ Concentrations at the Proposed Sensitive Receptor for Scenario 3			
Proposed Receptor	**Calculated Annual Mean Concentrations (µg/m³)**		
	NO_2	**PM_{10}**	**$PM_{2.5}$**
PR 1	17.10	14.12	9.14
PR 2	13.37	13.65	8.86

5.3.12 Pollutant concentrations have been modelled for the proposed receptors for the 2029 'With Development' scenario, as detailed in Table 25.

Table 25: Predicted Adjusted NO_2, and Unadjusted PM_{10} and $PM_{2.5}$ Concentrations at the Proposed Sensitive Receptor for Scenario 5			
Proposed Receptor	**Calculated Annual Mean Concentrations (µg/m³)**		
	NO_2	**PM_{10}**	**$PM_{2.5}$**
PR 1	17.29	14.15	9.15
PR 2	13.43	13.66	8.86

5.3.13 The results of the assessment show that all predicted receptor NO_2, PM_{10} and $PM_{2.5}$ concentrations are below the relevant objectives and limit values.

Assessment of Significance for Human Receptors

5.3.14 The significance of the overall effects of the proposed development has been assessed in accordance with the EPUK/IAQM guidance. This assessment is based on professional judgement and details of the assessors' experience is included in **Appendix D**.

5.3.15 The assessment of significance has taken into account a number of factors, including:

- The baseline PM_{10} and $PM_{2.5}$ concentrations in 2018, 2025 and 2029 are below the relevant annual mean objectives and limit values at all existing receptors considered;
- The baseline NO_2 concentrations in 2018 predict an exceedance of the air quality objective at ESR 1, ESR 2, and ESR 3. This is within the Priory Road AQMA, a known area of poor air quality;

- The impact assessment predicts a negligible impact on concentrations of NO_2, PM_{10} and $PM_{2.5}$ at all existing sensitive receptors considered, with the development in place in 2025 and 2029;
- A sensitivity analysis has also been undertaken, in which 2018 background concentrations and vehicle emission factors have been used robustly in the 2025 opening year and 2029 future year scenarios. This is considered to be a conservative approach, as it is likely that there will be some improvement in background air quality, and vehicle emissions, before 2025 and 2029;
- The sensitivity analysis predicts a negligible impact on concentrations of NO_2, PM_{10} and $PM_{2.5}$ at all existing sensitive receptors considered, with the development in place; and
- NO_2, PM_{10} and $PM_{2.5}$ concentrations within the proposed development site are predicted to be below the relevant objectives and limit values in all scenarios.

5.3.16 Based on the above factors, in accordance with the EPUK/IAQM guidance, the air quality effect of the proposed development is considered to be **not significant**.

Mitigation Strategies

5.3.17 The impact of the proposed development is predicted to be not significant for human receptors. However, mitigation measures will assist in reducing any potential impact and general best practice measures in relation to air quality could be implemented. Mitigation measures could include:

- The implementation of a green travel plan, as well as documents showing local public transportation routes for future residents;
- EV recharging points within the development (wall mounted or free standing in garage or off-street points);
- Support local walking and cycling initiatives;
- Support measures to reduce the need to travel;
- Support measures to reduce polluting motorised vehicle use;
- Measures to support improved public transport;
- Bike/e-bike hire schemes; and
- Installing low/ultra-low NO_x boilers at proposed dwellings.

6 CONCLUSIONS

6.1 Construction Phase

6.1.1 The construction phase assessment has been undertaken to determine the risk and significance of dust and fine particulate matter effects from earthworks, construction and trackout associated with the proposed development, in accordance with guidance published by the IAQM.

6.1.2 With site specific mitigation measures in place, the significance of dust and fine particulate effects from demolition, earthworks, construction and trackout is considered to be **not significant**.

6.2 Operational Phase

Existing Sensitive Receptors

6.2.1 An air quality assessment has been undertaken to consider the potential impact of development generated vehicles on air quality at thirteen existing sensitive human receptors. A sensitivity analysis has applied 2018 background pollution concentrations and vehicle emission factors to the 2025 opening year and 2029 future year to provide a robust conservative approach.

6.2.2 The impact assessment predicts that the development will have a negligible impact on concentrations of NO_2, PM_{10} and $PM_{2.5}$ at all thirteen existing sensitive receptors considered in 2025 and 2029.

6.2.3 The sensitivity analysis predicts that the development will have a negligible impact on concentrations of NO_2, PM_{10} and $PM_{2.5}$ at all thirteen existing sensitive receptors considered in 2025 and 2029.

6.2.4 NO_2, PM_{10} and $PM_{2.5}$ concentrations within the proposed development site are predicted to be below the relevant objectives and limit values in all scenarios.

6.2.5 The effect of the proposed development on human receptors is therefore considered to be **not significant.**

Recommendations for Mitigation

6.2.6 The impact of the proposed development is predicted to be not significant. However, mitigation measures will assist in reducing any potential impact and general best practice measures in relation to air quality could be implemented.

6.3 Summary

6.3.1 The air quality assessment demonstrates that the proposed development will not lead to an unacceptable risk from air pollution, nor will it lead to any breach of national objectives as required by national policy. Therefore, there are no material reasons in relation to air quality why the proposed scheme should not proceed.

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APPENDICES

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Appendix A: Air Quality Legislation and Guidance

European Legislation

A.1 The European Union (EU) Ambient Air Quality Directive 2008/50/EC[1] (i.e. the CAFE Directive) came into force in June 2008. This EU Directive consolidates previous air quality legislation, with the exception of the 4th daughter Directive[2], and sets air quality limit values for seven pollutants. The Directive also provides a regulatory framework for fine particulate matter smaller than 2.5µm in diameter ($PM_{2.5}$).

A.2 EU Directive 2008/50/EC was transposed into legislation in the UK on 11th June 2010 as The Air Quality Standards Regulations 2010[3].

National Air Quality Strategy

A.3 The Environment Act 1995 requires the UK government to prepare a national Air Quality Strategy. The first UK strategy was published in March 1997, setting out policies for the management of ambient air quality. This was subsequently updated in 2007[4].

A.4 The 2007 strategy establishes the framework for air quality management in England, Scotland, Wales and Northern Ireland. Air quality standards and objectives are set out for eight pollutants which may potentially occur at levels that give cause for concern. The strategy also provides details of the role that local authorities are required to take in working towards improvements in air quality, known as the Local Air Quality Management (LAQM) regime.

Air Quality Standards and Objectives

A.5 Air quality standards and objectives are set out in the strategy for the following pollutants: nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), lead (Pb), fine particulate matter (PM_{10}), benzene (C_6H_6), 1, 3–butadiene (C_4H_6) and ozone (O_3).

[1] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe
[2] Directive 2004/107/EC of the European Parliament and the Council of 15th December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air
[3] The Air Quality Standards Regulations 2010
[4] Department of Environment, Food and Rural Affairs, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007

A.6 Objectives for each pollutant, except O_3, were first given statutory status in the Air Quality Regulations 2000[5] and Air Quality (Amendment) Regulations 2002[6]. These objectives are defined in the strategy as:

"the maximum ambient concentration not to be exceeded, either without exception or with a permitted number of exceedances, within a specified timescale."

A.7 The EU limit values, transposed into UK legislation as The Air Quality Standards Regulations 2010, are mostly the same as the air quality objectives in terms of concentrations; however, there are differences in determining how compliance is achieved.

A.8 Whilst there is no specific objective for $PM_{2.5}$ in England and Wales, a limit value of 25µg/m^3 is referred to in the regulations, which has been adopted for use in this assessment (as recommended by the LAQM Helpdesk). An objective has been set for $PM_{2.5}$ in Scotland since early 2016.

A.9 Examples of where these objectives and limit values apply are detailed in the Defra LAQM Technical Guidance document LAQM.TG(16)[7] and are included in Table A1.

Table A1: Examples of Where the Air Quality Objectives Should Apply

Averaging Period	Objectives Should Apply at:	Objectives Should Generally Not Apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes, etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour mean and 8-hour mean	All locations where the annual mean objectives would apply, together with hotels. Gardens of residential properties[a]	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term

[5] The Air Quality Regulations 2000. SI No 928
[6] The Air Quality (Amendment) Regulations 2002
[7] Department for Environment, Food and Rural Affairs, Local Air Quality Management Technical Guidance LAQM.TG(16), February 2018

Table A1: Examples of Where the Air Quality Objectives Should Apply		
Averaging Period	**Objectives Should Apply at:**	**Objectives Should Generally Not Apply at:**
1-hour mean	All locations where the annual mean and 24 and 8-hour objectives apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations to which the public might reasonably be expected to spend one hour or longer	Kerbside sites where public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer	
[a] *Such locations should represent parts of the garden where relevant public exposure is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure to pollutants would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied*		

Local Air Quality Management

A.10 LAQM legislation in the Environment Act 1995 requires local authorities to conduct the periodic review and assessments of air quality. These aim to identify all those areas where the objectives are being, or are likely to be, exceeded. Where exceedances are likely to occur, local authorities are required to declare an Air Quality Management Area (AQMA).

A.11 LAQM.TG(16) presents a streamlined approach for LAQM in England and Scotland; however, Northern Ireland is still considering changes to LAQM and therefore works according to the previous regimes.

A.12 The Welsh Government amended the LAQM regime in Wales in 2017 by issuing new statutory policy guidance in order to bring the system into line with the Well-being of Future Generations (Wales) Act 2015[8]. This aims to achieve compliance with the national air quality objectives in specific hotspots and to reduce exposure to pollution more widely, so as to achieve the greatest public health benefit.

A.13 Local authorities in England are required to produce Annual Status Reports (ASRs), and in Scotland and Wales, Annual Progress Reports (APRs). These replace all other reports

[8] Well-being of Future Generations (Wales) Act 2015 (anaw 2)

which previously had to be submitted including Updating and Screening Assessments, Progress Reports and Detailed Assessments (which would be produced to assist with an AQMA declaration).

A.14 Local authorities now have the option of a fast track AQMA declaration option. This allows more expert judgement to be used and removes the need for a Detailed Assessment where a local authority is confident of the outcome. Detailed Assessments should however still be used if there is any doubt.

A.15 As part of the UK Government's requirement to improve air quality, selected local authorities in England are also currently investigating the feasibility of setting up Clean Air Zones (CAZs). These are areas where targeted action and co-ordinated resources aim to improve air quality within an urban setting, in order to achieve compliance with the EU limit values within the shortest possible time.

A.16 Five local authorities outside of London were initially selected to implement a CAZ by 2020 (Birmingham, Leeds, Nottingham, Derby and Southampton). A further 23 local authorities were subsequently chosen to investigate the feasibility of establishing a CAZ, and 33 local authorities may potentially have to proceed to this stage where compliance is not achieved.

National Planning Policy Framework

A.17 The National Planning Policy Framework (NPPF)[9], introduced in March 2012 and most recently updated in February 2019, requires that:

[9] Ministry of Housing, Communities and Local Government, National Planning Policy Framework, February 2019

"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of AQMAs and CAZs, and the cumulative impacts from individual sites in local areas.

Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications.

Planning decisions should ensure that any new development in AQMAs and CAZs is consistent with the local air quality action plan."

Planning Practice Guidance

A.18 The Planning Practice Guidance (PPG)[10], updated in March 2014, states that whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impacts in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife).

A.19 Where a proposed development is anticipated to give rise to concerns about air quality, an appropriate assessment needs to be carried out. Where the assessment concludes that the proposed development (including mitigation) will not lead to an unacceptable risk from air pollution, prevent sustained compliance with national objectives or fail to comply with the requirements of the Habitats Regulations, then the local authority should proceed to decision with appropriate planning conditions and/or obligations.

[10] Department for Communities and Local Government. Planning Practice Guidance: Air Quality, March 2014

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Appendix B: Methodology for Construction Phase Assessment

Institute of Air Quality Management Guidance

B.1 The methodology for the construction phase dust assessment is set out in guidance from the Institute of Air Quality Management (IAQM)[11].

Step 1

B.2 Step 1 is to screen the requirement for a more detailed assessment. The guidance states that an assessment will normally be required where there are existing sensitive human receptors within 350m of the site boundary and/or within 100m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

B.3 With regards to ecological receptors, the guidance states that an assessment will normally be required where there are existing receptors within 50m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

B.4 Where any of these criteria are met, it is necessary to proceed to Step 2.

Step 2

B.5 Step 2 determines the potential risk of dust arising in sufficient quantities to cause annoyance and/or health or ecological impacts. The risk is related to:

- The activities being undertaken (demolition, number of vehicles and plant etc);
- The duration of these activities;
- The size of the site;
- The meteorological conditions (wind speed, direction and rainfall);
- The proximity of receptors to the activity;
- The adequacy of the mitigation measures applied to reduce or eliminate dust; and
- The sensitivity of receptors to dust.

B.6 The risk of dust impacts is determined using four risk categories: negligible, low, medium and high risk. A site is allocated to a risk category based upon the following two factors (known as Step 2A and Step 2B).

[11] Institute of Air Quality Management, Guidance on the Assessment of Dust from Demolition and Construction, February 2014

B.7 **Step 2A** assesses the scale and nature of the works which determines the potential dust emission magnitude as small, medium or large. Examples of how the magnitude may be defined are included in Table B1.

Table B1: Determining the Dust Emission Magnitude of Construction Phase Activities

Activity	Dust Emission Class		
	Large	**Medium**	**Small**
Demolition	Total building volume >50,000m^3; Potentially dusty construction material (e.g. concrete); On-site crushing and screening; Demolition activities >20m above ground level	Total building volume 20,000-50,000m^3; Potentially dusty construction material; Demolition activities 10-20m above ground level	Total building volume <20,000m^3; Construction material with low potential for dust release (e.g. metal cladding or timber)
Earthworks	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 bunds >8m in height; Total material moved >100,000 tonnes	Total site area 2,500-10,000m^2; Moderately dusty soil type (e.g. silt); 5-10 heavy earth moving vehicles active at any one time; Formation of bunds 4-8m in height; Total material moved 20,000-100,000 tonnes	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 bunds <4m in height; Total material moved <20,000 tonnes; Earthworks during wetter months
Construction	Total building volume >100,000m^3; On-site concrete batching; Sandblasting	Total building volume 25,000-100,000m^3; Potentially dusty construction material (e.g. concrete); On-site batching	Total building volume <25,000m^3; Construction material with a low potential for dust release (e.g. metal cladding or timber)
Trackout	>50 HDV (>3.5t) outward movements[a] in any one day[b]; Potentially dusty surface material (e.g. high clay content); Unpaved road length >100m	10-50 HDV (>3,5t) outward movements[a] in any one day[b]; Moderately dusty surface material (e.g. high clay content); Unpaved road length 50-100m	<10 HDV (>3.5t) outward movements[a] in any one day[b]; Surface material with low potential for dust release; Unpaved road length <50m

a. A vehicle movement is a one way journey i.e. from A to B, and excludes the return journey
b. HDV movements during a construction project may vary over its lifetime, and the number of movements is the maximum not the average

B.8 **Step 2B** considers the sensitivity of the area to dust impacts which is defined as low, medium or high. The sensitivity categories for different types of receptors are described in Table B2.

Table B2: Sensitivity Categories for Dust Soiling, Human Health and Ecological Effects

Sensitivity Category	Dust Soiling Effects	Health effects of PM_{10}	Ecological Effects
High	Users can reasonably expect to enjoy a high level of amenity; Appearance, aesthetics or value of a property would be diminished; Examples include dwellings, museums and other culturally important collections, medium and long term car parks and car show rooms	Locations where members of the public are exposed over a period of time relevant to the air quality objective for PM_{10}; Examples include residential properties, hospitals, schools, and residential care homes	Locations with an international or national designation and the designated features may be affected by dust soiling; Locations where there is a community of a particularly dust sensitive species; Examples include a Special Area of Conservation with dust sensitive features
Medium	Users would expect 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; People or property wouldn't reasonably be expected to be continuously present or regularly for extended periods of time; Examples include parks and places of work	Locations where people are exposed as workers and exposure is over a period of time relevant to the air quality objective for PM_{10}; Examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; Locations with a national designation where the features may be affected by dust deposition; Examples include a Site of Special Scientific Interest with dust sensitive features

Table B2: Sensitivity Categories for Dust Soiling, Human Health and Ecological Effects			
Sensitivity Category	**Dust Soiling Effects**	**Health effects of PM_{10}**	**Ecological Effects**
Low	Enjoyment of amenity would not reasonably be expected; Property would not be diminished in appearance, aesthetics or value; People or property would be expected to be present only for limited periods of time; Examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads	Locations where human exposure is transient; Examples include public footpaths, playing fields, parks and shopping streets	Locations with a local designation where the features may be affected by dust deposition; Examples include a Local Nature Reserve with dust sensitive features

B.9 Based on the sensitivity of individual receptors, the overall sensitivity of the area to dust soiling, human health and ecological effects is then determined using the criteria detailed in Tables B3 to B5, respectively.

Table B3: Sensitivity of the Area to Dust Soiling Effects on People and Property[ab]					
Receptor Sensitivity	**Number of Receptors**	**Distance from Source (m)[c]**			
		<20m	**<50m**	**<100m**	**<350m**
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

a. The sensitivity to the area should be derived for each of the four activities
b. Estimate the total number of receptors within the stated distance. Only the highest level of sensitivity from the table needs to be considered
c. For trackout, distances should be measured from the side of the roads used by construction traffic. Without site specific mitigation, trackout may occur for up to 500m from large sites, 200m from medium sites and 50m from small sites, measured from the site exit. The impact declines with distance from the site and it is only necessary to consider trackout impacts up to 50m from the edge of the road

Table B4: Sensitivity of the Area to Human Health Impacts[ab]							
Receptor Sensitivity	**Annual Mean PM_{10} Concentration[c]**	**Number of Receptors[d]**	**Distance from Source (m)[e]**				
			<20m	**<50m**	**<100m**	**<200m**	**<350m**
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	>32µg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32µg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

a. *The sensitivity to the area should be derived for each of the four activities*
b. Estimate the total number of receptors within the stated distance. Only the highest level of sensitivity from the table needs to be considered
c. Most straightforwardly taken from the national background maps, but should also take account of local sources. The values are based on 32µg/m^3 being the annual mean concentration at which an exceedance of the 24-hour mean objective is likely in England, Wales and Northern Ireland. In Scotland, there is an annual mean objective of 18µg/m^3
d. In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties
e. For trackout, distances should be measured from the side of the roads used by construction traffic

Table B5: Sensitivity of the Area to Ecological Impacts[ab]		
Receptor Sensitivity	**Distance from the Source (m)[c]**	
	<20	**<50**
High	High	Medium
Medium	Medium	Low
Low	Low	Low

a. *The sensitivity to the area should be derived for each of the four activities*
b. Only the highest level of sensitivity from the table needs to be considered
c. For trackout, distances should be measured from the side of the roads used by construction traffic

B.10 These two factors are combined in **Step 2C** to determine the risk of dust impacts with no mitigation applied.

B.11 The risk of dust effects is determined for four types of construction phase activities, with each activity being considered separately. If a construction phase activity is not taking place on the site, then it does not need to be assessed. The four types of activities to be considered are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

B.12 The risk of dust being generated by demolition activities at the site is determined using the criteria in Table B6.

Table B6: Risk of Dust Impacts for Demolition			
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

B.13 The risk of dust being generated by earthworks and construction at the site is determined using the criteria in Table B7.

Table B7: Risk of Dust Impacts for Earthworks and Construction			
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

B.14 The risk of dust being generated by trackout at the site is determined using the criteria in Table B8.

Table B8: Risk of Dust Impacts for Trackout			
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

Step 3

B.15 Step 3 of the assessment determines the site-specific mitigation required for each of the activities, based on the risk determined in Step 2. Mitigation measures are detailed in guidance published by the Greater London Authority[12], recommended for use outside the capital by LAQM guidance, and the IAQM guidance document itself. Professional judgement should be used to determine the type and scale of mitigation measures required.

B.16 If the risk is classed as negligible, no mitigation measures beyond those required by legislation will be necessary.

Step 4

B.17 Step 4 assesses the residual effect, with mitigation measures in place, to determine whether or not these are significant.

[11] Greater London Authority, The Control of Dust and Emissions from Construction and Demolition: Best Practice Guidance, 2006

Professional Judgement

B.18 The IAQM guidance makes reference to the use of professional judgement when assessing the risks of dust and fine particulate matter from demolition and construction sites. Details of the experience of the personnel involved with the project are provided in **Appendix D**.

Appendix C: Methodology for Operational Phase Assessment

Air Dispersion Modelling Inputs

C.1 The air dispersion model ADMS-Roads (CERC, Version 4.1) has been used to assess the potential air quality impacts associated with development-generated road traffic emissions. This dispersion model is widely used and accepted for the purpose of undertaking assessments to support both planning and Environmental Permit applications.

Traffic Flow Data

C.2 The ADMS-Roads model requires the input of detailed road traffic flow data for those routes which may be affected by the proposed development. Traffic flow data has been provided for this project by Stirling Maynard, the appointed transport consultants for the project. The study extent of the model is shown in Figure C.1.

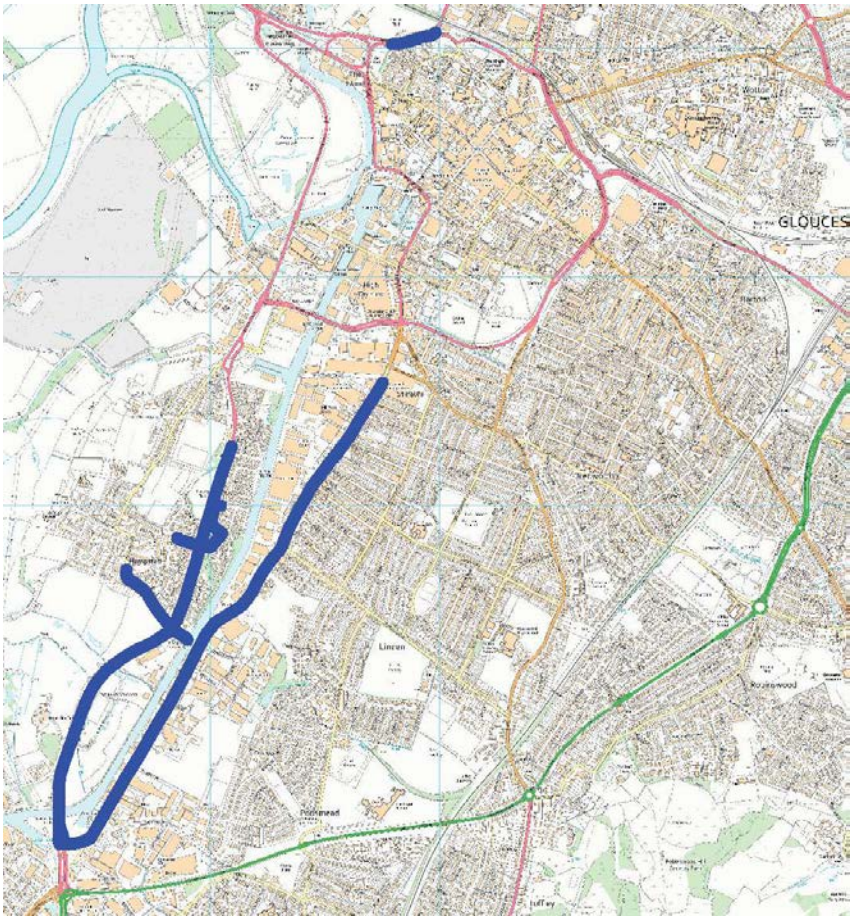


Figure C.1: Study Extent of Air Dispersion Model. The roads modelled in the assessment can be seen in blue (‘*Reproduced from Ordnance Survey Maps © Crown Copyright All Rights Reserved Licence No. AL100019512’)*

C.3 Data has been provided as 24-hour Annual Average Daily Traffic (AADT) flows, with HGV percentages. No average speed information was available and therefore speed limits have been used, with a reduction to 20kph in locations where congestion or the slowing down of vehicles would be expected. 100% occupancy has been assumed for both of the assessed years.

C.4 The traffic flow data used in the assessment is included in Tables C1 and C2.

Table C1: 24-hour AADT traffic data used in the assessment

Link Name	Scenario 1: 2018 Base Year		Scenario 2: 2025 Opening Year Without Development		Scenario 3: 2025 Opening Year With Development	
	Vehicles	HGV%	Vehicles	HGV%	Vehicles	HGV%
A430 s of j/w Bristol Road	34710	3.08	37310	3.08	37705	3.08
A430 n of j/w Bristol Road	22270	2.81	24085	2.81	24480	2.81
A430 s of j/w Hempsted Lane	23140	2.41	25225	2.41	25620	2.41
A430 n of j/w Hempsted Lane	22510	2.44	24260	2.44	25010	2.44
A430 s of j/w The Gallops	22550	2.46	24300	2.46	25050	2.46
A430 n of j/w The Gallops	22780	2.44	24550	2.44	25300	2.44
Goodridge Avenue w of j/w A430	1040	8.22	1115	8.22	1115	8.22
Bristol Road e of j/w A430	14480	4.04	15400	4.04	15400	4.04
Hempsted Lane w of j/w A430 (e of site access)	1065	1.39	1630	1.39	2775	1.39
Hempsted Lane w of site access	1065	1.39	1630	1.39	1630	1.39
Hempsted Lane e of j/w A430	545	3.33	585	3.33	585	3.33
The Gallops w of j/w A430	825	0.00	890	0.00	890	0.00
Soren Larsen Way e of j/w A430	705	0.00	750	0.00	750	0.00
Site Access	0	0.00	0	0.00	1145	0.00

St Oswald's Road e of j/w A4301	24135	1.28	25675	1.28	25755	1.28

Table C2: 24-hour AADT traffic data used in the assessment

Link Name	Scenario 4: 2029 Opening Year Without Development		Scenario 5: 2029 Opening Year With Development	
	Vehicles	HGV%	Vehicles	HGV%
A430 s of j/w Bristol Road	38810	3.08	39205	3.08
A430 n of j/w Bristol Road	25035	2.81	25430	2.81
A430 s of j/w Hempsted Lane	26085	2.41	26480	2.41
A430 n of j/w Hempsted Lane	25085	2.44	25835	2.44
A430 s of j/w The Gallops	25130	2.46	25880	2.46
A430 n of j/w The Gallops	25390	2.44	26140	2.44
Goodridge Avenue w of j/w A430	1150	8.22	1150	8.22
Bristol Road e of j/w A430	16025	4.04	16025	4.04
Hempsted Lane w of j/w A430 (e of site access)	1665	1.39	2810	1.39
Hempsted Lane w of site access	1665	1.39	1665	1.39
Hempsted Lane e of j/w A430	605	3.33	605	3.33
The Gallops w of j/w A430	915	0.00	915	0.00
Soren Larsen Way e of j/w A430	775	0.00	775	0.00
Site Access	0	0.00	1145	0.00
St Oswald's Road e of j/w A4301	26715	1.28	26795	1.28

Vehicle Emission Factors

C.5 The air quality assessment has used vehicle emission factors calculated using the Emissions Factor Toolkit (EFT) version 9, released in May 2019. This is the most up-to-date version of the EFT currently available.

C.6 As discussed in the section 3.4 of the report, there are uncertainties involved with the prediction of future NO_2 concentrations and therefore the air quality sensitivity analysis has applied 2018 background pollution concentrations and vehicle emission factors to the 2025 opening year and 2029 future year to provide a robust conservative approach.

Meteorological Data

C.7 The meteorological data used in the air quality modelling has been obtained from ADM Limited and is from the Gloucestershire recording station, with some missing wind data taken from the Pershore recording station, covering the period between 1st January and 31st December 2018.

C.8 The Gloucestershire recording station is located approximately 8km from the proposed development and is considered to be the most representative of the conditions at the proposed development, due to its relative location and similar altitude.

C.9 The 2018 wind rose for the Gloucestershire Meteorological Recording Station is shown in Figure C2.

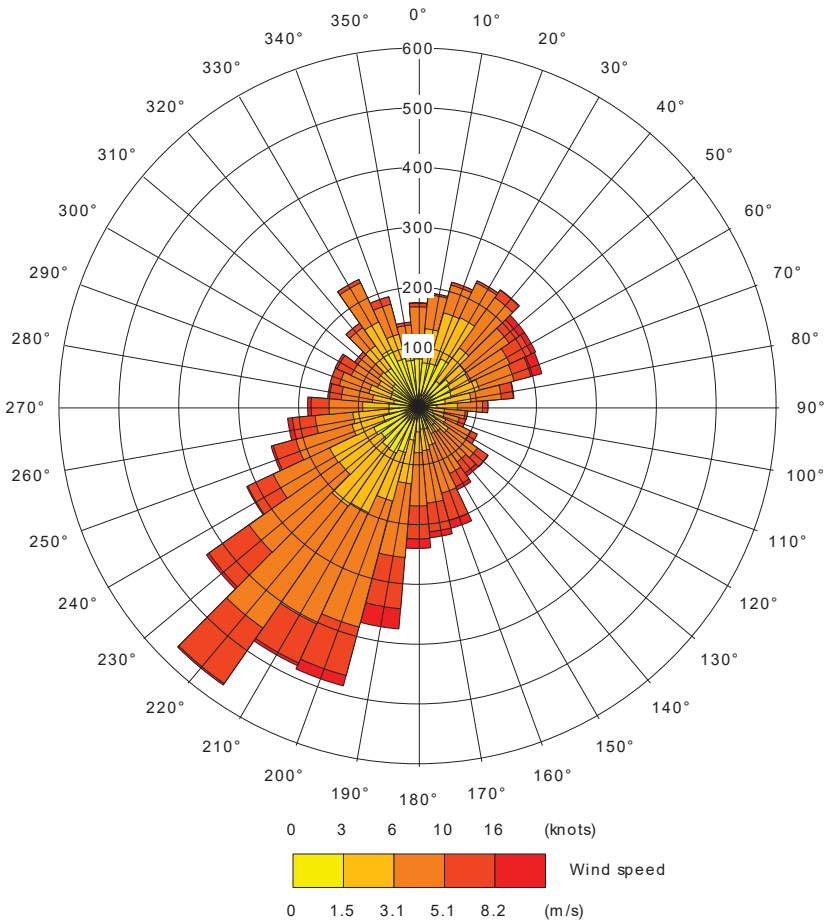


Figure C.2: 2018 Wind Rose for the Gloucestershire Meteorological Station

Dispersion and Meteorological Site Characteristics

C.10 The characteristics for the dispersion site and meteorological sites, included in the ADMS-Roads model, are detailed in Table C3.

Table C3: Dispersion and Meteorological Site Characteristics

Setting	Dispersion Site	Meteorological Site
Surface Roughness	1.0m	0.1m
Surface Albedo	0.23	0.23
Minimum Monin-Obukhov Length	30m	1m
Priestley-Taylor Parameter	1	1

NO_x to NO_2 Conversion

C.11 In accordance with the guidance within LAQM.TG(16), the ADMS-Roads model has been run to predict the road-contribution NO_x concentrations for each receptor location. These have then been converted to NO_2 concentrations using the Defra NO_x to NO_2 calculator[13].

Model Validation and Verification

C.12 LAQM.TG(16) refers to model validation as *"the general comparison of modelled results against monitoring data carried out by model developers"*. ADMS-Roads is widely accepted by regulatory authorities for use in this type of assessment.

C.13 Model verification is used to check the performance of the model at a local level. The verification of the ADMS-Roads air dispersion model is achieved by modelling concentration(s) at existing monitoring location(s) in the vicinity of the proposed development, and comparing the modelled concentration(s) with the measured concentration(s).

C.14 Following review of the 2018 Annual Status Report (ASR) for Gloucester City Council, it is understood there are a number of roadside air quality monitoring locations in close proximity to the proposed development site. Three monitoring locations have been discounted due to green infrastructure. Model verification has been undertaken using monitors 1, 2, 23, 24 and 25.

C.15 As no PM_{10} and $PM_{2.5}$ monitoring location is situated along roads where traffic flow data is available, it has not been possible to carry out model verification for modelled PM_{10} and $PM_{2.5}$ concentrations.

C.16 The monitoring data that has been used in the model verification procedure is detailed in Table C4.

Table C4: NO_2 Monitoring Data Used for Verification Purposes

Monitoring Location Reference	Type	Approximate Grid Reference		2018 Bias Adjusted NO_2 Annual Average Concentration (µg/m³)
		Easting	Northing	
1	Roadside Diffusion Tube	382693	217440	23.00
2	Roadside Diffusion Tube	382410	217013	23.20

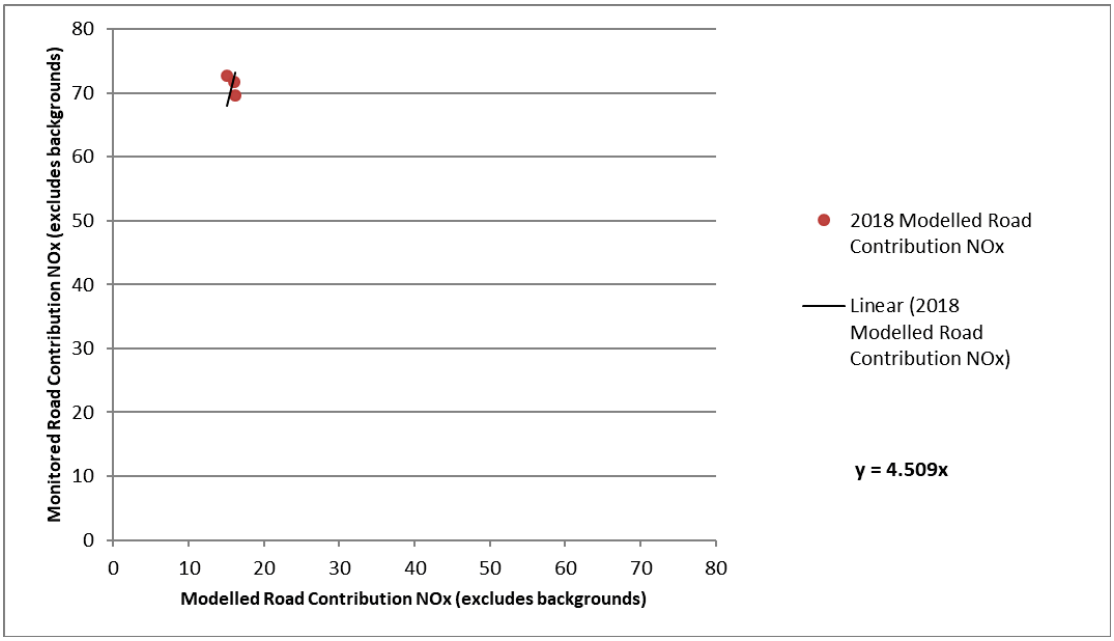
[13] Defra Local Air Quality Management web pages (http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html)

Table C4: NO_2 Monitoring Data Used for Verification Purposes				
Monitoring Location Reference	**Type**	**Approximate Grid Reference**		**2018 Bias Adjusted NO_2 Annual Average Concentration (µg/m³)**
		Easting	**Northing**	
23*	Roadside Diffusion Tube	382898	219029	46.30
24*	Roadside Diffusion Tube	382921	219034	47.45
25*	Roadside Diffusion Tube	382950	219040	47.10
**Located within the Priory Road AQMA*				

C.17 The modelled road-contribution NO_x concentration for the monitors has been compared against the measured road-contribution NO_x concentration for the same locations. The measured concentrations have been derived using the Defra NO_x to NO_2 calculator, taking into account the background NO_x concentration for the local area.

C.18 Two separate adjustment factors have been used in the assessment. The first one has used the three diffusion tubes located within the Priory Road AQMA to adjust ESRs 1 – 3, and the second uses the two diffusion tubes located on Bristol Road to adjust all of the remaining receptors.

C.19 The comparison shown in the graph below is for the Priory Road AQMA. The equation of the trend line is based on linear regression through zero, which provides an overall adjustment factor of 4.509.



C.20 This adjustment factor has been applied to the modelled road-contribution NO_x concentrations. The total NO_2 concentrations have been derived by combining the adjusted road-contribution NO_x concentration and background NO_2 concentration, using the Defra NO_x to NO_2 calculator.

C.21 A final comparison has been made between the total measured NO_2 concentrations and total modelled NO_2 concentrations, as shown in Table C5. Following adjustment, modelled concentrations are within 20% of measured concentrations.

Table C5: Comparison Between Measured and Monitored NO_2 Concentrations

Monitoring Location Reference	Measured Total NO_2 Concentration ($\mu g/m^3$)	Modelled Total NO_2 Concentration ($\mu g/m^3$)	Difference (%)
23	46.30	47.67	2.96
24	47.45	45.65	-3.79
25	47.10	47.39	0.62

C.22 A Root Mean Square Error (RMSE) calculation has been undertaken as part of the model verification for NO_2 concentrations. This has been carried out for the monitoring location included within the model verification, in accordance with the guidance detailed in LAQM.TG(16).

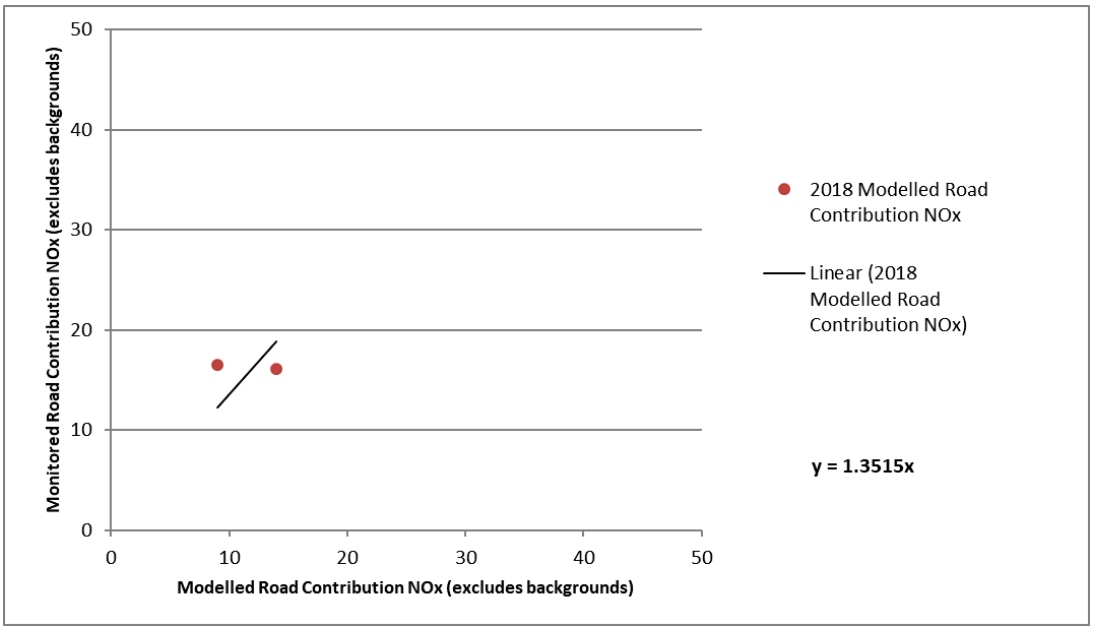
C.23 The RMSE calculation following adjustment is detailed in Table C6.

Table C6: RMSE Calculation for Nitrogen Dioxide Concentrations

Diffusion Tube Location	After Verification			
	Observed Value	Predicted Value	Difference	RMSE
23	46.30	47.67	1.37	**1.32**
24	47.45	45.65	-1.80	
25	47.10	47.39	0.29	

C.24 An RMSE of 1.32$\mu g/m^3$ is 3.29% of the NO_2 annual mean air quality objective. LAQM.TG(16) states that *"ideally an RMSE value within 10% of the objective would be derived"*, a value of within 25% is considered acceptable. Therefore, the model is considered to be performing to an acceptable standard.

C.25 The comparison shown in the graph below is for all areas not within the Priory Road AQMA. The equation of the trend line is based on linear regression through zero, which provides an overall adjustment factor of 1.3515.



C.26 This adjustment factor has been applied to the modelled road-contribution NO_x concentrations. The total NO_2 concentrations have been derived by combining the adjusted road-contribution NO_x concentration and background NO_2 concentration, using the Defra NO_x to NO_2 calculator.

C.27 A final comparison has been made between the total measured NO_2 concentrations and total modelled NO_2 concentrations, as shown in Table C7. Following adjustment, modelled concentrations are within 20% of measured concentrations.

Table C7: Comparison Between Measured and Monitored NO_2 Concentrations

Monitoring Location Reference	Measured Total NO_2 Concentration ($\mu g/m^3$)	Modelled Total NO_2 Concentration ($\mu g/m^3$)	Difference (%)
1	23.00	24.36	5.91
2	23.20	21.06	-9.22

C.28 A Root Mean Square Error (RMSE) calculation has been undertaken as part of the model verification for NO_2 concentrations. This has been carried out for the monitoring location included within the model verification, in accordance with the guidance detailed in LAQM.TG(16).

C.29 The RMSE calculation following adjustment is detailed in Table C8.

Table C8: RMSE Calculation for Nitrogen Dioxide Concentrations

Diffusion Tube Location	After Verification			
	Observed Value	Predicted Value	Difference	RMSE
1	23.00	24.36	1.36	**1.79**
2	23.20	21.06	-2.14	

C.30 An RMSE of 1.79µg/m^3 is 4.48% of the NO_2 annual mean air quality objective. LAQM.TG(16) states that *"ideally an RMSE value within 10% of the objective would be derived"*, a value of within 25% is considered acceptable. Therefore, the model is considered to be performing to an acceptable standard.

Assessment Criteria

Assessing the Impact of a Proposed Development on Human Receptors

C.31 Guidance has been prepared by Environmental Protection UK (EPUK) and the IAQM[14] with relation to the assessment of the air quality impacts of proposed developments and their significance.

C.32 The impact of a development is usually assessed at specific receptors, and takes into account both the long-term background concentrations, in relation to the relevant Air Quality Assessment Level (AQAL) at these receptors, and the change with the development in place.

C.33 The impact descriptors for individual receptors are detailed in Table C9.

[14] Moorcroft and Barrowcliffe et al, Land-Use Planning and Development Control: Planning for Air Quality (v1.2), January 2017

Table C9: Impact Descriptors for Individual Receptors				
Long Term Average Concentration at Receptor in Assessment Year*	**Percentage 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
**Percentage pollutant concentrations have been rounded to whole numbers, to make it easier to assess the impact. Changes of 0% (i.e. less than 0.5% or 0.2µg/m^3) should be described as Negligible*				

Determining the Significance of Effects

C.34 Impacts on air quality, whether adverse or beneficial, will have an effect on human health that can be judged as either 'significant' or 'not significant'.

C.35 Once the impact of the proposed development has been assessed for the individual impacts, the overall significance is determined using professional judgement. This takes into account a number of factors such as:

- The existing and future air quality in the absence of the development;
- The extent of the current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

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Appendix D: Professional Experience of Assessors

D.1 The assessment of air quality impacts, and the significance of the associated effects, takes into account the professional judgement of the assessor. Details of the experience of the personnel involved with the project are provided below:

Dr Matthew Barnes **Senior Environmental**
BSc (Hons), MSc, PhD **Scientist**

Matthew joined Wardell Armstrong in September 2016 as an Air Quality Scientist, following 18 months working as an air quality technical officer in a local authority. Before that he completed a BSc in Environmental Science, an MSc in Environmental Informatics and a PhD in Atmospheric Science, specialising in modelling urban air pollution. The majority of his work is carried out in support of planning applications and, therefore, he has experience of undertaking air quality assessments for a wide range of projects, small and large, including residential developments, commercial developments and mixed-use developments.

Malcolm Walton **Technical Director**
BSc (Env Health) Dip (Acoustics & Noise Control)
MCIEH AMIOA

Malcolm holds a Bachelor of Science degree in Environmental Health and the Diploma in Acoustics and Noise Control. Malcolm is a Member of the Chartered Institute of Environmental Health and an Associate Member of the Institute of Acoustics. Malcolm joined Wardell Armstrong in September 2001 following 12 years working as an Environmental Health Officer in several local authorities, responsible for the enforcement of environmental legislation and in particular air pollution and noise nuisance. Malcolm has experience in the technical co-ordination of environmental appraisal of large schemes to UK and international standards. Malcolm regularly carries out and co-ordinates noise and air quality assessment work associated with planning applications including EIA work and PPC permit application/compliance. He regularly acts as expert witness in planning inquiries in respect of noise, air quality and odour.

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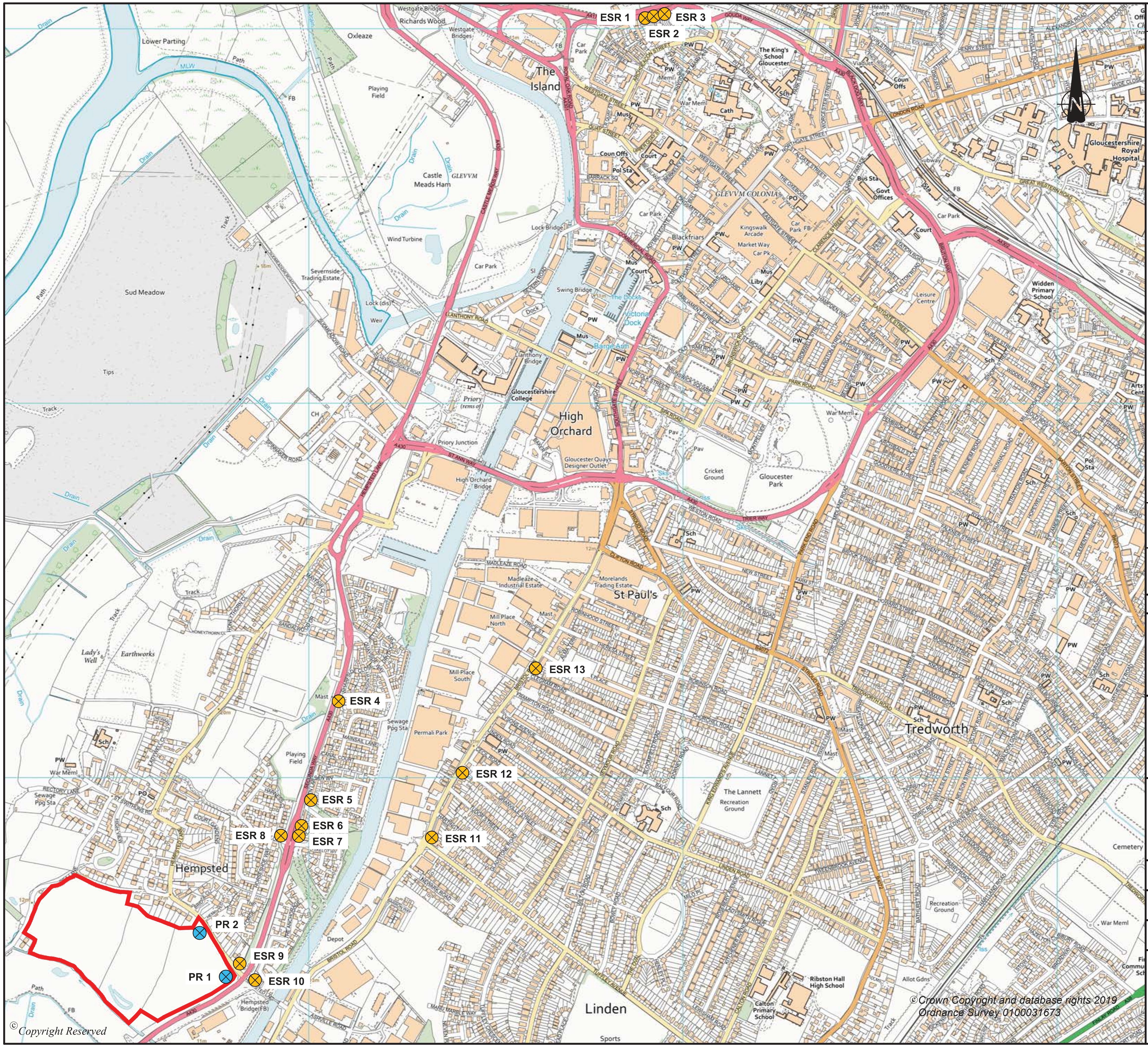

DO NOT SCALE FROM THIS DRAWING

KEY

SITE BOUNDARY

ESR EXISTING SENSITIVE RECEPTOR LOCATION

PR PROPOSED RECEPTOR LOCATION

REVISION	DETAILS	DATE	DR'N	CHK'D	APP'D
B	Red Line Boundary Updated	30-01-20	CT	MB	MW
A	First Issue	25-10-19	DR	MB	MW

CLIENT

Gladman Developments Limited

PROJECT

Land at Hempsted Lane, Gloucester

DRAWING TITLE

Existing and Proposed Sensitive Receptor Location Plan

DRG No.		REV
GM10710-019		B
DRG SIZE A3	SCALE 1:10000	DATE 22-10-19
DRAWN BY DR	CHECKED BY MB	APPROVED BY MW

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N:\GM\GM10710 - LAND AT HEMPSTED LANE\03 - DESIGN\AUTOCAD\GM10710-019-B EXISTING AND PROPOSED SENSITIVE RECEPTOR LOCATIONS.DWG

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