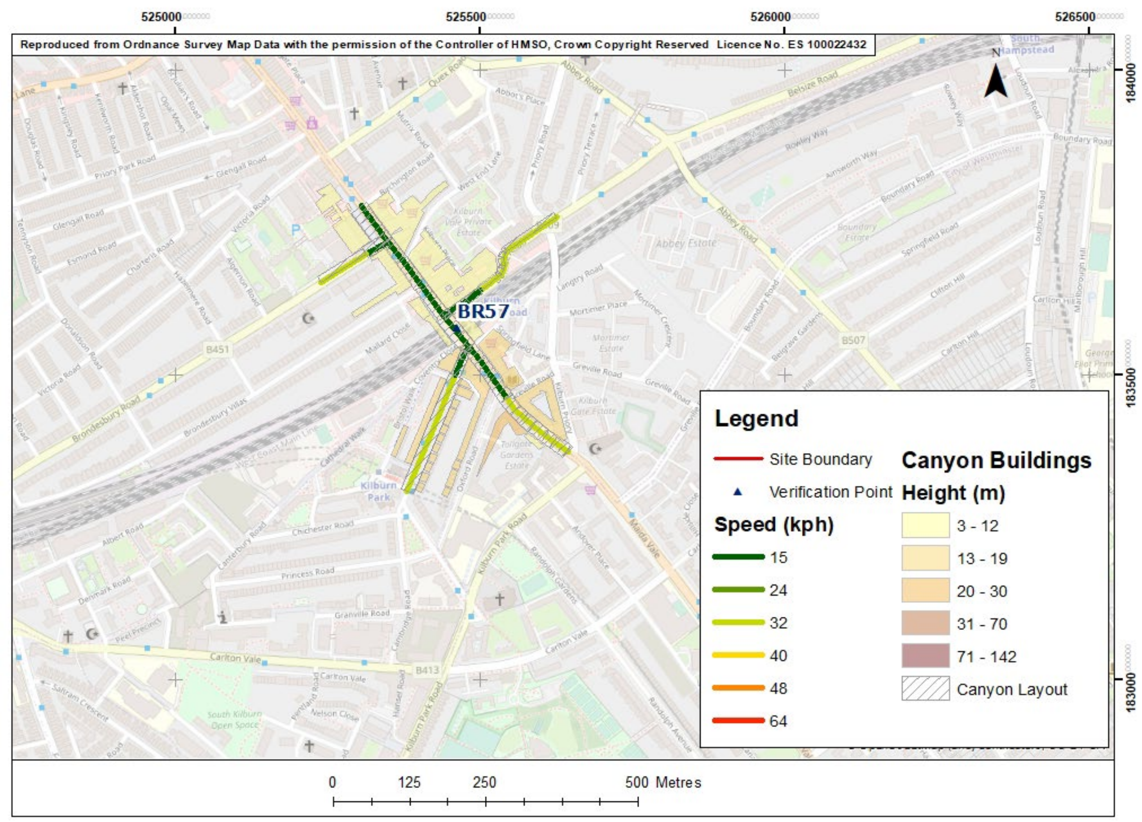


Figure 1.3c: Air Quality Verification Modelled Roads and Speed

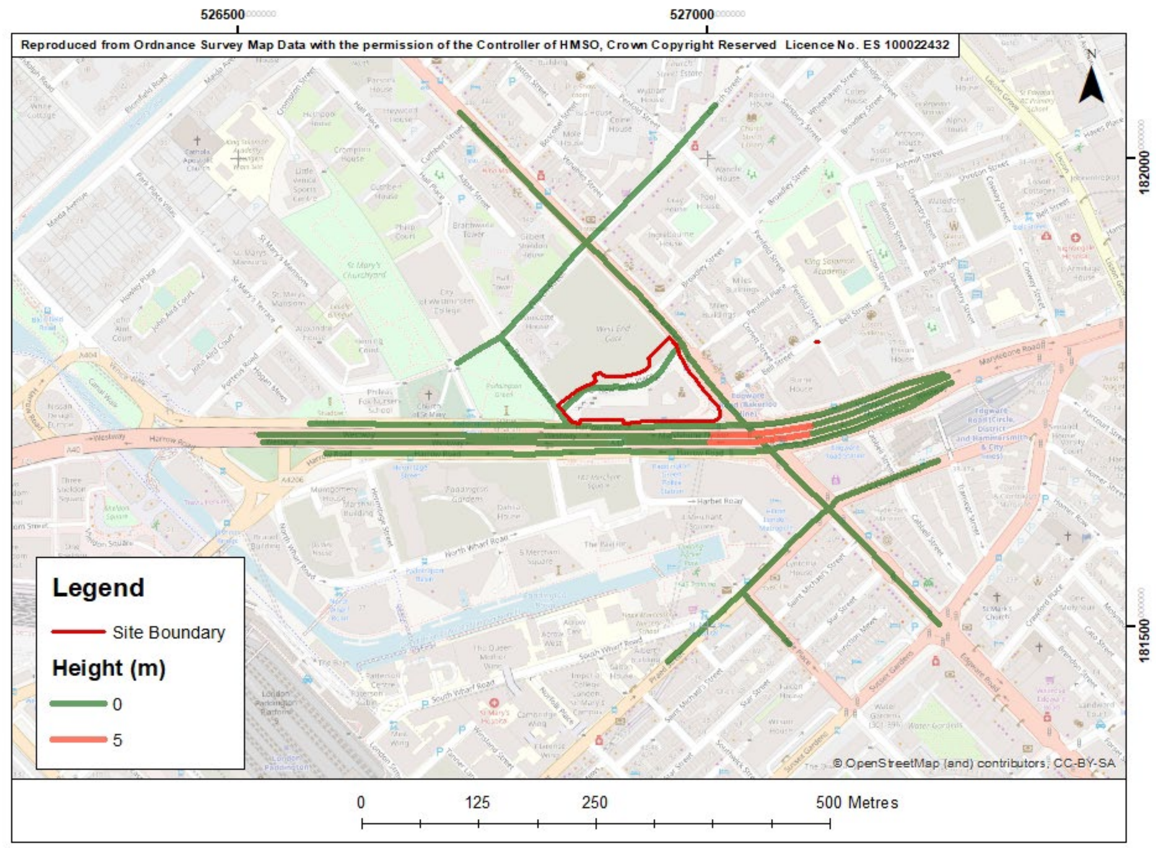


Figure 1.4d: Roads Height

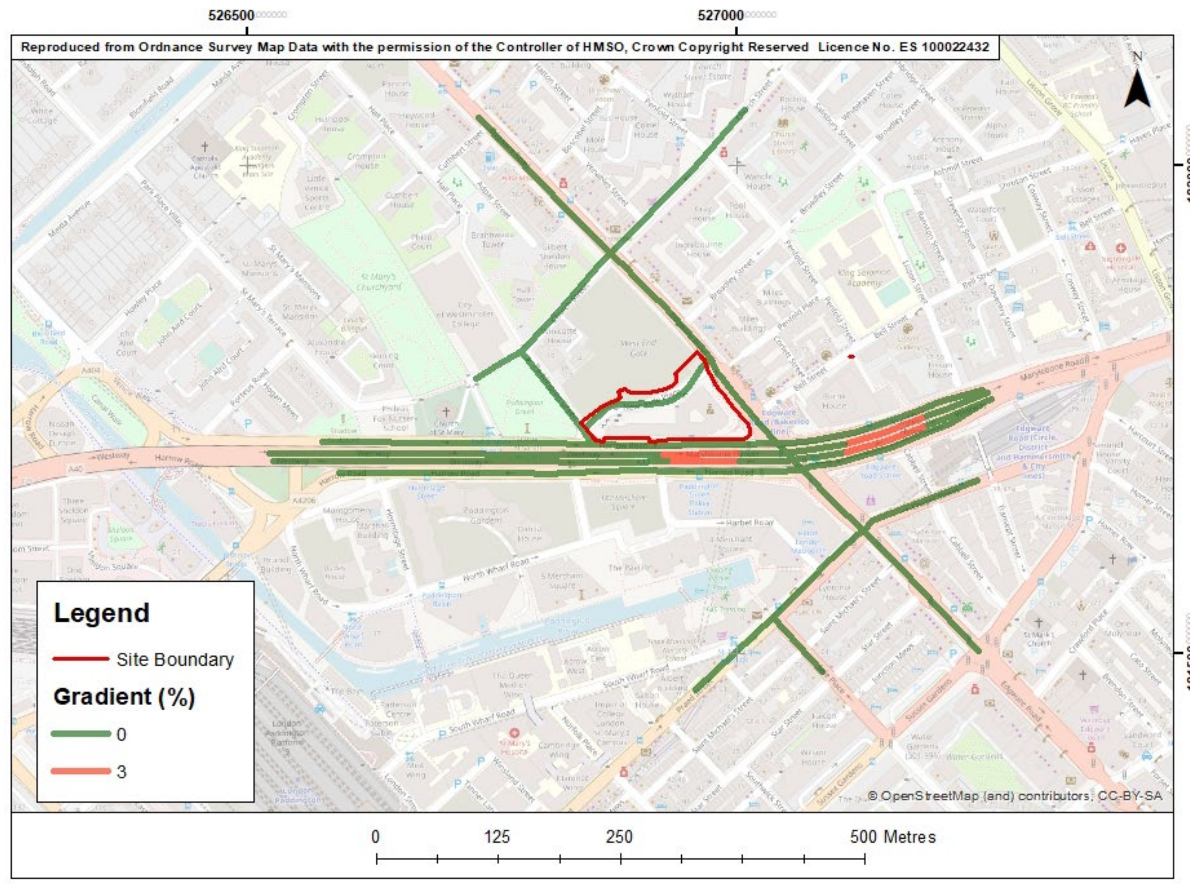


Figure 1.5e: Roads Gradient

1.3 Model Inputs

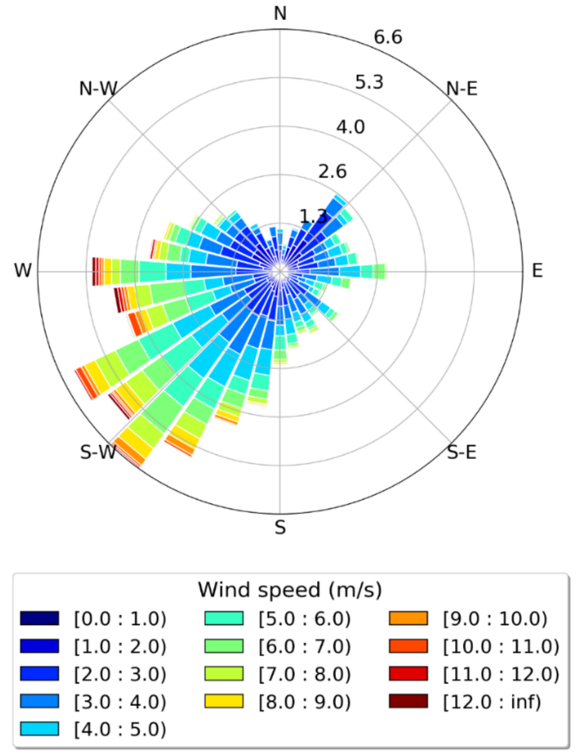
1.3.1 Traffic emissions were calculated using the Emission Factor Toolkit (EFT) v10.1 embedded in the ADMS model, which utilises nitrogen oxides (NO_x), PM_{10} and $PM_{2.5}$ emission factors from the European

Environment Agency COPERT 5.3 emission tool[1]. The traffic data were entered into the ADMS roads model, along with speed data to provide combined emission rates for each of the modelled road links. The model was run using 2019 meteorological data from Heathrow Airport meteorological station, which is considered to be the most representative meteorological monitoring station to the site.

1.3.2 The predicted concentrations of roadside NO_x were converted to roadside NO_2 using the LAQM conversion calculator available from the Defra air quality website[2].

1.3.3 Further information on the model set up is provided in Table 1. and provided in Figures 1.1a to 1.1e.

Table 1.4: ADMS Model Inputs

Meteorological Data	2019 Hourly meteorological data from Heathrow Airport Station has been used in the model. The wind rose is shown below. 
ADMS	ADMS Roads version 5.0.0.1, ADMS5 version 5.2
Latitude (º)	51.5
Surface Roughness	A value of 1.5 m for large urban areas was used to represent the modelled area and 0.2 Agricultural areas to represent the meteorological station site.
Minimum Monin-Obukhov length	A value of 100 for large conurbations was used to represent the modelled area and 30 mixed urban/industrial to represent the meteorological station site.
Elevation and gradients	Elevated roads sections modelled where flyovers or bridges with free air flow underneath where present. Embankments and slip roads modelled with gradient.
Emission Factor Toolkit (EFT)	V10.1. Road type inner London.
Diurnal Factor	2019 DfT national transport statistics[3].
Street Canyon	ADMS Advance street canyon used. Assume 3 m per floor to estimate building heights. Proposed development height plans used to determine the development heights.
NOx to NO2 Conversion	NO_x to NO_2 calculator version 8.1. Traffic Mix All London traffic.
Background Maps	2018 reference year background maps[4]

1.4 Terrain

1.4.1 The terrain in the vicinity of the site is flat with no slopes more than 10 %, and therefore terrain effects have not been included within the modelling.

1.5 Energy Centre Parameters

ADMS 5 Parameters

1.5.1 Information on the model set up is provided in Table 1..

Buildings

1.5.2 Entrainment of the plume into the wake of the stack (the so-called building downwash effect) has been taken into account by including the proposed development buildings within the model. The nearby buildings may also have an impact on the dispersion, and thus these have also been included. The buildings set out is shown in **Error! Reference source not found.** have been included within the ADMS 5 model.

[1] Department for Environment Food and Rural Affairs. Emissions Factors Toolkit. https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.htm.
[2] Department for Environment Food and Rural Affairs. NOx to NO2 calculator. https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

[3] Annual daily traffic flow and distribution (TRA03). https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra.
[4] https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

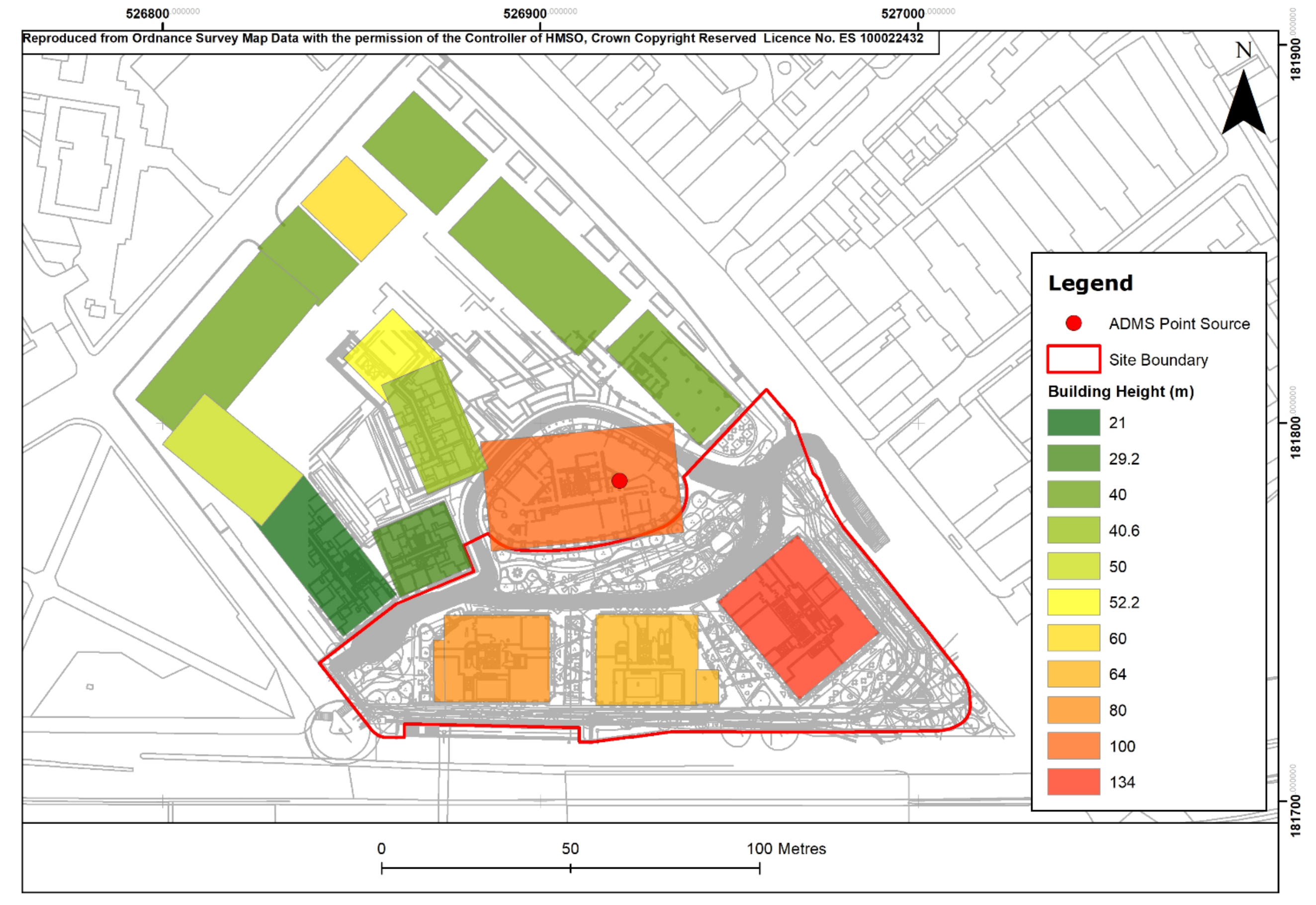


Figure 1.2: ADMS5 Modelled Buildings and Stack

Emissions and Parameters

1.5.3 The modelled process contribution (PC) has been derived assuming a conversion ratio of 35 % for short-term and 70 % for long-term of NOx to NO_2. This is in line with the EAs recommendation for a 'worst case scenario'[5]. The likelihood of exceeding the annual mean and the 1-hour mean objectives has taken into account the baseline roads modelled pollutant concentrations in the vicinity of the site. For the annual average the PC is added to the baseline concentrations (process environmental contribution- PEC) and for the short-term assessment, the baseline concentrations are assumed to be twice the annual mean determined from the roads modelling assessment.

1.5.4 The input data for the point sources are included in **Error! Reference source not found.**. The location of the modelled point sources is shown in Figure 1.2.

Table 1.5: WEG Stack Emissions Modelling Input Parameters

Parameter	CHP	Boilers
Number	1	31
Capacity (kWth)	507	1750
Stack Height (m) to nearest m	104	104
Number of Stacks	1	1
Stack Location	X526921 Y181784	X526921 Y181785
Stack Diameter(m)	0.30	0.75
Stack Temperature (°C)	42	54
Volume Flow (Nm³/h)	1	-
Volume Flow (kg/h)	-	0.63
Discharge Velocity (m/s)	13	7.6
Hours of Operation per day	17	10
NOx Emission (mg/Nm3)	95	-
NOx Emission (mg/kWh)	-	35
NOx Emission per Stack (g/s)	0.095	0.0258

Table 1.5: WEG Stack Emissions Modelling Input Parameters

Notes: [1] Although the energy centre would contain 4 boilers, only 3 would operate at any one time with the fourth being used as a back-up.

[5] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

Technical Appendix 7.4(R): Air Quality Background Concentrations and Model Verification

1. BACKGROUND CONCENTRATIONS

1.0.1 In order to more accurately reflect background concentrations across the study area, Defra mapped background concentrations have been compared against concentrations measured at North Kensington and London Bloomsbury Automatic Urban and Rural Network (AURN)[1] automatic urban background stations in 2019 to produce a calibration factor, which then has been applied to background concentrations across the study area (Table 1.1 to table 1.3). The location of the automatic sites is shown in Figure 1.1.

Table 1.1: 2019 DEFRA NO_2 Background Mapping adjustment factors (μg/m³)

Station	Distance to Application Site (km)	Data Capture (%)	Defra Modelled Background (μg/m³)	Measured Concentration (μg/m³)	Factor
KC1 Kensington AURN	3	99%	33.8	27.3	0.81
London Bloomsbury	3.1	98%	39.3	31.50	0.80
Average factor					**0.81**

Table 1.2: 2019 DEFRA PM_{10} Background Mapping adjustment factors (μg/m³)

Station	Distance to Application Site (km)	Data Capture (%)	Defra Modelled Background (μg/m³)	Measured Concentration (μg/m³)	Factor
KC1 Kensington AURN	**3**	100%	20.4	14.5	0.71
London Bloomsbury	3.1	92%	20.3	17.6	0.87
Average factor					**0.79**

Table 1.3: 2019 DEFRA $PM_{2.5}$ Background Mapping adjustment factors (μg/m³)

Station	Distance to Application Site (km)	Data Capture (%)	Defra Modelled Background (μg/m³)	Measured Concentration (μg/m³)	Factor
KC1 Kensington AURN	**3**	100%	12.9	**9.6**	0.74
London Bloomsbury	3.1	98%	12.9	10.8	0.83
Average factor					**0.79**

[1] https://uk-air.defra.gov.uk/networks/site-info?uka_id=UKA00253

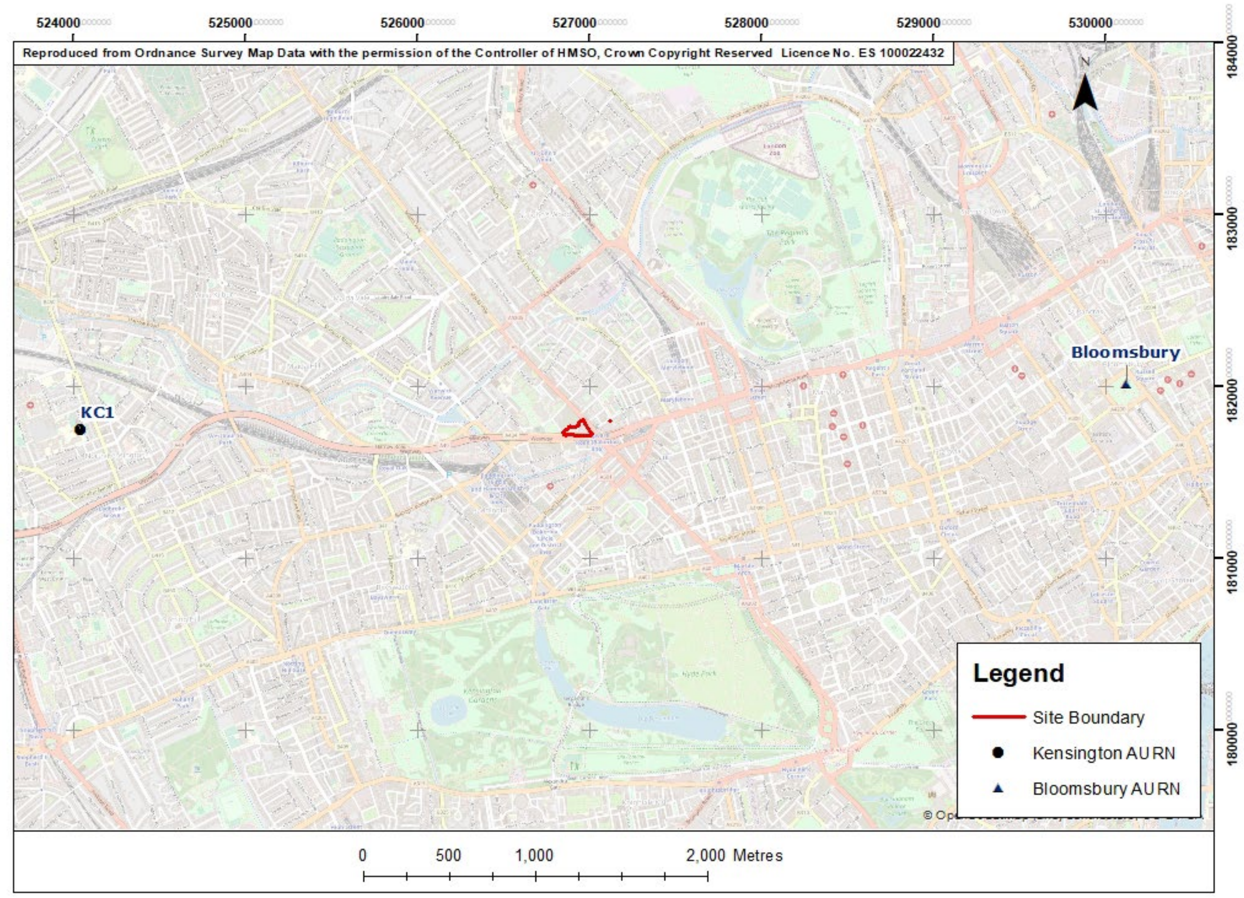


Figure 1.1: Air Quality Automatic Urban Background Site

2. MODEL VERIFICATION

2.1 Nitrogen Dioxide

2.1.1 The model has been run to predict the 2019 annual mean road-NOx contribution at four monitoring locations (identified in Table 2.1).

2.1.2 The initial model output of road-NOx was converted to NO_2, within the NOx from NO_2 calculator, and compared with the measured road-NO_2 as presented in Table 2.1.

Table 2.1: Verification Process Initial Comparison

Monitor	Height (m)	Measured NO_2 µg/m³	Modelled Road NO_x µg/m³	Unadjusted Modelled NO_2	% Difference Modelled/ Measured NO_2
Marylebone AURN	4	62.7	86.1	60.2	-4%
KC2	1.4	42.6	33.1	41.7	-2%
KC33	2	70.1	71.8	55.7	-21%
BR57	2.5	48.7	33.7	37.7	-23%

2.1.3 As the model has been used to predict NOx road contribution, the model output of road-NOx has been compared with the 'measured' road-NOx as per LAQM TG(16) Box 7.15. The model output of road-NOx has been compared with the 'measured' road-NOx, which was calculated from the measured NO_2 concentrations and the adjusted background NO_2 concentrations within the NOx from NO_2 calculator.

2.1.4 A primary adjustment factor was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution (Table 2.2, Figure 2.1). This factor was then applied to the modelled road-NOx concentration for each monitoring site to provide adjusted modelled road-NOx concentrations. A secondary adjustment factor was finally calculated as the slope of the best fit line applied to the adjusted data and forced through zero (Table 2.2, Figure 2.2). The total nitrogen dioxide concentrations were then determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx from NO_2 calculator (Table 2.3).

2.1.5 The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data:

Table 2.2: Verification Factors

Primary Adjustment Factor	1.3402
Secondary adjustment factor	1.0078

Table 2.3: Verification Process Followed by Adjustment

Monitor	Measured NO_2 µg/m³	Measured Road NOx µg/m³	Modelled Roadside NO_x µg/m³	Ratio Measured NOx/ Modelled road NOx	Total NO_2 after adjustment µg/m³	% Difference in NO_2 after adjustment
Marylebone AURN	62.7	94.1	86.1	1.09	69.1	11%
KC2	42.6	35.2	33.1	1.07	46.1	9%
KC33	70.1	118.6	71.8	1.65	63.5	-9%
BR57	48.7	60.9	33.7	1.81	42.1	-13%

2.1.6 The results imply that overall, the model was under-predicting the road-NOx contribution. This is a common experience with this and most other models. The final NO_2 adjustment is minor.

2.1.7 Figure 2.3 compares final adjusted modelled total NO_2 at each of the monitoring sites, to measured total NO_2, and shows the 1:1 relationship, as well as ±10% and ±25% of the 1:1 line.

2.1.8 Table 2.4 presents the Model uncertainty, which has been estimated by calculating the root mean square error (RMSE). The calculated RMSE is within the suggested value (25 % of the objective being assessed) in LAQM.TG(16). The model has therefore performed sufficiently well for use within this assessment.

Table 2.4: Model Uncertainty

RMSE	5.9 µg/m³
% NAQO	15%

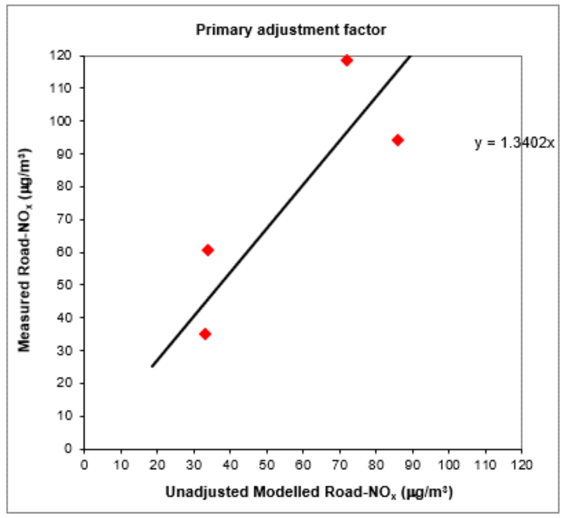


Figure 2.1: Comparison of Measured NO_2 with Primary Adjusted Modelled NO_2

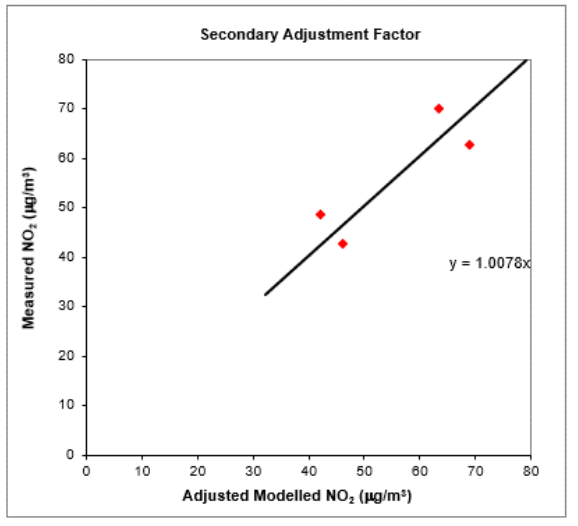


Figure 2.2: Comparison of Measured NO_2 with Primary Adjusted Modelled NO_2 Concentrations

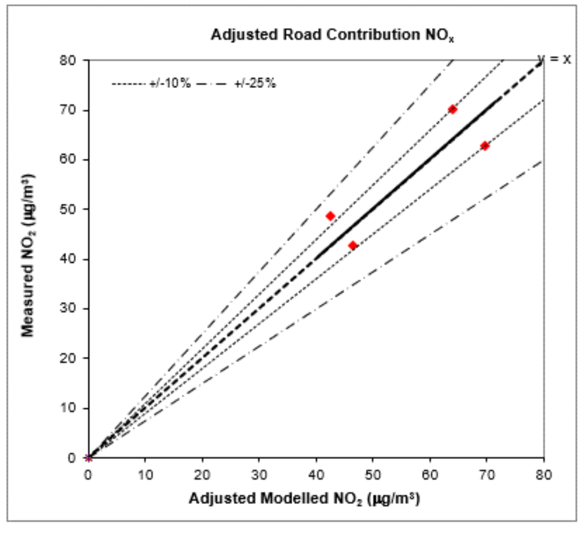


Figure 2.3: Comparison of Measured NO_2 with Fully Adjusted Modelled NO_2 Concentrations

2.2 Particulates

2.2.1 PM_{10} and $PM_{2.5}$ monitoring is undertaken at Marylebone AURN automatic site. Table 2.5 presents the particulates adjustment factor.

Table 2.5: Particulates Verification

Particulates	Measured Concentration (µg/m³)	Defra Modelled Background (µg/m³)	Measured Road (Measured – Background) (µg/m³)	Modelled Cocentration (µg/m³)	Factor
PM_{10}	22.2	15.5	6.8	5.5	1.23
$PM_{2.5}$	14.3	9.9	4.5	3.4	1.30

Technical Appendix 7.5(N): Air Quality Modelling Results

1. COMPLETED DEVELOPMENT ROAD TRAFFIC RESULTS

1.1 Existing Receptors

1.1.1 Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development

Table 1.1: Predicted Annual Mean NO_2 at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
PG_1_GF	1.5	29.5	29.7	0.28	0.7%	Negligible
PG_1_1stF	5.2	28.8	29.0	0.20	0.5%	Negligible
PG_1_2ndF	8.5	28.0	28.1	0.15	0.4%	Negligible
PG_1_3rdF	11.7	27.2	27.3	0.16	0.4%	Negligible
PG_1_4thF	14.9	26.5	26.7	0.14	0.4%	Negligible
PG_1_5thF	18.6	26.0	26.1	0.09	0.2%	Negligible
PG_1_6thF	22.3	25.7	25.8	0.09	0.2%	Negligible
PG_1_7thF	26.1	25.5	25.6	0.07	0.2%	Negligible
PG_2_GF	1.5	28.4	28.7	0.29	0.7%	Negligible
PG_2_1stF	5.2	28.1	28.3	0.20	0.5%	Negligible
PG_2_2ndF	8.5	27.5	27.7	0.16	0.4%	Negligible
PG_2_3rdF	11.7	27.0	27.2	0.16	0.4%	Negligible
PG_2_4thF	14.9	26.5	26.6	0.14	0.4%	Negligible
PG_2_5thF	18.6	26.1	26.2	0.09	0.2%	Negligible
PG_2_6thF	22.3	25.8	25.8	0.09	0.2%	Negligible
PG_2_7thF	26.1	25.5	25.6	0.07	0.2%	Negligible
PG_3_GF	1.5	27.4	28.7	1.31	3.3%	Negligible
PG_3_1stF	5.2	27.2	28.4	1.19	3.0%	Negligible
PG_3_2ndF	8.5	27.0	28.1	1.11	2.8%	Negligible
PG_3_3rdF	11.7	26.6	27.5	0.89	2.2%	Negligible
PG_3_4thF	14.9	26.3	27.1	0.82	2.0%	Negligible
PG_3_5thF	18.6	26.0	26.8	0.82	2.0%	Negligible
PG_3_6thF	22.3	25.7	26.5	0.81	2.0%	Negligible
PG_3_7thF	26.1	25.5	26.3	0.81	2.0%	Negligible
PG_4_GF	1.5	28.0	28.3	0.28	0.7%	Negligible
PG_4_1stF	5.2	27.7	28.0	0.21	0.5%	Negligible
PG_4_2ndF	8.5	27.3	27.5	0.16	0.4%	Negligible
PG_4_3rdF	11.7	26.9	27.1	0.17	0.4%	Negligible
PG_4_4thF	14.9	26.5	26.6	0.14	0.4%	Negligible
PG_4_5thF	18.6	26.1	26.2	0.08	0.2%	Negligible
PG_4_6thF	22.3	25.8	25.9	0.09	0.2%	Negligible
PG_4_7thF	26.1	25.5	25.6	0.06	0.2%	Negligible
WEG_1_GF	1.5	27.4	28.8	1.41	3.5%	Negligible
WEG_1_1stF	7.0	27.1	28.2	1.12	2.8%	Negligible
WEG_1_2ndF	10.8	26.7	27.7	0.96	2.4%	Negligible
WEG_1_3rdF	14.0	26.4	27.2	0.82	2.0%	Negligible
WEG_1_4thF	17.2	26.1	26.9	0.82	2.0%	Negligible
WEG_1_28thF	94.8	24.8	25.3	0.46	1.2%	Negligible
WEG_1_29thF	98.4	24.8	25.3	0.46	1.2%	Negligible
WEG_1_30thF	102.3	24.8	25.3	0.48	1.2%	Negligible
WEG_2_GF	1.5	26.9	28.3	1.42	3.6%	Negligible
WEG_2_1stF	7.0	26.7	27.8	1.11	2.8%	Negligible
WEG_2_2ndF	10.8	26.4	27.4	0.94	2.3%	Negligible
WEG_2_3rdF	14.0	26.2	27.0	0.81	2.0%	Negligible
WEG_2_4thF	17.2	26.0	26.8	0.80	2.0%	Negligible
WEG_2_28thF	94.8	24.8	25.3	0.42	1.1%	Negligible
WEG_2_29thF	98.4	24.8	25.3	0.42	1.1%	Negligible
WEG_2_30thF	102.3	24.8	25.3	0.45	1.1%	Negligible
WEG_3_GF	1.5	27.2	28.6	1.47	3.7%	Negligible
WEG_3_1stF	7.0	26.9	28.1	1.20	3.0%	Negligible
WEG_3_2ndF	10.8	26.6	27.6	1.00	2.5%	Negligible
WEG_3_3rdF	14.0	26.3	27.1	0.86	2.1%	Negligible
WEG_3_4thF	17.2	26.0	26.9	0.85	2.1%	Negligible
WEG_3_28thF	94.8	24.9	25.3	0.47	1.2%	Negligible
WEG_3_29thF	98.4	24.9	25.3	0.47	1.2%	Negligible
WEG_3_30thF	102.3	24.9	25.4	0.49	1.2%	Negligible
Objective		**40**		-		

Table 1.2: Predicted Annual Mean PM_{10} at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
PG_1_GF	1.5	16.8	17.0	0.12	0.7%	Negligible
PG_1_1stF	5.2	16.5	16.6	0.08	0.5%	Negligible
PG_1_2ndF	8.5	16.2	16.2	0.06	0.4%	Negligible
PG_1_3rdF	11.7	15.8	15.9	0.07	0.4%	Negligible
PG_1_4thF	14.9	15.5	15.6	0.06	0.4%	Negligible
PG_1_5thF	18.6	15.3	15.3	0.04	0.2%	Negligible
PG_1_6thF	22.3	15.2	15.2	0.04	0.2%	Negligible
PG_1_7thF	26.1	15.1	15.1	0.03	0.2%	Negligible
PG_2_GF	1.5	16.4	16.5	0.12	0.7%	Negligible
PG_2_1stF	5.2	16.2	16.3	0.08	0.5%	Negligible
PG_2_2ndF	8.5	16.0	16.0	0.06	0.4%	Negligible
PG_2_3rdF	11.7	15.7	15.8	0.07	0.4%	Negligible
PG_2_4thF	14.9	15.5	15.6	0.06	0.4%	Negligible
PG_2_5thF	18.6	15.3	15.4	0.04	0.2%	Negligible

Table 1.2: Predicted Annual Mean PM_{10} at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
PG_2_6thF	22.3	15.2	15.2	0.04	0.2%	Negligible
PG_2_7thF	26.1	15.1	15.1	0.03	0.2%	Negligible
PG_3_GF	1.5	15.9	16.5	0.55	3.3%	Negligible
PG_3_1stF	5.2	15.8	16.3	0.49	3.0%	Negligible
PG_3_2ndF	8.5	15.7	16.2	0.46	2.8%	Negligible
PG_3_3rdF	11.7	15.6	15.9	0.37	2.2%	Negligible
PG_3_4thF	14.9	15.4	15.7	0.33	2.0%	Negligible
PG_3_5thF	18.6	15.3	15.6	0.33	2.0%	Negligible
PG_3_6thF	22.3	15.2	15.5	0.33	2.0%	Negligible
PG_3_7thF	26.1	15.1	15.4	0.33	2.0%	Negligible
PG_4_GF	1.5	16.2	16.3	0.12	0.7%	Negligible
PG_4_1stF	5.2	16.1	16.1	0.09	0.5%	Negligible
PG_4_2ndF	8.5	15.9	15.9	0.07	0.4%	Negligible
PG_4_3rdF	11.7	15.7	15.7	0.07	0.4%	Negligible
PG_4_4thF	14.9	15.5	15.5	0.06	0.4%	Negligible
PG_4_5thF	18.6	15.3	15.4	0.04	0.2%	Negligible
PG_4_6thF	22.3	15.2	15.2	0.04	0.2%	Negligible
PG_4_7thF	26.1	15.1	15.1	0.03	0.2%	Negligible
WEG_1_GF	1.5	15.9	16.5	0.58	3.5%	Negligible
WEG_1_1stF	7.0	15.8	16.2	0.46	2.8%	Negligible
WEG_1_2ndF	10.8	15.6	16.0	0.39	2.4%	Negligible
WEG_1_3rdF	14.0	15.5	15.8	0.33	2.0%	Negligible
WEG_1_4thF	17.2	15.3	15.7	0.33	2.0%	Negligible
WEG_1_28thF	94.8	14.8	15.0	0.18	1.2%	Negligible
WEG_1_29thF	98.4	14.8	15.0	0.18	1.2%	Negligible
WEG_1_30thF	102.3	14.8	15.0	0.19	1.2%	Negligible
WEG_2_GF	1.5	15.6	16.2	0.59	3.6%	Negligible
WEG_2_1stF	7.0	15.6	16.0	0.46	2.8%	Negligible
WEG_2_2ndF	10.8	15.5	15.8	0.38	2.3%	Negligible
WEG_2_3rdF	14.0	15.4	15.7	0.33	2.0%	Negligible
WEG_2_4thF	17.2	15.3	15.6	0.32	2.0%	Negligible
WEG_2_28thF	94.8	14.8	15.0	0.17	1.1%	Negligible
WEG_2_29thF	98.4	14.8	15.0	0.17	1.1%	Negligible
WEG_2_30thF	102.3	14.8	15.0	0.18	1.1%	Negligible
WEG_3_GF	1.5	15.8	16.4	0.61	3.7%	Negligible
WEG_3_1stF	7.0	15.6	16.1	0.49	3.0%	Negligible
WEG_3_2ndF	10.8	15.5	15.9	0.41	2.5%	Negligible
WEG_3_3rdF	14.0	15.4	15.7	0.35	2.1%	Negligible
WEG_3_4thF	17.2	15.3	15.6	0.35	2.1%	Negligible
WEG_3_28thF	94.8	14.8	15.0	0.47	1.2%	Negligible
WEG_3_29thF	98.4	14.8	15.0	0.47	1.2%	Negligible
WEG_3_30thF	102.3	14.8	15.0	0.49	1.2%	Negligible
Objective		40				

Table 1.3: Predicted Annual Mean $PM_{2.5}$ at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
PG_1_GF	1.5	10.4	10.4	0.07	0.3%	Negligible
PG_1_1stF	5.2	10.2	10.3	0.05	0.2%	Negligible
PG_1_2ndF	8.5	10.0	10.0	0.04	0.2%	Negligible
PG_1_3rdF	11.7	9.8	9.8	0.04	0.2%	Negligible
PG_1_4thF	14.9	9.7	9.7	0.03	0.2%	Negligible
PG_1_5thF	18.6	9.5	9.6	0.02	0.1%	Negligible
PG_1_6thF	22.3	9.5	9.5	0.02	0.1%	Negligible
PG_1_7thF	26.1	9.4	9.4	0.02	0.1%	Negligible
PG_2_GF	1.5	10.1	10.2	0.07	0.3%	Negligible
PG_2_1stF	5.2	10.0	10.1	0.05	0.2%	Negligible
PG_2_2ndF	8.5	9.9	9.9	0.04	0.2%	Negligible
PG_2_3rdF	11.7	9.8	9.8	0.04	0.2%	Negligible
PG_2_4thF	14.9	9.6	9.7	0.03	0.2%	Negligible
PG_2_5thF	18.6	9.5	9.6	0.02	0.1%	Negligible
PG_2_6thF	22.3	9.5	9.5	0.02	0.1%	Negligible
PG_2_7thF	26.1	9.4	9.4	0.02	0.1%	Negligible
PG_3_GF	1.5	9.9	10.2	0.30	1.5%	Negligible
PG_3_1stF	5.2	9.8	10.1	0.27	1.4%	Negligible
PG_3_2ndF	8.5	9.8	10.0	0.25	1.3%	Negligible
PG_3_3rdF	11.7	9.7	9.9	0.20	1.0%	Negligible
PG_3_4thF	14.9	9.6	9.8	0.18	0.9%	Negligible
PG_3_5thF	18.6	9.5	9.7	0.18	0.9%	Negligible
PG_3_6thF	22.3	9.4	9.6	0.18	0.9%	Negligible
PG_3_7thF	26.1	9.4	9.6	0.18	0.9%	Negligible
PG_4_GF	1.5	10.0	10.1	0.06	0.3%	Negligible
PG_4_1stF	5.2	9.9	10.0	0.05	0.2%	Negligible
PG_4_2ndF	8.5	9.8	9.9	0.04	0.2%	Negligible
PG_4_3rdF	11.7	9.7	9.8	0.04	0.2%	Negligible
PG_4_4thF	14.9	9.6	9.7	0.03	0.2%	Negligible
PG_4_5thF	18.6	9.5	9.6	0.02	0.1%	Negligible
PG_4_6thF	22.3	9.5	9.5	0.02	0.1%	Negligible
PG_4_7thF	26.1	9.4	9.4	0.01	0.1%	Negligible
WEG_1_GF	1.5	9.9	10.2	0.32	1.6%	Negligible

Table 1.3: Predicted Annual Mean $PM_{2.5}$ at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
WEG_1_1stF	7.0	9.8	10.0	0.26	1.3%	Negligible
WEG_1_2ndF	10.8	9.7	9.9	0.22	1.1%	Negligible
WEG_1_3rdF	14.0	9.6	9.8	0.19	0.9%	Negligible
WEG_1_4thF	17.2	9.5	9.7	0.18	0.9%	Negligible
WEG_1_28thF	94.8	9.3	9.4	0.10	0.5%	Negligible
WEG_1_29thF	98.4	9.3	9.4	0.10	0.5%	Negligible
WEG_1_30thF	102.3	9.2	9.4	0.11	0.5%	Negligible
WEG_2_GF	1.5	9.7	10.0	0.33	1.6%	Negligible
WEG_2_1stF	7.0	9.7	9.9	0.25	1.3%	Negligible
WEG_2_2ndF	10.8	9.6	9.8	0.21	1.1%	Negligible
WEG_2_3rdF	14.0	9.6	9.7	0.18	0.9%	Negligible
WEG_2_4thF	17.2	9.5	9.7	0.18	0.9%	Negligible
WEG_2_28thF	94.8	9.3	9.3	0.09	0.5%	Negligible
WEG_2_29thF	98.4	9.3	9.3	0.09	0.5%	Negligible
WEG_2_30thF	102.3	9.2	9.3	0.10	0.5%	Negligible
WEG_3_GF	1.5	9.8	10.1	0.34	1.7%	Negligible
WEG_3_1stF	7.0	9.7	10.0	0.27	1.4%	Negligible
WEG_3_2ndF	10.8	9.6	9.9	0.23	1.1%	Negligible
WEG_3_3rdF	14.0	9.6	9.8	0.19	1.0%	Negligible
WEG_3_4thF	17.2	9.5	9.7	0.19	1.0%	Negligible
WEG_3_28thF	94.8	9.3	9.4	0.11	0.5%	Negligible
WEG_3_29thF	98.4	9.3	9.4	0.11	0.5%	Negligible
WEG_3_30thF	102.3	9.3	9.4	0.11	0.6%	Negligible
Objective		**20* 10****			-	

* UK national air quality exposure reduction objective to be achieved by 2020
** WHO recommended guideline. London policy to meet by 2030[1]

1.1.1 Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative

Table 1.4: Predicted Annual Mean NO_2 at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
PG_1_GF	1.5	29.5	29.7	0.28	0.7%	Negligible
PG_1_1stF	5.2	28.8	29.0	0.21	0.5%	Negligible
PG_1_2ndF	8.5	28.0	28.1	0.15	0.4%	Negligible
PG_1_3rdF	11.7	27.2	27.3	0.16	0.4%	Negligible
PG_1_4thF	14.9	26.5	26.7	0.14	0.4%	Negligible
PG_1_5thF	18.6	26.0	26.1	0.09	0.2%	Negligible
PG_1_6thF	22.3	25.7	25.8	0.09	0.2%	Negligible
PG_1_7thF	26.1	25.5	25.6	0.07	0.2%	Negligible
PG_2_GF	1.5	28.4	28.7	0.29	0.7%	Negligible
PG_2_1stF	5.2	28.1	28.3	0.20	0.5%	Negligible
PG_2_2ndF	8.5	27.5	27.7	0.16	0.4%	Negligible
PG_2_3rdF	11.7	27.0	27.2	0.16	0.4%	Negligible
PG_2_4thF	14.9	26.5	26.6	0.14	0.4%	Negligible
PG_2_5thF	18.6	26.1	26.2	0.09	0.2%	Negligible
PG_2_6thF	22.3	25.8	25.8	0.09	0.2%	Negligible
PG_2_7thF	26.1	25.5	25.6	0.07	0.2%	Negligible
PG_3_GF	1.5	27.4	28.8	1.32	3.3%	Negligible
PG_3_1stF	5.2	27.2	28.4	1.20	3.0%	Negligible
PG_3_2ndF	8.5	27.0	28.1	1.11	2.8%	Negligible
PG_3_3rdF	11.7	26.6	27.5	0.89	2.2%	Negligible
PG_3_4thF	14.9	26.3	27.1	0.82	2.0%	Negligible
PG_3_5thF	18.6	26.0	26.8	0.82	2.0%	Negligible
PG_3_6thF	22.3	25.7	26.5	0.82	2.0%	Negligible
PG_3_7thF	26.1	25.5	26.3	0.82	2.0%	Negligible
PG_4_GF	1.5	28.0	28.3	0.28	0.7%	Negligible
PG_4_1stF	5.2	27.7	28.0	0.21	0.5%	Negligible
PG_4_2ndF	8.5	27.3	27.5	0.17	0.4%	Negligible
PG_4_3rdF	11.7	26.9	27.1	0.17	0.4%	Negligible
PG_4_4thF	14.9	26.5	26.6	0.14	0.4%	Negligible
PG_4_5thF	18.6	26.1	26.2	0.09	0.2%	Negligible
PG_4_6thF	22.3	25.8	25.9	0.09	0.2%	Negligible
PG_4_7thF	26.1	25.5	25.6	0.07	0.2%	Negligible
WEG_1_GF	1.5	27.4	28.8	1.41	3.5%	Negligible
WEG_1_1stF	7.0	27.1	28.2	1.12	2.8%	Negligible
WEG_1_2ndF	10.8	26.7	27.7	0.96	2.4%	Negligible
WEG_1_3rdF	14.0	26.4	27.2	0.82	2.0%	Negligible
WEG_1_4thF	17.2	26.1	26.9	0.82	2.0%	Negligible
WEG_1_28thF	94.8	24.8	25.3	0.46	1.2%	Negligible
WEG_1_29thF	98.4	24.8	25.3	0.46	1.2%	Negligible
WEG_1_30thF	102.3	24.8	25.3	0.48	1.2%	Negligible

[1] London Environment Strategy, Greater London Authority, 2018

Table 1.4: Predicted Annual Mean NO_2 at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
WEG_2_GF	1.5	26.9	28.3	1.42	3.6%	Negligible
WEG_2_1stF	7.0	26.7	27.8	1.11	2.8%	Negligible
WEG_2_2ndF	10.8	26.4	27.4	0.94	2.3%	Negligible
WEG_2_3rdF	14.0	26.2	27.0	0.81	2.0%	Negligible
WEG_2_4thF	17.2	26.0	26.8	0.80	2.0%	Negligible
WEG_2_28thF	94.8	24.8	25.3	0.42	1.1%	Negligible
WEG_2_29thF	98.4	24.8	25.3	0.43	1.1%	Negligible
WEG_2_30thF	102.3	24.8	25.3	0.45	1.1%	Negligible
WEG_3_GF	1.5	27.2	28.6	1.47	3.7%	Negligible
WEG_3_1stF	7.0	26.9	28.1	1.20	3.0%	Negligible
WEG_3_2ndF	10.8	26.6	27.6	1.01	2.5%	Negligible
WEG_3_3rdF	14.0	26.3	27.2	0.87	2.2%	Negligible
WEG_3_4thF	17.2	26.0	26.9	0.86	2.1%	Negligible
WEG_3_28thF	94.8	24.9	25.3	0.47	1.2%	Negligible
WEG_3_29thF	98.4	24.9	25.3	0.47	1.2%	Negligible
WEG_3_30thF	102.3	24.9	25.4	0.49	1.2%	Negligible
Objective		**40**		-		

Table 1.5: Predicted Annual Mean PM_{10} at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
PG_1_GF	1.5	16.8	17.0	0.12	0.3%	Negligible
PG_1_1stF	5.2	16.5	16.6	0.09	0.2%	Negligible
PG_1_2ndF	8.5	16.2	16.2	0.07	0.2%	Negligible
PG_1_3rdF	11.7	15.8	15.9	0.07	0.2%	Negligible
PG_1_4thF	14.9	15.5	15.6	0.06	0.1%	Negligible
PG_1_5thF	18.6	15.3	15.3	0.04	0.1%	Negligible
PG_1_6thF	22.3	15.2	15.2	0.04	0.1%	Negligible
PG_1_7thF	26.1	15.1	15.1	0.03	0.1%	Negligible
PG_2_GF	1.5	16.4	16.5	0.12	0.3%	Negligible
PG_2_1stF	5.2	16.2	16.3	0.08	0.2%	Negligible
PG_2_2ndF	8.5	16.0	16.0	0.06	0.2%	Negligible
PG_2_3rdF	11.7	15.7	15.8	0.07	0.2%	Negligible
PG_2_4thF	14.9	15.5	15.6	0.06	0.1%	Negligible
PG_2_5thF	18.6	15.3	15.4	0.04	0.1%	Negligible

Table 1.5: Predicted Annual Mean PM_{10} at Existing Receptors (µg/m³)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
PG_2_6thF	22.3	15.2	15.2	0.04	0.1%	Negligible
PG_2_7thF	26.1	15.1	15.1	0.03	0.1%	Negligible
PG_3_GF	1.5	15.9	16.5	0.55	1.4%	Negligible
PG_3_1stF	5.2	15.8	16.3	0.49	1.2%	Negligible
PG_3_2ndF	8.5	15.7	16.2	0.46	1.1%	Negligible
PG_3_3rdF	11.7	15.6	15.9	0.37	0.9%	Negligible
PG_3_4thF	14.9	15.4	15.7	0.33	0.8%	Negligible
PG_3_5thF	18.6	15.3	15.6	0.33	0.8%	Negligible
PG_3_6thF	22.3	15.2	15.5	0.33	0.8%	Negligible
PG_3_7thF	26.1	15.1	15.4	0.33	0.8%	Negligible
PG_4_GF	1.5	16.2	16.3	0.12	0.3%	Negligible
PG_4_1stF	5.2	16.1	16.1	0.09	0.2%	Negligible
PG_4_2ndF	8.5	15.9	15.9	0.07	0.2%	Negligible
PG_4_3rdF	11.7	15.7	15.7	0.07	0.2%	Negligible
PG_4_4thF	14.9	15.5	15.6	0.06	0.1%	Negligible
PG_4_5thF	18.6	15.3	15.4	0.04	0.1%	Negligible
PG_4_6thF	22.3	15.2	15.2	0.04	0.1%	Negligible
PG_4_7thF	26.1	15.1	15.1	0.03	0.1%	Negligible
WEG_1_GF	1.5	15.9	16.5	0.58	1.5%	Negligible
WEG_1_1stF	7.0	15.8	16.2	0.46	1.2%	Negligible
WEG_1_2ndF	10.8	15.6	16.0	0.39	1.0%	Negligible
WEG_1_3rdF	14.0	15.5	15.8	0.33	0.8%	Negligible
WEG_1_4thF	17.2	15.3	15.7	0.33	0.8%	Negligible
WEG_1_28thF	94.8	14.8	15.0	0.18	0.5%	Negligible
WEG_1_29thF	98.4	14.8	15.0	0.18	0.5%	Negligible
WEG_1_30thF	102.3	14.8	15.0	0.19	0.5%	Negligible
WEG_2_GF	1.5	15.6	16.2	0.59	1.5%	Negligible
WEG_2_1stF	7.0	15.6	16.0	0.46	1.1%	Negligible
WEG_2_2ndF	10.8	15.5	15.8	0.38	1.0%	Negligible
WEG_2_3rdF	14.0	15.4	15.7	0.33	0.8%	Negligible
WEG_2_4thF	17.2	15.3	15.6	0.32	0.8%	Negligible
WEG_2_28thF	94.8	14.8	15.0	0.17	0.4%	Negligible
WEG_2_29thF	98.4	14.8	15.0	0.17	0.4%	Negligible
WEG_2_30thF	102.3	14.8	15.0	0.18	0.5%	Negligible
WEG_3_GF	1.5	15.8	16.4	0.61	1.5%	Negligible
WEG_3_1stF	7.0	15.6	16.1	0.49	1.2%	Negligible
WEG_3_2ndF	10.8	15.5	15.9	0.41	1.0%	Negligible
WEG_3_3rdF	14.0	15.4	15.7	0.35	0.9%	Negligible
WEG_3_4thF	17.2	15.3	15.6	0.35	0.9%	Negligible
WEG_3_28thF	94.8	24.9	15.0	0.19	0.5%	Negligible
WEG_3_29thF	98.4	24.9	15.0	0.19	0.5%	Negligible

Table 1.5: Predicted Annual Mean PM_{10} at Existing Receptors ($\mu g/m^3$)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
WEG_3_30thF	102.3	24.9	15.0	0.20	0.5%	Negligible
Objective		40 -				

Table 1.6: Predicted Annual Mean $PM_{2.5}$ at Existing Receptors ($\mu g/m^3$)

Receptor	Height (m)	Scenario 2 Future Baseline (2030)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	Development Traffic Contribution	Change in Concentration Relative AQO (%)	Impact Descriptor
PG_1_GF	1.5	10.4	10.4	0.07	0.3%	Negligible
PG_1_1stF	5.2	10.2	10.3	0.05	0.2%	Negligible
PG_1_2ndF	8.5	10.0	10.0	0.04	0.2%	Negligible
PG_1_3rdF	11.7	9.8	9.8	0.04	0.2%	Negligible
PG_1_4thF	14.9	9.7	9.7	0.03	0.2%	Negligible
PG_1_5thF	18.6	9.5	9.6	0.02	0.1%	Negligible
PG_1_6thF	22.3	9.5	9.5	0.02	0.1%	Negligible
PG_1_7thF	26.1	9.4	9.4	0.02	0.1%	Negligible
PG_2_GF	1.5	10.1	10.2	0.07	0.3%	Negligible
PG_2_1stF	5.2	10.0	10.1	0.05	0.2%	Negligible
PG_2_2ndF	8.5	9.9	9.9	0.04	0.2%	Negligible
PG_2_3rdF	11.7	9.8	9.8	0.04	0.2%	Negligible
PG_2_4thF	14.9	9.6	9.7	0.03	0.2%	Negligible
PG_2_5thF	18.6	9.5	9.6	0.02	0.1%	Negligible
PG_2_6thF	22.3	9.5	9.5	0.02	0.1%	Negligible
PG_2_7thF	26.1	9.4	9.4	0.02	0.1%	Negligible
PG_3_GF	1.5	9.9	10.2	0.30	1.5%	Negligible
PG_3_1stF	5.2	9.8	10.1	0.27	1.4%	Negligible
PG_3_2ndF	8.5	9.8	10.0	0.25	1.3%	Negligible
PG_3_3rdF	11.7	9.7	9.9	0.20	1.0%	Negligible
PG_3_4thF	14.9	9.6	9.8	0.19	0.9%	Negligible
PG_3_5thF	18.6	9.5	9.7	0.18	0.9%	Negligible
PG_3_6thF	22.3	9.4	9.6	0.18	0.9%	Negligible
PG_3_7thF	26.1	9.4	9.6	0.18	0.9%	Negligible
PG_4_GF	1.5	10.0	10.1	0.06	0.3%	Negligible
PG_4_1stF	5.2	9.9	10.0	0.05	0.2%	Negligible
PG_4_2ndF	8.5	9.8	9.9	0.04	0.2%	Negligible
PG_4_3rdF	11.7	9.7	9.8	0.04	0.2%	Negligible
PG_4_4thF	14.9	9.6	9.7	0.03	0.2%	Negligible
PG_4_5thF	18.6	9.5	9.6	0.02	0.1%	Negligible
PG_4_6thF	22.3	9.5	9.5	0.02	0.1%	Negligible
PG_4_7thF	26.1	9.4	9.4	0.02	0.1%	Negligible
WEG_1_GF	1.5	9.9	10.2	0.32	1.6%	Negligible
WEG_1_1stF	7.0	9.8	10.0	0.26	1.3%	Negligible
WEG_1_2ndF	10.8	9.7	9.9	0.22	1.1%	Negligible
WEG_1_3rdF	14.0	9.6	9.8	0.19	0.9%	Negligible
WEG_1_4thF	17.2	9.5	9.7	0.18	0.9%	Negligible
WEG_1_28thF	94.8	9.3	9.4	0.10	0.5%	Negligible
WEG_1_29thF	98.4	9.3	9.4	0.10	0.5%	Negligible
WEG_1_30thF	102.3	9.2	9.4	0.11	0.5%	Negligible
WEG_2_GF	1.5	9.7	10.0	0.33	1.6%	Negligible
WEG_2_1stF	7.0	9.7	9.9	0.25	1.3%	Negligible
WEG_2_2ndF	10.8	9.6	9.8	0.21	1.1%	Negligible
WEG_2_3rdF	14.0	9.6	9.7	0.18	0.9%	Negligible
WEG_2_4thF	17.2	9.5	9.7	0.18	0.9%	Negligible
WEG_2_28thF	94.8	9.3	9.3	0.09	0.5%	Negligible
WEG_2_29thF	98.4	9.3	9.3	0.09	0.5%	Negligible
WEG_2_30thF	102.3	9.2	9.3	0.10	0.5%	Negligible
WEG_3_GF	1.5	9.8	10.1	0.34	1.7%	Negligible
WEG_3_1stF	7.0	9.7	10.0	0.27	1.4%	Negligible
WEG_3_2ndF	10.8	9.6	9.9	0.23	1.1%	Negligible
WEG_3_3rdF	14.0	9.6	9.8	0.19	1.0%	Negligible
WEG_3_4thF	17.2	9.5	9.7	0.19	1.0%	Negligible
WEG_3_28thF	94.8	9.3	9.4	0.11	0.5%	Negligible
WEG_3_29thF	98.4	9.3	9.4	0.11	0.5%	Negligible
WEG_3_30thF	102.3	9.3	9.4	0.11	0.6%	Negligible
Objective			20* 10**			

* UK national air quality exposure reduction objective to be achieved by 2020

** WHO recommended guideline. London policy to meet by 2030[1]

1.2 Site Suitability

Table 1.7: Predicted Annual Mean NO_2 at Future Receptors (µg/m³)

Receptor	Height (m)	WEG Energy Centre PC	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	PEC (Scenario 3 + WEG PC)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	PEC (Scenario 4 + WEG PC)
I_1_GF	1.5	0.1	33.4	33.5	33.4	33.5
I_1_1stF	7.64	0.1	30.8	30.9	30.8	30.9
I_1_2ndF	11.8	0.1	29.1	29.2	29.1	29.2
I_1_3rdF	15	0.1	28.2	28.3	28.2	28.3
I_1_4thF	18.2	0.1	27.6	27.6	27.6	27.6
I_1_22ndF	76.5	0.1	24.9	25.0	24.9	25.0
I_1_23rdF	79.8	0.1	24.9	25.0	24.9	25.0
I_1_24thF	83	0.1	24.9	25.0	24.9	25.0
I_2_GF	1.5	0.1	33.9	34.0	33.9	34.0
I_2_1stF	7.64	0.1	31.0	31.1	31.0	31.1
I_2_2ndF	11.8	0.1	29.2	29.3	29.2	29.3
I_2_3rdF	15	0.1	28.2	28.3	28.2	28.3
I_2_4thF	18.2	0.1	27.5	27.6	27.5	27.6
I_2_22ndF	76.5	0.1	24.9	25.0	24.9	25.0
I_2_23rdF	79.8	0.1	24.9	25.0	24.9	25.0
I_2_24thF	83	0.1	24.9	25.0	24.9	25.0
I_3_GF	1.5	0.2	33.8	34.0	33.8	34.0
I_3_1stF	7.64	0.2	30.9	31.1	30.9	31.1
I_3_2ndF	11.8	0.2	29.2	29.3	29.2	29.3
I_3_3rdF	15	0.2	28.2	28.4	28.2	28.4
I_3_4thF	18.2	0.2	27.5	27.7	27.6	27.7
I_3_22ndF	76.5	0.2	24.9	25.0	24.9	25.0
I_3_23rdF	79.8	0.2	24.9	25.0	24.9	25.0
I_3_24thF	83	0.2	24.9	25.0	24.9	25.0
I_4_GF	1.5	0.2	28.3	28.5	28.3	28.5
I_4_1stF	7.64	0.2	27.6	27.8	27.6	27.8
I_4_2ndF	11.8	0.2	26.9	27.1	26.9	27.1
I_4_3rdF	15	0.2	26.4	26.6	26.4	26.6
I_4_4thF	18.2	0.2	26.0	26.2	26.0	26.2
I_4_22ndF	76.5	0.2	24.9	25.1	24.9	25.1
I_4_23rdF	79.8	0.2	24.9	25.1	24.9	25.1
I_4_24thF	83	0.2	24.9	25.0	24.9	25.0
J_1_GF	1.5	0.1	34.1	34.2	34.1	34.2
J_1_1stF	7.6	0.1	31.1	31.2	31.1	31.2
J_1_2ndF	11.7	0.1	29.3	29.3	29.3	29.3
J_1_3rdF	14.9	0.1	28.3	28.4	28.3	28.4
J_1_4thF	18.1	0.1	27.6	27.7	27.6	27.7

Table 1.7: Predicted Annual Mean NO_2 at Future Receptors (µg/m³)

Receptor	Height (m)	WEG Energy Centre PC	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	PEC (Scenario 3 + WEG PC)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	PEC (Scenario 4 + WEG PC)
J_1_15thF	53.9	0.1	26.1	26.2	26.1	26.2
J_1_16thF	57.14	0.1	26.0	26.1	26.1	26.1
J_1_17thf	61.34	0.1	26.0	26.1	26.0	26.1
J_2_GF	1.5	0.1	35.9	36.0	35.9	36.0
J_2_1stF	7.6	0.1	32.5	32.6	32.6	32.6
J_2_2ndF	11.7	0.1	30.4	30.5	30.4	30.5
J_2_3rdF	14.9	0.1	29.3	29.3	29.3	29.3
J_2_4thF	18.1	0.1	28.6	28.6	28.6	28.6
J_2_15thF	53.9	0.1	27.0	27.0	27.0	27.0
J_2_16thF	57.14	0.1	27.0	27.0	27.0	27.0
J_2_17thf	61.34	0.1	26.9	27.0	26.9	27.0
J_3_GF	1.5	0.2	28.4	28.6	28.4	28.6
J_3_1stF	7.6	0.2	27.7	27.9	27.7	27.9
J_3_2ndF	11.7	0.2	26.9	27.1	26.9	27.1
J_3_3rdF	14.9	0.2	26.4	26.6	26.4	26.6
J_3_4thF	18.1	0.2	26.0	26.2	26.0	26.2
J_3_15thF	53.9	0.2	24.9	25.2	24.9	25.2
J_3_16thF	57.14	0.2	24.9	25.1	24.9	25.1
J_3_17thf	61.34	0.2	24.9	25.1	24.9	25.1
K_1_GF	1.5	0.1	36.2	36.3	36.2	36.3
K_1_1stF	7	0.1	33.2	33.3	33.2	33.3
K_1_2ndF	11.2	0.1	30.9	31.0	30.9	31.0
K_1_3rdF	15.4	0.1	29.4	29.5	29.4	29.5
K_1_4thF	18.6	0.1	28.7	28.8	28.7	28.8
K_1_27th	92.89	0.1	24.9	25.0	24.9	25.0
K_1_28th	96.75	0.1	24.9	25.0	24.9	25.0
K_1_29th	99.94	0.2	24.9	25.0	24.9	25.0
K_1_30th	103.14	0.7	24.9	25.6	24.9	25.6
K_1_31st	106.35	1.2	24.9	26.1	24.9	26.1
K_1_32nd	109.54	1.5	24.8	26.4	24.8	26.4
K_1_33rd	112.75	1.3	24.8	26.1	24.8	26.1
K_1_34th	117	0.7	24.8	25.5	24.8	25.5
K_1_35th	120.2	0.4	24.8	25.2	24.8	25.2
K_1_36th	123.4	0.3	24.8	25.1	24.8	25.1
K_1_37thF	126.6	0.2	24.8	25.0	24.8	25.0
K_1_38thF	129.8	0.2	24.8	25.0	24.8	25.0
K_2_GF	1.5	0.1	38.5	38.6	38.5	38.6
K_2_1stF	7	0.1	36.7	36.7	36.7	36.7

Table 1.7: Predicted Annual Mean NO_2 at Future Receptors (µg/m^3)

Receptor	Height (m)	WEG Energy Centre PC	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	PEC (Scenario 3 + WEG PC)	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development	PEC (Scenario 4 + WEG PC)
K_2_2ndF	11.2	0.1	34.7	34.7	34.7	34.7
K_2_3rdF	15.45	0.1	32.8	32.8	32.8	32.8
K_2_4thF	18.65	0.1	31.9	32.0	31.9	32.0
K_2_27th	92.89	0.1	28.4	28.5	28.4	28.5
K_2_28th	96.75	0.1	28.3	28.5	28.3	28.5
K_2_29th	99.94	0.5	28.3	28.9	28.3	28.9
K_2_30th	103.14	1.1	28.3	29.4	28.3	29.4
K_2_31st	106.35	1.8	24.8	26.6	24.8	26.6
K_2_32nd	109.54	2.2	24.8	27.0	24.8	27.0
K_2_33rd	112.75	1.8	24.8	26.6	24.8	26.6
K_2_34th	117	0.9	24.8	25.8	24.8	25.8
K_2_35th	120.2	0.6	24.8	25.4	24.8	25.4
K_2_36th	123.4	0.4	24.8	25.2	24.8	25.2
K_2_37thF	126.6	0.3	24.8	25.1	24.8	25.1
K_2_38thF	129.8	0.2	24.8	25.0	24.8	25.0
K_3_GF	1.5	0.1	38.1	38.2	38.1	38.2
K_3_1stF	7	0.1	36.4	36.5	36.4	36.5
K_3_2ndF	11.2	0.1	34.6	34.6	34.6	34.6
K_3_3rdF	15.45	0.1	32.7	32.8	32.7	32.8
K_3_4thF	18.65	0.1	31.8	31.9	31.9	31.9
K_3_27th	92.89	0.1	28.3	28.5	28.4	28.5
K_3_28th	96.75	0.2	28.3	28.5	28.3	28.5
K_3_29th	99.94	0.2	28.3	28.5	28.3	28.5
K_3_30th	103.14	1.3	28.3	29.7	28.3	29.7
K_3_31st	106.35	2.4	24.8	27.2	24.8	27.2
K_3_32nd	109.54	2.9	24.8	27.7	24.8	27.7
K_3_33rd	112.75	2.1	24.8	27.0	24.8	27.0
K_3_34th	117	1.0	24.8	25.8	24.8	25.8
K_3_35th	120.2	0.6	24.8	25.4	24.8	25.4
K_3_36th	123.4	0.4	24.8	25.2	24.8	25.2
K_3_37thF	126.6	0.3	24.8	25.1	24.8	25.1
K_3_38thF	129.8	0.2	24.8	25.0	24.8	25.0
K_4_GF	1.5	0.1	36.4	36.4	36.4	36.4
K_4_1stF	7	0.1	35.1	35.1	35.1	35.1
K_4_2ndF	11.2	0.1	33.6	33.7	33.7	33.7
K_4_3rdF	15.45	0.1	32.1	32.2	32.1	32.2
K_4_27th	92.89	0.2	28.8	29.0	28.8	29.0
K_4_28th	96.75	0.3	28.8	29.1	28.8	29.1
K_4_29th	99.94	0.5	28.8	29.3	28.8	29.3
K_4_30th	103.14	2.1	28.8	30.9	28.8	30.9
K_4_31st	106.35	4.3	28.8	33.0	28.8	33.0
K_4_32nd	109.54	4.7	28.7	33.5	28.8	33.5
K_4_33rd	112.75	2.7	28.7	31.5	28.7	31.5
K_4_34th	117	1.1	28.7	29.8	28.7	29.8
K_4_35th	120.2	0.6	28.7	29.4	28.7	29.4
K_4_36th	123.4	0.4	28.7	29.1	28.7	29.1
K_4_37thF	126.6	0.3	28.7	29.0	28.7	29.0
K_4_38thF	129.8	0.2	28.7	28.9	28.7	28.9
K_5_GF	1.5	0.1	28.0	28.1	28.0	28.1
K_5_1stF	7	0.1	27.5	27.6	27.5	27.6
K_5_2ndF	11.2	0.1	26.9	27.0	26.9	27.0
K_5_3rdF	15.45	0.1	26.3	26.5	26.3	26.5
K_5_4thF	18.65	0.1	26.0	26.1	26.0	26.1
K_5_27th	92.89	0.1	24.8	25.0	24.8	25.0
K_5_28th	96.75	0.1	24.8	25.0	24.8	25.0
K_5_29th	99.94	0.2	24.9	25.0	24.9	25.0
K_5_30th	103.14	2.1	24.8	26.9	24.8	26.9
K_5_31st	106.35	5.5	24.8	30.4	24.8	30.4
K_5_32nd	109.54	6.4	24.8	31.2	24.8	31.2
K_5_33rd	112.75	3.1	24.8	27.9	24.8	27.9
K_5_34th	117	1.1	24.8	25.9	24.8	25.9
K_5_35th	120.2	0.6	24.8	25.5	24.8	25.5
K_5_36th	123.4	0.4	24.8	25.2	24.8	25.2
K_5_37thF	126.6	0.3	24.8	25.1	24.8	25.1
K_5_38thF	129.8	0.2	24.8	25.0	24.8	25.0
PS1_GF	1.5	0.1	31.9	31.9	31.9	31.9
PS2_GF	1.5	0.1	36.6	36.6	36.6	36.6
PS3_GF	1.5	0.1	30.7	30.8	30.7	30.8
PS4_GF	1.5	0.1	33.3	33.4	33.3	33.4
PS5_GF	1.5	0.1	34.0	34.1	34.0	34.1
Objective		**40**				

Table 1.8: Predicted Annual Mean PM_{10} at Future Receptors (μg/m³)

Receptor	Height (m)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development
I_1_GF	1.5	18.7	18.7
I_1_1stF	7.64	17.5	17.5
I_1_2ndF	11.8	16.7	16.7
I_1_3rdF	15	16.3	16.3
I_1_4thF	18.2	16.0	16.0
I_1_22ndF	76.5	14.8	14.8
I_1_23rdF	79.8	14.8	14.8
I_1_24thF	83	14.8	14.8
I_2_GF	1.5	19.0	19.0
I_2_1stF	7.64	17.6	17.6
I_2_2ndF	11.8	16.7	16.7
I_2_3rdF	15	16.3	16.3
I_2_4thF	18.2	16.0	16.0
I_2_22ndF	76.5	14.8	14.8
I_2_23rdF	79.8	14.8	14.8
I_2_24thF	83	14.8	14.8
I_3_GF	1.5	18.9	18.9
I_3_1stF	7.64	17.5	17.5
I_3_2ndF	11.8	16.7	16.7
I_3_3rdF	15	16.3	16.3
I_3_4thF	18.2	16.0	16.0
I_3_22ndF	76.5	14.8	14.8
I_3_23rdF	79.8	14.8	14.8
I_3_24thF	83	14.8	14.8
I_4_GF	1.5	16.3	16.3
I_4_1stF	7.64	16.0	16.0
I_4_2ndF	11.8	15.7	15.7
I_4_3rdF	15	15.5	15.5
I_4_4thF	18.2	15.3	15.3
I_4_22ndF	76.5	14.8	14.8
I_4_23rdF	79.8	14.8	14.8
I_4_24thF	83	14.8	14.8
J_1_GF	1.5	19.0	19.0
J_1_1stF	7.6	17.6	17.6
J_1_2ndF	11.7	16.7	16.7
J_1_3rdF	14.9	16.3	16.3
J_1_4thF	18.1	16.0	16.0
J_1_15thF	53.9	15.3	15.3
J_1_16thF	57.14	15.3	15.3
J_1_17thf	61.34	15.3	15.3
J_2_GF	1.5	19.7	19.7
J_2_1stF	7.6	18.2	18.2
J_2_2ndF	11.7	17.2	17.2
J_2_3rdF	14.9	16.7	16.7
J_2_4thF	18.1	16.4	16.4
J_2_15thF	53.9	15.7	15.7
J_2_16thF	57.14	15.7	15.7
J_2_17thf	61.34	15.7	15.7
J_3_GF	1.5	16.3	16.3
J_3_1stF	7.6	16.0	16.0
J_3_2ndF	11.7	15.7	15.7
J_3_3rdF	14.9	15.5	15.5
J_3_4thF	18.1	15.3	15.3
J_3_15thF	53.9	14.8	14.8
J_3_16thF	57.14	14.8	14.8
J_3_17thf	61.34	14.8	14.8
K_1_GF	1.5	18.9	18.9
K_1_1stF	7	17.8	17.8
K_1_2ndF	11.2	16.9	16.9
K_1_3rdF	15.4	16.3	16.3
K_1_4thF	18.6	16.1	16.1
K_1_27th	92.89	14.8	14.8
K_1_28th	96.75	14.8	14.8
K_1_29th	99.94	14.8	14.8
K_1_30th	103.14	14.8	14.8
K_1_31st	106.35	14.8	14.8
K_1_32nd	109.54	14.8	14.8
K_1_33rd	112.75	14.8	14.8
K_1_34th	117	14.8	14.8
K_1_35th	120.2	14.8	14.8
K_1_36th	123.4	14.8	14.8
K_1_37thF	126.6	14.8	14.8
K_1_38thF	129.8	14.8	14.8
K_2_GF	1.5	19.4	19.4
K_2_1stF	7	18.7	18.7
K_2_2ndF	11.2	18.0	18.0
K_2_3rdF	15.45	17.3	17.3
K_2_4thF	18.65	17.0	17.0
K_2_27th	92.89	15.8	15.8
K_2_28th	96.75	15.8	15.8
K_2_29th	99.94	15.8	15.8
K_2_30th	103.14	15.8	15.8
K_2_31st	106.35	14.8	14.8
K_2_32nd	109.54	14.8	14.8
K_2_33rd	112.75	14.8	14.8
K_2_34th	117	14.8	14.8

Table 1.8: Predicted Annual Mean PM_{10} at Future Receptors ($\mu g/m^3$)

Receptor	Height (m)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development
K_2_35th	120.2	14.8	14.8
K_2_36th	123.4	14.8	14.8
K_2_37thF	126.6	14.8	14.8
K_2_38thF	129.8	14.8	14.8
K_3_GF	1.5	19.2	19.2
K_3_1stF	7	18.6	18.6
K_3_2ndF	11.2	17.9	17.9
K_3_3rdF	15.45	17.3	17.3
K_3_4thF	18.65	17.0	17.0
K_3_27th	92.89	15.8	15.8
K_3_28th	96.75	15.8	15.8
K_3_29th	99.94	15.8	15.8
K_3_30th	103.14	15.8	15.8
K_3_31st	106.35	14.8	14.8
K_3_32nd	109.54	14.8	14.8
K_3_33rd	112.75	14.8	14.8
K_3_34th	117	14.8	14.8
K_3_35th	120.2	14.8	14.8
K_3_36th	123.4	14.8	14.8
K_3_37thF	126.6	14.8	14.8
K_3_38thF	129.8	14.8	14.8
K_4_GF	1.5	19.8	19.8
K_4_1stF	7	19.2	19.2
K_4_2ndF	11.2	18.6	18.6
K_4_3rdF	15.45	17.9	17.9
K_4_27th	92.89	16.5	16.5
K_4_28th	96.75	16.5	16.5
K_4_29th	99.94	16.5	16.5
K_4_30th	103.14	16.5	16.5
K_4_31st	106.35	16.4	16.5
K_4_32nd	109.54	16.4	16.4
K_4_33rd	112.75	16.4	16.4
K_4_34th	117	16.4	16.4
K_4_35th	120.2	16.4	16.4
K_4_36th	123.4	16.4	16.4
K_4_37thF	126.6	16.4	16.4
K_4_38thF	129.8	16.4	16.4
K_5_GF	1.5	16.1	16.1
K_5_1stF	7	15.9	15.9
K_5_2ndF	11.2	15.6	15.6
K_5_3rdF	15.45	15.4	15.4
K_5_4thF	18.65	15.3	15.3
K_5_27th	92.89	14.8	14.8
K_5_28th	96.75	14.8	14.8
K_5_29th	99.94	14.8	14.8
K_5_30th	103.14	14.8	14.8
K_5_31st	106.35	14.8	14.8
K_5_32nd	109.54	14.8	14.8
K_5_33rd	112.75	14.8	14.8
K_5_34th	117	14.8	14.8
K_5_35th	120.2	14.8	14.8
K_5_36th	123.4	14.8	14.8
K_5_37thF	126.6	14.8	14.8
K_5_38thF	129.8	14.8	14.8
PS1_GF	1.5	17.4	17.4
PS2_GF	1.5	19.0	19.0
PS3_GF	1.5	17.2	17.2
PS4_GF	1.5	18.6	18.6
PS5_GF	1.5	34.1	19.0
Objective		**40**	

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Table 1.9: Predicted Annual Mean $PM_{2.5}$ at Future Receptors ($\mu g/m^3$)

Receptor	Height (m)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development
I_1_GF	1.5	11.4	11.4
I_1_1stF	7.64	10.7	10.7
I_1_2ndF	11.8	10.3	10.3
I_1_3rdF	15	10.1	10.1
I_1_4thF	18.2	9.9	9.9
I_1_22ndF	76.5	9.3	9.3
I_1_23rdF	79.8	9.3	9.3
I_1_24thF	83	9.3	9.3
I_2_GF	1.5	11.6	11.6
I_2_1stF	7.64	10.8	10.8
I_2_2ndF	11.8	10.3	10.3
I_2_3rdF	15	10.1	10.1
I_2_4thF	18.2	9.9	9.9
I_2_22ndF	76.5	9.3	9.3
I_2_23rdF	79.8	9.3	9.3
I_2_24thF	83	9.3	9.3
I_3_GF	1.5	11.5	11.5
I_3_1stF	7.64	10.8	10.8

Table 1.9: Predicted Annual Mean $PM_{2.5}$ at Future Receptors (µg/m³)

Receptor	Height (m)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development
I_3_2ndF	11.8	10.3	10.3
I_3_3rdF	15	10.1	10.1
I_3_4thF	18.2	9.9	9.9
I_3_22ndF	76.5	9.3	9.3
I_3_23rdF	79.8	9.3	9.3
I_3_24thF	83	9.3	9.3
I_4_GF	1.5	10.1	10.1
I_4_1stF	7.64	9.9	9.9
I_4_2ndF	11.8	9.7	9.7
I_4_3rdF	15	9.6	9.6
I_4_4thF	18.2	9.5	9.5
I_4_22ndF	76.5	9.3	9.3
I_4_23rdF	79.8	9.3	9.3
I_4_24thF	83	9.3	9.3
J_1_GF	1.5	11.6	11.6
J_1_1stF	7.6	10.8	10.8
J_1_2ndF	11.7	10.3	10.3
J_1_3rdF	14.9	10.1	10.1
J_1_4thF	18.1	9.9	9.9
J_1_15thF	53.9	9.5	9.5
J_1_16thF	57.14	9.5	9.5
J_1_17thf	61.34	9.5	9.5
J_2_GF	1.5	12.0	12.0
J_2_1stF	7.6	11.1	11.1
J_2_2ndF	11.7	10.6	10.6
J_2_3rdF	14.9	10.3	10.3
J_2_4thF	18.1	10.2	10.2
J_2_15thF	53.9	9.8	9.8
J_2_16thF	57.14	9.8	9.8
J_2_17thf	61.34	9.8	9.8
J_3_GF	1.5	10.1	10.1
J_3_1stF	7.6	9.9	9.9
J_3_2ndF	11.7	9.7	9.7
J_3_3rdF	14.9	9.6	9.6
J_3_4thF	18.1	9.5	9.5
J_3_15thF	53.9	9.3	9.3
J_3_16thF	57.14	9.3	9.3
J_3_17thf	61.34	9.3	9.3
K_1_GF	1.5	11.6	11.6
K_1_1stF	7	10.9	10.9
K_1_2ndF	11.2	10.4	10.4
K_1_3rdF	15.4	10.1	10.1
K_1_4thF	18.6	10.0	10.0
K_1_27th	92.89	9.3	9.3
K_1_28th	96.75	9.3	9.3
K_1_29th	99.94	9.3	9.3
K_1_30th	103.14	9.3	9.3
K_1_31st	106.35	9.3	9.3
K_1_32nd	109.54	9.3	9.3
K_1_33rd	112.75	9.3	9.3
K_1_34th	117	9.2	9.2
K_1_35th	120.2	9.2	9.2
K_1_36th	123.4	9.2	9.2
K_1_37thF	126.6	9.2	9.2
K_1_38thF	129.8	9.2	9.2
K_2_GF	1.5	11.8	11.8
K_2_1stF	7	11.4	11.4
K_2_2ndF	11.2	11.0	11.0
K_2_3rdF	15.45	10.7	10.7
K_2_4thF	18.65	10.5	10.5
K_2_27th	92.89	9.8	9.8
K_2_28th	96.75	9.8	9.8
K_2_29th	99.94	9.8	9.8
K_2_30th	103.14	9.8	9.8
K_2_31st	106.35	9.3	9.3
K_2_32nd	109.54	9.3	9.3
K_2_33rd	112.75	9.2	9.2
K_2_34th	117	9.2	9.2
K_2_35th	120.2	9.2	9.2
K_2_36th	123.4	9.2	9.2
K_2_37thF	126.6	9.2	9.2
K_2_38thF	129.8	9.2	9.2
K_3_GF	1.5	11.7	11.7
K_3_1stF	7	11.4	11.4
K_3_2ndF	11.2	11.0	11.0
K_3_3rdF	15.45	10.6	10.6
K_3_4thF	18.65	10.5	10.5
K_3_27th	92.89	9.8	9.8
K_3_28th	96.75	9.8	9.8
K_3_29th	99.94	9.8	9.8
K_3_30th	103.14	9.8	9.8
K_3_31st	106.35	9.3	9.3
K_3_32nd	109.54	9.2	9.2
K_3_33rd	112.75	9.2	9.2
K_3_34th	117	9.2	9.2
K_3_35th	120.2	9.2	9.2

Table 1.9: Predicted Annual Mean $PM_{2.5}$ at Future Receptors (μg/m³)

Receptor	Height (m)	Scenario 3: Future Baseline (2030) + 2022 Amended Proposed Development	Scenario 4: Future Baseline (2030) + 2022 Amended Proposed Development + Cumulative Development
K_3_36th	123.4	9.2	9.2
K_3_37thF	126.6	9.2	9.2
K_3_38thF	129.8	9.2	9.2
K_4_GF	1.5	12.0	12.0
K_4_1stF	7	11.7	11.7
K_4_2ndF	11.2	11.3	11.4
K_4_3rdF	15.45	11.0	11.0
K_4_27th	92.89	10.2	10.2
K_4_28th	96.75	10.2	10.2
K_4_29th	99.94	10.2	10.2
K_4_30th	103.14	10.2	10.2
K_4_31st	106.35	10.2	10.2
K_4_32nd	109.54	10.2	10.2
K_4_33rd	112.75	10.2	10.2
K_4_34th	117	10.2	10.2
K_4_35th	120.2	10.1	10.2
K_4_36th	123.4	10.1	10.1
K_4_37thF	126.6	10.1	10.1
K_4_38thF	129.8	10.1	10.1
K_5_GF	1.5	10.0	10.0
K_5_1stF	7	9.9	9.9
K_5_2ndF	11.2	9.7	9.7
K_5_3rdF	15.45	9.6	9.6
K_5_4thF	18.65	9.5	9.5
K_5_27th	92.89	9.3	9.3
K_5_28th	96.75	9.3	9.3
K_5_29th	99.94	9.3	9.3
K_5_30th	103.14	9.3	9.3
K_5_31st	106.35	9.2	9.2
K_5_32nd	109.54	9.2	9.2
K_5_33rd	112.75	9.2	9.2
K_5_34th	117	9.2	9.2
K_5_35th	120.2	9.2	9.2
K_5_36th	123.4	9.2	9.2
K_5_37thF	126.6	9.2	9.2
K_5_38thF	129.8	9.2	9.2
PS1_GF	1.5	10.7	10.7
PS2_GF	1.5	11.6	11.6
PS3_GF	1.5	10.6	10.6
PS4_GF	1.5	11.4	11.4
PS5_GF	1.5	11.6	11.6
Objective		**20* 10****	
* UK national air quality exposure reduction objective to be achieved by 2020			
** 2005 WHO recommended guideline. London policy to meet by 2030[1]			

Technical Appendix 8.1(R): Noise and Vibration Legislation and Policy

TECHNICAL APPENDIX 8.1(R): LEGISLATION AND GUIDANCE

1. National Legislation

1.1 Control of Pollution Act, 1974, Part III - Noise

The Control of Pollution Act, 1974[1] (CPA) is a combination and refinement of earlier Acts including: The Public Health Act, 1936[2] (replaced by the Public Health Act 1990, Part III) and the Noise Abatement Act 1960[3].

Section 60 enables a Local Authority to serve a notice on a person (this includes a company) who is carrying out, or who is planning to carry out, works of construction, demolition, road-works, railway maintenance etc. in order to control the noise from those operations.

Section 61 also enables such a person to apply to the Local Authority for consent in respect of such works. The Act introduces the concept of using 'Best Practicable Means' (BPM) to control the impact of noise, where significant impacts are likely to occur. BPM refers to the selection of plant, techniques and equipment to reduce noise whilst considering local conditions, current state of technical knowledge and the financial implications. Factors such as timing, duration, location and opportunities for acoustic screening or separation are employed; in order to ensure that impacts are controlled in so far as is reasonably practicable. The demonstrable use of BPM can also be used as a defence to enforcement action under nuisance legislation.

1.2 The Environmental Protection Act, 1990 (as amended)

Section 79 of the Environmental Protection Act 1990[4] (EPA) declares that a number of matters, including noise, are to be statutory nuisances. Under the provisions of the Environmental Protection Act, the Local Authority is required to inspect its area periodically to detect any nuisance and, where a complaint of a statutory nuisance is made by a person living within its area, to take such steps as are reasonably practicable to investigate the complaint.

1.3 National Planning Policy Framework, 2021

The National Planning Policy Framework (NPPF)[5] adopted in 2021 in England outlines the Government's planning policies and requirements for the planning system. The NPPF forms a material consideration in planning decisions and hence must be complied with for planning permission to be granted.

Paragraph 185 of the NPPF states that the planning system should seek to:

- *"Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; …"*

To achieve these aims the NPPF refers to the Noise Policy Statement for England 2010.

[1] Secretary of State, 1974, Control of Pollution Act, HMSO. Available: http://www.legislation.gov.uk/ukpga/1974/40/contents
[2] Secretary of State, 1960, Noise Abatement Act, HMSO.
[3] Secretary of State, 1960, Noise Abatement Act, HMSO. Available: http://www.legislation.gov.uk/ukpga/1960/68/section/1/enacted
[4] Secretary of State, 1990. Environmental Protection Act 1990, The Stationary Office. Available: http://www.legislation.gov.uk/ukpga/1990/43/contents
[5] Ministry of Housing, Communities and Local Government, 2021. The National Planning Policy Framework. HMSO.

1.4 Noise Policy Statement for England, 2010

The Noise Policy Statement[6] for England sets out the long-term vision of Government noise policy: to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

The NPSE outlines the following three aims for the effective management and control of environmental, neighbour and neighbourhood noise:

- *"Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life."*

The guidance defines three concepts applied to noise impacts. These are:

- NOEL is defined as: *"This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.";*
- LOAEL which is defined as: *"This is the level above which adverse effects on health and quality of life can be detected.";* and
- SOAEL which is defined as the level above which significant adverse effects on health and quality of life occur.

The three aims can therefore be interpreted as follows:

- The first aim is to avoid noise levels above the SOAEL;
- The second aim considers situations where noise levels are between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur; and
- The third aim considers situations where noise levels are between the LOAEL and NOEL. In these circumstances, where possible, reductions in noise levels should be sought through the pro-active management of noise.

The NPSE recognises that it is not possible to have single objective noise-based measures that define the SOAEL, LOAEL and NOEL that are applicable to all sources of noise in all situations. The levels are likely to be different for different noise sources, receptors and at different times of the day.

1.5 Planning Practice Guidance

In March 2014, The Department for Communities and Local Government (DCLG) (now the Ministry for Housing, Communities and Local Government) published the Planning Practice Guidance (PPG) web-based resource to support the NPPF. This was subsequently updated in July 2019 and the updated guidance has been referred to.

PPG advises that local planning authorities should consider:

- "*Whether or not a significant adverse effect is occurring or likely to occur;*
- *Whether or not an adverse effect is occurring or likely to occur; and*
- *Whether or not a good standard of amenity can be achieved*."

The PPG qualifies the effect of noise based on whether a source is noticeable and/or intrusive and/or causes a change in behaviour or attitude.

[6] Ministry of Housing, Communities and Local Government, Planning practice guidance. HMSO. London. https://www.gov.uk/guidance/noise--2. Accessed October 2022.

The Lowest Observed Adverse Effect Level (LOAEL) is described as noise that can be heard and can cause small changes to behaviour and/or attitudes, for example turning up the volume on the television. The LOAEL affects the acoustic character of the area such that there is a perceived change in the quality of life.

The Significant Observed Adverse Effect Level (SOAEL) is defined as the level at which noise causes a change in behaviour and/or attitude, such as avoiding certain activities during periods of intrusion or, where there is no alternative to ventilation, having to keep windows closed most of the time because of the noise.

The latest version of PPG introduced the concepts of NOEL (No Observed Effect Level), and UAEL (Unacceptable Adverse Effect Level). Full details of the PPG on effects are provided in Table 1.

Table 1: PPG Guidance

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Factors to be considered in determining if noise is a concern are identified including the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, character of the noise and cumulative impacts.

2. Regional Policy

2.1 London Plan, 2021

The London Plan[7] provides strategic planning guidance for Greater London. Boroughs' local development documents have to be 'in general conformity' with the London Plan, which is also legally part of the development plan that has to be taken into account when planning decisions are taken in any part of London unless there are planning reasons why it should not.

The following policies applicable to the proposed development refer to noise:

'D8 – Public Realm': *"Development proposals should…include[s] design that reduces the impact of traffic noise"*

'D9 – Tall Buildings': *"noise created by air movements around the building(s), servicing machinery or building uses, should not detract from the comfort and enjoyment of open spaces".*

'D12 – Agent of Change': "*Development should be designed to ensure that established noise-generating venues… remain viable and can continue or grow without unreasonable restrictions being placed on them*."

'D13 – Noise': *"Residential and other non-aviation proposals should manage noise by:*

- *Avoiding significant adverse noise impacts on health and quality of life*
- *Reflecting the Agent of Change principle as set out in Policy D13 Agent of Change*
- *Mitigation and minimising the existing and potential adverse impact of noise on, form, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses*
- *improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquility)*
- *separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening, layout, orientation, uses and materials – in preference to sole reliance on sound insulation*
- *where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any*

[7] Greater London Authority, 2021. The London Plan. The Spatial Development Strategy for Greater London. London. GLA.

potential adverse effects should be controlled and mitigated through applying good acoustic design principles

- *promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver"*

Policy T7: Development plans should consider noise from deliveries, servicing and construction.

Other key themes are the consideration of traffic / transport noise, suitable façade design to limit internal noise levels and the use of emerging technologies e.g. electric vehicles to reduce noise.

2.2 London Environment Strategy, 2018

The London Environmental Strategy[8], published in May 2018, evaluates the current condition of London's environment at a city-wide level. The following policy is relevant to the proposed development:

- Policy '9.3.3 - Reduce the impacts of noise through good design'.

2.3 Sounder City, The Mayor's Ambient Noise Strategy, 2004

The London Ambient Noise Strategy[9] aims to minimise the adverse effects of noise on people living, working in and visiting London by using the best available practices and technologies within a sustainable development framework.

The Strategy states:

"*This strategy sets out the main steps that need to be taken, including quieter road surfaces, smoother traffic flow, rail infrastructure improvements, aircraft noise measures, and improved design for new developments*."

"*The aim of the Mayor's ambient noise strategy is a practical one – to minimise the adverse impacts of noise on people living and working in, and visiting London using the best available practices and technology within a sustainable development framework*."

2.4 Sustainable Design and Construction Supplementary Planning Guidance, 2014

This SPG[10] aims to support developers, local planning authorities and neighbourhoods to achieve sustainable development.

Regarding noise, this SPG provides information for the following key areas:

- Sources of noise;
- Ways to mitigate noise emitted by developments;
- Ways to mitigate the impact of noise on developments; and
- Some detailed design considerations.

[8] Greater London Authority, 2018. London Environment Strategy. London. GLA.

[9] Greater London Authority, 2004. Sounder City, The Mayor's Ambient Noise Strategy, London. GLA.

[10] Greater London Authority, 2014. Sustainable Design and Construction Supplementary Planning Guidance. London. GLA.

3. Local Policy

3.1 Westminster City Plan 2019-2040

The City Plan 2019-2040[11] was adopted by WCC in April 2021 and is the Local Plan for Westminster, replacing all current policies in Westminster's City Plan and UDP saved policies.

Objective 7 in the City Plan is to *"improve air quality, minimise noise and other polluting impacts"*. It requires that development must prevent unacceptable environmental impacts on existing and new users of buildings or its neighbours. This includes utilising Agent of Change principle, which requires the applicant to safeguard future local amenity and prevent the existing nearby users from having to curtail their activity.

In particular, it states:

"Development should prevent adverse effects of noise and vibration and improve the noise environment in compliance with the council's Noise Thresholds, with particular attention to:

1. minimising noise impacts and preventing noise intrusion to residential developments and sensitive uses;

2. minimising noise from plant machinery and internal activities;

3. minimising noise from servicing and deliveries; and

4. protecting the relative tranquillity in and around open spaces"

It acknowledges that people go to the city for work, culture and entertainment and that noise is a by-product of these activities, making ambient noise levels in Westminster higher than regional and national averages. It requires that developments should be constructed and operated to minimise noise (particularly if noise-generating uses are proposed) including cumulative effects. It references the Noise Technical Guidance Note (outlined in section 3.4).

Other reference to noise applicable to the proposed development are that:

- single-aspect dwellings / homes where noise levels need to remain closed owing to external noise will require design measures to mitigate against overheating and provide adequate ventilation
- noise from servicing should be considered, including spreading of movements across the day
- development should be predominantly car free so as to minimise noise
- construction noise should be considered.

3.2 Westminster Environmental Supplementary Planning Document, 2022

The Environmental Supplementary Planning Document[12], adopted February 2022, provides guidance on the City Plan's environment policies and builds upon environmental policy within the City Plan 2019–2040. The SPD does not introduce new planning policies into the development plan.

Noise thresholds for different types of development are set out in the ESPD, as well as vibration limits and guidance on assessment of construction noise and vibration.

Note that the ESPD was published part way through during the EIA process for this scheme.

[11] Westminster City Council, 2021. Westminster City Plan 2019 – 2040. London. WCC.

[12] City of Westminster, 2022. Environmental Supplementary Planning Document.

3.3 Westminster City Plan, 2016 (for information)

The Westminster City Plan 2016[13] acknowledges that the 24-hour nature of some parts of the city strongly affects noise levels; and references the A40 as a particular source of noise. The City Plan also recognises that new development will impact residents and businesses, both during construction and post-construction.

It requires that new homes should be designed to ensure a high-quality residential environment with attention paid to noise pollution. It also states that the amenity impact should be minimised by careful siting of plant to reduced noise nuisance.

The 'Noise Pollution' section outlines that reducing average noise level in the city continues to be an important objective. However, it recognises that *"it is not necessarily the loudest or continuous noise that causes the most annoyance; some individual noise incidences are a problem because they are intermittent and unpredictable; other noises have tonal characteristics that most people find unpleasant."* It advocates a holistic approach to managing noise and improving the overall quality of the sound environment.

Policy 32 states: "The council will work to reduce noise pollution and its impacts and protect Noise Sensitive Receptors from noise by:

- *Requiring development to minimise and contain noise and vibration;*
- *Ensuring development provides an acceptable noise and vibration climate for occupants and is designed to minimise exposure to vibration and external noise sources; and*
- *Securing improvements to Westminster's sound environment, including protecting open spaces of particular value for their relative tranquillity."*

3.4 Westminster Unitary Development Plan, 2010 (Saved Policies): Chapter 9 Environment (for information)

The UDP[14] Noise Pollution section references the aforementioned planning policy, as well as the Institute of Acoustics and the Institute of Environmental Management and Assessment draft ' Guidelines for Noise impact Assessment'. It aims to reduce noise levels throughout the City to below the maximum levels set out in the world Health Organisation guidance; to limit noise from development and to protect noise sensitive properties from noise disturbance/

Policy Env 6 states that council will require:

- design to contain noise from developments and protect noise sensitive properties including adjoining properties
- a noise and vibration assessment report where development or change of use could affect noise sensitive properties
- residential developments to provide adequate protection from existing background noise
- conditions restricting noise
- mechanical, ventilation and ducting equipment must be contained within the building envelope of new developments

[13] Westminster City Council, 2016. Available online: https://www.westminster.gov.uk/planning-building-and-environmental-regulations/city-plan-neighbourhood-planning-and-planning-policy/westminsters-city-plan-and-unitary-development-policies-udp/unitary-development-plan-udp

[14] Westminster City Council, 2010. Available online: https://www.westminster.gov.uk/planning-building-and-environmental-regulations/city-plan-neighbourhood-planning-and-planning-policy/westminsters-city-plan-and-unitary-development-policies-udp/unitary-development-plan-udp

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- construction should be kept to minimum disturbance and hours of work must be agreed with the City Council prior to commencement onsite. T
- traffic noise to be minimised.

It also lists out how to achieve these measures. It requires that <30dB L_{Aeq}, <45dB L_{Amax} is achieved at night (<35dB L_{Aeq} in the day) internally in residential developments. With regard to externally noise, it states that

"Where proposed residential development would be subject to a noise exposure category from mixed sources exceeding:

a) 72 dB (LAeq,T) between 07.00 and 23.00 hours

b) 66 dB (LAeq,T) between 23.00 and 07.00 hours,

conditions will be imposed to ensure that the development incorporates highly effective protection against these very high levels of noise for a residential area."

Policy Env 7 requires that where the external noise level exceed WHO guidelines of $L_{Aeq,12hr}$ 55dB (day); $L_{Aeq,4hr}$ 50dB (evening); $L_{Aeq,8hr}$ 45dB (night) plant noise should not exceed 10dB (or 15dB if tonal / intermittent) below the minimum external background noise at the nearest noise-sensitive properties. Noise from emergency plant should increase the minimum background noise levels by no more than 10dB for the purposes of testing. This can be for up to 1 hour per month 0900-1700 Monday to Friday excluding bank holidays.

3.5 Westminster Draft Noise Technical Guidance Note, 2019

This document[15] replaces much of the guidance that was previously set out in the UDP Saved Policies Chapter 9. The guidance relevant to the proposed development has been outlined; references to gym facilities / music and entertainment are not applicable to the proposed development.

Internal noise levels

It sets out the internal guideline noise values: <30dB L_{Aeq} and <45dB L_{Amax} at night; and <35dB L_{Aeq} in the day in residential developments.

External noise levels

It outlines external guideline noise values of <55dB L_{Aeq} as having risk of serious annoyance and <50dB L_{Aeq} as having moderate annoyance.

Vibration levels

It states that the design and structure of the development should protect future occupiers from vibration; limiting the levels to <0.4m/s$^{-1.75}$ in the day and <0.2 m/s$^{-1.75}$ at night.

Plant noise

Where external noise levels are in excess of 55dB L_{Aeq} in the day and 45dB L_{Aeq} at night, plant noise should be 10dB below the minimum external background noise levels and 15dB if the plant contains tones / intermittent characteristics.

3.6 Westminster Code of Construction Practice, 2022

Westminster City Council published an updated Code of Construction Practice (CoCP) in February 2022. The CoCP sets out what the Council expects from developers and those involved in construction across the City.

[15] City of Westminster, 2019. Draft Noise Technical Guidance Note.

The following general points form the CoCP[16] are relevant to noise:

- Core working hours will be 0800 to 1800 on weekdays and 0800 to 1300 on Saturday – operations anticipated to cause disturbance would be limited to these hours, except in case of emergency. Any additional working hours must have prior agreement with the City Council and 14 days notification is required as a minimum.
- Standard hoarding is 2.44 m minimum height, plywood faced, timber framed boundary n n 7 kg/m^2
- "*The developer / contractor must take all reasonable precautions to ensure that equipment is operated in a manner so as not to cause nuisance to surrounding residents and occupiers*."

The Noise and Vibration Policy outlines how the contractor must monitor and control levels of noise and vibration from the site. Best Practical Means (BPM) as defined in the Control of Pollution Act applies to all activities and prior permission may be sought from the planning authority relating to noisy construction activities.

Prior to commencement

The WCC may require the developer to establish baseline noise sources to formulate acceptable noise levels for each site audible at the site boundary. The WCC may also undertake noise level monitoring prior to commencement to cross-check developers' assumptions. Prior to commencement, the contractor will be required by the WCC to demonstrate their proposals to reduce noise and vibration. Formal consents may be required in line with relevant standards.

During construction

Sound levels should be monitored in accordance with BS5228: Part 1, to achieve noise levels at or below the specified limits. To achieve this, the following items must be considered:

- Worksite gates should be controlled so as to minimise time open;
- Fixed items of plant should be electrically driven rather than diesel- or petrol-driven; where this is not possible, suitable attenuation measures should be provided;
- Exhaust silencers should be fitted to vehicle and mechanical plant;
- Compressors must be "*sound reduced*" i.e. fitted with properly lined and sealed acoustic covers;
- Pneumatic percussive tools must be fitted with the most effect muffler or silencer;
- Machines in intermittent use should be shut down in the intervening periods / throttled down to a minimum;
- Continuously running plant may have to be house in a suitable acoustic enclosure;
- Equipment that breaks concrete by bending rather than by percussion should be used as far as possible;
- Sheet piling with diesel / air driven impact / drop hammer may not be acceptable on some sites. Use of hydraulically operated or vibratory hammers may be necessary in these instances;
- Rotary drills and bursters using hydraulic or electrical power should be used for excavating hard material;

[16] City of Westminster, 2022. Code of Construction Practice, February 2022.

- Noise plant should be sited as far away as possible from noise-sensitive buildings. The use of barriers including bunds should also be employed;
- Care should be taken when loading or unloading vehicles / dismantling scaffolding; and
- A method statement stating the plant to be used including sound power levels of plant from the manufacturer, including control methods and programme of work should be supplied to the Environmental Inspectorate. Alterations should by submitted to City Council for prior consent.

With regard to vibration, the contractor will be obliged to comply with vibration levels agreed with the City Council. Both human exposure (in accordance with BS6472:2992) and protection of structures (no significant damage to adjacent structures) must be considered.

4. Guidance

4.1 BS5228:2009+A1:2014 - 'Code of Practice for Noise and Vibration Control on Construction and Open Sites'

BS5228:2009+A1:2014 (British Standards Institute (a), 2009) gives recommendations for basic methods of noise and vibration control relating to construction work. It also provides guidance concerning methods of predicting and measuring noise and vibration and assessing its impact on those exposed to it. The prediction method considers the noise emissions level of proposed plant, the separation distance between the source and the receiver and the effect of the intervening topography and structures.

4.2 BS4142:2014 - 'Methods for Rating and Assessing Industrial and Commercial Sound'

BS4142:2014 – Method for rating and assessing industrial and commercial sound provides a method for assessing the significance of noise emissions from industrial and/or commercial sound source.

The significance of industrial and commercial sound is assessed based on the difference between the rating level resulting from plant operation measured or predicted at the nearest noise sensitive premises, and the existing background noise level in the area, as determined by a noise survey. BS 4142 states:

'a) *Typically, the greater this difference, the greater the magnitude of the impact.*

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.'

e) A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value.'

BS4142 also sets out the following rating penalties based on the characteristics of the noise source:

- <u>Tonality</u>: up to 6 dB rating penalty applicable depending on its perception;

- Impulsivity: up to 9 dB rating penalty applicable depending on its perception;
- *Other sound characteristics*: a 3 dB penalty applicable for readily distinctive sound feature characteristics that are neither tonal or impulsive;
- Intermittency: a 3 dB penalty applicable for specific sound that has identifiable on/off conditions.

4.3 BS8233:2014 - 'Guidance on sound insulation and noise reduction for buildings'

Guidance on the acceptable noise levels within residential buildings is given in British Standard BS8233:2014. The internal noise levels depend on the use of each room and the sensitivity to noise of the activities expected to be conducted in the rooms. An extract of the indoor ambient noise levels for dwellings is reproduced in Table 2.

Table 2: BS8233 Indoor Ambient Noise Levels for Dwellings

Activity	Location	Daytime	Night-time
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room / area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Note 7 referring to Table 5 in BS8233 states that where development is considered necessary or desirable, despite external noise levels above World Health Organisation guidelines (detailed in section 3.8), the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

For external amenity areas such as gardens, courtyards and terraces, BS8233 specifies that it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ acceptable in noisier environments. However, it is also recognised that these guidelines values are sometimes not achievable in all circumstances where the development might be desirable.

4.4 World Health Organisation Guidelines

The World Health Organisation (WHO) published their 'Guidelines for Community Noise' in 1999. The 'Guidelines for Community Noise' set out guidance on appropriate noise levels for different scenarios to ensure that communities are not subjected to unacceptable levels of noise. These are presented in Table 3. It should be noted that the WHO guidelines, although widely referenced in UK, have no legal status.

Table 3: World Health Organisation Guidelines for Noise

Specific Environment	Critical Health Effect(s)	LAeq /dB	Time Base [hours]	LAFmax / dB
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, Indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

It is acknowledged that updated WHO guidelines were issued in 2018; however the 1999 guidelines are considered more appropriate and relevant for assessment purposes.

4.5 BS7385-2:1993 – Evaluation and measurement for vibration in buildings

BS 7385-2, 'Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground-borne vibration' contains guidance on the potential effects of ground-borne vibration on buildings, as well as guidance on measuring ground-borne vibration for the proposes of assessing the possibility of vibration-induced building damage.

The potential effects are influenced by many variables including the characteristics of the ground-borne vibration (duration, frequency range and type of source) and characteristics of the building (foundation type, ground conditions, type and construction of the receiving building).

BS7385-2 states that peak particle velocity (PPV) has been found to be best single descriptor for correlating with case-history data on the occurrence of vibration-induced damage. The risk of vibration-induced damage should be evaluated taking account for the magnitude, frequency of vibration as well as the type of building being affected.

Section 7.4 of the Standard provides suggested vibration levels which are judged to give a minimal risk of vibration-induced damage. For residential or light commercial type buildings, these guide values for cosmetic damage due to transient vibration are:

- **For vibration with a predominant pulse in the frequency range of 4 to 15 Hz:** a guide value of 15 $mm.s^{-1}$ at 4 Hz increasing to 20 $mm.s^{-1}$ at 15 Hz is stated.
- **For vibration with a predominant pulse in the frequency range of 15 Hz or greater:** a guide value of 20 $mm.s^{-1}$ at 15 Hz increasing to 50 $mm.s^{-1}$ at 40 Hz and above is stated.

The above values apply at the base of the building and for transient vibration sources only. For continuous sources of vibration, these guide values should be reduced by 50%. The Standard recommends that special or important buildings should be considered on a case-by-case basis.

Technical Appendix 8.2: Baseline Noise and Vibration Survey

TECHNICAL APPENDIX 8.2: BASELINE NOISE AND VIBRATION SURVEY

1. Baseline Noise and Vibration Survey

1.1 Methodology

A baseline noise and vibration survey was carried out by Ramboll to establish the existing conditions around the proposed development and at nearby noise-sensitive receptors.

The baseline noise survey comprised a combination of one-week unattended noise monitoring undertaken between Tuesday 15 September and Monday 21 September 2020 at two locations (LT1 and LT2 on Figure 1) and attended day and night-time measurements undertaken on Monday 21 - Tuesday 22 September (ST1-ST3 and NT1-NT3 on Figure 1). Vibration measurements were taken in the basement between 15 and 21 September.

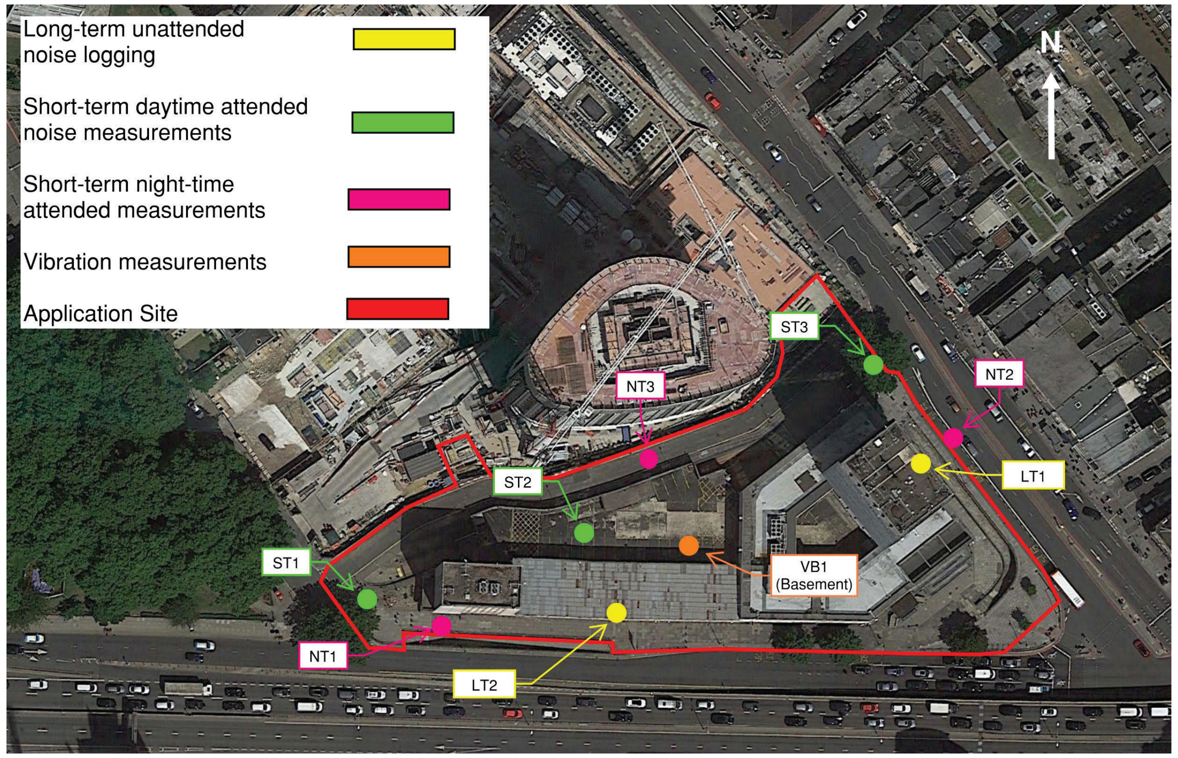


Figure 1: Measurement Locations

The logger locations (LT1 and LT2) were chosen to inform the sound insulation performance of the proposed building façade of noise sources from sources to the north and east of the site.

The noise sources heard during the daytime at each of the attended measurement locations were:

- ST1: Traffic noise from the A40 was the dominant noise source, construction noise from both to the north and south, some idling vehicles as they wait to pull out into Paddington Green road junction;
- ST2: Traffic from the A40 including public buses and audible construction noise; and
- ST3: Traffic from Edgware Road, construction noise to the north of the site, pedestrians and occasional aircraft noise.

The noise sources heard during the night time at each of the attended measurement locations were:

- NT1: Road traffic from A40, some construction noise but less in second and third measurement periods;
- NT2: Construction noise from road resurfacing; and
- NT3: Some construction noise in first measurement, minimal in second measurement.

1.2 Equipment

The survey was carried out using the following equipment as presented in Table 1.

Table 1: Equipment Used

Position	Equipment Type	Model Number	Serial Number(s)
ST1 and ST2	Sound Level Meter	NTi XL2-TA	A2A-09209-E0
	Microphone	NTi MC230	8072
	Calibrator (94 dB)	CAL200	16089
LT1 (Edgware Road)	Sound Level Meter	Norsonic 140 (Class 1)	1406951
	Microphone	Nor 1225	285522
	Calibrator	Nor 1251	34964
LT2 (A40)	Sound Level Meter	Norsonic 140 (Class 1)	1403396
	Microphone	Nor 1225	112825
	Calibrator	Nor 1251	32853
V1	Vibration Meter	Svan 958a	15812
	3 nos. PCBs accelerometers	393B31	27605,58661,27624

All measurement equipment owned or hired and operated by Ramboll has regular calibration checks carried out by external companies traceable to UKAS or national standards. Copies of all calibration records are kept and can be provided upon request.

Attended noise measurements were taken at an approximate height of 1.5 m from the ground and a minimum of 3 m from the façade of any surrounding buildings. These measurements are, therefore, considered representative of free-field measurements. The calibration of the sound level meter was checked before and after measurements was taken. No significant drift was observed.

1.3 Results

The key results of the daytime attended measurements are presented in Table 2 and the night-time attended measurements are presented in Table 3.

Table 2: Summary of Daytime Attended Measurements

Location	Time	Ambient noise levels / dB $L_{Aeq,15min}$	Background noise levels / dB $L_{A90,15min}$	Maximum noise levels / dB $L_{AFmax,15min}$
ST1	12:37	70	67	84
	13:40	71	69	80
	14:40	71	67	86
ST2	13:00	66	63	80
	14:01	67	63	80
	15:01	66	64	80
ST3	13:20	69	63	83
	14:21	69	64	86
	15:21	69	64	82

Table 3: Summary of Night-Time Measurements				
Location	**Time**	**Ambient noise levels / dB $L_{Aeq,15min}$**	**Background noise levels / dB $L_{A90,15min}$**	**Maximum noise levels / dB $L_{AFmax,15min}$**
NT1	01:20	68	62	77
	02:05	66	58	77
	02:40	66	56	79
NT2*	01:40	78	66	88
NT3	01:02	63	60	74
	01:47	62	56	75
	02:21	58	55	66
	02:59	58	54	71
*Cut short after 5 minutes due to high levels of construction noise				

Results of the unattended measurements at location LT1 and LT2 are detailed in Tables 4-5. A graphical representation of the logging results is presented in Figures 2-3.

Table 4: Results of Baseline Noise Survey at LT1 (Edgeware Road)				
Time Period (T)	**Representative ambient noise level⁺ / dB $L_{Aeq,T}$**	**Highest ambient noise levels / dB $L_{Aeq,15min}$**	**Lowest background noise levels / dB $L_{A90,15min}$**	**Maximum noise levels* / dB $L_{AFmax,15min}$**
Daytime (07:00-23:00)	71	93	57	107
Night-time (23:00-07:00)	76	88	53	88
⁺ 90th percentile has been considered representative of the noise climate. As there was construction noise in the surrounding area, the ambient night-time noise levels used for the site-suitability assessment at this location are equal to that of the daytime ambient noise levels. * Top 10 noise event in each night-time period have been excluded, in accordance with BS8233:2014. Then the average of the nights taken.				

Table 5: Results of Baseline Noise Survey at LT2 (A40)				
Time Period (T)	**Representative ambient noise level⁺ / dB $L_{Aeq,T}$**	**Highest ambient noise levels / dB $L_{Aeq,15min}$**	**Lowest background noise levels / dB $L_{A90,15min}$**	**Maximum noise levels* / dB $L_{AFmax,15min}$**
Daytime (07:00-23:00)	74	91	57	104
Night-time (23:00-07:00)	73	87	53	85
⁺ 90th percentile has been considered representative of the noise climate. As there was construction noise in the surrounding area, the noise levels used for the site-suitability assessment are those from previous noise surveys conducted for West End Gate. *Top 10 noise event in each night-time period have been excluded, in accordance with BS8233:2014. Then the average of the nights taken.				

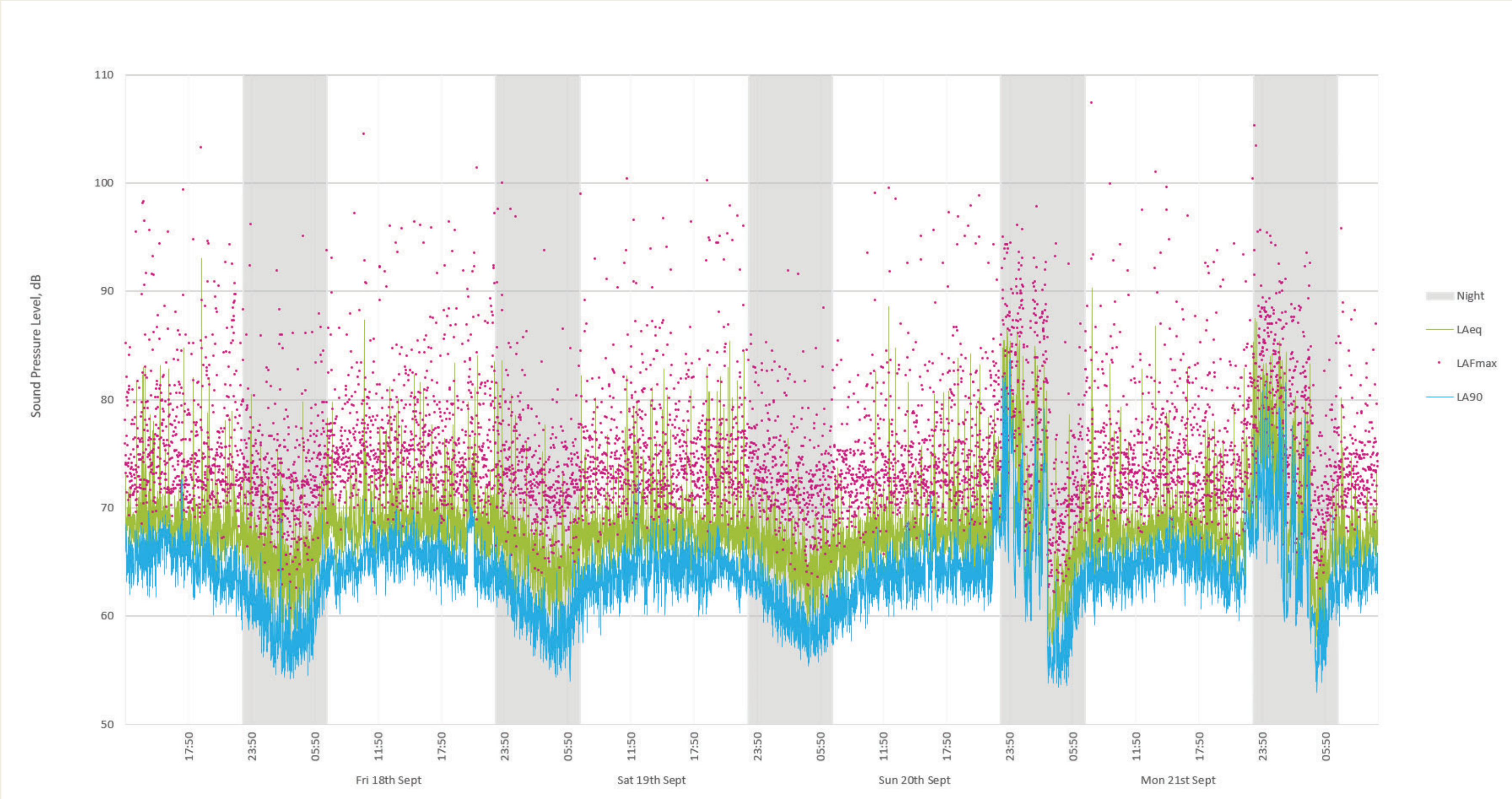


Figure 2: Measurement Results at LT1

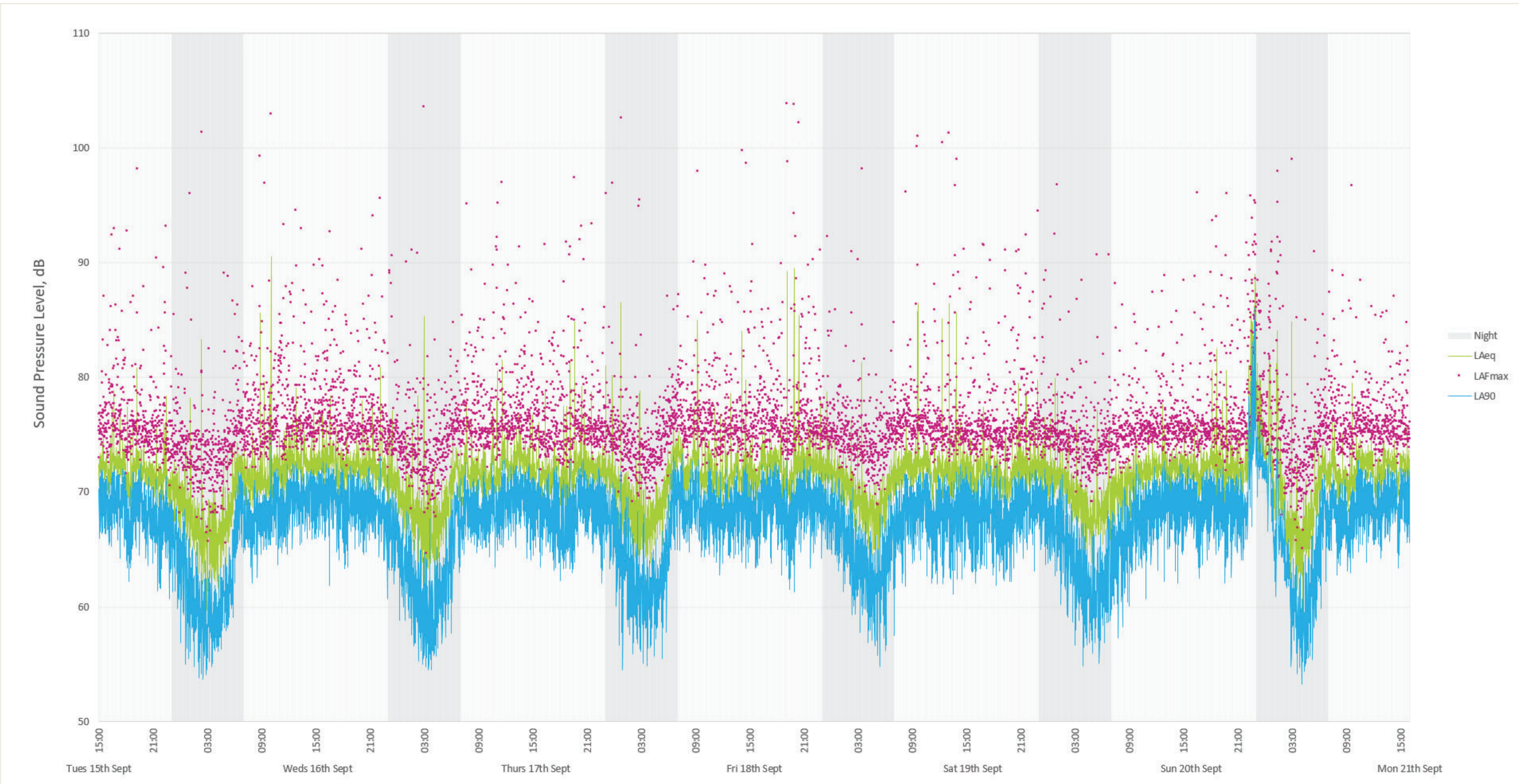


Figure 3: Measurement Results at LT2

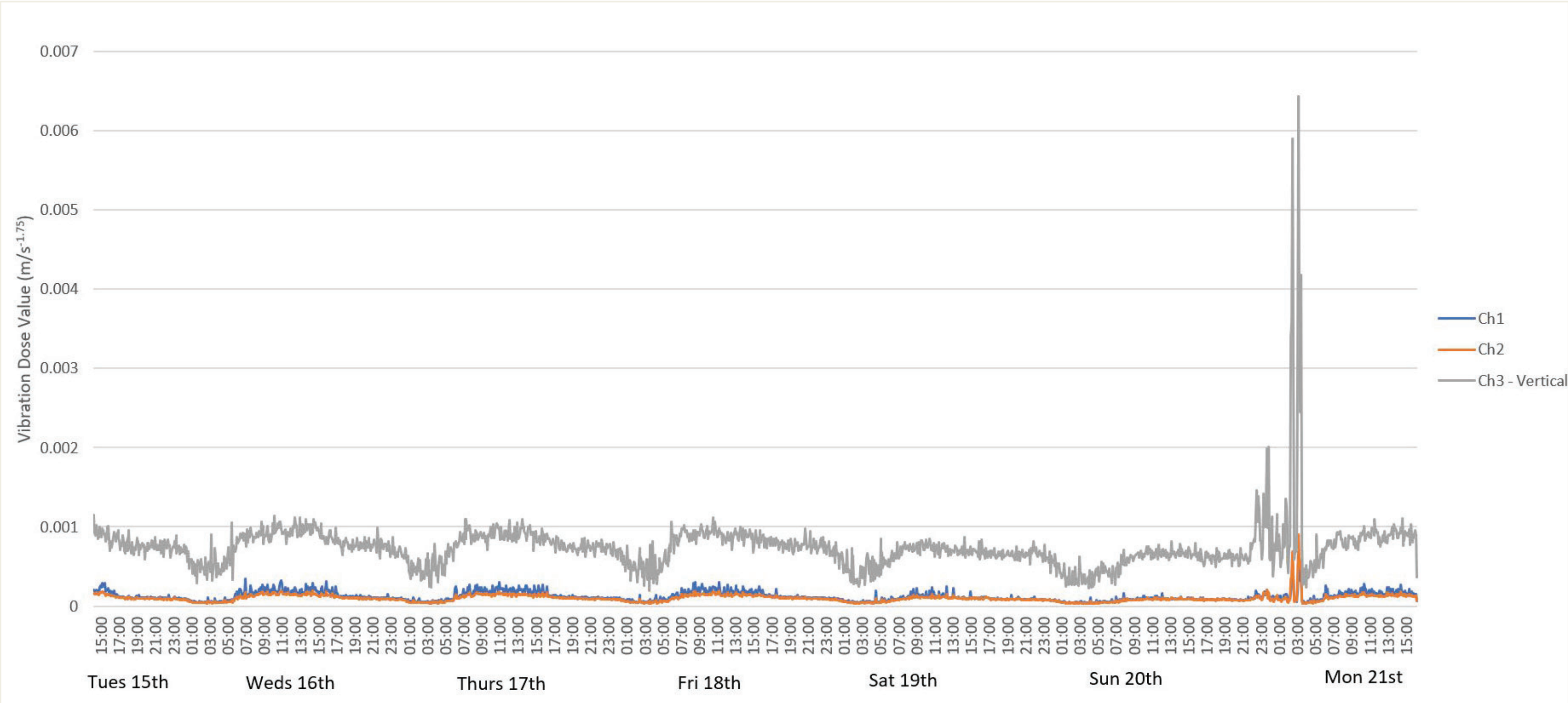


Figure 4: Measurement Results at V1 (vibration)

1.4 Weather

The weather history during the unattended logging period taken from www.timeanddate.com for Northolt, London is summarised in Table 6.

Table 6: Weather History

Date	Rain conditions	Wind speed (mph)
15 September	Dry	1-7
16 September	Dry	5-15 (highest in afternoon)
17 September	Dry	7-15 (highest in early evening)
18 September	Dry	8 – 20 (peaks around 3pm)
19 September	Dry	7 – 17 (peaks around 3pm)
20 September	Dry	7 – 13 (highest in afternoon)
21 September	Dry	3 – 6
22 September (half day)	Dry	1-9

The level of uncertainty in the data and associated calculations has been considered. The following may contribute to the overall measurement uncertainty:

- The level of rounding of each measurement recorded;
- The complexity and level of variability of the residual acoustic environment;
- The complexity of the sound source and the level of variability in sound emission from the source; and
- The distance between sources of sound and the measurement location and intervening ground conditions.

Periods that were noted to be dominated by construction noise have been excluded when utilised in the assessment. The data used in the assessment is reproduced in Chapter 8.

2. Historic Data

The assessment reports or data below have not been warranted for use on the proposed development, but the surveys provide a reasonable benchmark for the 2020 surveys undertaken by Ramboll, and are more accurate than predicting noise levels from traffic data alone. This approach was disucssed with WCC in light of corroborating the recent survey undertaken during the COVID-19 pandemic. No responsibility is placed on the authors or owners of these reports for any outcome or conclusion for the PGPS project.

2.1 West End Green Noise and Vibration Survey[1]

A noise and vibration survey was undertaken for the WEG development environmental impact assessment (EIA) between Thursday 27 August and Tuesday 1 September 2015. The noise measurement locations are shown in Figure 5. A summary of the results for locations MP2 and MP3 is presented in Figures 6 and 7 respectively.

[1] ES Main Report, Chapter 2, ref UK11-22851, Ramboll Environ, February 2016

Paddington Green

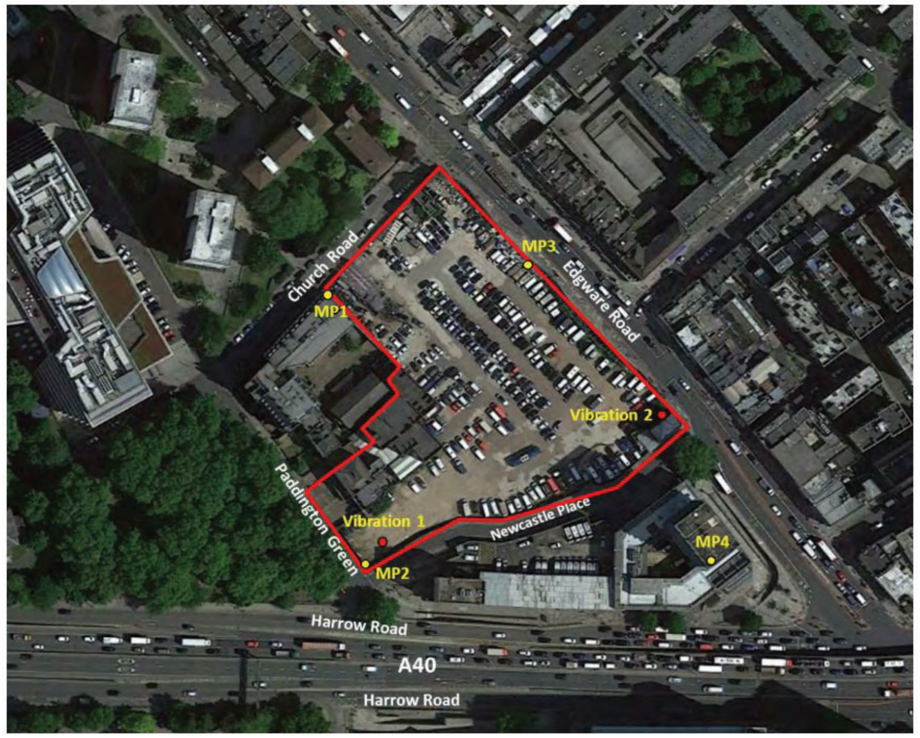


Figure 5: Noise Measurement Locations

Table 10.11: Summary of Measurement Results – Position 2

Period	Daytime (07:00 – 23:00 Hours)				Night-time (23:00 – 07:00 Hours)			
	L_{Aeq}	Lowest $L_{A90,15min}$	$L_{A10,T}$	L_{AFmax}	L_{Aeq}	Lowest $L_{A90,15min}$	$L_{A10,T}$	L_{AFmax}
Thursday 27/08/15*	72.7	64.3	72.7	90.0	69.7	60.4	72.0	83.8
Friday 28/08/15	71.0	64.7	72.5	89.5	70.3	61.8	72.4	86.9
Saturday 29/08/15**	-	-	-	-	-	-	-	-
Sunday 30/08/15**	72.0	64.1	72.4	88.4	-	-	-	-
Monday 31/08/15**	-	-	-	-	70.1	57.4	72.0	82.5

Notes: The presented noise levels are the aggregated 16-hour (daytime) / 8-hour (night-time) logarithmic average $L_{Aeq,T}$, the lowest $L_{A90,15min}$ levels, arithmetic average $L_{A10,T}$ levels and 90th percentile of the maximum L_{AFmax}.
(*): Daytime measurements started at 13:30h.
(**): Measurements were impacted by rainy periods, therefore the measured noise levels have been omitted from our analyses.

Figure 6: Measured Levels for Relevant Survey Positions, West End Green, 2016

Table 10.12: Summary of Measurement Results – Position 3								
Period	Daytime (07:00 – 23:00 Hours)				Night-time (23:00 – 07:00 Hours)			
	L_{Aeq}	Lowest $L_{A90,15min}$	$L_{A10,T}$	L_{AFmax}	L_{Aeq}	Lowest $L_{A90,15min}$	$L_{A10,T}$	L_{AFmax}
Thursday 27/08/15*	68.8	59.5	70.5	93.1	69.1	54.5	71.0	97.2
Friday 28/08/15	69.9	59.7	70.6	98.6	70.1	54.5	71.0	100.2
Saturday 29/08/15**	-	-	-	-	-	-	-	-
Sunday 30/08/15**	69.4	55.6	70.7	96.7	-	-	-	-
Monday 31/08/15**	-	-	-	-	67.8	52.7	71.1	88.1

Notes: The presented noise levels are the aggregated 16-hour (daytime) / 8-hour (night-time) logarithmic average $L_{Aeq,T}$, the lowest $L_{A90,15min}$ levels, arithmetic average $L_{A10,T}$ levels and 90th percentile of the maximum L_{AFmax}.
(*): Daytime measurements started at 14:30h.
(**): Measurements were impacted by rainy periods, therefore the measured noise levels have been omitted from our analyses.

Figure 7: Measured Levels for Relevant Survey Positions, West End Green, 2016

It can be seen from the measured levels that there is little difference in noise levels between the daytime (16 hours) and night-time (8 hours).

The maximum noise levels recorded over the four nights have been analysed. This typical maximum noise levels at MP2 and MP3 are summarised in Table 5.

Table 7: Typical Maximum Noise Levels	
Measurement Position	Typical Maximum Level
MP2 (facing Marylebone Road/Harrow Road)	81 dB LAFmax
MP3 (facing Edgware Road)	89 dB LAFmax

2.2 Noise survey for Merchant Square[2]

A noise survey was carried out in April and May 2010 at the site directly opposite the Paddington Green Police Station site on the A40. The locations of the survey are shown in Figure 8 and the key results reproduced in Figure 9.

[2] Environmental Statement, Chapter 9, ref UK11-22851, URS, November 2010

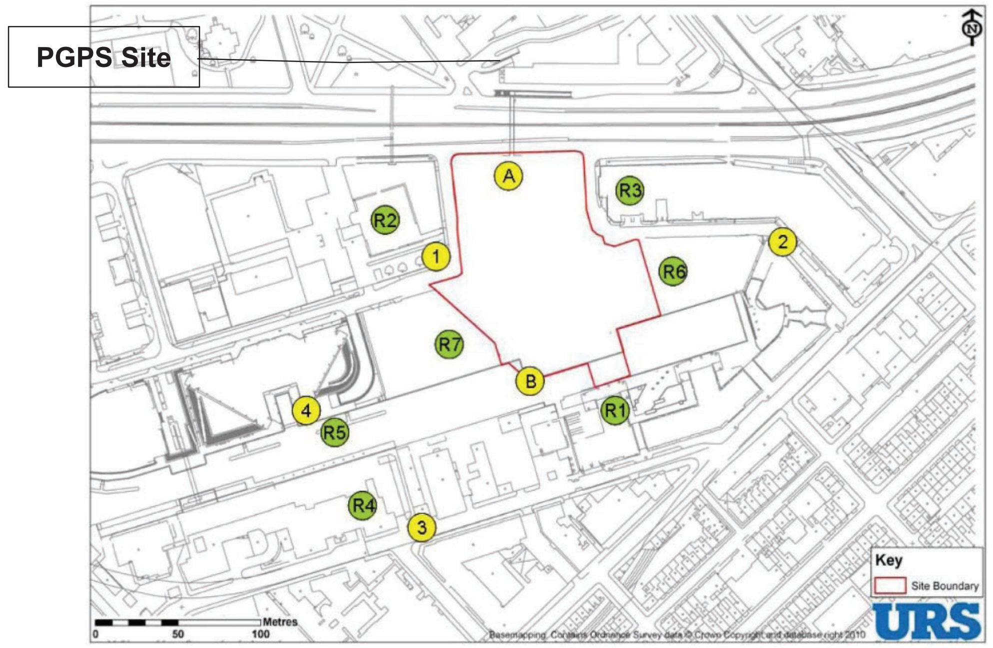


Figure 8: Measurement Positions, Merchant Square, 2010

Table 10-12 Daytime, Evening and Night-Time Average Free-Field Ambient Levels

Location	Average Ambient Level dB LAeq		
	Daytime 07:00 - 19:00	Evening 19:00 - 23:00	Night-time 23:00 - 07:00
A	69	69	67
B	60	58	56
1	65-68	65	-
2	-	60	61-63
3	62-63	59	56-58
4	59	55	55

Table 10-13 Typical Upper Range of Night-Time Free-Field Maximum Levels

Location	Typical Upper Range of Night-Time Maximum Levels dB LAmax
A	79
B	71
1	-
2	81
3	78
4	71

Figure 9: Measured Levels for Relevant Survey Positions, Merchant Square, 2010

The historic data indicates that the data collected for the site in 2020 is representative despite the COVID-19 restrictions. It is noted that at the time of the survey, no national or regional lockdown was imposed.

Technical Appendix 8.3(R): Construction Noise Assumptions

TECHNICAL APPENDIX 8.3(R): CONSTRUCTION NOISE ASSUMPTIONS

Demolition and Construction Plant / Programme

The plant used for the assessment of demolition and construction noise to each of the noise-sensitive receptors is outlined in Table 1. The demolition and construction programme given in Table 2 has been used to compile the periods with the greatest number of activities occurring simultaneously. These are detailed in Volume 1(R): Chapter 8.

Table 1: Demolition and Construction Plant Items

Activity	Project Plant	No. of plant	On-time (% of hour)	BS5228-1 Reference
Site Enabling Works	Bulldozers	1	30	Table C.2 no. 11
	Cranes and hoists	2	20	Table C.4 no. 48
	Cutters, drills and small tools	1	20	Table C.5 no. 6
	Floodlights	1	100	Table C.4 no. 86
	Generators	1	100	Table C.4 no. 85
	HGVs/lorries/vans	1	100	Table D.7 nos. 121-122
	Piling rigs	1	50	Table C.3 no. 22
	Scaffolding and mobile hydraulic access platforms	1	20	Table C.4 no. 57
Demolition	Bulldozers	1	30	Table C.2 no. 11
	Cranes and hoists	2	20	Table C.4 no. 48
	Cutters, drills and small tools	1	35	Table C.5 no. 6
	Crushers	1	40	Table C.1 no. 14
	360 excavators	1	40	Table C.2 no. 4
	Floodlights	1	100	Table C.4 no. 86
	Forklift truck	1	10	Table D.7 no. 94
	Generators	1	100	Table C.4 no. 85
	Hydraulic benchers and cutters	1	40	Table C.1 no. 18
	HGVs/lorries/vans	1	100	Table D.7 nos. 121-122
	Scaffolding and mobile hydraulic access platforms	1	20	Table C.4 no. 57
Excavation and Remediation	Bulldozers	1	30	Table C.2 no. 11
	Cranes and hoists	2	10	Table C.4 no. 48
	Crushers	1	40	Table C.1 no. 14

Table 1: Demolition and Construction Plant Items

Activity	Project Plant	No. of plant	On-time (% of hour)	BS5228-1 Reference
	360 excavators	1	40	Table C.2 no. 4
	Floodlights	1	100	Table C.4 no. 86
	Generators	1	100	Table C.4 no. 85
	HGVs/lorries/vans	1	100	Table D.7 nos. 121-122
	Piling rigs	1	50	Table C.3 no. 22
	Water pump	1	50	Table C.2 no. 45
	Temporary supports	1	10	Table D.7 no. 1
Substructure	Bulldozers	1	30	Table C.2 no. 11
	Compaction plant	1	30	Table C.2 no. 42
	Cranes and hoists	2	20	Table C.4 no. 48
	Cutters, drills and small tools	1	50	Table C.4 no. 93
	Floodlights	1	100	Table C.4 no. 86
	Forklift truck	1	10	Table D.7 no. 94
	Generators	1	100	Table C.4 no. 85
	Hydraulic benchers and cutters	1	30	Table C.1 no. 18
	HGVs/lorries/vans	1	100	Table D.7 nos. 121-122
	Piling rigs	1	50	Table C.3 no. 22
	Ready-mix concrete lorry	1	20	Table C.4 no. 20
	Concrete pump	1	20	Table C.4 no. 29
	Water pump	1	50	Table C.2 no. 45
	Temporary supports	1	10	Table D.7 no. 1
Superstructure	Cranes and hoists	2	20	Table C.4 no. 48
	Cutters, drills and small tools	1	50	Table C.4 no. 93
	Floodlights	1	100	Table C.4 no. 86
	Forklift truck	1	10	Table D.7 no. 94
	Generators	1	100	Table C.4 no. 85
	Hydraulic benchers and cutters	1	30	Table C.1 no. 18
	HGVs/lorries/vans	1	100	Table D.7 nos. 121-122
	Scaffolding and mobile hydraulic access platforms	1	20	Table C.4 no. 57
	Ready-mix concrete lorry	1	20	Table C.4 no. 20

Table 1: Demolition and Construction Plant Items				
Activity	**Project Plant**	**No. of plant**	**On-time (% of hour)**	**BS5228-1 Reference**
	Concrete pump	1	20	Table C.4 no. 29
	Temporary supports	1	10	Table D.7 no. 1
Fit-out	Cranes and hoists	2	20	Table C.4 no. 48
	Cutters, drills and small tools	1	50	Table C.4 no. 93
	Forklift truck	1	10	Table D.7 no. 94
	Generators	1	100	Table C.4 no. 85
	HGVs/lorries/vans	1	100	Table D.7 nos. 121-122
	Scaffolding and mobile hydraulic access platforms	1	20	Table C.4 no. 57
	Mortar batching plant	1	20	Table D.5 no. 11
	Hoists	1	20	Table C.4 no. 61
Roads and Landscaping	Bulldozers	1	30	Table C.2 no. 11
	Compaction plant	1	20	Table C.2 no. 42
	360 excavators	1	40	Table C.2 no. 4
	Floodlights	1	100	Table C.4 no. 86
	Forklift truck	1	10	Table D.7 no. 94
	Generators	1	100	Table C.4 no. 85
	HGVs/lorries/vans	1	100	Table D.7 nos. 121-122
	Water pump	1	50	Table C.2 no. 45

Paddington Green

Works	**Table 2: Demolition and Construction Programme**																										
	Q3 2023	**Q4 2023**	**Q1 2024**	**Q2 2024**	**Q3 2024**	**Q4 2024**	**Q1 2025**	**Q2 2025**	**Q3 2025**	**Q4 2025**	**Q1 2026**	**Q2 2026**	**Q3 2026**	**Q4 2026**	**Q1 2027**	**Q2 2027**	**Q3 2027**	**Q4 2027**	**Q1 2028**	**Q2 2028**	**Q3 2028**	**Q4 2028**	**Q1 2029**	**Q2 2029**	**Q3 2029**	**Q4 2029**	**Q1 2030**
Site Enabling Works	x	x	x	x	x																						
Demolition	x	x	x	x	x																						
Excavation and Remediation	x	x	x	x	x																						
Substructure					x	x	x	x	x	x	x	x															
Superstructure								x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Fit-out													x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Roads and Landscaping															x	x	x	x	x	x	x	x	x	x	x	x	x

Technical Appendix 8.4(R): Transport Data

TECHNICAL APPENDIX 8.4(R): TRANSPORT DATA

Traffic Data

The traffic data used for the noise assessment is outlined in Tables 1-4.

The data for the Existing Baseline scenario in Table 1, includes the completed and occupied Paddington Exchange Scheme and WEG Blocks A to F.

Table 1: Existing Baseline (2022) Scenario

Highway Links	AAWT			Speed Limit (kph)
	All Vehs	HGVs	% HGV	
1. A5 Edgware Road (between Newcastle Place and Church Street)	22,844	3,113	14%	32
2. Church Street (west of Edgware Road)	2,196	108	5%	32
3. Newcastle Place	388	55	14%	32
4. Paddington Green	1,390	37	3%	32
5. A404 Harrow Road eastbound (west of Paddington Green)	21,586	1,147	5%	48
6. A40 Westway	58,637	2,645	5%	48
7. A404 Harrow Road eastbound (east of Paddington Green)	21,468	1,488	7%	48
8. A5 Edgware Road (north of Church Street)	23,537	3,105	13%	32
9. A5 Edgware Road (south of Newcastle Place)	22,874	2,981	13%	32
10. Loop road (north of WEG Block A)	37	0	0%	32

The data for the Demolition and Construction scenario in Table 2, includes the completed and occupied Paddington Exchange Scheme, WEG Blocks A to F and 14-17 PG.

Table 2: Future Baseline (2026) + 2022 Amended Proposed Development Demolition and Construction Traffic Scenario

Highway Links	AAWT			Speed Limit (kph)
	All Vehs	HGVs	% HGV	
1. A5 Edgware Road (between Newcastle Place and Church Street)	23,078	3,132	14%	32
2. Church Street (west of Edgware Road)	2,359	133	6%	32
3. Newcastle Place	455	55	12%	32
4. Paddington Green	1,422	38	3%	32
5. A404 Harrow Road eastbound (west of Paddington Green)	21,621	1,156	5%	48
6. A40 Westway	58,639	2,646	5%	48

Table 2: Future Baseline (2026) + 2022 Amended Proposed Development Demolition and Construction Traffic Scenario

Highway Links	AAWT			Speed Limit (kph)
	All Vehs	HGVs	% HGV	
7. A404 Harrow Road eastbound (east of Paddington Green)	21,654	1,497	7%	48
8. A5 Edgware Road (north of Church Street)	23,701	3,113	13%	32
9. A5 Edgware Road (south of Newcastle Place)	23,108	3,000	13%	32
10. Loop road (north of WEG Block A)	37	0	0%	32

The data for the Completed Development Scenario is presented in Table 3 and includes the completed and occupied Paddington Exchange Scheme, WEG Blocks A to F and 14-17 PG.

Table 3: Future Baseline (2030) + 2022 Amended Proposed Development Scenario

Highway Links	AAWT			Speed Limit (kph)
	All Vehs	HGVs	% HGV	
1. A5 Edgware Road (between Newcastle Place and Church Street)	23,035	3,133	14%	32
2. Church Street (west of Edgware Road)	2,423	137	6%	32
3. Newcastle Place	0	0	0%	32
4. Paddington Green	1,512	42	3%	32
5. A404 Harrow Road eastbound (west of Paddington Green)	21,635	1,152	5%	48
6. A40 Westway	58,637	2,645	5%	48
7. A404 Harrow Road eastbound (east of Paddington Green)	21,711	1,494	7%	48
8. A5 Edgware Road (north of Church Street)	23,660	3,115	13%	32
9. A5 Edgware Road (south of Newcastle Place)	23,065	3,001	13%	32
10. Loop road (north of WEG Block A)	547	58	11%	32

The data for the Cumulative Completed Development scenario is presented in Table 4.

Table 4: Completed Development: Future Baseline (2030) + Proposed Development + Cumulative Schemes Scenario

Highway Links	AAWT			Speed Limit (kph)
	All Vehs	HGVs	% HGV	
1. A5 Edgware Road (between Newcastle Place and Church Street)	23,121	3133	14%	32
2. Church Street (west of Edgware Road)	2,423	137	6%	32
3. Newcastle Place	0	0	0%	32
4. Paddington Green	1,512	42	3%	32
5. A404 Harrow Road eastbound (west of Paddington Green)	21,635	1152	5%	48
6. A40 Westway	58,637	2645	5%	48
7. A404 Harrow Road eastbound (east of Paddington Green)	21,711	1494	7%	48
8. A5 Edgware Road (north of Church Street)	23,746	3115	13%	32
9. A5 Edgware Road (south of Newcastle Place)	23,151	3001	13%	32
10. Loop road (north of WEG Block A)	547	58	11%	32

Technical Appendix 8.5(R): Site Suitability Assessment for Residential Use

TECHNICAL APPENDIX 8.5(R): SITE SUITABILITY FOR RESIDENTIAL USE

1. Introduction

This technical appendix outlines the site suitability for its intended purpose from a noise perspective. It is, therefore, an outline assessment of possible design solutions.

The effect of noise sources on the proposed residential development (as the most noise-sensitive of the proposed uses) have been assessed in line with BS8233:2014 and Professional Practice Guidance (ProPG) on Planning and Noise developed by the Institute of Acoustics (IOA) and the ANC Acoustics, Ventilation and Overheating Residential Design Guide.[1]

ProPG considers new residential dwellings that will primarily be exposed to transportation noise. The preparation of this guidance was overseen by a Working Group consisting of representatives of the Association of Noise Consultants (ANC), IOA and Chartered Institute of Environmental Health (CIEH), together with practitioners from a planning and local authority background.

This guidance has been produced to provide practitioners with advice on a recommended approach to the management of noise within the planning system in England. It takes into account the guidance on the control and mitigation of noise detailed in the National Planning Policy Framework (NPPF) and the Noise Policy Statement for England (NPSE) and presents them in one overall document. It also provides further clarification and guidance for appropriate noise levels and suitable design, such as proposing suitable maximum noise levels in bedrooms at night.

The assessment covers the following:

- Internal ambient noise levels during whole-dwelling ventilation;
- Internal ambient noise levels during the overheating condition;
- External amenity noise levels; and
- Internal vibration levels.

2. Criteria

2.1 Internal Ambient Noise Level

2.1.1 Whole dwelling (background) ventilation

The internal ambient noise levels have been assessed in line with BS8233:2014, which recommends that for resting/sleeping conditions in living rooms and bedrooms, the internal noise levels should not exceed 35 dB $L_{Aeq,16hour}$ (daytime) and 30 dB $L_{Aeq,8hour}$ (night-time).

Consideration has also been given to the individual noise events, which should not regularly exceed 45 dB L_{Amax} during night-time hours (more than 10-15 times a night).

2.1.2 Overheating

The ANC AVO Design Guide[1] provides a two-level assessment methodology for assessing noise impacts within developments during the overheating condition:

- Level One – high-level assessment based on external noise levels (see Figure 1) and determines whether a level two assessment is required.
- Level Two – based on internal noise levels, where the frequency of overheating is also considered.

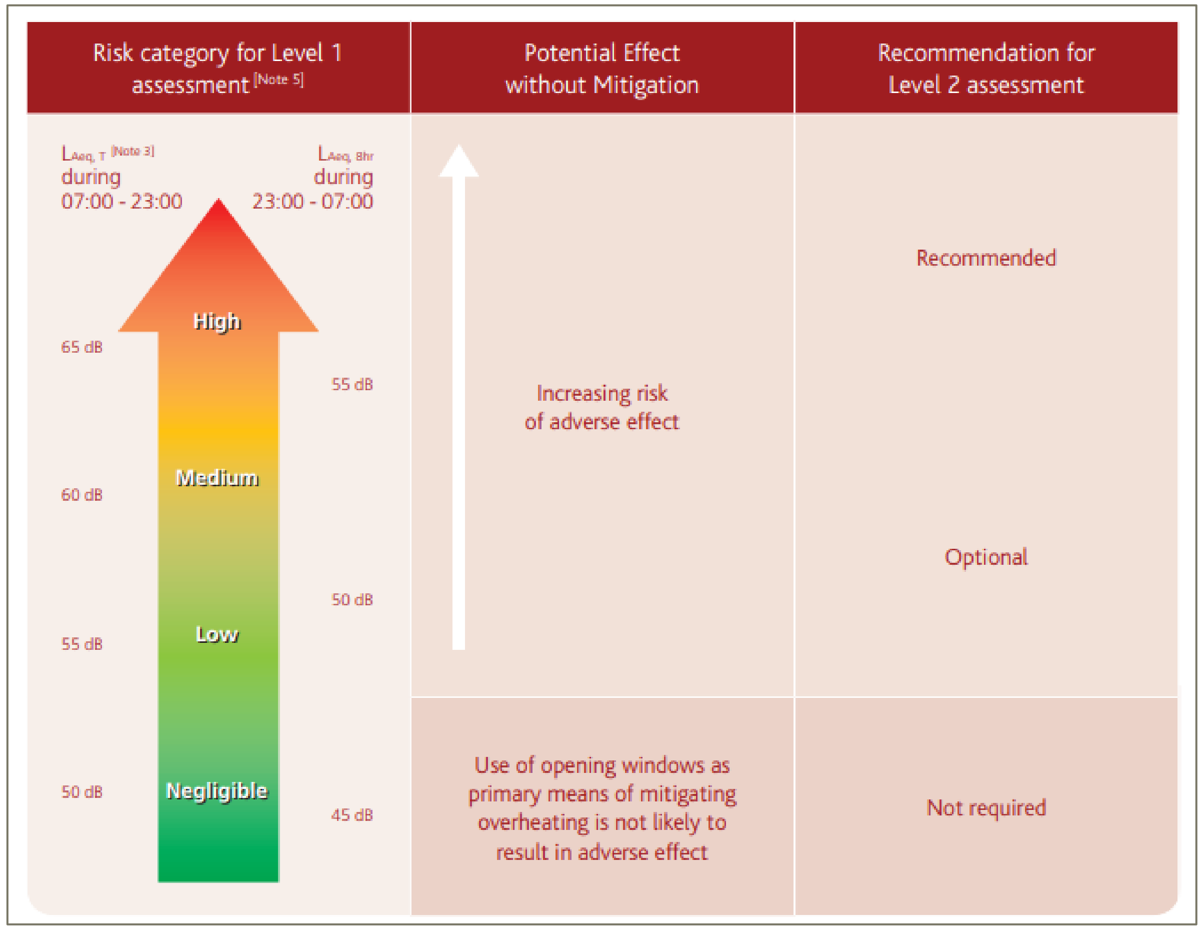


Figure 1: ANC AVO Guide Level 1 Assessment

The AVO Guidance provides a sliding scale that states that the more often overheating occurs, the lower the internal ambient noise level limit should be. Assuming that overheating occurs often ('worst-case' scenario), Significant Observed Adverse Effect Level (SOAEL) is considered when the internal ambient noise level exceeds 40 dB $L_{Aeq,16hour}$ during daytime hours (0700-2300) and $L_{Aeq,8hr}$ 35 dB during night-time hours (2300-0700), i.e. 5dB higher than the BS8233:2014 guideline levels. This is based on Appendix B of the AVO guide.

In addition, Approved Document O[2] (ADO) of the Building Regulations specifies noise limits in dwellings at night when open windows are used to control temperature. ADO limits are not based on the frequency of exceedance and do not specify the types of noise referred to.

ADO states that:

"*In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am)*".

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).

b. 55dB L_{AFmax}, more than 10 times a night (between 11pm and 7am).

[1] Association of Noise Consultants, 2020. Acoustics, Ventilation and Overheating: Residential Design Guide.

[2] The Building Regulations 2010 Approved Document O Overheating, HM Government, 2021 edition

On the basis of a window open to alleviate overheating providing around 5dB reduction from outside to inside, the implication of these limits is that residents are likely to close windows where night time external levels are around 45dB L_{Aeq} or around 60dB L_{Afmax} or higher and an alternative means of ventilation/cooling is likely to be required in that situation.

2.2 External Amenity Noise Levels

The noise levels in external amenity areas have been assessed in line with BS 8233:2014, which recommends that noise in external amenity spaces should not normally exceed 50dB $L_{Aeq,T}$ or 55 dB $L_{Aeq,T}$ in busy areas such as adjoining a transport network. It also recognises that the guideline values are not achievable in all circumstances where development might be desirable and that a compromise between elevated noise and other factors is warranted. In these instances, the development should seek to achieve the lowest practicable levels in these external amenity spaces and should not be prohibited.

In addition, ProPG states the following:

- "*Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:*
- *a relatively quiet façade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or a relatively quiet, protected, publicly accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance).*"

Consultation was undertaken with the Environmental Health Officer at Westminster City Council (WCC), Mark Walshe, who confirmed the following (by email) regarding acceptable noise levels in external amenity areas and balconies: *"Where possible all external areas should achieve noise levels in line with WHO and BS8233, however we accept that this is not always possible. We would encourage all developments to try and meet these levels where possible through good design".*

2.3 Vibration

BS 6472-1:2008 – 'Guide to evaluation of human exposure to vibration in buildings, Part 1: Vibration sources other than blasting' outlines methods for evaluating human response to structural vibration in buildings for residential use. It provides guidance on how to undertake vibration measurements, determining vibration dose value (VDV) and uses this metric to estimate the probability of adverse comment. These are summarised in Table 1.

Table 1: Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings

Measurement	Low probability of adverse comment / $ms^{-1.75}$	Adverse comment possible / $ms^{-1.75}$	Adverse comment probable / $ms^{-1.75}$
Residential buildings 16_{hr} day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8_{hr} night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

3. Baseline

Noise and vibration measurements were undertaken to quantify the baseline noise and vibration climate at the site as described in Technical Appendix 8.2: Baseline Noise and Vibration Survey.

The noise measurements were used to calibrate the baseline noise model (undertaken with commercially available noise mapping software – CadnaA) and the noise levels incident on the façade were predicted using the predicted future traffic flows.

4. Modelling and Prediction

Noise levels at the proposed development have been predicted using the CadnaA suite of noise modelling software. This software utilises standard acoustic principles in conjunction with approved prediction methodologies (ISO 9613-2) and is an industry-standard method for predicting and assessing the impact of noise from a variety of sources.

The following noise sources were incorporated into the model:

- Traffic links surrounding the application site.
- The model allows for no ground absorption, as surfaces are understood to be hard / tarmacked. All buildings were assumed as acoustically reflecting. The model was set to consider three-orders of reflection.

The CadnaA model was calibrated to the levels recorded during the noise survey.

The noise levels at the proposed facades have then been calculated. Predicted future traffic flows are not predicted to result in measurable change to the façade noise levels.

The predicted daytime façade noise levels are shown in Figures 2 - 4.

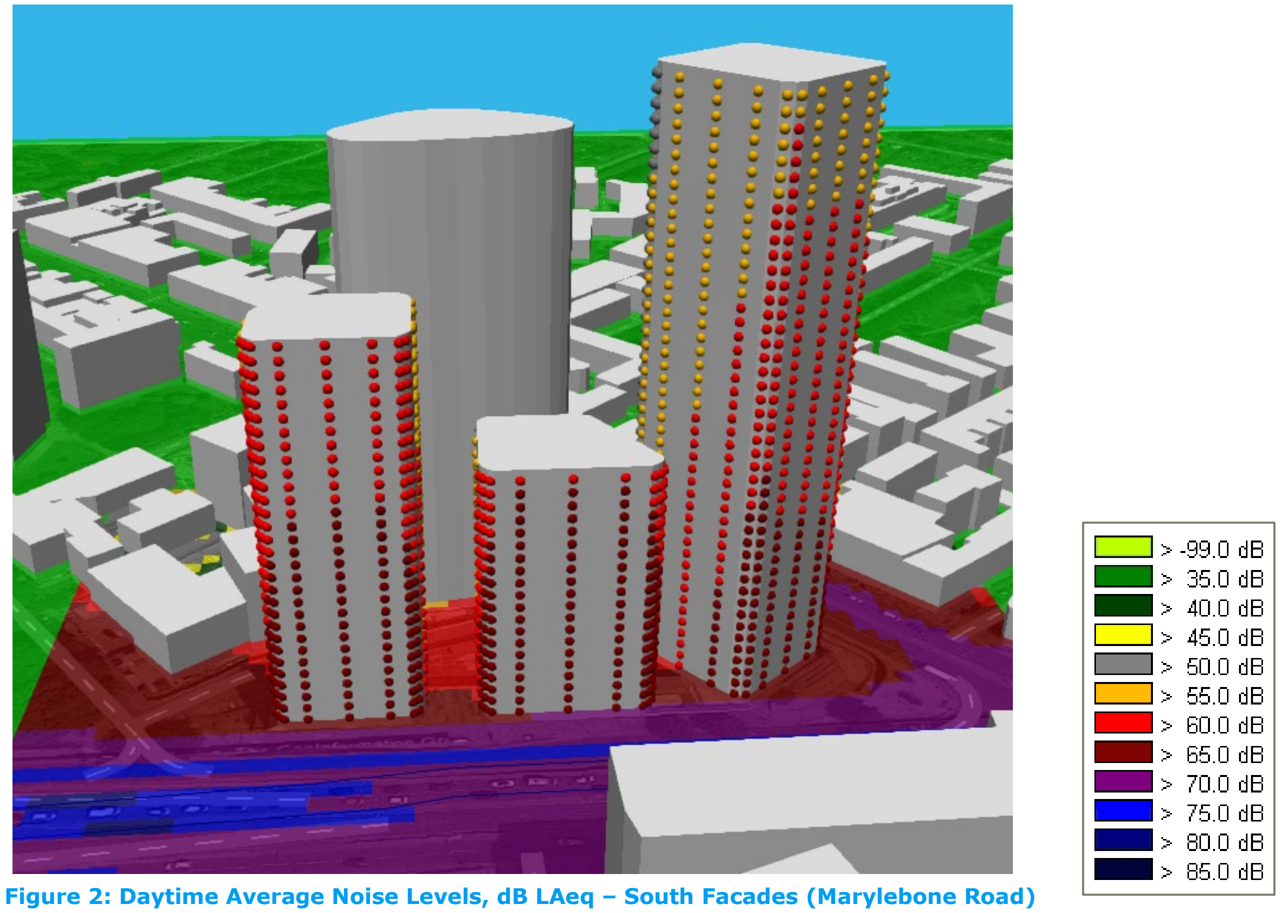


Figure 2: Daytime Average Noise Levels, dB LAeq – South Facades (Marylebone Road)

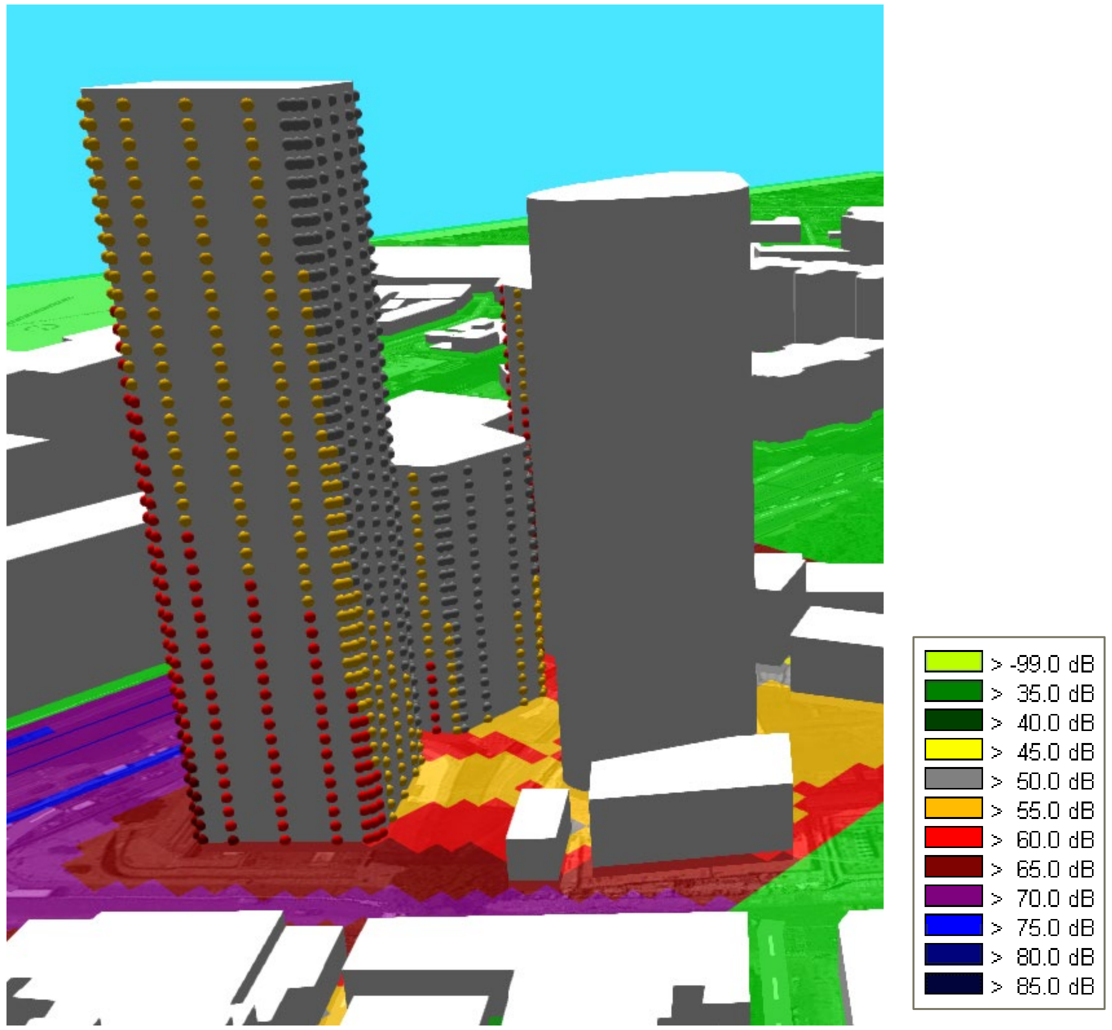


Figure 3: Daytime Average Noise Levels, dB LAeq – East Facades (Edgware Road) and North Facades

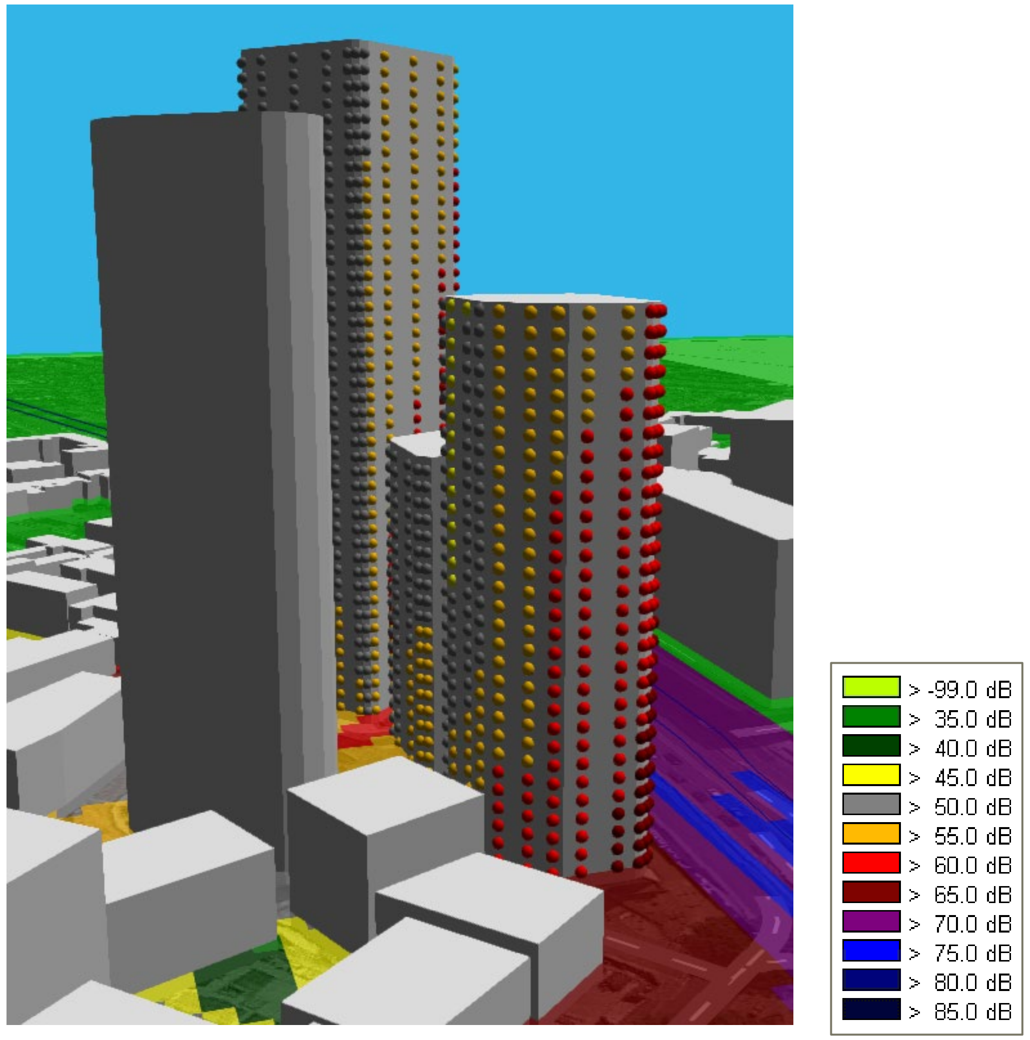


Figure 4: Daytime Average Noise Levels, dB LAeq – West Facades (Marylebone Road) and North Facades

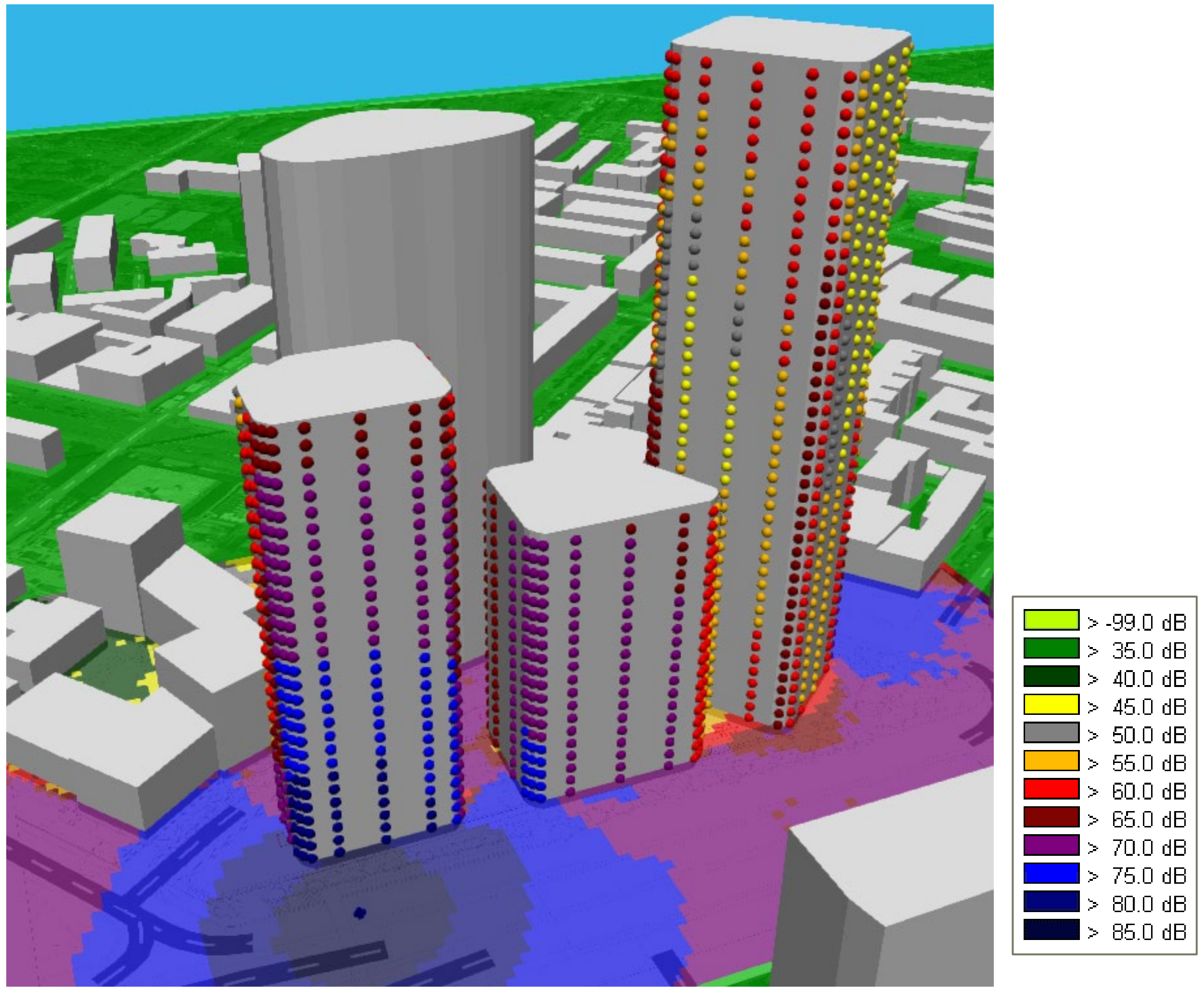


Figure 5: Night Time Maximum Noise Levels, dB LAFmax – South Facades (Marylebone Road). Source of maxima in front of Block I.

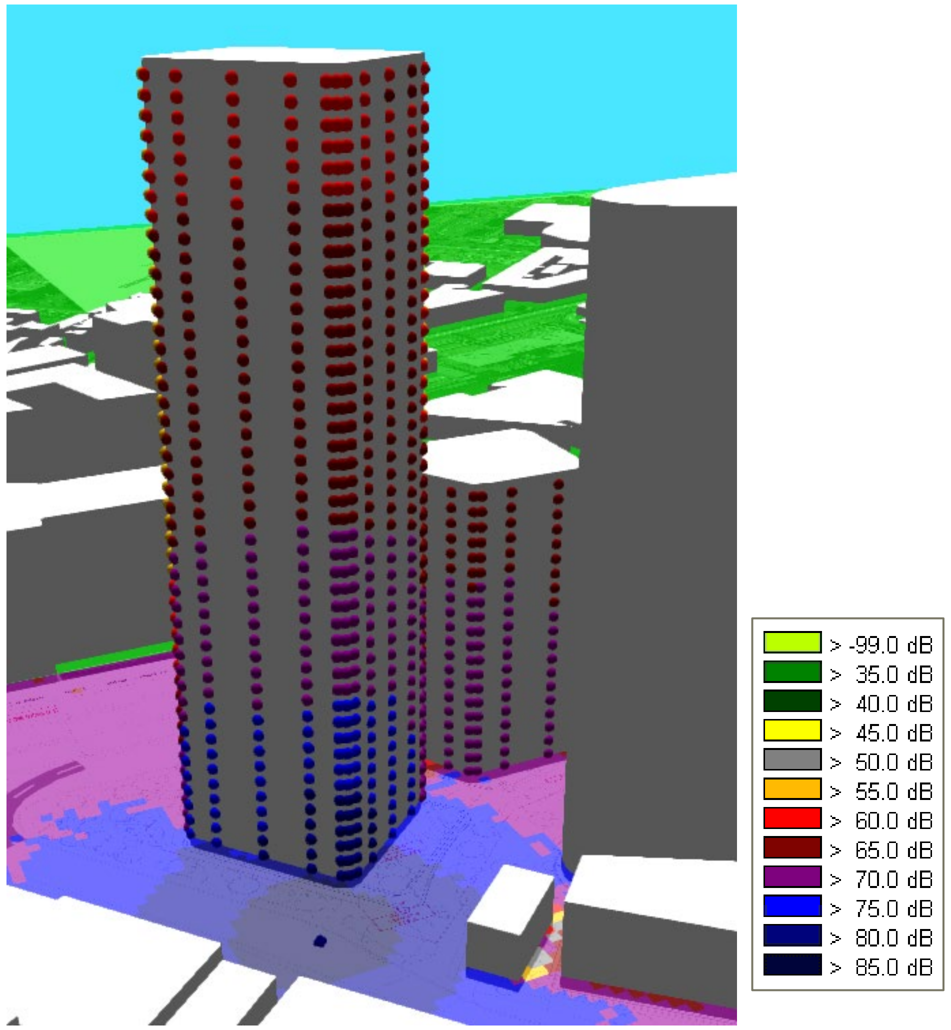


Figure 6: Night Time Maximum Noise Levels, dB LAFmax – East Facades (Edgware Road). Source of maxima in front of Block K.

5. Assessment

5.1 Internal Ambient Noise Level

Whole-Dwelling Ventilation

Façade specifications are given in Table 3 which would be capable of achieving the internal noise level requirements:

- 35dB L_{Aeq} Day; and
- 30dB L_{Aeq}, 45 dB L_{AFmax} Night.

Calculations are based on a typical bedroom size of 3.8 m x 3.4 m x 2.4 m, and a window area of 4 m^2.

Façade specifications are driven by achieving the maximum noise level (L_{AFmax}) criterion in bedrooms. The façade specifications required to control maximum levels are also sufficient to meet the average (L_{Aeq}) level criteria (day and night).

It is assumed that the same glazing would be applied to living rooms as to bedrooms (for consistency); however, in practice it may be possible to reduce the specification of living room glazing slightly as the maximum noise level criterion does not apply in living rooms.

In all cases it is assumed that the remaining façade construction achieves at least 43 dB R_w+C_{tr}. This is typically achievable with heavy rainscreen cladding or brick slips on insulation-filled SFS with two layers of acoustic plasterboard internally.

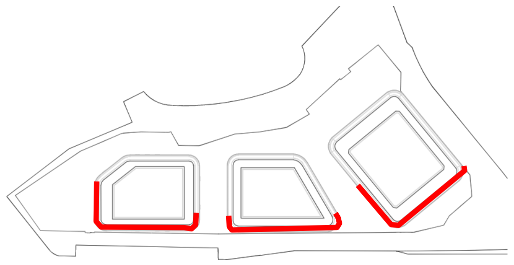
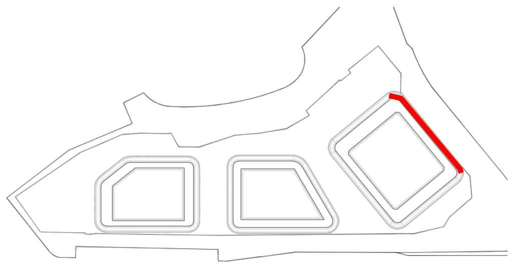
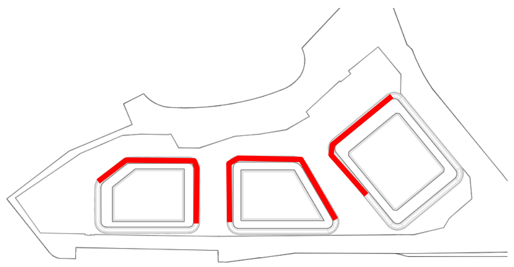
Example glazing configurations that are suitable to achieve the performance specifications in Table 3 are given in Table 2 to provide an indication of widths/weights etc. However, octave frequency band performance of any final glazing proposals would need to be reviewed and the R_w+C_{tr} values are used here to provide an initial guide.

The Applicant would aim to rationalise the glazing so as to minimise the types of glazing on-site. This will be developed during detailed design and co-ordinated in respect of energy performance requirements.

Table 2: Example Glazing Configurations – For Guidance

Performance Requirement	Example Glazing Specification (for guidance)
44 R_w+C_{tr}	16.8A / 15 / 16.8A acoustic laminate, or secondary glazing
43 R_w+C_{tr}	14.4A / 24 / 8.4A acoustic laminate, or secondary glazing
42 R_w+C_{tr}	12 / 20 / 12.8A acoustic laminate, or secondary glazing
41 R_w+C_{tr}	12 / 20 / 8.8A acoustic laminate
40 R_w+C_{tr}	10 / 16 / 12.4A acoustic laminate
39 R_w+C_{tr}	10 / 16 / 8.4A acoustic laminate
37 R_w+C_{tr}	10 / 12 / 8.4A acoustic laminate
36 R_w+C_{tr}	10 / 12 / 8.4A acoustic laminate
35 R_w+C_{tr}	10 / 20 / 6
34 R_w+C_{tr}	10 / 12 / 6

Table 3: External Maximum Noise Levels and Façade Specifications Required to Meet WCC Requirements

Façade (approximate extents shown in red)	Floor Level	Approx. External Levels, Typical L_{AFmax}	Outline Glazing Performance	Ventilation Strategy
South Facing A40 	00 01 02 03 04 05 06 07 08 09 10 11+	84 84 84 84 84 83 82 81 81 80 79 78	41 R_w+C_{tr} 41 R_w+C_{tr} 41 R_w+C_{tr} 41 R_w+C_{tr} 41 R_w+C_{tr} 40 R_w+C_{tr} 39 R_w+C_{tr} 38 R_w+C_{tr} 38 R_w+C_{tr} 37 R_w+C_{tr} 36 R_w+C_{tr} 35 R_w+C_{tr}	MVHR i.e. ventilation provided by mechanical means. Windows can be openable at user discretion, but noise and ventilation requirements must be met when windows are closed.
East Facing Edgware Road 	00 01 02 03 04 05 06 07 08 09 10 11+	87 87 86 85 84 83 82 81 80 79 78 77	44 R_w+C_{tr} 44 R_w+C_{tr} 43 R_w+C_{tr} 42 R_w+C_{tr} 41 R_w+C_{tr} 40 R_w+C_{tr} 39 R_w+C_{tr} 38 R_w+C_{tr} 37 R_w+C_{tr} 36 R_w+C_{tr} 35 R_w+C_{tr} 34 R_w+C_{tr}	MVHR
North 	All levels	<77 (though maxima from development traffic will need to be assessed)	34 R_w+C_{tr}	MVHR Potential scope for acoustic trickle vents in some rooms.

Note that the performance stated must be achieved by the window/curtain wall as a whole including the frame and any opening lights. The acoustic performance of the frame becomes a significant factor for glazing over about 38dB R_w+C_{tr}.

Attenuators are likely to be required on the atmospheric connections of MVHRs at least up to the 10th floor on the facades facing Marylebone and Edgware Road. This is to control noise breaking in through the façade connections and out of the ductwork into the room.

All specifications are subject to a detailed review, since final room sizes, glazing areas and façade constructions are all variables which must be factored into the calculations used to determine the specifications outlined above.

5.1.1 Overheating Condition

Based on the risk categories given in the Level 1 assessment from AVO (Figure 2) the site is in a 'high' risk category, meaning that there is a significant risk of adverse effects on residents if overheating is relieved with open windows or other façade openings. Some parts of the buildings facing north may fall into a 'medium" risk category during the day but as night time levels at the site do not fall significantly from daytime levels, these parts of the buildings fall into the 'high' risk category at night.

With external levels of around 70dB L_{Aeq} at the lowest floor levels and around 60dB L_{Aeq} at the highest floor levels facing the roads, internal levels would be in the region of 57-47dB L_{Aeq} when windows are opened for rapid cooling (depending on the opening area required). Comparing this to the AVO guidance, the internal levels would have significant impacts on sleep disturbance and quality of life (see Red category of Figure 2) and levels are likely to be higher than ADO limits at night. On this basis, control of overheating through open windows (or other simple façade openings) is not likely to be possible on any façade or floor level of the building.

In order to comply with the overheating requirements the design should use a combination of passive (minimising solar gains using blinds / balconies / external fins) and non-passive (mechanical cooling via FCU served from an air cooled chiller on the roof in the private apartments / inline DX cooling module within the affordable units) measures. The exact combination would be finalised at detailed design stage when more advanced thermal analysis for the building has been undertaken.

5.1.2 Summary

With the application of a façade strategy similar to that given in Table 3 (and consideration of the overheating provision), the internal ambient noise levels are predicted to fall below the target level. On the basis that these requirements are secured by planning condition, the proposed development would be acceptable for residential use and the effects would be Negligible.

5.2 External Amenity Noise Levels

The proposed amenity spaces are private recessed balconies and communal external amenity areas around the buildings.

5.2.1 Ground level communal areas

The ambient noise levels predicted in the communal external amenity areas around the buildings are in the region of 60 dB $L_{Aeq,16hr}$ at the rear of the site in areas screened from the A40 by the intervening buildings, with higher noise levels experienced in a single area located closer to the A40.

The predicted ambient noise levels are higher than the upper guideline value stated within BS 8233:2014 due to the proximity to the trunk road network. However, the predicted levels are typical for external amenity areas associated with similar residential development in the vicinity, and similar to the existing ambient noise levels in the southern parts of Paddington Green. In these instances, guidance within BS 8233:2014 states that the "development should be designed achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.". The proposed development has been designed to achieve the lowest practicable levels through locating the main external amenity areas on the opposite side of the proposed buildings to the A40.

5.2.2 Balconies

The EHO consultation acknowledges that higher levels than WHO guidelines may be acceptable; although no definitive limits are provided. The facade noise levels have been categorised as high / medium / low (without mitigation) to show regional variation (see Table 5 and Figures 7-9). It should be noted that these bands are intended as a way of judging the potential risk of using typical, open balconies at different parts of the building facades. These are not fixed limits and it is not to say that open balconies could not be proposed for 'High Risk' areas. These noise level bandings are marked on the building elevations in the Figures 7 to 9, where each coloured dot represents a building storey with a vertical interval between dots of approximately 3.4 m. The first dot is 1.5 m from ground level.

Table 5: Assessment of Balcony Noise in Urban Environment

Balcony Noise Levels	Noise Level on Balcony	Comment
Low	$_{Aeq,16hr}$	Levels in line with WHO, assumed to be acceptable
Medium	56-65 dB $L_{Aeq,16hr}$	Levels up to 10dB higher than WHO. Risk of unacceptability increases with noise level, but should be balanced with the benefit afforded by private amenity space.
High	>65 dB $L_{Aeq,16hr}$	

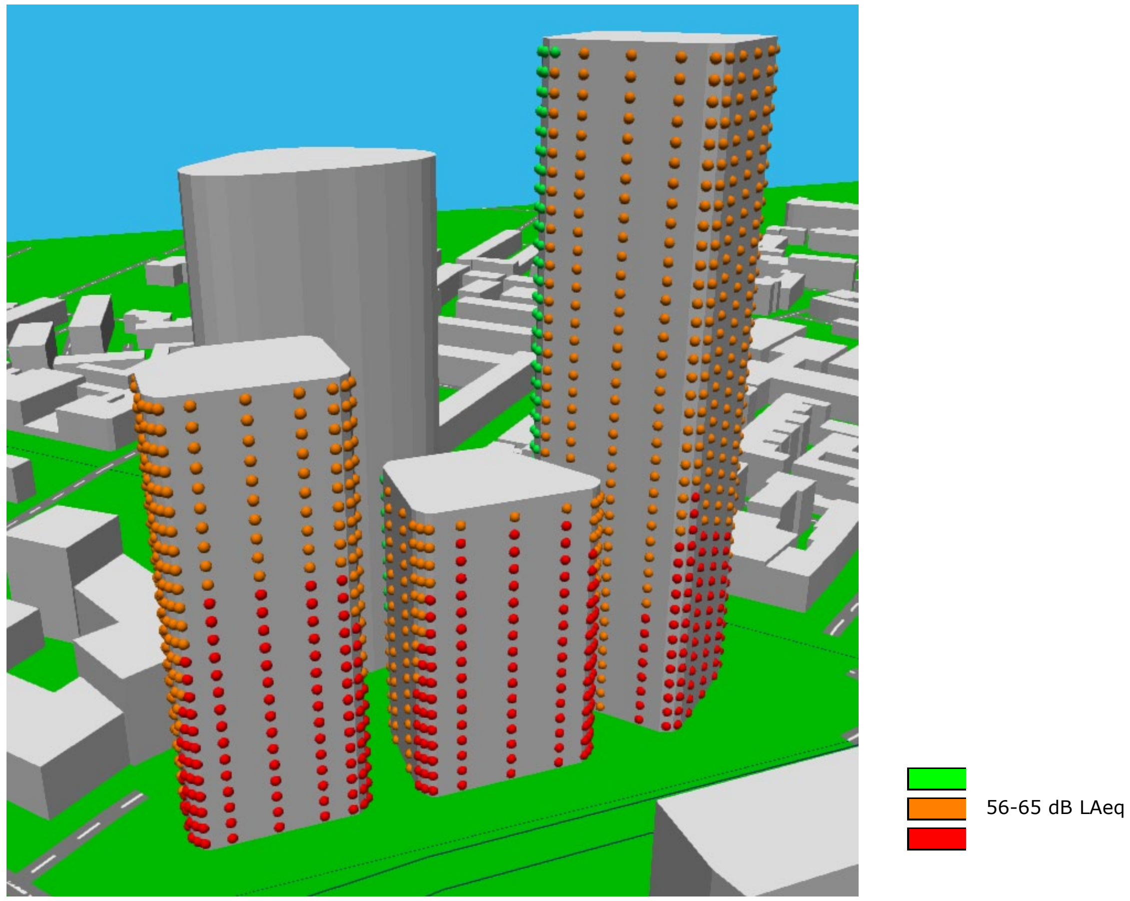


Figure 7: Façade Noise Levels at Different Storeys, Facing A40

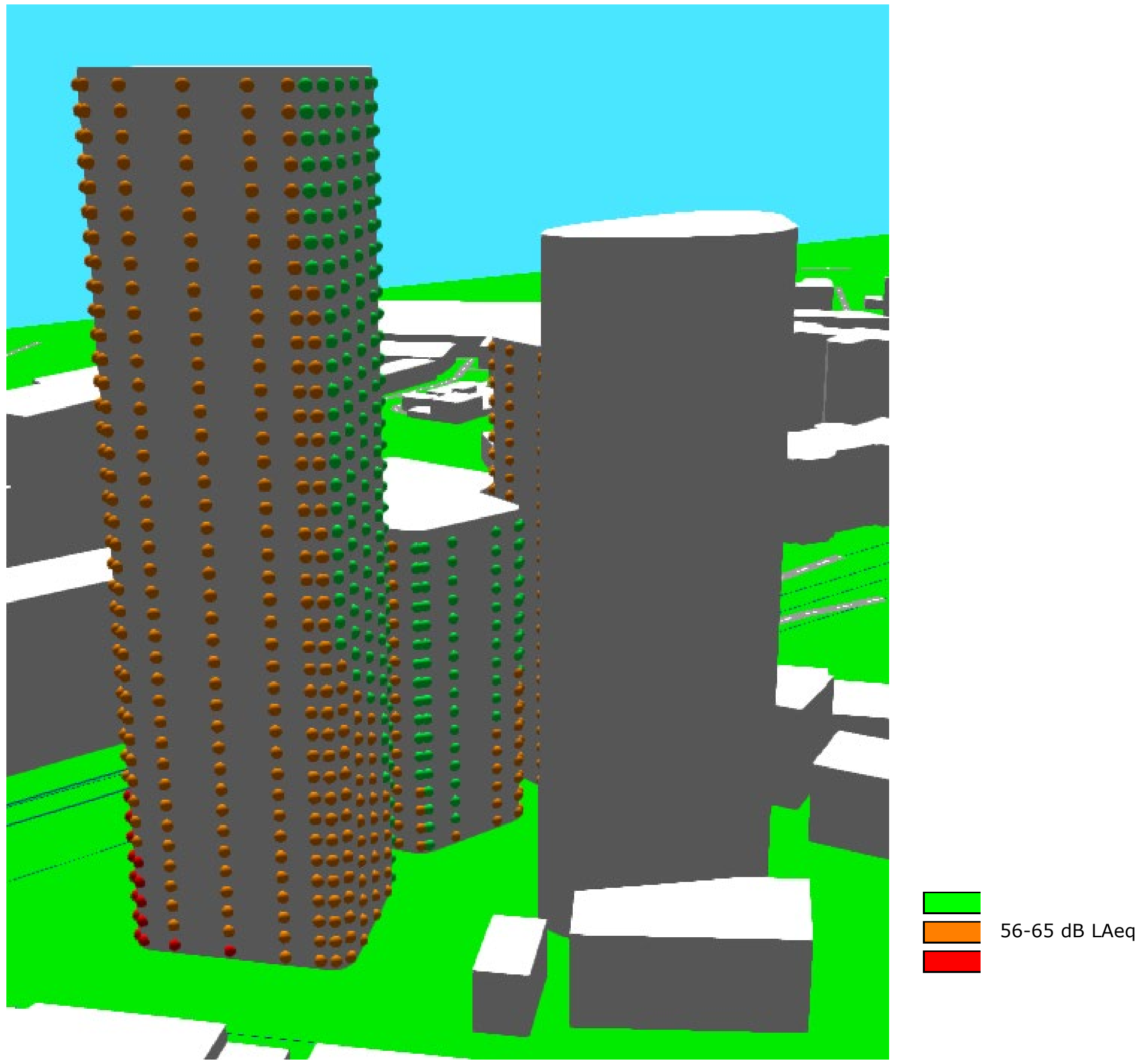


Figure 8: Façade Noise Levels at Different Storeys, Facing Edgeware Road

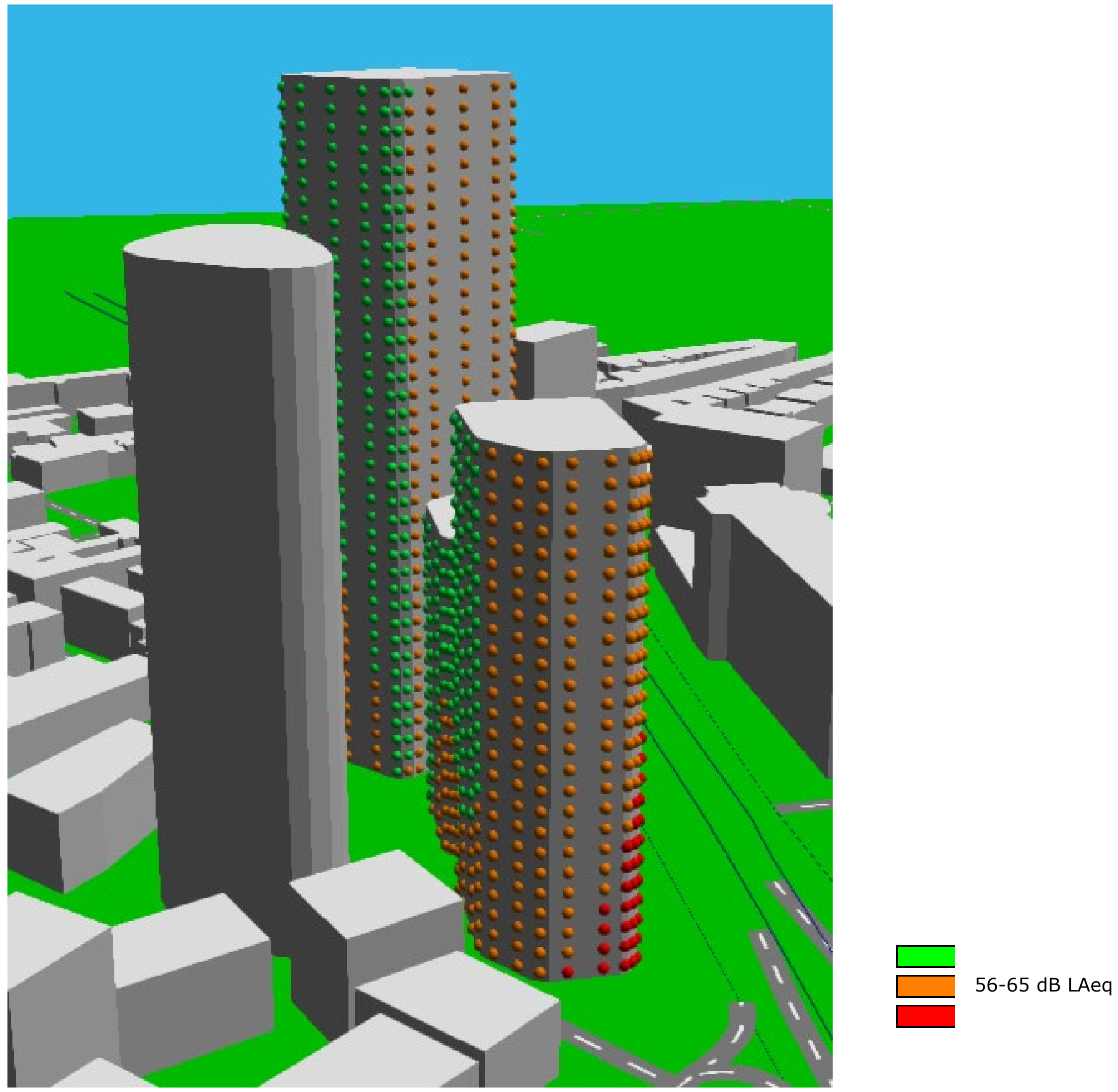


Figure 9: Façade Noise Levels at Different Storeys, Facing Paddington Green

The proposed balconies are to be recessed from the façade with solid balustrades. This is expected to reduce the noise levels on the balconies by up to 5dB at lower levels and by up to 10dB at higher levels (approximately 10th floor and above) when seated.

5.2.3 Summary

External amenity areas are predicted to experience noise levels in excess of the guideline value for urban areas within BS 8233:2014 of 55 dB $L_{Aeq,16hr}$, due to proximity to the trunk road network. However, the proposed development has been designed to achieve the lowest practicable levels through locating the main external amenity areas on the opposite side of the proposed buildings to the A40.

The majority of balconies are predicted to experience noise levels in excess of the guideline value for urban areas within BS 8233:2014. However, with the proposed embedded mitigation, at least 5dB of attenuation is expected. It should also be noted that, residents would have access to additional amenity areas such as the rooftop terraces, Paddington Green and Paddington Basin within 5 minutes walk.

Taking into account the urban location of the site and the open balconies provided within the adjacent WEG and 14-17 PB schemes, noise levels within the proposed external amenity areas are not unusual for the site context. The proposed development has been designed to achieve the lowest practicable levels in the proposed external amenity spaces, as recommended within BS 8233:2014, and alternative quieter external amenity areas are available in the vicinity.

5.3 Vibration

As outlined in the BS6472, the vibration measurement results provided in Technical Appendix 6.2 indicate that there is 'low probability of adverse comment' in both the daytime and the night-time.

However, the measured levels are indicators at surface level only and that driven piles for any buildings may result in significantly higher levels of vibration within any buildings due to structureborne noise propagating through the foundations. Vibration levels typically reduce as they enter the structure of a building due to impedance differences. However, this is not necessarily a linear trend. Vibration levels can amplify as the move up through the first few floors of a building due to structural elements and connections. The precise foundation and building constructions are not known at this time, therefore it is not possible to predict the transfer function between the vibration in the ground and the vibration experienced by the occupiers.

Based on the current levels measured on the basement slab, it is considered that proposed development would be acceptable for residential use from a vibration perspective.

Technical Appendix 9.1(R): Pedestrian Level Wind Microclimate Assessment

FINAL REPORT

PADDINGTON GREEN POLICE STATION

LONDON, UK

PEDESTRIAN LEVEL WIND MICROCLIMATE ASSESSMENT

RWDI #2201683

17TH NOVEMBER 2022

SUBMITTED TO

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VERSION HISTORY

RWDI Project #2201683	Paddington Green Police Station London, UK	
Report	**Releases**	**Dated**
Reports	Rev A Rev B	01/11/2022 17/11/2022
Project Team	Mazen Hama Andrew Proud Aimee Crook	Project Engineer Senior Project Engineer Project Manager

1 INTRODUCTION

RWDI was appointed by Ramboll to conduct a pedestrian level wind microclimate (PLW) assessment for the proposed Paddington Green Police Station development in London, UK. This report presents the methodology employed by RWDI.

Wind tunnel tests were conducted on a 1:300 scale model of the Paddington Green Police Station development (referred to as the "Proposed Development" in this report). The investigation quantifies the wind conditions within and around the Site through comparison of the measured wind velocity and frequency of occurrence with the Lawson Comfort Criteria. Meteorological data for London, UK has been combined, analysed and adjusted to the Site conditions by modelling the effect of upstream terrain roughness on the wind velocities approaching the Site.

Measurements were taken at up to 194 locations for 36 wind directions, in 10° increments. The measurements covered ground level locations along the building façades and at corners, near main entrances, on pedestrian routes within and around the Site, bus stops, and balconies on the Proposed Development. The analysis was conducted on a seasonal basis, however, the report focuses primarily on the windiest season (i.e. winter) and the summer season results, when pedestrian activity generally requires calmer conditions.

The following list details the five configurations tested in the wind tunnel:

- Configuration 1: Existing Site with Existing Surrounding Buildings and Existing Landscaping, including Blocks A – F of West End Green and Associated Landscaping;
- Configuration 2: Proposed Development with Existing Surrounding Buildings, including West End Green and 14-17 Paddington Green and their Associated Landscaping (excluding overlapping landscape proposals);
- Configuration 3: Proposed Development with Existing Surrounding Buildings, including West End Green and 14-17 Paddington Green and their Associated Landscaping (excluding overlapping landscape proposals) and Mitigation Measures;
- Configuration 4: Proposed Development with Existing and Cumulative Surrounding Buildings, including West End Green and 14-17 Paddington Green and their Associated Landscaping (excluding overlapping landscape proposals); and
- Configuration 5: Proposed Development with Existing and Cumulative Surrounding Buildings, including West End Green and 14-17 Paddington Green and their Associated Landscaping (excluding overlapping landscape proposals) and Mitigation Measures.

2 METHODOLOGY AND ASSESSMENT CRITERIA

Wind tunnel testing is a well-established and robust technique to assess the pedestrian wind microclimate of the Development. It provides the means to quantify the wind conditions at the Site and for the measurements to be classified in accordance with the Lawson Comfort Criteria (outlined in Section 2.5). Wind tunnel investigations were conducted using a 1:300 scale model of the Development with existing and cumulative surrounding buildings and terrain covering a radius of 360m centred on the Site.

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

1. Measure the wind speeds at pedestrian level in the wind tunnel relative to a reference wind speed;
2. Adjust standard meteorological data to account for conditions at the Site;
3. Combine these to obtain the expected frequency and magnitude of wind velocities at pedestrian level; and
4. Compare the results with the Lawson Comfort Criteria to 'grade' conditions around the Site.

2.1 Simulation of Atmospheric Winds

The wind is turbulent, or gusty, and this turbulence varies depending upon the Site. It is necessary to reflect these differences in the wind tunnel test. In addition, the atmospheric boundary layer is a shear flow which means that the mean wind speed increases with height.

Modelling these effects is achieved by a combination of spires and floor roughness elements to create a naturally grown boundary layer that is representative of urban or open country conditions, as appropriate. The detailed contoured proximity model around the Site is used to fine-tune the flow and create conditions similar to those expected at full scale (as shown in Figure 2).

2.2 Measurement Technique

Wind speed measurements were made using Irwin probes. For pedestrian comfort studies, both the mean wind speed and the peak wind speed are measured at each location at a scaled height of 1.5m above ground level. The typical equivalent full-scale time period for measuring the mean wind speed is around 90 minutes, whereas the peak wind speed is taken as the wind speed exceeded for 1% of the time.

Wind speeds at each location were measured for 36 wind directions in 10° intervals, with 0° representing a wind blowing from the north and 90° a wind blowing from the east.

2.3 Scaling

The length scale of the model was 1:300 and the velocity scale was approximately 1:2 for strong winds. Consequently, the time scale for the tests was 1:150, or in other words 1 second in the wind tunnel is equivalent to 150 seconds at full scale. The sampling frequency for the data acquisition equipment is therefore adjusted for the time scale.

2.4 Meteorological Data

Approximately thirty years' worth of data were obtained from the meteorological stations at two London airports (London City and Heathrow) and was categorised by season. This is presented in Figure 1 as seasonal wind roses. The radial axis indicates the percentage hours per season that the wind speed exceeds the particular velocity range. The seasons are defined as spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February).

The data has been corrected to standard conditions of 10m above open flat level country terrain, over which pedestrian level wind speeds are greatest. The meteorological station data is then adjusted to the Site conditions using the methodology set out in ESDU 01008[1] with the mean factors for the Site displayed in Table 1. Low to medium rise inner city environments increase the turbulence within the atmospheric boundary layer which reduces the mean wind speed, requiring terrain roughness factors to be specified and applied to the meteorological data to account for the variations in terrain surrounding the Site.

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

The combination of meteorological data, Site altitude and velocity ratios permits the percentage of time that wind speeds are exceeded at ground level on the Site to be evaluated. The locations can then be assessed using the Lawson Comfort Criteria, as described below.

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

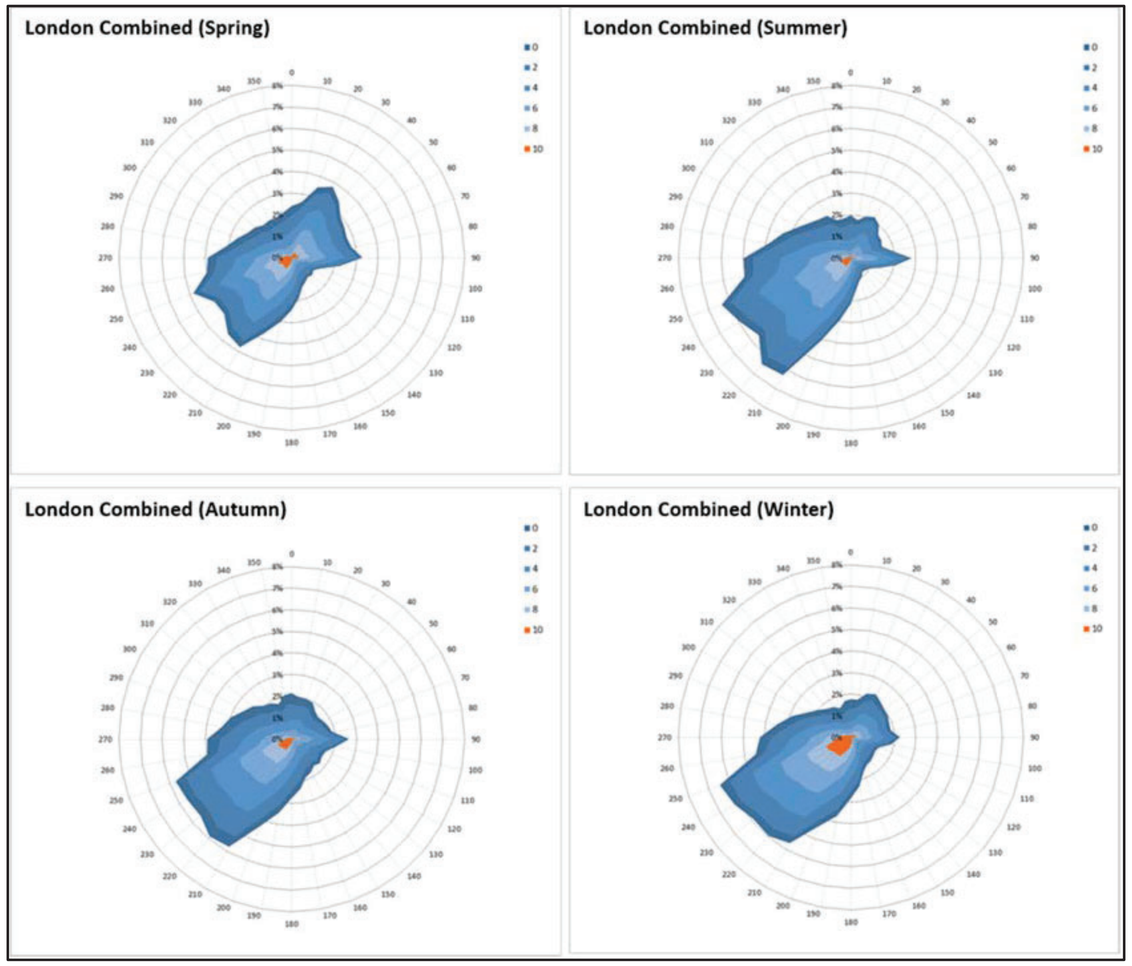

Figure 1. Seasonal wind roses for the wider London area (in m/s) - (Radial axis indicates the percentage of time for which the stated threshold is exceeded)

Table 1: ESDU Mean Factors at 120m above ground level

Wind Direction	0˚	10˚	20˚	30˚	40˚	50˚	60˚	70˚	80˚	90˚	100˚	110˚
Mean Factor at 120m	1.22	1.22	1.25	1.22	1.22	1.22	1.22	1.22	1.18	1.18	1.18	1.18
Wind Direction	**120˚**	**130˚**	**140˚**	**150˚**	**160˚**	**170˚**	**180˚**	**190˚**	**200˚**	**210˚**	**220˚**	**230˚**
Mean Factor at 120m	1.18	1.18	1.19	1.19	1.19	1.19	1.19	1.19	1.21	1.21	1.20	1.20
Wind Direction	**240˚**	**250˚**	**260˚**	**270˚**	**280˚**	**290˚**	**300˚**	**310˚**	**320˚**	**330˚**	**340˚**	**350˚**
Mean Factor at 120m	1.20	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.21	1.22

2.5 Pedestrian Comfort

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

The Criteria sets out four pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The categories are sitting, standing, strolling and walking, in ascending order of activity level, with a fifth category for conditions that are uncomfortable for all pedestrian uses. In other words, the wind conditions in an area for sitting need to be calmer than a location that people merely walk past.

The distinction between strolling and walking is that in the strolling scenario pedestrians are more likely to take on a leisurely pace, with the intention of taking time to move through the area, whereas in the walking scenario pedestrians are intending to move through the area quickly and are therefore expected to be more tolerant of stronger winds.

The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season.

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

The coloured key in Table 2 corresponds to the presentation of wind tunnel test results described in the results section of this report.

Table 2: Lawson Comfort Criteria

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

2.6 Desired Pedestrian Activity around the Development

Generally, for a mixed-use development, the target conditions are:

- Strolling during the windiest season on pedestrian thoroughfares;
- Standing/entrance conditions at main entrances and drop off areas throughout the year;
- Sitting conditions at outdoor seating during the summer season when these areas are more likely to be frequently used by pedestrians; and
- Sitting or standing use conditions during the summer season on balconies and private amenity spaces.

The walking and uncomfortable classifications are usually avoided because of their association with occasional strong winds, unless they are on a minor pedestrian route or a route where pedestrian access could be controlled in the event of strong winds.

Achieving a sitting classification in the summer usually means that the same measurement location would be suitable for standing in the windiest season because winds are stronger during this period. This is considered an acceptable occurrence for the majority of external amenity spaces because other factors such as air temperature and precipitation influence people's perceptions about the 'need' to use seating in the middle of winter.

For a large terrace space, a mix of standing and sitting wind conditions is acceptable provided that any desired seating areas are situated in areas having sitting wind conditions.

Due to the scheme being assessed in outline, the locations of entrances and ground floor amenity spaces has yet to be finalised and will be defined at the detailed design stage.

PEDESTRIAN LEVEL WIND MICROCLIMATE ASSESSMENT
PADDINGTON GREEN POLICE STATION
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2.7 Potential Uses

Expected usage of each probe location in the proposed scenario is shown in Table 3, below.

Table 3: Expected Receptor Usage

Receptor Type (Season)	Location/Receptor Reference (Probe Measurement Number)
On-site	
Pedestrian Thoroughfares (Windiest)	9, 10, 14, 15, 19, 21, 22, 23, 25, 27, 30, 31, 32, 36, 41, 42, 45, 49, 50, 51, 55, 56, 58, 61, 65, 67, 68, 95, 96, 98, 99, 112, 113, 129, 130, 169
Entrances (Windiest)	20, 24, 26, 33, 34, 37, 39, 40, 43, 44, 52, 53, 60, 63, 64, 66, 69, 71, 91, 92, 93, 114, 127, 128, 162, 163, 168
Ground Level Amenity – Mixed Use (Summer)	16, 18, 62, 72, 73, 83, 89, 90, 109, 126
Ground Level Amenity – Seating (Summer)	17, 28, 29, 35, 38, 48, 59, 70, 74, 75, 76, 84, 86, 87, 88, 94, 97, 111, 115, 131, 155, 156, 157, 158, 160, 161, 164, 165, 166, 167
Balconies (Summer)	171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194
Off-site	
Pedestrian Thoroughfares (Windiest)	5, 8, 12, 77, 78, 79, 80, 81, 82, 101, 134
Entrances (Windiest)	85, 102, 103, 105, 107, 118, 119, 120, 121, 122, 133, 135, 136, 137, 138, 139, 140, 141, 144, 145, 147, 148, 149
Bus Stops (Windiest)	57, 123
Pedestrian Crossings (Windiest)	100, 104, 150, 152, 154
Roads (Windiest)	11, 13, 46, 47, 54, 106, 108, 110, 116, 117, 124, 125, 132, 142, 143, 146, 151, 153, 159, 170
Ground Level Amenity – Mixed Use (Summer)	1, 2, 6, 7
Ground Level Amenity – Seating (Summer)	3, 4

2.8 Strong Winds

In addition, the criteria stipulate two strong wind threshold limits; when winds exceed 15m/s or 20m/s for more than 0.025% of the time (approximately two hours of the year). Strong winds in excess of 15m/s for more than this period would be a potential safety concern for cyclists and more vulnerable pedestrians and would require mitigation, apart from where these conditions are pre-existing and occurring in the baseline. Wind speeds that exceed the 20m/s threshold for more than approximately two hours per year would represent a safety risk for all members of the population and would therefore require mitigation to provide an appropriate wind environment.

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

APPENDIX A

APPENDIX A: WIND TUNNEL PHOTOGRAPHS

Figure 2: Configuration 1 – view in the Wind Tunnel from the south

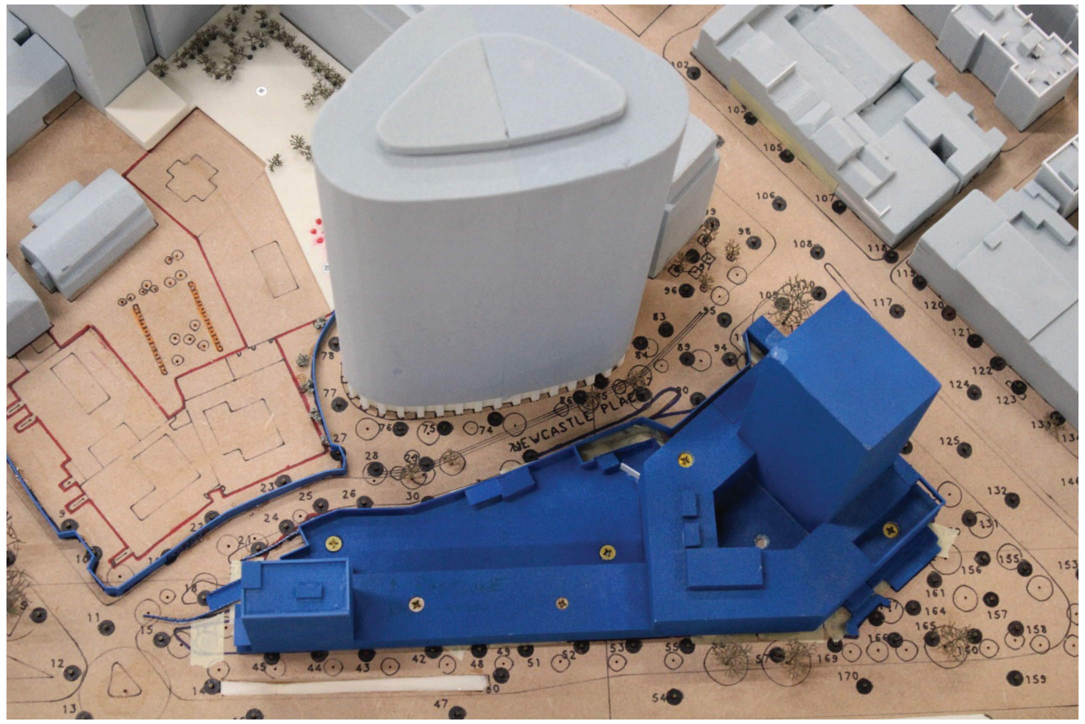

Figure 3: Configuration 1 – view in the Wind Tunnel from the south

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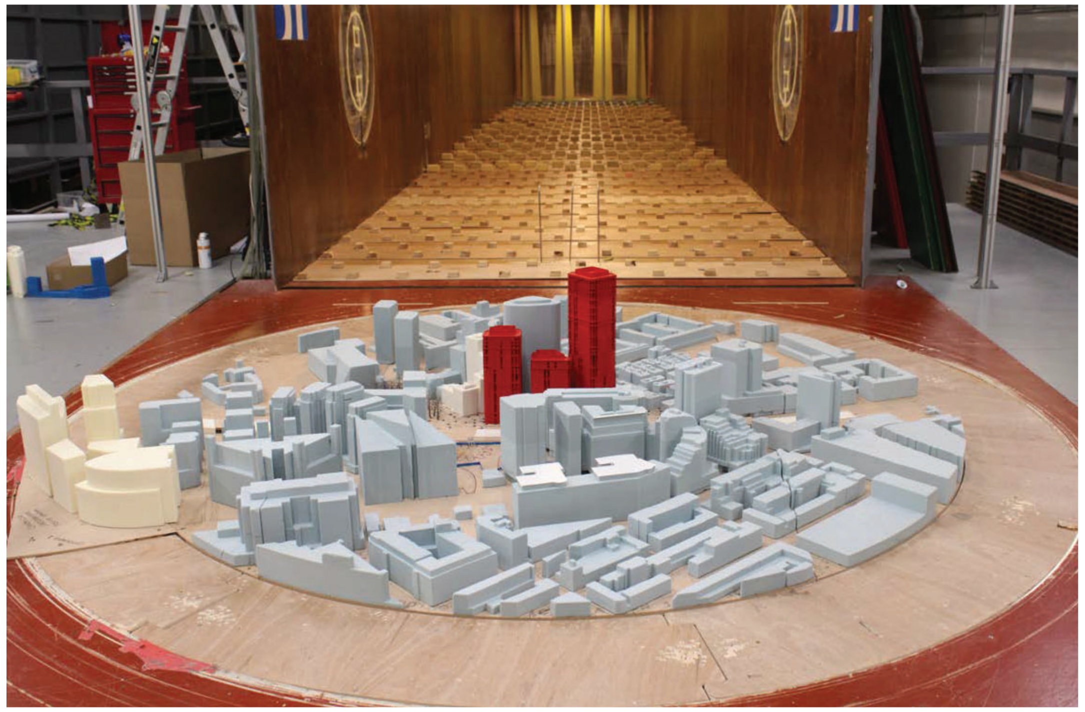

Figure 4: Configuration 2 – view in the Wind Tunnel from the south

Figure 5: Configuration 2 – view in the Wind Tunnel from the south