- Plan site layout: machinery and dust causing activities should be located away from receptors;
- Erect solid screens or barriers around dust activities or the site boundary that are, at least, as high as any stockpiles on site;
- Fully enclosure site or specific operations where there is a high potential for dust production and the site is active for an extensive period;
- Avoid site runoff of water or mud;
- Keep site fencing, barriers and scaffolding clean using wet methods;
- Remove materials from site as soon as possible;
- Cover, seed or fence stockpiles to prevent wind whipping;
- Agree monitoring locations with the Local Authority;
- Where possible, commence baseline monitoring at least three months before phase begins; and
- Put in place real-time dust and air quality pollutant monitors across the site and ensure they are checked regularly.

Operating Vehicle/ Machinery and Sustainable Travel

- Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone;
- The use of appropriate technology is considered the most effective way of achieving a reduction in NRMM emissions. - Ensure all NRMM comply with the standards set within the guidance;
- Ensure all vehicles switch off engines when stationary – no idling vehicles;
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where possible;
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; and
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).

Operating Vehicle/ Machinery and Sustainable Travel

- Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone;
- Ensure all non-road mobile machinery (NRMM) comply with the standards set within this guidance;
- Ensure all vehicles switch off engines when stationary – no idling vehicles;
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where possible;
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; and
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems;
- Ensure an adequate water supply on the site for effective dust/particulate matter mitigation (using recycled water where possible);
- Use enclosed chutes, conveyors and covered skips;
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate; and
- Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- Reuse and recycle waste to reduce dust from waste materials; and
- Avoid bonfires and burning of waste materials.

Measures Specific to Demolition

- Ensure water suppression is used during demolition operations;
- Avoid explosive blasting, using appropriate manual or mechanical alternatives; and
- Bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Construction

- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.

Measures Specific to Trackout

- Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site;
- Avoid dry sweeping of large areas;
- Ensure vehicles entering and leaving sites are securely covered to prevent escape of materials during transport;
- Record all inspections of haul routes and any subsequent action in a site log book;
- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems and regularly cleaned;
- Inspect haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable;
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable);
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits; and
- Access gates to be located at least 10 metres from receptors where possible.

A Construction Management Plan (CMP) will identify the potential impacts of the construction phase of the development and state how any potential negative impacts will be mitigated. The developer will provide the CMP to demonstrate how a development will minimise impacts from the movement of goods and materials during the construction process. The CMP will specify the hours of site activity; pick-up and delivery times for materials and equipment; limits on construction vehicle size; trip numbers and routes; the safety of road users during construction; and any temporary use of the highway for siting of construction plant. It will also address any temporary disruption or severance of highway links needed during the development process, as well as any other relevant measures needed to effectively manage the construction phase impacts.

Ensuring the use of established good site management practices including the above proposed measures should effectively control and minimise dust generation. Mitigation measures to control dust during demolition and construction should be specified within contractor documentation, such as the AQDMP.

To ensure successful dust mitigation, it will be essential that the contractor actively plans, manages and inspects application of controls on a regular basis. Site personnel need to be appropriately trained. The process by which dust control measures are implemented should be documented and roles and responsibilities clearly assigned. The developer and contractor are to actively monitor the Site to ensure the control of dust and emission. A log of all inspections shall be maintained at the site office.

5. Operational Effects

The proposed development is expected to be occupied by the end of 2017. Once operational, the traffic generated by the proposed development and emissions from on-site gas boilers could have an effect on local pollution concentrations. Furthermore, the LBC EHO is concerned that a new residential development could introduce sensitive receptors into an existing area of poor air quality. As agreed with the LBC, a detailed air quality assessment has been carried out, which includes modelling of pollutant concentrations at the Site for the future opening year, comparing concentrations without the development and with the development.

The requirement for undertaking an air quality assessment for the development was based on recommendations in the EPUK Development Control guidance[17]; this states that the decision should take into account the sensitivity of the area. In this case, the proposed site is within an AQMA, a highly sensitive area with roadside NO_2 concentrations above the AQS annual mean objective for NO_2. In accordance with EPUK guidance and DEFRA's technical guidance, LAQM.TG(09), a quantitative assessment using a detailed dispersion model has been undertaken (Sections 5.1 – 5.5).

Furthermore, the proposed development falls under the air quality neutral policy highlighted in the London Plan and the 'Sustainable Design and Construction' SPG2. As such, an 'Air Quality Neutral' Assessment has been carried out (Section 5.6), in line with guidance provided in the SPG on Sustainable Design and Construction, and the accompanying Air Quality Neutral Planning Support Update report[18].

5.1 Model Methodology

Dispersion modelling software ADMS Roads (version 3.2.4) was used to determine pollutant concentrations at the development site for the opening year (2017) with and without the development. Base year (2013) modelling was also carried out for the purposes of model verification.

The ADMS-Roads model uses traffic data (vehicle flows, speed and proportion of heavy duty vehicles), vehicle pollutant emission rates[34], geographical information on road layout and meteorological data to estimate the concentrations of the pollutants NO_2 and PM_{10}. The model generates estimates of annual mean pollutant concentrations at selected receptors at representative heights above ground level. These concentrations are then compared with the relevant long-term and short-term air quality criteria, taking account of background concentrations.

The boundary of an AQMA does not necessarily define the limit of the area of exceeding air quality criteria. The key aim of the air quality assessment was therefore to examine concentrations of pollutants at the building façade at increasing height and distance from the road edge to determine the extent to which the air quality criteria may or may not be exceeded at the development site. On this basis, the need for further mitigation in order to prevent new receptors from being exposed to concentrations above air quality objectives can be determined.

In order to verify model performance, the modelled baseline concentrations were compared with available monitoring data from the local authority.

5.2 Model Inputs and Assumptions

Receptors

Four discrete sensitive receptor points were selected for assessment within the development site itself, representing each corner of the Site:

- North west corner (rear of development),
- South west corner (western facade of 44 Gloucester Avenue),
- North east corner (rear of development), and

[34] The latest updated Emissions Factors Toolkit (Version EFTv6.0.2) has been used and updated emission factors applied to the model: http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#eft

- South east corner (eastern facade of 44 Gloucester Avenue- the existing domestic property).

Receptors were also modelled at different heights above ground. The ground floor receptors at each corner were modelled at a height of 1.5m (breathing height); and each floor above that as relevant at each corner:

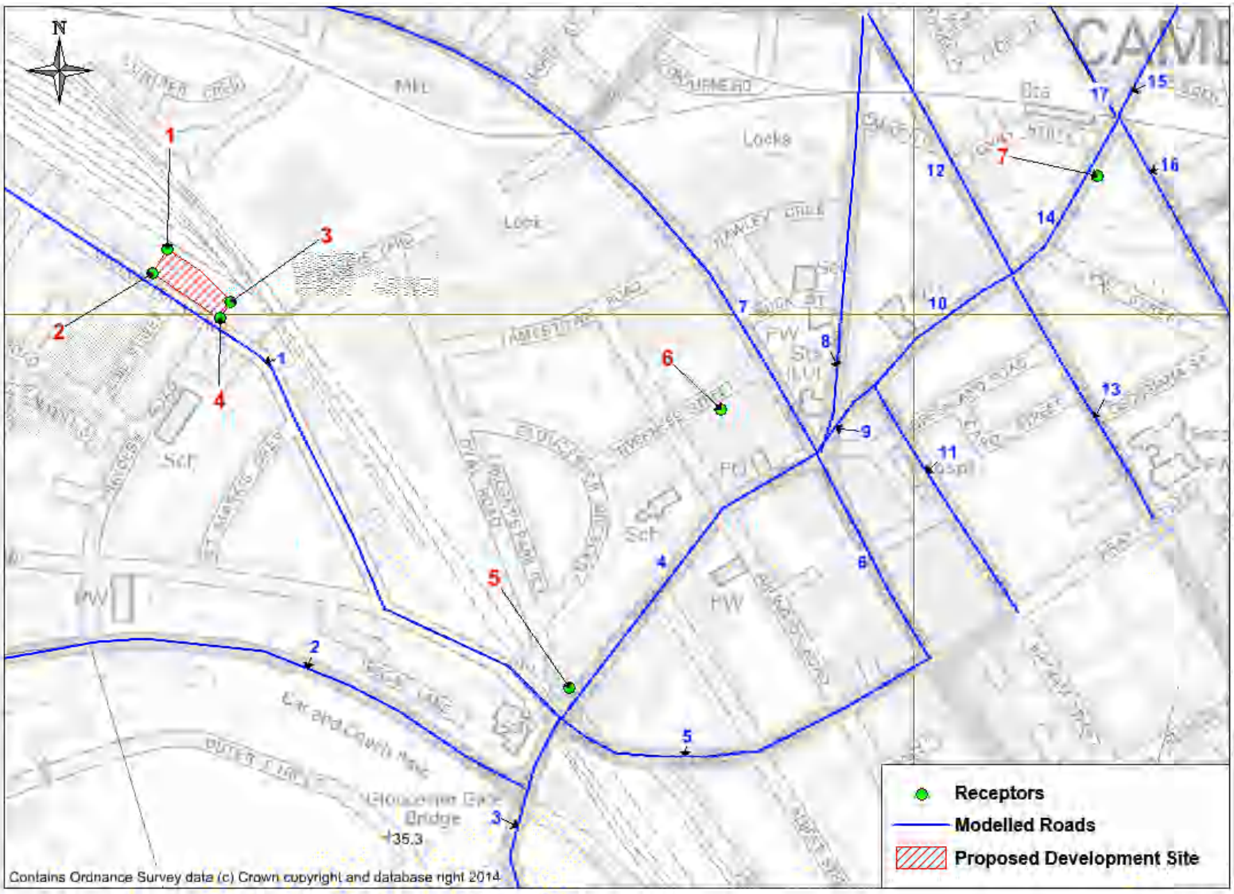
- 4.5m - 1st floor (top floor of the SE corner)
- 8.0m - 2nd floor,
- 11.5m - 3rd floor (top floor of the NE and SW corners),
- 15.0m - 4th floor, and
- 18.5m - 5th floor (top floor of the NW corner).

Only one local authority monitoring site is located within one kilometre of the site boundary; the CA23 diffusion tube. The sites CA18 and CA19 are no longer used but were also included as receptors to assist in interpreting model performance. Receptor locations and heights are provided in Table 11 and illustrated in Figure 4.

Table 11. **Model Receptors and Locations**

ID	Receptor Name	Grid Reference		Floor	Height (m)
		Easting	Northing		
1	**44 Gloucester Ave - NW Corner – ground floor**	**528288**	**184060**	**Ground**	**1.5**
1.1	*NW Corner- 1st floor*	*528288*	*184060*	*1st*	*4.5*
1.2	*NW Corner- 2nd floor*	*528288*	*184060*	*2nd*	*8.0*
1.3	*NW Corner- 3rd floor*	*528288*	*184060*	*3rd*	*11.5*
1.4	*NW Corner- 4th floor*	*528288*	*184060*	*4th*	*15.0*
1.5	*NW Corner- 5th floor*	*528288*	*184060*	*5th*	*18.5*
2	**44 Gloucester Ave - SW Corner – ground floor**	**528274**	**184038**	**Ground**	**1.5**
2.1	*SW Corner- 1st floor*	*528274*	*184038*	*1st*	*4.5*
2.2	*SW Corner- 2nd floor*	*528274*	*184038*	*2nd*	*8.0*
2.3	*SW Corner- 3rd floor*	*528274*	*184038*	*3rd*	*11.5*
3	**44 Gloucester Ave - NE Corner – ground floor**	**528349**	**184011**	**Ground**	**1.5**
3.1	*NE Corner- 1st floor*	*528349*	*184011*	*1st*	*4.5*
3.2	*NE Corner- 2nd floor*	*528349*	*184011*	*2nd*	*8.0*
3.3	*NE Corner- 3rd floor*	*528349*	*184011*	*3rd*	*11.5*
4	**44 Gloucester Ave - SE Corner – ground floor**	***528338***	***183995***	**Ground**	**1.5**
4.1	*SE Corner- 1st floor*	*528338*	*183995*	*1st*	*4.5*
	Monitoring sites				
5	CA18 Diffusion Tube	528672	183642	-	2.5
6	CA19 Diffusion Tube	528815	183909	-	2.5
7	CA23 Diffusion Tube	529173	184129	-	2.5

Figure 4: Modelled Receptor Locations



Traffic Data

Annual Average Daily Traffic (AADT) flows (24 hour) and percentages of heavy duty vehicles (HDVs) for the for main roads within 200 metres of the proposed development and nearby monitoring sites were obtained for the year 2013, the base year used to verify model performance.

Although not considered a main road due the low volume of traffic carried, Gloucester Avenue was also included in the model due to its proximity to the Site. Data for Gloucester Avenue were provided by SLR Consulting, the traffic consultants responsible for producing the Transport Statement for the proposal. The measurement data were derived from a traffic count survey carried out on Gloucester Avenue for two weeks in December 2014. These data were back-calculated by SLR Consulting to provide an estimated flow in 2013 for modelling purposes. As well as vehicle flow and composition, the average speed was also provided.

Data for all other roads were obtained from the Department for Transport (DfT) website[35] which provides street-level data for every junction-to-junction link on the 'A' road and motorway network in Britain.

The geometry of links was determined from scaled, digital Ordnance Survey base mapping.

Despite the fact that the DfT traffic counts indicate that flows have decreased over recent years, a low growth factor has been applied to estimate flows in the anticipated opening year of 2017. A factor of 1.048 for principal and 1.046 for minor roads was used, as provided by SLR Consulting[36].

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[35] Department for Transport Traffic Counts: http://www.dft.gov.uk/traffic-counts/
[36] The NTM 09 database of the Trip End Modal Presentation Program (TEMPro) was used by SLR to derive the growth factors.

The measured average speed of 15 kph was applied on Gloucester Avenue, while the average traffic speed of 18 kph for Inner London during PM peak hours[37] was assumed for all other road links included in the model. This provides a worst-case scenario, as it is the slowest time period reported, which will result in highest exhaust emissions.

The additional traffic generated by the proposal is estimated to be 102 vehicles as a two way flow per day. The traffic associated with the development is considered to be additive to future year traffic flows. This estimate does not take into account the traffic generation potential of the existing site which could in fact generate more traffic in 2017 hence in theory there should be a net reduction in vehicle movements with the development in 2017 due to the traffic management measures incorporated in the design. The additional development traffic has been conservatively added to each road link modelled in the opening year scenario i.e. links 1 to 7 (links 8 to 17 are only included for the baseline scenario for the purposes of model verification).

The traffic data for the baseline (2013) and opening year (2017) without and with the development are presented in Table 12.

Table 12. **Traffic data used in the assessment**

ID	Road Link Description	Speed kph	2013 Baseline		2017 Without Development		2017 With Development	
			AADT	%HDV	AADT	%HDV	AADT	%HDV
1	Gloucester Avenue	15	1,316	1.9	1,377	1.9	1,479	1.8
2	Prince Albert Road (A5202)	18	18,187	5.0	19,064	5.0	19,166	5.0
3	Parkway (A4201), South of Delancey Street	18	10,798	3.7	11,319	3.7	11,421	3.6
4	Parkway (A4201), North of Delancey Street	18	14,630	3.6	15,336	3.6	15,438	3.5
5	Delancey Street (A503)	18	10,919	3.6	11,446	3.6	11,548	3.6
6	Camden High Street (A400)	18	12,828	4.4	13,447	4.4	13,549	4.4
7	Chalk Farm Road (A502)	18	8,129	4.3	8,521	4.3	8,623	4.3
8	Kentish Town Road (A400)	18	6,980	4.5	-	-	-	-
9	Camden Road (A503) South of Bayham Street	18	16,504	4.0	-	-	-	-
10	Camden Road (A503) North of Bayham Street	18	23,348	3.5	-	-	-	-
11	Bayham Street (A503)	18	15,180	4.0	-	-	-	-
12	Camden Street (A400) North of Camden Road	18	17,456	3.6	-	-	-	-
13	Camden Street (A400) South of Camden Road	18	14,436	6.0	-	-	-	-
14	Camden Road (A503) South of Royal Collage Street	18	29,407	4.3	-	-	-	-
15	Camden Road (A503) North of Royal Collage Street	18	29,755	3.7	-	-	-	-
16	Royal Collage Street (A5202)	18	10,783	3.4	-	-	-	-
17	A5202 North of Camden Road	18	5,516	3.8	-	-	-	-

Meteorology

Hourly sequential meteorological data from the London City Airport meteorological station for the year 2013 were used in the modelling study, as this is the baseline year chosen for the study. The station is located 14.7 km east south east of the Site and is considered to be representative.

[37] Mayor of London's Travel in London Report 7, Transport for London 2014. http://www.tfl.gov.uk/corporate/publications-and-reports/travel-in-london-reports

The meteorological data used in the model include: date, time, wind direction (angle wind blowing from), wind speed (in metres per second), surface air temperature (degrees Celsius), and cloud cover (in oktas – or eighths of sky covered).

The surface roughness at both the development site and the London City meteorological station was set at one metre, corresponding to the 'cities and woodland' option in ADMS. This is generally representative of the surroundings at both locations.

A minimum Monin-Obukhov length was set to reasonably limit the occurrence of very stable atmospheric conditions. In this case it was defined as 100 metres within the development area and weather station which is broadly representative of urban areas.

Background

The modelling provides an estimate of the contribution of a road to pollutant concentrations; it does not take into account the background concentrations, which are composed of contributions from minor roads, diesel rail, domestic combustion, etc. A background contribution must hence be added to the road contribution to give a total pollutant concentration for comparison with air quality criteria.

In the absence of ambient measurements at a true "background" location in the immediate vicinity of the Site, estimates of background concentrations were taken from the UK-Air websitefor each of the one kilometre grid squares encompassing the modelled receptors. A comparison was made in Section 3.4 between the 2013 concentrations measured at the nearest urban background site and the background mapped concentrations at the same location. The comparison indicated that the mapped background agreed well with the CMS data, hence the use of mapped values in the assessment in lieu of any measurement data is considered to be an acceptable approach. Furthermore, the mapped data will include the specific contribution from the railway adjacent to the Site.

The annual mean background concentrations for the relevant pollutants and assessment years, for the grid squares containing the receptor sites, are presented in Table 13. Background concentrations are assumed in the DEFRA mapping methodology to decrease over time; such a trend is not, however, clearly evident from local diffusion tube monitoring data and hence a sensitivity test has also been carried out (see Section 5.3 below).

Table 13. **2013 Mapped Background Concentrations Used in Assessment (µg/m^3)**

Pollutant	528500, 184500 (Receptors 1-3)		528500, 183,500 (Receptor 4-6)		529,500, 184,500 (Receptor 7)	
	2013	2017	2013	2017	2013	2017
Oxides of nitrogen	56.8	49.2	58.4	50.6	60.6	52.5
Nitrogen dioxide	34.4	30.5	35.3	31.2	36.3	32.1
PM_{10}	23.3	22.2	23.3	22.1	24.1	22.9
$PM_{2.5}$	16	15	16	14.9	16.4	15.3

Conversion of NO_x to NO_2

Vehicle emissions of NO_x are mostly (80 - 90%) released in the form of NO, which is oxidised in the atmosphere to NO_2 in a series of complex chemical reactions. To derive total NO_2 concentrations from the modelled road NO_x concentrations (and hence to allow a comparison with the air quality criteria) the 'Abbott method' described in DEFRA's LAQM.TG(09) was used. The total annual mean NO_2 is calculated from the modelled road NO_x and background NO_2. The conversion was carried out using the DEFRA supported 'NO_x to NO_2' updated tool - Version 4.1[38]. The updated tool released in June 2014 can be used for years 2008 to 2030 and should only be used with the 2011 based background maps and the new Emission Factor Toolkit (v6).

[38] DEFRA's NO_x and NO_2 calculator, Version 4.1, 19 June 2014, http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html

In addition to the modelled road NO_x and background NO_2 data the NO_x to NO_2 conversion spreadsheet requires the local authority to be specified in order to determine regional oxidant concentrations, and a traffic mix, to determine the proportion of primary NO_2. The local authority selected was Camden and the traffic mix used was "All London Traffic".

PM_{10} 24-hour Mean Air Quality Objective

Annual mean PM_{10} concentrations were used to estimate the number of 24-hour exceedances of the AQS objective using the method described in LAQM.TG(09). This method shows the relationship between the number of 24-hour exceedances of 50 µg/m^3 and the annual mean to be as follows:

Number of exceedances of 24-hour mean of 50 µg/m^3	=	-18.5 + 0.00145 * annual mean^3 + 206/annual mean

5.3 Sensitivity Test

Research published by DEFRA in 2011 examining trends in NO_x and NO_2 in ambient air[39] indicated that concentrations may not be declining at the rates previously anticipated by the Government. This means that future year NO_x emission factors and background estimates may be overly optimistic. The use in this assessment of the latest vehicle emissions factors and the related DEFRA tools published in June 2014 addresses some of these issues; however it is considered good practice to include a sensitivity test to address uncertainty over future trends in background concentrations, particularly where there is a risk that the air quality objective for NO_2 may be exceeded[40].

An overall decreasing trend in local concentrations of NO_2 is not evident, and therefore a 'no background concentration reduction' sensitivity test has been undertaken. This sensitivity test uses 2013 background concentrations to determine total concentrations in the 2017 in the 'with development' scenario, but assumes vehicle emission rates will continue to improve over time.

5.4 Model Verification

Model verification is the process of comparing modelled results with measured data in order to determine the accuracy and performance of the model. The process involves modelling concentrations at the location of a monitoring site and then comparing the modelled and measured results. Model verification should preferably be focused on the element that is actually modelled, and not the final post-processed result. Thus the unit for use in verification should ideally be the roads-contributed concentrations, compared to a roadside CMS measurement. Having multiple sites at which to verify results rather than just one continuous monitor increases the value gained from the exercise.

There are no continuous monitoring sites within the modelling study area and only one active diffusion tube site within a kilometre of the Site. Adjustment of model results is not recommended by DEFRA's LAQM.TG(09) with only one diffusion tube, particularly not when the measurement site is not representative of concentrations expected at the modelled location.

The 2013 modelled and monitored total NO_2 at the diffusion tube site still operational (CA23) are nonetheless presented in Table 14. The results indicate that the model is under performing by 30% and therefore underestimating NO_2 results at that location.

Two additional diffusion tubes were included in the model for comparison, although monitoring data are only available up to 2010. The 2010 measured data for all three diffusion tubes are compared to modelled data as a

[39] DEFRA's 'Trends in NO_x and NO_2 emissions and ambient measurements in the UK', July 2011, http://uk-air.defra.gov.uk/reports/cat05/1108251149_110718_AQ0724_Final_report.pdf
[40] Bureau Veritas, April 2012, LAQM 'Note on Projecting NO_2 concentrations', Produced for DEFRA, http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

model verification exercise in Table 14. The results further indicate that the model is under performing at the roadside locations, however the performance is better at C18 and C19. It should be noted the 2013 modelled estimates use data for 2013, however although traffic flows are expected to have decreased slightly in recent years this is unlikely to have materially affected the comparison.

Modelled total NO_2 within 25% of the monitored total NO_2 is stated as acceptable in DEFRA LAQM TG(09) guidance. The model performance at sites C18 and C19 is in line with this guideline. However, with data available for only one diffusion tube site in 2013, and since the development site is considered to be an urban background rather than a roadside location, the model performance at the roadside site is less relevant to this background site and adjustment of model results has not been carried out. The potential for model underestimation is recognised, and this may be due to a lower than actual background component. Given this possibility, the sensitivity test for the year 2017 is of additional importance.

Table 14. **Comparison of Modelled and Measured Total NO_2 Concentrations at Diffusion Tube Locations**

Site ID and Name	Modelled total NO_2 ($\mu g/m^3$)	Monitored total NO_2 ($\mu g/m^3$)	Difference
2013 DT measured data compared with 2013 modelled total (using 2013 background)			
7 – CA23	54.3	77.9	-30%
2010 DT measured data compared with 2013 modelled total (using 2010 background)			
5 – CA18	46.4	63.0	-26%
6 – CA19	41.7	55.0	-24%
7 – CA23	57.2	84.0	-32%

5.5 Model Assessment Results

This section presents the results from the local air quality assessment for NO_2, PM_{10} and $PM_{2.5}$ for the opening year 2017. Only the results with the development are presented, as there was found to be an imperceptible change (<0.1 $\mu g/m^3$) due to the additional development traffic.

Estimated NO_2 concentrations at receptors are presented in Table 15 while estimated PM_{10} and $PM_{2.5}$ are presented in Table 16. The findings of the sensitivity test for NO_2 (i.e. assuming no change in background NO_2) are also presented in Table 15.

Table 15. **Annual Mean NO_2 Concentrations ($\mu g/m^3$) at Modelled Receptors in Opening Year**

ID	Receptor Name	2017 With Development	2017 Sensitivity test
1	NW Corner – ground floor	31.0	35.0
1.1	*NW Corner- 1st floor*	31.0	34.9
1.2	*NW Corner- 2nd floor*	30.9	34.9
1.3	*NW Corner- 3rd floor*	30.9	34.8
1.4	*NW Corner- 4th floor*	30.8	34.8
1.5	*NW Corner- 5th floor*	30.8	34.7
2	SW Corner – ground floor	31.5	35.5
2.1	*SW Corner- 1st floor*	31.2	35.1
2.2	*SW Corner- 2nd floor*	31.0	34.9
2.3	*SW Corner- 3rd floor*	30.9	34.8
3	NE Corner – ground floor	31.2	35.1
3.1	*NE Corner- 1st floor*	31.1	35.1
3.2	*NE Corner- 2nd floor*	31.0	35.0

ID	Receptor Name	2017 With Development	2017 Sensitivity test
3.3	*NE Corner- 3rd floor*	31.0	34.9
4	SE Corner – ground floor	32.4	36.5
4.1	*SE Corner- 1st floor*	32.0	36.0

Table 16. **Annual Mean PM_{10} and $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Modelled Receptors in Opening Year**

ID	Receptor Name	PM_{10}	$PM_{2.5}$
		2017 With Development	2017 With Development
1	NW Corner – ground floor	22.3	15.0
1.1	*NW Corner- 1st floor*	22.3	15.0
1.2	*NW Corner- 2nd floor*	22.2	15.0
1.3	*NW Corner- 3rd floor*	22.2	15.0
1.4	*NW Corner- 4th floor*	22.2	15.0
1.5	*NW Corner- 5th floor*	22.2	15.0
2	SW Corner – ground floor	22.3	15.0
2.1	*SW Corner- 1st floor*	22.3	15.0
2.2	*SW Corner- 2nd floor*	22.3	15.0
2.3	*SW Corner- 3rd floor*	22.2	15.0
3	NE Corner – ground floor	22.3	15.0
3.1	*NE Corner- 1st floor*	22.3	15.0
3.2	*NE Corner- 2nd floor*	22.3	15.0
3.3	*NE Corner- 3rd floor*	22.3	15.0
4	SE Corner – ground floor	22.3	15.1
4.1	*SE Corner- 1st floor*	22.2	15.0

Estimated concentrations for all modelled pollutants are below their AQS objectives at all sensitive receptors in the opening year, 2017. Total NO_2 concentrations range between 30.8 and 32.4 $\mu g/m^3$ at all receptors, comfortably below the AQS objective for the annual mean. The highest concentrations are found at ground floor level at the south east corner of the development. This is due to this location being closest to modelled roads, as would be expected. The AQS criteria for the 1-hour mean concentration is not expected to be exceeded as concentrations are well below 60 $\mu g/m^3$.

Estimates of annual mean PM_{10} and $PM_{2.5}$ concentrations are in the range of 22.2 to 22.3 $\mu g/m^3$ and 15.1 to 15.0 $\mu g/m^3$ respectively at all receptors in the opening year. The estimated number of days exceeding the 24-hour mean standard of 50 ug/m^3 was calculated to be up to 7 days at any site in 2017. The AQS criteria for both the annual mean and the 24-hour mean concentration are therefore not expected to be exceeded.

All receptors are estimated to have an "imperceptible" magnitude of change in modelled concentrations (<0.1 $\mu g/m^3$) in the opening year. The significance of the increase in concentrations at all receptors is classed as "negligible" according to the EPUK criteria. On this basis the effect of the development traffic on pollutant concentrations is considered to be negligible.

Concentrations decrease with height, as distance from the road source increases. The greatest reduction is 0.6 $\mu g/m^3$ for annual mean NO_2 and 0.1 $\mu g/m^3$ for annual mean PM_{10}, which occurs from the ground floor to the top floor (3rd) at the SW corner (receptor 2). The lowest concentration modelled at any receptor was at receptor 1 (4th and 5th floors of the NW corner) in 2017: 30.8 $\mu g/m^3$ for annual mean NO_2 (assuming background reduction) and 22.2 $\mu g/m^3$ for annual mean PM_{10}. These concentrations are just 0.3 $\mu g/m^3$ and <0.1 $\mu g/m^3$ respectively above their background component (30.5 $\mu g/m^3$ and 22.2 $\mu g/m^3$), indicating that road traffic emissions still slightly affect concentrations even at this height above ground.

The results of the sensitivity test in Table 15 show that, if no improvement in background air quality is assumed between the year 2013 and 2017, annual mean NO_2 concentrations are to be approximately 4 µg/m^3 higher at each location. Total concentrations will, however, continue to be below the AQS objective of 40 µg/m^3. The highest result was modelled at the SE corner ground floor receptor (the two-storey residential property), at 36.5 µg/m^3.

The limited model verification exercise suggested that the model may be underestimating existing conditions in the base year, at roadside locations. It should be noted that when only one diffusion tube result is available for verification any such interpretation should be applied with caution. The modelling study has recognised this and whilst a correction factor has not been applied, robust assumptions have been included in the traffic data for the model. A sensitivity test assuming no improvement in current conditions has shown that the AQS objective for NO_2 will be met at the Site in 2017, even at ground floor receptors.

5.6 Model Uncertainty

Any dispersion model has inherent areas of cumulative uncertainty, which may include:

- Traffic flow data;
- Appropriateness of emissions data;
- Simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere;
- Suitability of background concentrations; and
- Selection of meteorological data.

The uncertainties associated with traffic data have been minimised by using robust assumptions where traffic data was not available for local roads. These include using a peak hour average speed on A-roads) and assuming increasing flows to 2017 despite observed trends suggesting the opposite.

Uncertainty associated with emissions data has been minimised by using the most recent published data in EFT version 6.0.2 (November 2014), rather than the dataset that is incorporated within the ADMS Roads model or that in the DMRB screening tool, which has not yet been updated since 2007.

Uncertainties associated with model algorithms and empirical relationships have been minimised by using a detailed dispersion model incorporating algorithms and relationships that have been independently validated and judged as fit for purpose, rather than a simple screening method such as the DMRB.

Uncertainty associated with background data has been minimised by using the most recently published and updated background maps based from DEFRA which are based on 2011 monitoring data and which were found to agree well with measurements at a CMS in LBC. Furthermore, a sensitivity test for NO_2 assuming no reduction in background concentrations has been carried out as a conservative assumption for the proposed development opening year.

With regard to using historical meteorological data to estimate future concentrations, the key limiting assumption is that conditions in the future will be the same as in the past; however, in reality no two years are - or will be - the same. DEFRA guidance note LAQM.TG(09) reviews a number of studies examining inter-annual variability of meteorological data and the effect on dispersion model output; it is suggested that variability in source contribution should be no more than 30% between any two years.

5.7 'Air Quality Neutral' Assessment

The approach used in the Air Quality Neutral Assessment is to compare the expected emissions from the building heating and energy use and the transport use associated with the new development, against defined emissions benchmarks for building and transport in London. These benchmarks are referred to as the "Building Emissions Benchmarks" (BEBs) and the "Transport Emission Benchmarks" (TEBs). To achieve compliance with the air quality neutral policy, the development must demonstrate that the building and transport emissions would achieve the benchmark.

Building Use Emissions

London BEBs for different land-use categories are provided in the 'Air Quality Neutral Support Update' (AQC, 2014)[18]. Specific BEBs for developments are based on land-use category and gross internal floor area (GIA) of development. The calculation of total BEBs for the proposed development is presented in Table 17.

In order to assess against the BEBs, it is necessary to combine the expected on-site emissions of NO_x and PM_{10} associated with the building use. This is calculated from the energy, oil and fuel use and site specific emission factors.

The proposed development will receive its heat and energy supply from a combination of photovoltaics (PV), air source heat pumps (ASHP) and individual boilers in each of the 40 residential flats. The PV and ASHP will run independently of the gas boilers and will have no direct impact on the building emissions for assessment purposes. NO_x emission factors for the boilers will meet CSH/BREEAM Ultra-Low NO_x standard (<40mg/kWh) in accordance with the policy outlined in the Sustainable Design and Construction SPG. The total annual power consumption of the boilers will be 344,177 kWh. As the boilers will be fuelled by natural gas, rather than oil or solid fuel, only emissions of NO_x are calculated. The Development Building Emission is hence calculated to be 13.8 kg/yr for NO_x (Table 18), well within the development benchmarks of 126.9 kg/yr for NO_x (Table 17).

The proposed development is thus deemed to be "air quality neutral" in terms of building emissions and will comply with the Sustainable Design and Construction SPG in terms of the minimum emission standards for NO_x and PM_{10}.

Table 17. **Calculation of Development-Specific BEBs**

Land Use	GIA (m^2)	London NO_x BEB ($g/m^2/yr$)	London PM_{10} BEB ($g/m^2/yr$)	Total NO_x BEB (kg/yr)	Total PM_{10} BEB (kg/yr)
Source	**Developer Plans**	**Appendix 5 of the SPG**[2]		**=GIA*London BEB/ 1000**	
B1 (offices)	698	30.8	1.8	21.5	1.2
C3 (residential)	4,022	26.2	2.3	105.4	9.2
Total				**126.9**	10.4

Table 18. **Calculation of Development Building Emissions**

Energy	No. Boilers	Output (kW)	Energy Use (kWh/ annum/ boiler)	NO_x EF (kg/kWh)	Total NO_x Emissions (kg/yr)
	Developer Plans				**=No. Boilers x Energy Use x EF**
Boiler	40	<40	8,604	0.000040	13.8
Total					**13.8**

Transport Emissions

London TEBs for each zone (Central, Inner and Outer) and land-use category, are provided in the Sustainable Design and Construction, SPG[2]. Development-specific TEBs are based on land-class category, size (area or number of dwellings) and emissions per year. The calculation of the total TEBs for the proposal is presented in Table 19.

In order to assess against the TEBs, it is necessary to combine the expected trip generation from the development with estimates of average trip length and average emission per vehicle. For the purposes of the air quality neutral calculation, it is assumed that half of the 17 parking spaces will be used by residents and the other half by office workers. Each space will generate three vehicle trips daily as indicated in the Transport Statement[41]. The four electrically supplied spaces will not contribute to emissions and have therefore not been included in the calculations. The default average trip length for residential and office use in 'Inner London', as well as the average NO_x and PM_{10} emissions per vehicle-kilometre were derived from the 'Air Quality Neutral Support Update' (AQC, 2014)[18]. This information has been used to calculate the transport emissions generated by the development, as shown in Table 20.

The estimates of transport emissions generated by the new development (Table 20) have been compared with the transport NO_x and PM_{10} emissions benchmarks for Inner London (Table 19). The total development transport emissions (30.0 kg/yr for NO_x and 5.4 kg/yr for PM_{10}) are just below the TEB for NO_x and equal to the TEB for PM_{10}. The development meets the air quality neutral requirements for transport emission on this basis.

It is important to note that the Transport Statement[39] indicates an overall reduction in vehicle traffic movements. The central courtyard of the application site was previously utilised for unallocated surface level car parking. The Site has been designed with minimal car parking, 17 spaces for the combined employment use and 40 apartments; therefore the majority of person trips will be undertaken by non-car modes of travel. Finally, the detailed assessment indicates that the development will have a negligible impact on air quality in terms of emissions from traffic.

Table 19. **Calculation of Development-Specific TEBs**

Land Class	Description	Inner London NO_x TEB	Inner London PM_{10} TEB	Development NO_x TEB Emissions (kg/yr)	Development PM_{10} TEB Emissions (kg/yr)
Source	**Developer Plans**	**Appendix 6 of the Sustainable Design and Construction, SPG[2]**		**= dwelling (or GIA) x TEB / 1000**	
C3 (residential)	40 dwellings	558 g/dwelling/yr	100 g/dwelling/yr	22.3	4.0
B1 (offices)	698 m^2	11.4 $g/m^2/yr$	2.1 $g/m^2/yr$	8.0	1.4
Total				**30.3**	**5.4**

[41] SLR global environmental solutions, 44 Gloucester Avenue, London, Transport Statement, Dec 2014.

Table 20. **Calculation of Development Transport Emissions**

Land Class	Average Distance per Trip (km)	Average NO_x Emissions (g/veh-km)	Average PM_{10} Emissions (g/veh-km)	Total Vehicle Trips per Year	NO_x Transport Emissions (kg/yr)	PM_{10} Transport Emissions (kg/yr)
Source	**Tables 7 and 8 of AQC (2014)[18]**			**= No. Spaces* x trips**	**= total vehicle trips x average distance x emissions /1000**	
C3 (residential)	3.7	0.37	0.07	7,118	9.7	1.8
B1 (offices)	7.7	0.37	0.07	7,118	20.3	3.6
Total					**30.0**	**5.4**

*The number of spaces relates to those effecting emissions, a total of 13 halved for each use.

The development is well served by public transport and has cycle parking provisions for 70 bicycles. The limited number of 17 vehicle parking spaces, four of which will be for electric vehicles and two designated for disabled users, serves to encourage the uptake of sustainable modes of transport. In order to avoid the potential for any additional on-street parking, the Applicant is willing to agree a permit free agreement to minimise the potential for overspill parking. The proposed development is therefore designed as a 'car capped development', in that a limited amount of on-site car parking will be provided, but with no access to on-street parking permits.

The proposed development is well placed in terms of sustainable transport infrastructure, benefitting from local pedestrian, cycle and public transport facilities. A Transport Plan has been produced for the development and will help to promote awareness of the sustainable transport options available to residents, staff and visitors. As part of the Travel Plan for the development, notice boards will be provided within communal areas of the building. These will display information such as maps of the local area highlighting safe pedestrian and cycle routes and up-to-date public transport information. Furthermore a Travel Plan Co-ordinator will be appointed to promote the Plan to residents, employees and visitors, implement the measures in the Plan, provide the necessary reporting and liaison with the local authority and develop the Travel Plan in accordance with local transport conditions and development travel habits/trends.

5.8 Mitigation of Operational Effects

The dispersion modelling study shows that in 2017 concentrations are expected to be below the AQS objective for annual mean NO_2 and particulates at on-site receptors, hence no mitigation is considered necessary to limit exposure of the new residents to existing air quality at the development site. However, due to the proximity of the railway track at the rear side of the development, which is used by some diesel trains; as a precautionary principle it is recommended that the residential unit on the ground floor level adjacent to the track is supplied with mechanical ventilation.

The proposed development is based on an energy efficient building design[42] minimising air pollution resulting from the use of gas boilers. Adopting this building design reduces thermal heat losses and result in less gas use leading to lower NO_x emissions. The proposed development meets the "air quality neutral" requirement for building emissions and therefore no additional mitigation measures are proposed for the building heating/ energy supply associated with the development.

Vehicle emissions are mitigated for at European level, through the introduction of more stringent standards in the future. The proposed development will focus on a low-car-use scheme with limited amount of on-site car parking provided for mixed users. The development meets the "air quality neutral" requirements for transport emissions based on robust parking use assumptions and therefore no additional mitigation measures are proposed beyond those already taken into consideration by the developer.

[42] XCO2energy for Victoria Square Property Company Limited ,44 Gloucester Avenue Energy Statement, January 2015.

6. Conclusions

The proposal at 44 Gloucester Avenue is for a mixed-use development to provide 40 residential units and office and storage space of no more than 700m^2. The main concern with regard to air quality is the introduction of new sensitive receptors into an AQMA; an area where existing concentrations may be elevated above national criteria for the protection of human health and the environment. Construction dust may also have a temporary adverse effect on sensitive locations if not effectively controlled.

The Site is situated within the LBC AQMA, declared for the traffic pollutants NO_2 and PM_{10}. Monitoring data indicate that the NO_2 annual mean criterion of 40 µg/m^3 is currently exceeded at roadside and urban background locations. Mapped background concentrations, however, shows NO_2 annual mean concentrations of below the criterion at the Site itself.

There is potential for dust raising activities during the construction phase of the development. The Site is considered to present a ‘medium’ risk during demolition activities due to the proximity of highly sensitive receptors, and of ‘low’ risk during subsequent phases. Suitable mitigation measures for a ‘medium’ risk site have been outlined for all phases and should be applied by the developer, who will produce an AQDMP for submission to the local authority. The contractor should ensure that good practice measures are applied to control dust emissions. This can be outlined within a CMP. With the effective application of suitable mitigation, construction dust effects should be ‘not significant’.

Air quality conditions for new receptors at the proposed development in the opening year were considered by means of a detailed modelling study. Pollutant concentrations were estimated to be below the air quality objectives at all locations assessed, including at the ground floor level. A sensitivity test, assuming no reduction in background in future years, found that air quality conditions would be acceptable in 2017. No additional mitigation is considered to be required. The effect of development traffic was classed as “negligible” and the change would be imperceptible.

An air quality neutral assessment was undertaken in line with the Sustainable Design and Construction SPG. This demonstrated that the proposal is expected to meet the relevant benchmarks for both building related emissions and transport related emissions. No further mitigation is considered to be required for the heating/energy supply and transport associated with the development, beyond those already included in the proposal in order that the air quality neutral requirement is met.

Appendix A – Camden Air Quality Planning Checklist

***The checklist*[4]**

Travel and Transport

1) If there will be parking in the development, will electric vehicle charging points be included?
Y/N – **Yes,** the proposal will include **4 electronic charging points** as part of the 17 parking spaces proposed.

2) Will secure cycle storage be provided for users of the building?
Y/N – **Yes,** the basement will hold bicycle parking, 70 **spaces.** Fitting the minimum permissible cycle parking provisions of: one cycle space per unit and two cycle spaces per dwelling with three or more bedrooms, one visitor space per 10 units and one cycle space per 250m^2 of B1 use for staff .

Energy

3) If a CHP is to be included, did you ensure that this technology is suitable for the energy requirements of the building? Please see Camden's Boiler Guidance Manual B for more information.
Y/N – **No CHP proposed**
If yes, please briefly summarise why CHP was selected for this site.

4) If CHP is to be included, was this included within the air quality modelling in the AQA?
Y/N – if no, please state why.
N/A

5) If CHP will be included and the final technology agreed, have you ensured that it is the best in class in terms of NOx emissions?
Y/N
N/A

Exposure

6) If located in an area of poor air quality and/or next to a busy road or diesel railway line, does the AQA include details of the way in which the building has been designed to reduce the exposure of occupants (e.g. through orientation, greening, placement of residential properties, or, only for developments in areas of very poor air quality, mechanical ventilation?)

   Y/N – **Yes,** exposure has been addressed in Chapter 4; all ground floor units adjacent to the railway are commercial furthermore all basement and ground floors will be supplied with mechanical ventilation.

Construction Dust

7) Does the project have a Construction Management Plan written in accordance with the recommendations in the Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance, including an assessment of the risk? And, if the risk is High, a real time monitoring proposal?

   Y/N - **Yes, the Site is considered to present a medium risk** during demolition and a low risk during subsequent construction activities. Suitable mitigation measures for a medium risk site have been outlined in Chapter 4 of the AQA and should be applied by the developer, who will produce the CMP for submission to the local authority.