APPENDIX D AIR QUALITY

D.1 Appendix D.1 – Air Quality Monitoring Method

Method

D.1.1 A three-month NO_2 diffusion tube survey was carried out in accordance with TG22. Diffusion tubes are an indicative monitoring method with an uncertainty of approximately ± 25%. The tubes contain the chemical reagent triethanolamine (TEA) to absorb the pollutant to be measured from ambient air.

D.1.2 The diffusion tubes were supplied and analysed by Gradko International Limited (Gradko), a UKAS certified laboratory accredited to the AIR Proficiency Testing Scheme. The tubes were prepared with a known volume of 20% TEA in acetone.

D.1.3 In accordance with TG22 guidance, five tubes were installed at five locations adjacent to roads in the vicinity of the Site. It should be noted that six locations were originally proposed at the outset of the survey. However, diffusion tube 4 was missing from the monitoring location upon arrival following the first monitoring period. It was therefore subsequently excluded from the monitoring survey. The monitoring locations were agreed with the LBTH Air Quality Officer. As agreement with the London Borough of Hackney (LBH) to co-locate three diffusion tubes with their roadside automatic monitor was not obtained before sitework commenced, it was not possible to undertake a co-location exercise; hence, the national bias adjustment factor has been used.

D.1.4 All diffusion tubes were exposed to ambient air for a four or five-week period depending on the length of the calendar month between 31st August 2022 and 7th December 2022.

D.1.5 The tubes were then collected and sent back to the Gradko Environmental laboratory for analysis by U.V. spectrophotometry, which reported the time-weighted average NO_2 concentration ($\mu g/m^3$) over the four / five-week period registered for each tube at each location.

D.1.6 A travel blank was also carried to and from the site during the installation and collection site visits to demonstrate that tubes from the batch were not contaminated before use, as a method of quality assurance in agreement with TG22.

D.1.7 The monitoring locations are presented in **Figure D.1** and described in **Table D.1** below.

Table D.1: Description of air quality monitoring locations

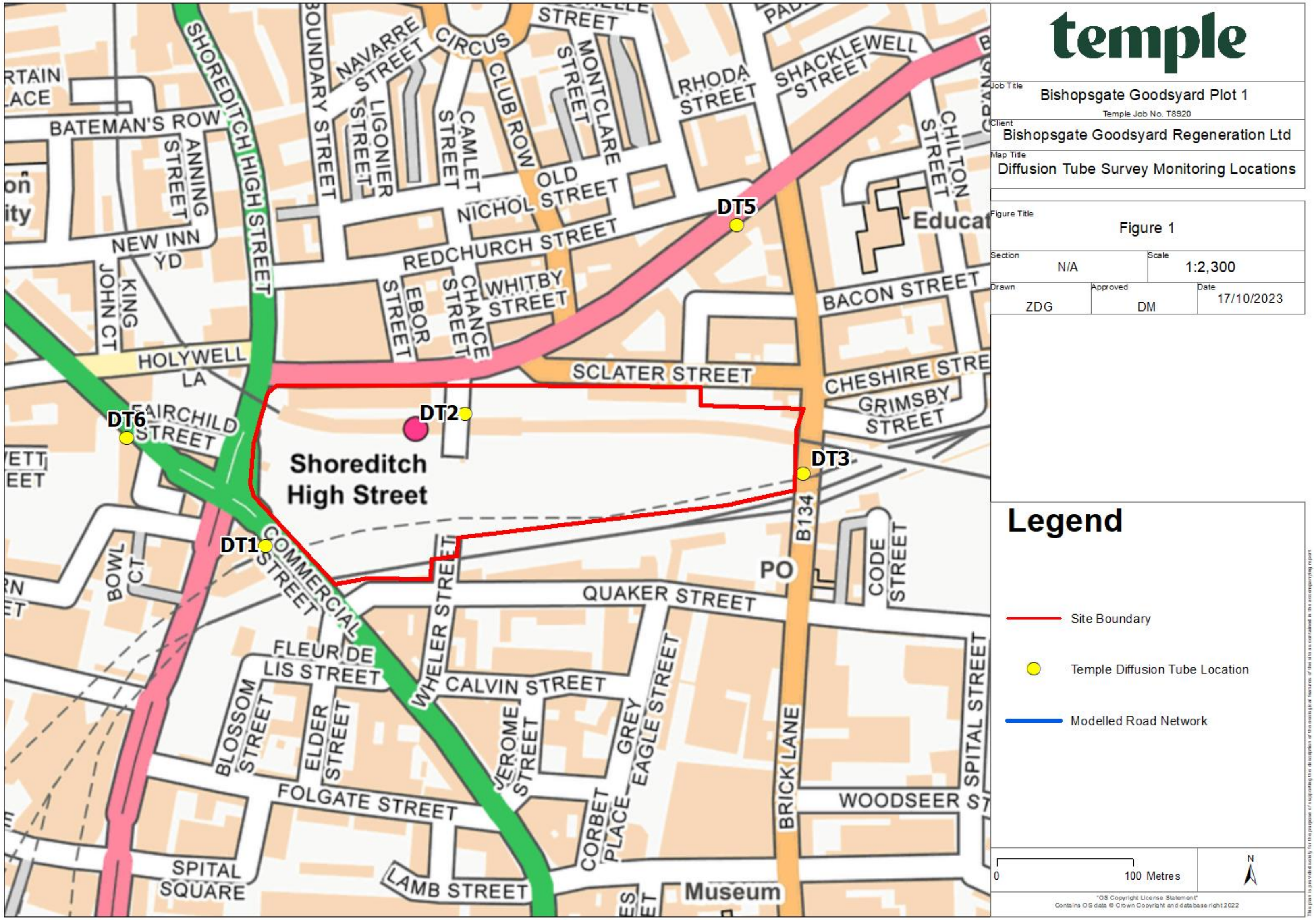
Site ID	Site Name	X	Y	Site Type
DT1	Commercial Street	533488	182153	Roadside
DT2	Braithwaite Street	533634	182250	Roadside
DT3	Brick Lane	533882	182206	Roadside
DT5	Benthal Green Road	533833	182388	Roadside
DT6	Great Eastern Street	533386	182232	Roadside

D.1.8 The following method was used to process monitoring data collected from the survey.

- The time-weighted average at each monitoring location was calculated as the December tube collection was not synchronised with the diffusion tube calendar, and the results from each triplicate averaged;
- Monitoring data were 'annualised' in accordance with TG22, which outlines a method for converting shorter monitoring periods to an equivalent annual mean concentration by calculating a factor representing the proportion of the period mean to the annual mean and multiplying the monitored data by the calculated factor. Annualisation was undertaken using the 2022 data at four nearby urban background monitoring locations (Camden Bloomsbury, Westminster Covent Garden, City of London The Aldgate School, Newham Wren Close) near the from the London Air website; and
- As diffusion tubes are an indicative monitoring technique, they do not offer the same accuracy as an automatic chemiluminescent analyser, which could lead to results under- or over-reading (leading to negative or positive bias). To reduce bias, the 2022 national bias adjustment factor (0.84) was applied to the annualised averaged monitoring results located at roadside locations.

D.1.9 It should be noted that in some instances, some tubes from each monitoring location were missing upon arrival. In these instances, the averages from the tubes present at each location were calculated. For this reason, the same annualisation factor was applied at all monitoring locations.

Figure D-1: Survey monitoring locations



D.2 Appendix D.3 - Detailed Dispersion Modelling Assessment Method (Air Quality Vehicle Emissions)

Modelling Software

D.2.1 The ADMS-Roads detailed dispersion model (version 5) was used to assess direct effects from the additional traffic on local air quality during 2027 and 2030.

D.2.2 The ADMS-Roads model considers the key variables that influence pollutant emission and dispersion (meteorology, surface roughness, diurnal traffic flows, predicted future traffic mixes and predicted future engine emission standard mixes). Annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ were predicted at a number of locations in the vicinity of the Proposed Development. The receptors chosen include those that are representative of worst-case exposure locations within the modelled study area.

Assessment Scenarios

D.2.3 Predictions of NO_2, PM_{10} and $PM_{2.5}$ were made for the following scenarios:

- **Scenario 1 (S1):** Base year, using 2022 traffic data and 2022 background pollutant concentrations and emissions factors;
- **Scenario 2 (S2):** Peak Construction baseline (without the Proposed Development) 2027, including traffic from committed and consented schemes, using 2027 emission factors and 2022 background pollutant concentrations;
- **Scenario 3 (S3):** Peak Construction baseline + Proposed Development 2027, including traffic from committed and consented schemes, using 2027 emission factors and 2022 background pollutant concentrations;
- **Scenario 2 (4):** traffic flows anticipated during 2030, without the Proposed Development in place but inclusive of committed / consented development traffic, using 2030 emission factors and 2022 background pollutant concentrations; and
- **Scenario 5 (S5):** traffic flows anticipated during 2030, with the Proposed Development in place and inclusive of committed / consented development traffic, using 2030 emission factors and 2022 background pollutant concentrations.

D.2.4 Phase 1 of the Proposed Development is expected to fully open during 2030, meaning that the background concentrations and emissions factors selected apply to the first year during which future Site users will be occupied.

Traffic Data

D.2.5 The AADT, the percentage of HDVs (%HDVs) and vehicle speeds for the local roads of interest were obtained from the Transport Consultants, WSP. Vehicle speeds were based on the speed limits on each road link, but sometimes adjusted with reference to the advice on modelling junctions and congestion provided within TG22, and professional judgement. **Table D.2** summarises the information used within the assessment (AADT and %HDVs). The roads and receptors included in the dispersion modelling assessment are also presented in **Figure D.2** and **Figure D.3** below.

D.2.6 The traffic data provided also accounted for cumulative schemes located within (1) km radius from the boundary of the Site. Since the 2019 ESA, additional traffic flows generated from the below list of cumulative schemes have been taken into consideration:

- Huntingdon Industrial Estate
- 9 Hewett Street

Table D.2: Traffic Data for all modelled scenarios

Link Name	S1		S2		S3		S4		S5		Speed (kph)
	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	
Great Eastern Street	28,134	8.53	29,602	8.53	29,602	8.53	30,946	8.53	31,361	8.57	31 (20 for junction links)
Shoreditch High Street (North)	11,921	22.09	12,544	22.09	12,574	22.28	13,113	22.09	13,222	22.05	29 (20 for junction links)
Bethnal Green Road	14,539	10.76	15,298	10.76	15,329	10.94	15,993	10.76	16,714	10.70	25 (20 for junction links)
Sclater Street	1,987	10.93	2,091	10.93	2,091	10.93	2,186	10.93	2,536	10.91	23 (20 for junction links)
Brick Lane	2,266	14.22	2,384	14.22	2,384	14.22	2,493	14.22	2,653	13.98	22
Braithwaite Street	625	41.04	658	41.04	688	43.65	688	41.04	896	35.32	28 (20 for junction links)
Commercial Street	25,600	8.96	26,936	8.96	26,966	9.07	28,159	8.96	28,668	9.06	33 (20 for junction links)
Principal Place	16,224	23.69	17,071	23.69	17,071	23.69	17,846	23.69	18,195	23.38	27 (20 for junction links)
Shoreditch High Street (South of Bethnal Green Road)	22,607	18.30	23,786	18.30	23,786	18.30	24,866	18.30	25,619	18.09	20
Bethnal Green Road (East of Sclater Street)	7,891	7.46	8,302	7.46	8,333	7.80	8,679	7.46	8,770	7.58	25 (20 for junction links)

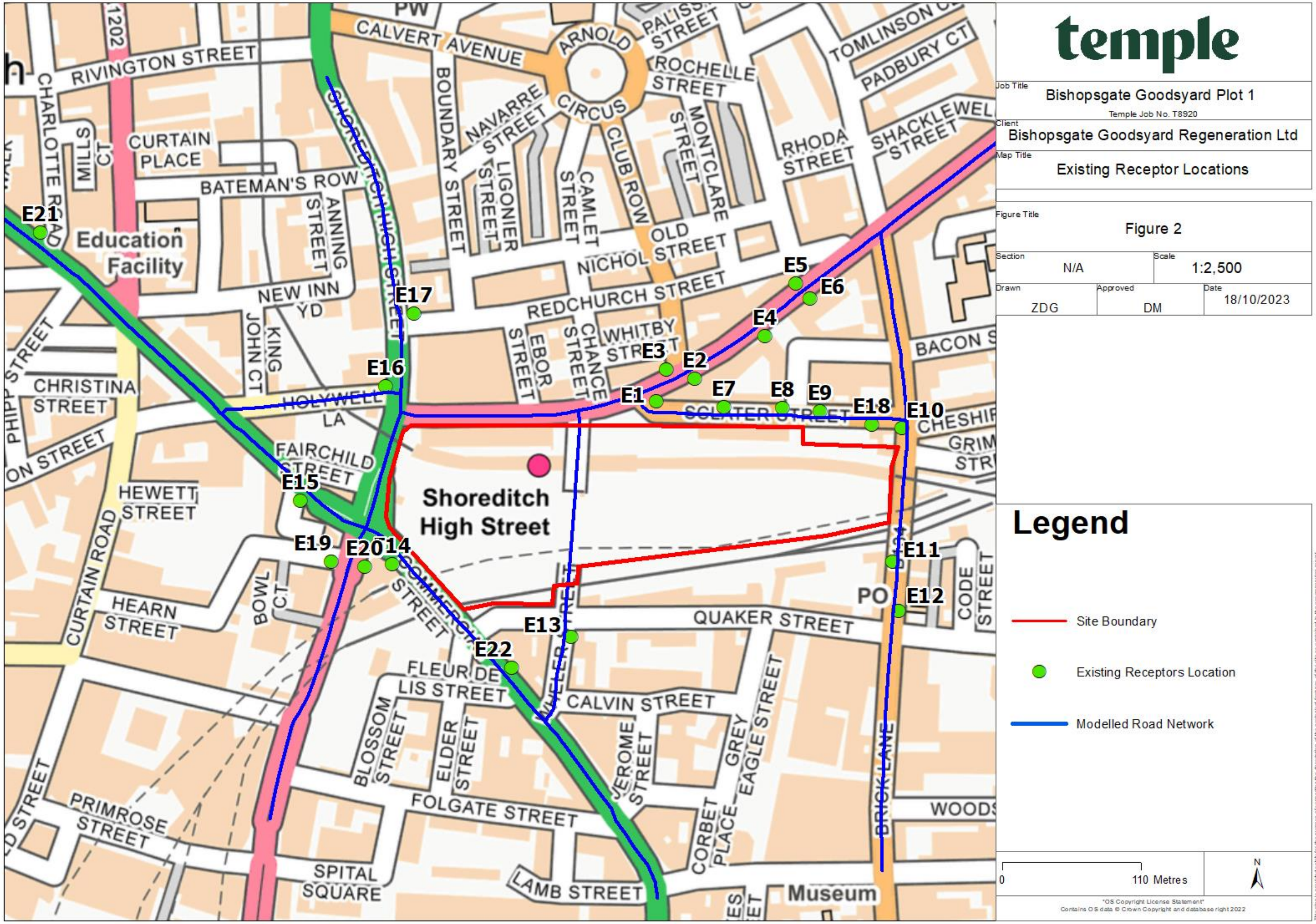
Link Name	S1		S2		S3		S4		S5		Speed (kph)
	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	
Brick Lane (North)	2,266	14.22	2,384	14.22	2,384	14.22	2,493	14.22	2,535	14.63	22 (20 for junction links)
Brick Lane (South)	2,891	20.02	3,042	20.02	3,042	20.02	3,180	20.02	3,341	19.55	22
Holywell Lane	3,940	12.93	4,145	12.93	4,145	12.93	4,334	12.93	4,397	13.04	20

Vehicle Emissions Factors

D.2.7 The ADMS-Roads model assesses the volume of pollutants generated along each stretch of modelled road based on inputted 'emissions factors' (g/km/s). Defra's emissions factors toolkit (2022, 2027 and 2030, as appropriate) was used to determine the emissions of NOx, PM_{10} and $PM_{2.5}$ from operational traffic along the affected links. London (Inner) settings were selected, with reference to the 'Emissions Factors Toolkit v11.0 User Guide.'

The method

Figure D-2: Roads and existing receptors included in the modelling assessment



Modelled Receptors

D.2.8 Sensitive existing human and ecological receptors were selected at a range of locations (including worst-case ones) where members of the public are expected to be present and potentially regularly exposed to air pollutants. In addition. The receptors included are shown in **Table D.3** below.

D.2.9 The assessment has assumed that all human receptors at ground floor level are elevated to 1.5m, to represent the average breathing height for a human.

Table D.3: List of receptors modelled in all scenarios

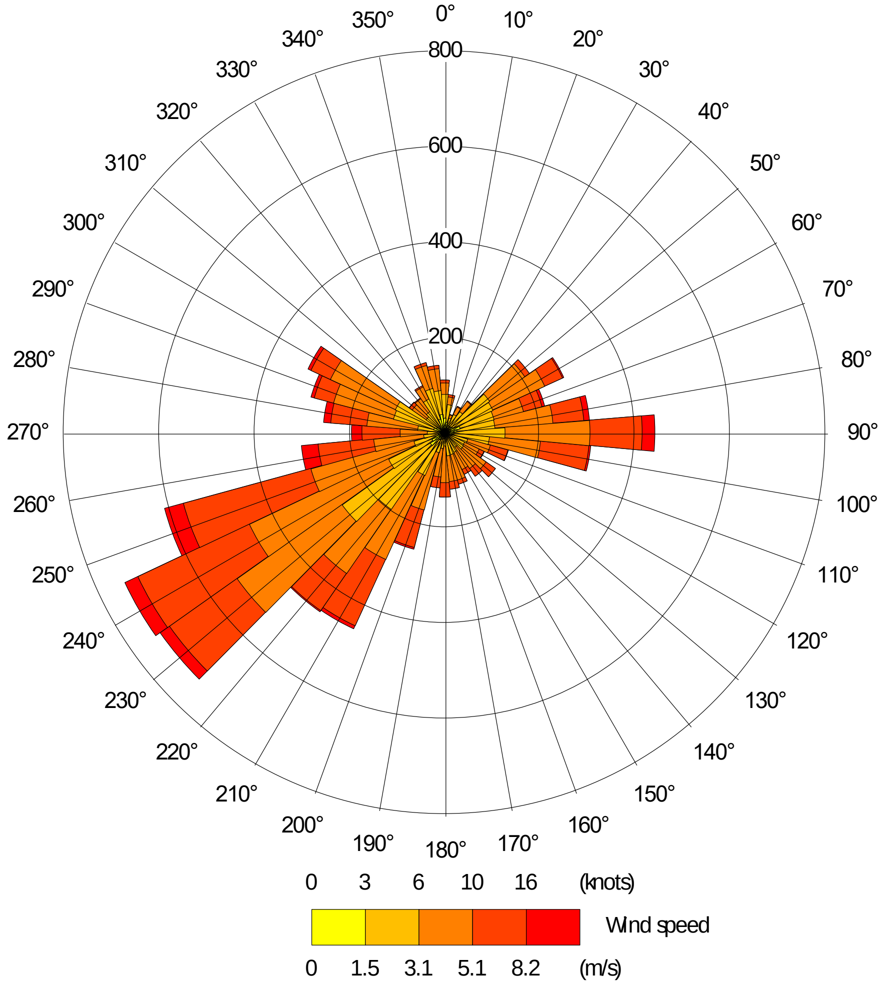
Receptor ID	Receptor Type	X	Y	Z
E1	Existing Sensitive Receptors	533691	182290	1.5
E2		533722	182307	1.5
E3		533699	182315	1.5
E4		533777	182341	1.5
E5		533801	182383	1.5
E6		533813	182371	1.5
E7		533744	182285	1.5
E8		533791	182284	1.5
E9		533821	182282	1.5
E10		533886	182269	1.5
E11		533878	182163	1.5
E12		533883	182124	1.5
E13		533623	182103	1.5
E14		533482	182161	1.5
E15		533409	182211	1.5
E16		533476	182302	1.5
E17		533499	182359	1.5
E18		533862	182271	1.5
E19		533434	182162	1.5
E20		533460	182159	1.5
E21		533203	182423	1.5
E22		533576	182078	1.5

Meteorological data

D.2.10 This study utilised the 2022 year of meteorological data for London City Airport. The wind rose (showing the wind direction and speed) for each year of meteorological data used are set out in **Figure D-3**, below.

D.2.11 The source of the meteorological data was used for consistency with the odour assessment. Data for 2022 was used to enable consistency with the year for which baseline traffic data were provided.

Figure D.3: Wind rose from the London City Airport meteorological station during 2022



Background Concentrations

D.2.12 The total concentration of a pollutant comprises those from the modelled local emission sources and background pollutant concentrations, which are transported into an area by the wind from further away.

D.2.13 The Defra UK-AIR concentration applicable to the assessed year and 1km^2 grid within which each receptor is located has been applied for NOx, PM_{10} and $PM_{2.5}$ background concentrations. It should be noted that Defra's NOx Sector Removal Tool[1] was applied to background NOx concentrations for A-road sectors. This was applied avoid double counting of background NOx values attributable to local A Roads, due to the site and modelled receptors being in close proximity to several A Roads. Additionally, the background NO_2 concentrations utilised for the study area was the 2022 monitored concentration at London Borough of Hackney's urban background monitor, Shoreditch Park (DT 64).

D.2.14 The annual mean NO_2, PM_{10} and $PM_{2.5}$ background concentrations applied (following adjustment) at each of the receptor locations is shown in **Table D.4 (**all receptors are located within the same grid). A worst-case assessment was undertaken where no improvement in background pollutant concentrations was assumed for the future year scenarios. Therefore, all assessment scenarios have utilised 2022 background pollutant concentrations.

Table D.4: 2022 Background annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations applied at modelled receptor locations

Grid square	NO_2	NO_X	PM_{10}	$PM_{2.5}$
533500, 182500	21.0	46.6	19.2	12.2

Summary of additional model inputs

A summary of the additional parameters considered in the dispersion modelling study are outlined in **Table D.5** below.

Table D.5: Summary of additional model input parameters

Parameter	Input into model
Road elevation	No terrain file used.
Road width	Road widths determined based on approximate measurement of roads using online measurement tools.
Canyons	Street canyons were included in the model along Brick Lane, Sclater Street, Bethnal Green Road, Wheler Street, the A1202 and the A10.

[1] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/no2-adjustment-for-nox-sector-removal-tool/.

Parameter	Input into model
Surface roughness	A value of 1.5 (representative of large urban areas) at the dispersion site and 1 (representative of cities and woodlands) at the meteorological site.
Monin-Obukhov length	Assumed to be 100m (representative large conurbations) both at the site and at the meteorological site.

Post-processing of modelled results

D.2.15 At each human receptor, the following method was used to estimate total annual mean pollutant concentrations:

- Modelled road NO_x, PM_{10} and $PM_{2.5}$ concentrations were adjusted (as part of model verification) using the method set out below, as per TG22;
- The road source NO_2 at each receptor was estimated from the modelled NO_x concentration using version 8.1 of the NO_x to NO_2 calculator; and,
- Adjusted annual mean road NO_2, PM_{10} and $PM_{2.5}$ concentrations were added to the applicable background contribution.

D.2.16 According to the EPUK-IAQM guidance, the 24-hour mean PM_{10} AQO will not be exceeded unless the annual mean PM_{10} AQO exceeds ~31µg/m^3. TG22 indicates that exceedances of the hourly mean NO_2 AQO should not be excepted if annual mean NO_2 concentrations are below 60µg/m^3. These criteria have been used to determine whether the Proposed Development is likely to expose human receptors into an area where the relevant short-term AQOs may be exceeded.

Model verification

D.2.17 Model verification refers to checks that are carried out on model performance in relation to roads modelling at a local level. Modelled concentrations are compared with the results of local monitoring and, where there is a disparity between modelled and monitored concentrations, an adjustment may be applied to the final model output.

D.2.18 Model verification for NO_2 was undertaken for this assessment using the 2022 data monitored at the 5 roadside duplicate diffusion tubes sites, obtained via surveys undertaken by Temple, as well as three additional roadside monitoring locations operated by LBH for which 2022 data was available, including the automatic monitoring station HK 006. These monitoring locations were selected as they are located on the nearest 'roadside' locations likely to be impacted by the Proposed Development site.

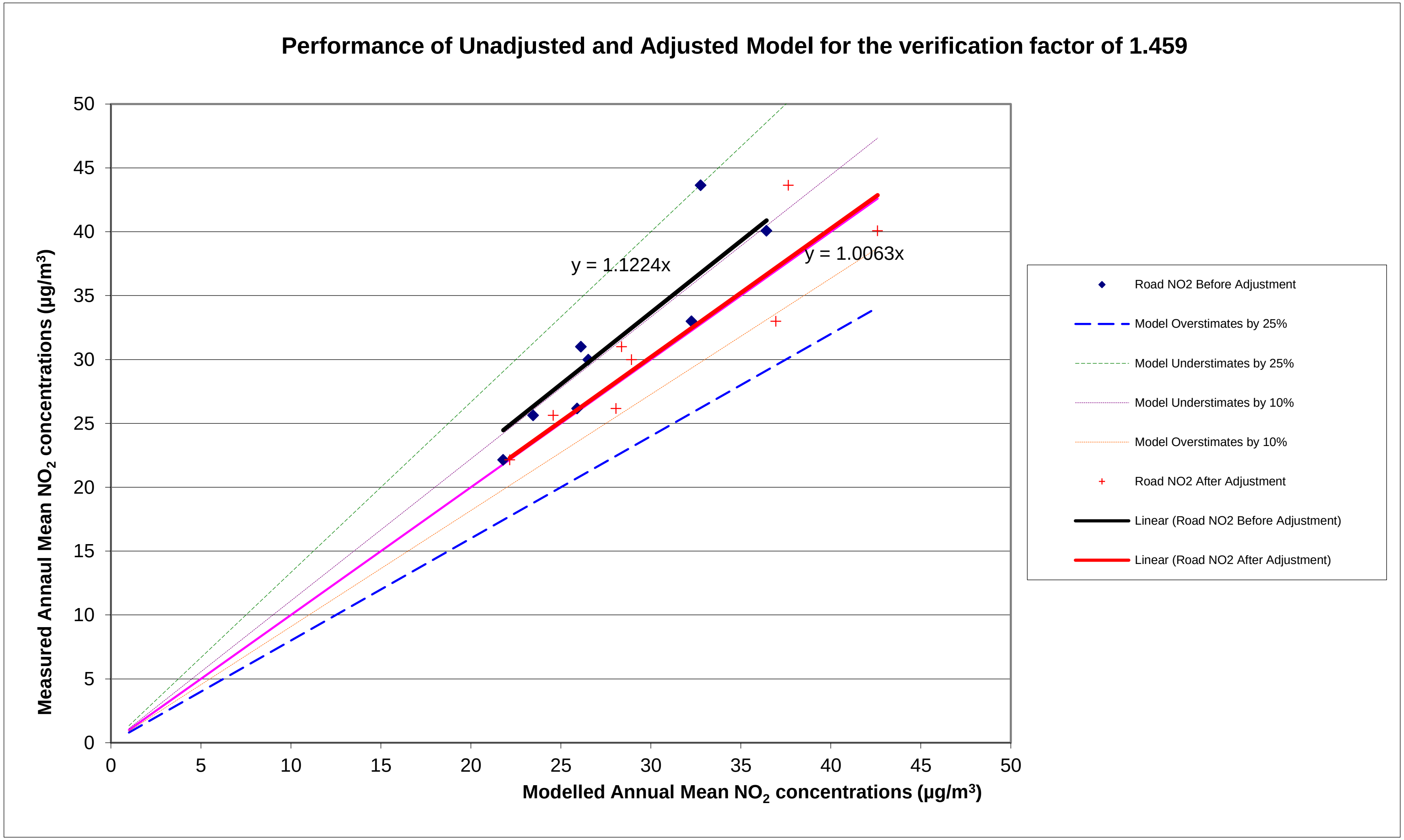
D.2.19 Model verification for PM_{10} and $PM_{2.5}$ was undertaken using the NOx verification factor. This approach is recommended in TG22 where there are no suitable 'roadside' verification sites within the vicinity of the Proposed Development site.

D.2.20 **Table D.6** and **Figure D.4** below summarises the comparison of monitored versus modelled NOx concentrations at the diffusion tube used for model verification and assessment purposes. The monitored road NOx was calculated by converting roadside NO_2 (i.e. monitored NO_2 – background NO_2) to NOx using the latest version of the NOx to NO_2 calculator. The model was identified as underpredicting modelled pollutant concentrations by a factor of 1.459. This adjustment factor was applied to all modelled road concentrations before being combined with background concentrations.

Table D.6: Verification Table for NOx in the study area

Site number	Temple Diffusion Tubes					LBH Monitoring Locations		
	DT1 (Temple)	DT2 (Temple)	DT3 (Temple)	DT4 (Temple)	DT5 (Temple)	27	6	HK 006
Monitored total NO_2 (µg/m^3)	40.1	25.6	22.1	26.2	43.6	30	33	31
Background NO_2 (µg/m^3)	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6
Modelled road contribution NO_X (µg/m^3)	33.98	5.01	1.60	10.11	25.30	11.42	24.14	10.58
Monitored road contribution NO_X (µg/m^3)	43.04	9.53	2.31	10.67	52.34	19.02	25.84	21.27
Monitored NO_X / Modelled NO_X (Correction Factor)	1.459							

Figure D.4: Comparison of modelled and monitored NO_2 after adjustment at model verification locations considered in this assessment



temple

D.2.22 To determine whether the unadjusted modelled NOx concentrations are suitable post-adjustment, the percentage difference between the total modelled NO_2 and total monitored NO_2 at each monitoring site is required to be within 25% or ideally within 10%.

D.2.23 **Table D.7** below compares the percentage difference between the total monitored and modelled NO_2 concentrations, the latter calculated by inputting the modelled road NOx and background NO_2 into the NOx to NO_2 calculator. The average percentage difference and root mean square error (RMSE, which measures the average error or uncertainty in a model, with an ideal value of 0 $\mu g/m^3$) was -0.54% and 2.97 $\mu g/m^3$ respectively.

Table D.7: Comparison of the modelled and monitored annual mean NO_2 concentrations at the verification locations post-adjustment

Monitoring Location	Monitoring Result NO_2	Background NO_X	Background NO_2	Post-adjustment modelled road NO_X	Total modelled NO_2	% difference in monitored vs modelled NO_2
DT1	40.08	46.62	21	49.57	42.60	6.29%
DT2	25.63	46.62	21	7.31	24.57	-4.13%
DT3	22.15	46.62	21	2.34	22.16	0.06%
DT5	26.17	46.62	21	14.76	28.07	7.27%
DT6	43.65	46.62	21	36.92	37.64	-13.76%
27	30.00	46.62	21	16.66	28.93	-3.57%
6	33.00	46.62	21	35.23	36.94	11.94%
HK 006	31.00	56.10	21	15.44	28.38	-8.45%