



Air Quality Assessment

Land South of Water Lane
Angmering, West Sussex

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Land off Water Lane Angmering, West Sussex Air Quality Assessment

October 2016

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1. Introduction

- *****
- 1.1 Phlorum Ltd has been commissioned by Gleeson Developments Ltd and Rydon Homes Ltd to undertake an air quality assessment for a proposed residential-led development on land to the south of Water Lane, Angmering, West Sussex. The National Grid Reference for the centre of the site is 507550, 104535. A site location plan is included as Figure 1.
 - 1.2 The proposals comprise the construction of up to 175 residential dwellings (detached, semi-detached and terraced), plus associated highways and landscaping work. There will also be a new bridge over the stream that runs parallel to Water Lane, creating a new permanent access to the site. The total (Red Line) area of the site is approximately 90,400m².
 - 1.3 The application site is located to the east of the existing large village of Angmering. To the north and east of the site is further farmland. The eastern boundary of the site is formed by the A280 Angmering Bypass. The boundary of South Downs National Park lies 170m to the east. To the west of the site are the buildings of Avenals Farm and low density residential areas of Angmering. To the south of the site are a number of new housing schemes at various stages of development.
 - 1.4 Air quality in the general area is thought to be good, being a fairly rural location. The main pollution sources in the vicinity of the application site are vehicles travelling on the local road network, specifically the A27 Trunk Road (Arundel Road) 870m to the north of the site, the A280 to the east and Water Lane, immediately to the north of the site.
 - 1.5 There are currently no air quality management areas (AQMAs) in Arun District. The focus of this assessment is the potential for traffic generated by the development to affect air quality at nearby sensitive receptors, particularly those in Angmering village.

2. Policy Context

- *****
- 2.1 This section details the legislative and planning context that form the basis for this assessment.

The UK Air Quality Strategy (UKAQS)

- 2.2 The UKAQS¹ sets a number of “standard” (AQS) concentrations for a number of key pollutants that are to be achieved at sensitive receptor locations across the UK by various “objective” dates. The sensitive locations at which the standards and objectives apply are places where the population is expected to be exposed to the various pollutants over the particular averaging period. Thus for those objectives to which an annual mean standard applies, the most common sensitive receptor locations used to measure concentrations against the set standards are areas of residential housing, since it is reasonable to expect that people living in their homes could be exposed to pollutants over such a period of time. Schools and children’s playgrounds are also often used as sensitive locations for comparison with annual mean objectives due to the increased sensitivity of young people to the effects of pollution (regardless of whether or not their exposure to the pollution could be over an annual period). For shorter averaging periods of between 15 minutes, 1 hour or 1 day, the sensitive receptor location can be anywhere where the public could be exposed to the pollutant over these shorter periods of time.
- 2.3 The objectives adopted in the UK are based on the Air Quality (England) Regulations 2000², as amended, for the purpose of Local Air Quality Management (LAQM). These Air Quality Regulations have been adopted into UK law from the limit values required by European Union Daughter Directives on air quality.
- 2.4 Obligations under the Environment Act 1995 require local authorities to declare an AQMA at sensitive receptor locations where an objective concentration has been predicted to be exceeded. In setting an AQMA, the local authority must then formulate an Air Quality Action Plan (AQAP) to seek to reduce pollution concentrations to values below the objective levels.

1 Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2) July 2007.

2 The Air Quality (England) (Amendment) Regulations 2002 - Statutory Instrument 2002 No.3043.

- 2.5 Arun District Council (ADC) continues to produce annual Review and Assessment reports under the LAQM regime, informed by the requirements of the Environment Act 1995, however monitoring results have not yet indicated a need for the declaration of any AQMAs, as the key AQs are generally met across the district.

National Planning Policy Framework (NPPF)

- 2.6 The NPPF, which was published in March 2012, sets out the Government's planning policy for England. At its heart is an intention to promote more sustainable development. A core principle in the NPPF that relates to air quality effects from development is that planning should "contribute to conserving and enhancing the natural environment and reduce pollution". In achieving this, it states in paragraph 109 that:

"The planning system should contribute to and enhance the natural and local environment by: [...]

preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability [...]"

- 2.7 With regard to assessing cumulative effects the NPPF states the following at paragraph 120:

"To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or Proposed Development to adverse effects from pollution, should be taken into account"

- 2.8 The NPPF offers a broad framework, but does not afford a detailed methodology for assessments. Specific guidance for air quality continues to be provided by organisations such as the Department for Environment, Food and Rural Affairs (Defra), Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM).

- 2.9 The future with-development scenario that was modelled in the air quality assessment was undertaken using traffic data that took account of cumulative effects.

National Planning Practice Guidance (PPG)

- 2.10 Reference ID 32 (Air Quality) of the National Planning Practice Guidance (PPG)³, which was updated in March 2014, provides guiding principles on how planning can take account of the impact of new development on air quality. The PPG summarises the importance of air quality in planning and the key legislation relating to it.
- 2.11 As well as describing the importance of International, National and Local Policies (detailed elsewhere in this report), it summarises the key sources of air quality information. It also explains when air quality is likely to be relevant to a planning decision:

"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife) [...]"

When deciding whether air quality is relevant to a planning application, considerations could include whether the development would:

- Significantly affect traffic in the immediate vicinity of the proposed development site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; adds to turnover in a large car park; or result in construction sites that would generate Heavy Goods Vehicle flows over a period of a year or more.*

3 Planning Practice Guidance (PPG) 32. (2014). Air Quality.
<http://planningguidance.planningportal.gov.uk/blog/guidance/air-quality/>.

- ❖ *Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; or extraction systems (including chimneys) which require approval under pollution control legislation or biomass boilers or biomass-fuelled CHP plant; centralised boilers or CHP plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area.*
- ❖ *Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality.*
- ❖ *Give rise to potentially unacceptable impact (such as dust) during construction for nearby sensitive locations.*
- ❖ *Affect biodiversity. In particular, this is likely to result in deposition or concentration of pollutants that significantly affect a European-designated wildlife site, and is not directly connected with or necessary to the management of the site, or does it otherwise affect biodiversity, particularly designated wildlife sites.”*

2.12 Details are also provided of what should be included within an air quality assessment. Key considerations include:

- ❖ Baseline local air quality;
- ❖ Whether the proposed development could significantly affect local air quality during construction/operation; and
- ❖ Whether the development is likely to expose more people to poor air quality.

2.13 Examples of potential air quality mitigation measures are also provided in the PPG.

Local Planning Policy

- 2.14 ADC has not declared any air quality management areas (AQMA) and air quality across the District is generally good. However, it recognises the potential for adverse air quality impacts from development within the emerging Local Plan⁴, and states in 'Policy QE SP1: Quality of the environment' that:

"the council requires that all development contributes positively to the quality of the environment and will ensure that development does not have a significantly negative impact upon residential amenity, the natural environment or upon leisure and recreational activities enjoyed by residents and visitors to the District.

The location of existing industrial and commercial uses [...] must be taken into consideration when assessing proposals for development sensitive to noise, light, odour and outputs to air."

- 2.15 This is supported by 'Policy QE DM3: Air pollution', which states:

"All major development proposals will be required to assess the likely impacts of the development on air quality and mitigate any negative impacts by:

- a. Ensuring the development is located within easy reach of established public transport services;*
- b. Maximising provision for cycling and pedestrian facilities;*
- c. Encouraging the use of cleaner transport fuels on site, through the inclusion of electric car charging points; and*
- d. Contributing towards the improvement of the highway network where the development is predicted to result in increased congestion on the highway network."*

4 Arun District Council. (October 2014). Arun Local Plan 2011 – 2031 Publication Version.

- 2.16 It is likely that ADC will require at least some of these mitigation measures to be included within the proposed development.
- 2.17 The Local Plan also cross-references the Sussex air quality guidance⁵, which was developed to provide a standard, Sussex-wide approach for assessing potential air quality impacts, with a consistent approach to mitigating those impacts. It also provides technical advice to Sussex local authorities on how to deal with planning applications that could have an impact on air quality.

5 Sussex Air Quality Partnership. (January 2014). Air quality and emissions mitigation guidance for Sussex authorities (2013).

3. Baseline

- 3.1 This chapter is intended to establish prevailing air quality conditions in the vicinity of the application site.

UK-AIR Background Pollution

- 3.2 Defra provides estimated background concentrations of the UKAQs pollutants at the UK Air Information Resource (UK-AIR) website⁶. These estimates are produced using detailed modelling tools and are presented as concentrations at central 1km² National Grid square locations across the UK. These were updated in July 2016 and are based on monitoring data from 2013.
- 3.3 Being background concentrations, the UK-AIR data are intended to represent a homogenous mixture of all emissions sources in the general area of a particular grid square location. Concentrations of pollutants at various sensitive receptor locations can, therefore, be calculated by modelling the emissions from a nearby pollution source, such as a busy road, and then adding this to the appropriate UK-AIR background datum.
- 3.4 The predicted background pollution concentrations for NO₂ and PM₁₀ for 2014 to 2016 are presented in Table 3.1. These data were taken from the central grid square location closest to the centre of the application site (i.e. grid reference: 507500, 104500).

Table 3.1: 2014 to 2016 UK-AIR predicted background concentrations of pollutants at the application site

Pollutant	Predicted background concentration (µg.m ⁻³)			Averaging period	Air quality standard concentration (µg.m ⁻³)	Objective to achieve the standard by
	2014	2015	2016			
NO ₂	10.9	10.5	10.1	annual mean	40	31 December 2005
PM ₁₀ *	14.4	14.2	14.1	(gravimetric) annual mean	40	31 December 2004

*Proposed PM₁₀ objectives for 2010 were dropped in the 2007 Air Quality Strategy (the objective now is to adopt an exposure reduction approach from 2010-2020 for finer PM_{2.5} particulates).

⁶ Defra: UK-AIR. www.uk-air.defra.gov.uk (accessed 22/08/2016).

- 3.5 The data in Table 3.1 show that annual mean background concentrations of NO₂ and PM₁₀ at the application site from 2014 to 2016 are predicted to be well below their respective 40µg.m⁻³ AQSs. Concentrations of both pollutants are predicted to decline each year. The data show that in 2016, NO₂ concentrations are predicted to be below the AQSs by 75% and 65%, respectively.

Local Sources of Monitoring Data

Automatic Monitoring

- 3.6 Monitoring at background locations is considered an appropriate source of data for the purposes of describing baseline air quality.
- 3.7 ADC has a widespread monitoring network but does not currently have any real-time, automatic monitoring stations. However, neighbouring Adur & Worthing Councils undertake continuous monitoring of NO₂, with results from the nearest monitor included in Table 3.2 below.
- 3.8 No monitoring of PM₁₀ is carried out by ADC in the vicinity of the application site and it is considered to be less of a concern, locally, than NO₂.

Table 3.2: NO₂ monitoring data from Worthing Automatic Monitor

Monitor	Type	Distance from the application site (km)	NO ₂ annual mean concentration (µg.m ⁻³)				
			2011	2012	2013	2014	2015
Worthing, A27 Grove Lodge	K	6.6	38	40	41	51	37

Note: "K" = kerbside. **Bold** denotes exceedence of the AQS.

- 3.9 The data in Table 3.2 show that annual mean concentrations of NO₂ were around the 40µg.m⁻³ AQS in 2011, 2012, 2013 and 2015. A 28% exceedence was recorded in 2014, though it is believed that this was a result of increased congestion due to roadworks.
- 3.10 This monitoring site is in an urban location next to a very congested section of the A27, and therefore not representative of the application site, particularly as it is some distance away.

Non-Automatic Monitoring

- 3.11 ADC operates an extensive non-automatic, NO₂ diffusion tube monitoring network across the district, although this primarily focuses on the relatively heavily trafficked, built-up areas of Arundel, Bognor and Littlehampton. Recent records from the closest ADC tubes to the application site are included in Table 3.3.

Table 3.3: NO₂ monitoring data from ADC diffusion tubes

Monitor	Site Type	Distance from the application site (km)	NO ₂ annual mean concentration (µg.m ⁻³)			
			2011	2012	2013	2014
Westlands	UB	3.5	17	14	-	-
Worthing Road	UR	4.2	24	26	28	20
A27 The Causeway	RR	5.1	33	29	33	25
A27 The Causeway	F	5.1	19*	19	18	15
Thatchway Close	UB	5.1	13	13	12	10
Terminus Road	UR	5.4	21	22	23	18
Lyminster Road	UR	5.8	-	-	24	17
Arundel High Street	UR	5.7	18	17	18	14
A27 Chichester Road	RR	6.1	-	-	26	23
Priory Road	UB	6.5	13	11	-	-
Ford Road	RR	7.1	-	-	19	16

Note: "UB" = urban background; "UR" = urban roadside; "RR" = rural roadside; "F" = façade.

*Annualised as data capture <75%.

- 3.12 The data in Table 3.3 show that annual mean concentrations of NO₂ were consistently below, and generally well below the 40µg.m⁻³ AQS across the District between 2011 and 2014. In these years, the highest concentrations were recorded at The Causeway in Arundel in 2011 and 2013, adjacent to the A27, at 18% below the AQS. Being only 1m from the kerb, this tube does not represent a high-sensitivity location.

- 3.13 At the three background locations, annual mean NO₂ concentrations were much lower, at 58% to 73% below the AQS. This is comparable to the UK-AIR data in Table 3.3.

Summary of Data used in Assessment

- 3.14 To ensure conservative predictions of pollutant concentrations, no reduction has been applied to the annual mean background NO₂ and PM₁₀ concentrations used in this assessment for future years. A decline is predicted by Defra due to the gradual renewal of the UK fleet with cleaner-engined vehicles. The background concentrations used in the assessment are included in Table 3.4.

Table 3.4: Background annual mean concentrations used in this assessment

Pollutant	Concentration	Data Source
NO ₂	10.9	UK-AIR, 2014
PM ₁₀	14.4	UK-AIR, 2014

4. Assessment

Methodology

Guidance

- 4.1 Local Air Quality Management Technical Guidance TG(16)⁷ was followed in carrying out the assessment. Guidance published by the IAQM⁸ on *the 'Assessment of Dust from Demolition and Construction'* was used when assessing the construction phase of the proposed development. The Greater London Authority (GLA) Supplementary Planning Guidance⁹ on the control of dust from construction has also been referred to. It details a number of mitigation measures that should be adopted to minimise impacts of dusts and fine particles. Whilst specifically produced for developments in London, it is used as benchmark guidance across the UK.
- 4.2 The latest Environmental Protection UK (EPUK) & IAQM guidance on *'Planning for Air Quality'*¹⁰ was also referred to for the operational phase assessment. It provides significance criteria which were followed in assessing the significance of operational phase impacts; these are included in Appendix A. The Sussex air quality guidance⁵ has also been referred to.

7 Defra. (2016). Part IV of the Environment Act 1995, Environment Order 2002 Part III, Local Air Quality Management, Technical Guidance LAQM. TG(16). London: Defra.

8 IAQM. (2014). Guidance on the assessment of dust from demolition and construction.

9 Greater London Authority. (2014). The Control of Dust and Emissions During Construction and Demolition.

10 EPUK & IAQM. (2015). Land-Use Planning & Development Control: Planning For Air Quality.



Construction Phase

- 4.3 The construction phase of the proposed development will involve a number of activities that could produce polluting emissions to air. Predominantly, these will be emissions of dust. However, they could also include releases of odours and/or more harmful gases and particles. The IAQM's guidance to assess the impacts of construction on human and ecological receptors has been followed in carrying out this air quality assessment. The guidance suggests that where a receptor is located within 350m of a site boundary and/or 100m of a route used by construction vehicles, up to 500m from the site entrance, a dust assessment should be undertaken. High sensitivity receptors are considered particularly sensitive when located within 20m of a works area. Figure 2 shows receptors that could be sensitive to dust that are located within 350m of the boundaries of the site.
- 4.4 A detailed schedule of construction is not available at present. However, it is anticipated that the development will be completed some time in 2019.
- 4.5 Review of the Multi Agency Geographic Information for the Countryside (MAGIC) website¹¹, which incorporates Natural England's interactive maps, has not identified any specifically ecological statutory sensitive receptors within close proximity of the application site. However, it should be noted that the South Downs National Park lies 100m to the east of the site. Whilst National Parks are primarily a landscape designation, their statutory purposes include the conservation and enhancement of "*natural beauty, wildlife and cultural heritage*". As such, the potential for impacts on wildlife within the National Park has been considered.
- 4.6 It should also be noted that there is an area of Ancient Woodland, Groom's Copse, 330m to the north-east of application site. Whilst not a statutory designation ancient woodlands tend to have a particularly high species diversity and this site has also been considered as a receptor.
- 4.7 Both the National Park and Groom's Copse are indicated on Figure 2.
- 4.8 The annual mean concentration of PM₁₀ is well below the AQS, according to local monitoring and the UK-AIR background maps. This provides a good indication that PM₁₀ concentrations for both annual mean and daily mean concentrations are likely to be below the respective AQSs at the application site and adjacent uses.
- 4.9 The IAQM guidance suggests that Demolition, Earthworks, Construction and Trackout should all be assessed individually to determine the overall significance of the construction phase.

11 Natural England and MAGIC partnership organisations. Multi Agency Geographic Information for the Countryside. <http://www.magic.gov.uk/> (accessed 07/01/2015).

Construction Significance

- 4.10 In the IAQM dust guidance, the first step in assessing the risk of impacts is to define the potential dust emission magnitude. This can be considered 'Negligible', 'Small', 'Medium' or 'Large' for each of the construction stages. Whilst the IAQM provides examples of criteria that may be used to assess these magnitudes, the vast number of potential variables mean that every site is different and therefore professional judgement must be applied by what the IAQM refer to as a "technically competent assessor". The construction phase assessment therefore relies on the experience of the appraiser.
- 4.11 As such, attempts to define precisely what constitutes a negligible, small, medium or large dust emission magnitude should be treated with caution. Factors such as the scale of the work, both in terms of size and time, the construction materials and the plant to be used must be considered.
- 4.12 The second step is to define the sensitivity of the area around the construction site. As stated in the IAQM guidance:

"the sensitivity of the area takes into account a number of factors:

- * the specific sensitivities of receptors in the area;*
- * the proximity and number of those receptors;*
- * in the case of PM₁₀, the local background concentrations; and*
- * site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust."*

- 4.13 Based on these factors, the area is categorised as being of 'Low', 'Medium' or 'High' sensitivity.
- 4.14 When dust emission magnitudes for each stage and the sensitivity of the area have been defined, the risk of dust impacts can be determined. The IAQM provides a risk of impacts matrix for each construction stage. The overall significance for the construction phase can then be judged from the stages assessed. Again, this is subject to professional judgement.
- 4.15 Combustion exhaust gases from diesel-powered plant and construction vehicles accessing the application site will also be released. However, the volumes and periods over which these releases will occur are unlikely to result in any significant peaks in local air pollution concentrations and therefore this has been scoped out of the assessment.

Operational Phase

Vehicle Emissions

- 4.16 Vehicle emissions will arise from the combustion of fossil fuels in vehicle engines and their subsequent release to atmosphere via tailpipe exhausts. The most significant pollutants released by cars and other vehicles are oxides of nitrogen (NO₂/NO_x) and fine particulate matter (PM₁₀ and PM_{2.5}). Releases of carbon monoxide (CO) and some volatile hydrocarbons (e.g. benzene and 1,3-butadiene) are of less significance and are not assessed further in this report.
- 4.17 As it is elevated annual mean concentrations of NO₂ and PM₁₀ that have resulted in the declaration of most AQMAs across the UK, these are the pollutants of most concern and they have therefore been the focus of this air quality assessment.

ADMS-Roads Assessment

- 4.18 In order to determine the effects on local air pollution concentrations from the operation of the proposed development, emissions from local roads have been assessed using a detailed air dispersion model. The model used was ADMS-Roads (version 4.0.1), which is produced by CERC and has been validated and approved by Defra for use as an assessment tool for calculating the dispersion of pollutants from traffic on UK roads. The latest Defra Emissions Factor Toolkit (EFT)¹² was used within the model to estimate vehicle emissions. Emissions factors for 2016 were used in all modelled scenarios
- 4.19 Detailed, hourly sequential, meteorological data are used by the model to determine pollutant transportation and levels of dilution by the wind and vertical air movements. Meteorological data used in the model were obtained from Shoreham-by-Sea meteorological station, as it was considered to provide the most representative data of similar conditions to the application site and was indicated to be the usual source of data for assessments in the district by ADC's Senior Environmental Health Officer (EHO). The meteorological data used for this assessment were from 2013, as both traffic data and monitoring data were also available for this year; these were used for model verification purposes. The surface roughness applied to the model for the meteorological station and application site was 0.5m, which is typically used for open suburbia.
- 4.20 Discrete model receptors were positioned at the façades of new and existing residential dwellings closest to the main sources of pollution. Modelled receptor locations are shown on Figure 3. The modelling of proposed receptors has been used to assess the suitability of the site for its proposed use, by determining whether pollutant levels will be below the relevant AQs at the façades of the new dwellings.

¹² Defra. (2015). Emissions Factor Toolkit. <http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html> (accessed 23/08/2016).

- 4.21 The receptors were modelled at “breathing height”, which is, by convention, 1.5m above ground level.
- 4.22 Traffic data used in the assessment were provided by the project’s Transport Consultant, i-Transport, and were derived primarily from project specific traffic counts undertaken in 2015. Additional data for the model verification were derived from Department for Transport (DfT) Traffic Counts¹³. Flows were modelled for the following scenarios:
- ☉ **A** – Baseline 2015: based on the raw traffic counts;
 - ☉ **B** – 2019 Baseline: Calculated using the growth factor for the general development in the surrounding area (using TEMPro growth factors) applied to the 2015 data;
 - ☉ **C** – 2019 B + committed: including projected flows from the Roundstone Lane development of up to 700 houses (planning refs: A/51/14/OUT, A/82/12, A/135/12, A/154/14/OUT, A/122/12 and others), to allow evaluation of cumulative effects; and
 - ☉ **D** – 2019 C + proposed development.
- 4.23 All modelled road links are shown in Figure 3, with traffic model inputs included in Appendix B.

Model Verification

- 4.24 It is recommended, following guidance set out in LAQM.TG(16)⁷, that the model results be compared with measured data to determine whether they need adjusting to more accurately reflect local air quality. This process is known as verification and reduces the uncertainty associated with local effects on pollution dispersion and allows the model results to be more site-specific.
- 4.25 A verification study has been undertaken using local authority monitoring data from Arundel and Littlehampton, as recommended by the EHO. Full details of this study are included in Appendix C. The model was found to be under-predicting concentrations, which is not unusual, and therefore an adjustment factor of 1.61 was applied to the model results.

Consultation

- 4.26 The proposed development was discussed with ADC’s EHO during November 2016. He confirmed his acceptance of the scope of assessment detailed above.

¹³ DfT Traffic Counts. www.dft.gov.uk/traffic-counts (accessed 07/01/2016).

5. Construction Phase Impacts

- *****
- 5.1 The construction phase of the proposed development will involve a number of activities that could produce polluting emissions to air. Predominantly, these will be emissions of dust. The total construction period is expected to last less than one year.
 - 5.2 The estimates for the dust emission magnitude for demolition, earthworks, construction and trackout below are, where appropriate, based on the construction information provided by the client.

Dust Emission Magnitude

Demolition

- 5.3 There are no significant existing structures on site and therefore the dust emission magnitude for demolition is expected to be *Negligible*.

Earthworks

- 5.4 At approximately 90,400m², the area of the application site is well over the IAQM's 10,000m² 'Large' threshold. There is considerable topographical variation across the site and earthworks will be required for the new bridge structure, to the north of the site, as well as for foundations and services for the houses.
- 5.5 Overall, therefore, the dust emission magnitude for the earthworks stage is considered to be *Large*.
- 5.6 The site, which currently consists of fields, is not thought to be significantly contaminated. The potential health effects from the release of contaminated dusts are not considered in this report and it is assumed that this will be covered in a separate specialist assessment, if required.

Construction

- 5.7 There are a number of particularly dusty activities that commonly take place during the construction stage such as piling, sandblasting and concrete batching. However, being a residential development, it is anticipated that few particularly dusty activities will be undertaken. Localised use of cement power, the general handling of construction materials and wind-blow from any stockpiles can also generate dust.
- 5.8 The main materials to be used during construction are roof tiles, bricks and mortar. These have a low to moderate potential for dust release.
- 5.9 It is anticipated that the total building volume will be within the IAQM's 'Medium' emission category (25,000m³ to 100,000m³) and as such, the dust emission magnitude for the construction stage is considered to be *Medium*.

Trackout

- 5.10 Construction traffic, when travelling over soiled road surfaces, has the potential to generate dust emissions and also to soil the local road network. During dry weather, un-surfaced and soiled roads can lead to dust being emitted due to pick-up by vehicle wheels. The potential for roads to be soiled is dependent on the length of the onsite unpaved road.
- 5.11 It is not known at this point how many heavy duty vehicles (HDVs) will access the site per day, but there are likely to be unpaved roads, at least in the initial stages of construction. Overall, the dust emission magnitude for trackout is considered to be *Medium*.
- 5.12 Combustion exhaust gases from diesel-powered plant and construction vehicles accessing the application site will also be released. However, the volumes and periods over which these releases will occur are unlikely to result in any significant peaks in local air pollution concentrations and therefore this has been scoped out of the assessment.

Emission Magnitude Summary

- 5.13 A summary of the dust emission magnitude as a result of the activities of Demolition, Earthworks, Construction and Trackout as specified in the IAQM guidance, and discussed above, are listed in Table 5.1 below. Overall, the dust emission magnitude is considered to be *Medium*.

Table 5.1: Dust Emission Magnitude for the construction activities, based on the IAQM's guidance

Activity	Dust Emission Magnitude
Demolition	Negligible
Earthworks	Large
Construction	Medium
Trackout	Medium

Sensitivity of the Area

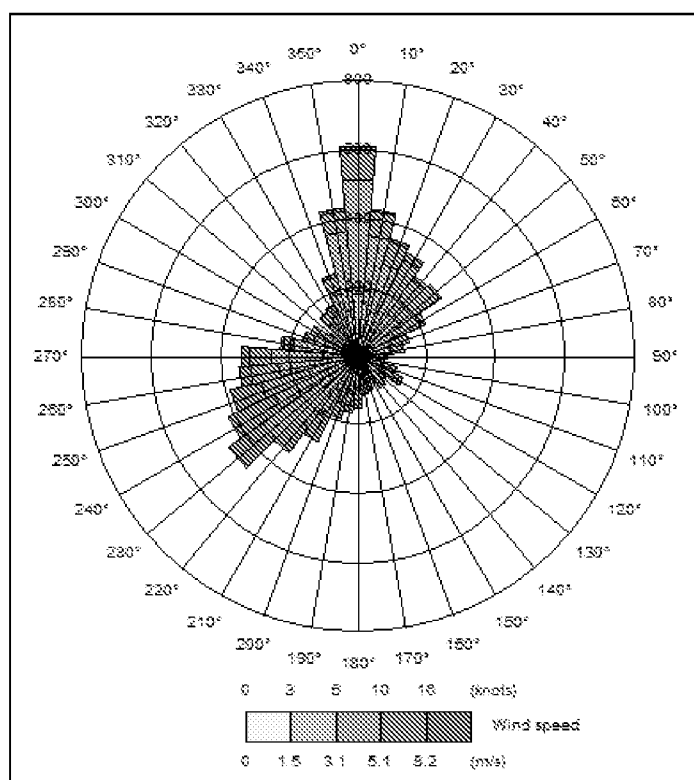
- 5.14 Having established the emission magnitude for dust above, the sensitivity of the area must be considered to establish the significance of effects. The effect of dust emissions depends on the sensitivity of each receptor. High sensitivity human receptors include residential dwellings, schools and hospitals.
- 5.15 The impacts of dust emissions from the sources discussed above have the potential to cause an annoyance to human receptors living in the local area. Within distances of 20m of the site boundary there is a high risk of dust impacts, regardless of the prevailing wind direction. Up to 100m from the construction site, there may still be a high risk, particularly if the receptor is downwind of the dust source.
- 5.16 With the exponential decline in dust with distance from dust generating activities, it is considered that for receptors more than 350m from the site boundary, the risk is negligible. Furthermore, the risks at over 100m only have the potential to be significant in certain weather conditions, e.g. downwind of the source during dry periods.
- 5.17 The approximate number of high sensitivity human receptors in the vicinity of the application site is detailed in Table 5.2 below, with distance contours shown in Figure 2. There are relatively few sensitive receptors within close proximity of the site. Seven dwellings were identified within 20m of the boundary the western part of the site, which is known as "Sussex Village". Three further receptors, including two houses and The Spotted Cow public house, are just within 20m of the east part of the site.
- 5.18 No significant non-residential receptors, such as schools and hospitals, were identified within 350m of the application site.

Table 5.2: Approximate number of High Sensitivity Human Receptors close to the application site

Distance to site (m)	Approximate number of receptors	Details
<20	10	Dwellings on The Avenals and High Street.
20-100	50	Dwellings to the west and south-west of the application site.
100-350	500	Dwellings in eastern and central Angmering. South Downs National Park. Groom's Copse Ancient Woodland.

5.19 Plate 5.1, below, shows that there are significant prevailing winds from both the south-west and the north, though the former tends to involve much higher wind speeds.

Plate 5.1: Wind Rose for Shoreham, 2013



5.20 Most of the residential receptors within 100m of the site are to the west, broadly upwind of the prevailing winds. Receptors within 20m and those to the south of Sussex Village are likely to be most susceptible to dust impacts.

- 5.21 Given the relatively low number of receptors in the immediate vicinity of the site, the overall sensitivity of the area is considered to be *Medium*.

Risk of Impacts

- 5.22 Having established the likely dust emission magnitudes and sensitivity of the area, the risk of impacts can be determined in accordance with the IAQM guidance. These are summarised in Table 5.3.

Table 5.3: Summary of Impact Risk by Construction Stage based on the IAQM's dust guidance

Stage	Impact Risk		
	Nuisance Dust	Ecology	PM ₁₀
Demolition	Negligible	Negligible	Negligible
Earthworks	Medium Risk	Low Risk	Negligible
Construction	Medium Risk	Low Risk	Negligible
Trackout	Low Risk	Low Risk	Negligible

- 5.23 Overall, the development is considered to be *Medium Risk* for nuisance dust soiling effects and *Negligible* risk for PM₁₀ health effects, in the absence of mitigation. Whilst there is considered to be a low risk of ecological impacts, the successful mitigation of any nuisance dust effects should ensure that no ecological receptors are significantly affected.

Site Specific Mitigation

- 5.24 The GLA guidance, which is used as a benchmark across the UK, suggests a number of mitigation measures that should be adopted in order to minimise impacts from dusts and fine particles. Appropriate measures that could be included in the construction of the proposed development include:
- ☞ ideally cutting, grinding and sawing should not be conducted on-site and pre-fabricated material and modules should be brought in where possible;
 - ☞ where such work must take place, water suppression should be used to reduce the amount of dust generated;

- ☛ skips, chutes and conveyors should be completely covered and, if necessary enclosed to ensure that dust does not escape;
- ☛ no burning of any materials should be permitted on site;
- ☛ any excess material should be reused or recycled on-site in accordance with appropriate legislation;
- ☛ developers should produce a waste or recycling plan;
- ☛ following earthworks, exposed areas and soil stockpiles should be re-vegetated to stabilise surfaces, or otherwise covered with hessian or mulches;
- ☛ stockpiles should be stored in enclosed containers and kept damp where necessary;
- ☛ hard surfaces should be used for haul routes where possible;
- ☛ haul routes should be swept/washed regularly;
- ☛ vehicle wheels should be washed on leaving the site;
- ☛ all vehicles carrying dusty materials should be securely covered; and
- ☛ delivery areas, stockpiles and particularly dusty items of construction plant should be kept as far away from neighbouring properties as possible.

5.25 In addition, the IAQM lists recommended mitigation measures for low, medium and high Dust Impact Risks. The highly recommended mitigation measures for Medium Risk sites are included in Appendix D of this report. It is also recommended that the most significant dust generating activities are avoided in the Sussex Village area, where possible, as most of the nearby sensitive receptors are close to this part of the site.

5.26 Where dust generation cannot be avoided in areas close to neighbouring properties, additional mitigation measures should be put in place, such as: windbreaks, sprinklers, and/or time/weather condition limits on the operation of some items of plant or the carrying out of activities that are likely to generate a particularly significant amount of dust.

5.27 It is anticipated that the project's dust control measures will be included in a Construction Environmental Management Plan (CEMP).

Residual Effects

5.28 After the implementation of the mitigation measures listed above and in Appendix D, the significance of each phase of the construction programme will be reduced and the residual significance of impact for the construction phase is expected to be *Negligible*.

6. Operational Impacts

- 6.1 A comparison of modelled and monitored data, as laid out in TG(16), has been undertaken. Full details of this are provided in Appendix C. This ensures that the assessment provides a more conservative estimate of pollution concentrations than using unadjusted modelling results. As the model was found to be under-predicting concentrations, road contributions of both NO_x and PM₁₀ were adjusted by a factor of 1.61.
- 6.2 Results from the ADMS-Roads assessment of the proposed development are presented below. Modelled road links and receptor points are displayed in Figure 3.

Existing Receptors

- 6.3 Tables 6.1 and 6.2 show the predicted annual mean concentrations of NO₂ and PM₁₀, respectively, at existing receptors in the vicinity of the key roads in the area.

Table 6.1: Predicted annual mean NO₂ concentrations at existing receptors

Receptor Point	Annual mean NO ₂ concentration (µg.m ⁻³)				Change due to committed		Change due to proposed		
	2015 Baseline	2019 Base	2019 Base + Committed	2019 With Development	µg.m ⁻³	As a % of the AQ5	µg.m ⁻³	As a % of the AQ5	EPUK & IAQM Significance
	A	B	C	D	C - B		D - C		
1	15.9	16.2	16.2	16.4	0.05	0.1	0.14	0.4	Negligible
2	16.6	17.0	17.1	17.2	0.06	0.2	0.15	0.4	Negligible
3	13.1	13.3	13.3	13.3	0.07	0.2	0.01	0.0	Negligible
4	15.6	15.9	15.9	16.1	0.02	0.1	0.22	0.5	Negligible
5	12.2	12.3	12.3	12.4	0.01	0.0	0.06	0.1	Negligible
6	12.7	12.8	12.8	12.9	0.02	0.0	0.09	0.2	Negligible
7	13.8	14.0	14.1	14.2	0.04	0.1	0.15	0.4	Negligible

Receptor Point	Annual mean NO ₂ concentration (µg.m ⁻³)				Change due to committed		Change due to proposed		
	2015 Baseline	2019 Base	2019 Base + Committed	2019 With Development	µg.m ⁻³	As a % of the AQS	µg.m ⁻³	As a % of the AQS	EPUK & IAQM Significance
	A	B	C	D	C - B		D - C		
8	11.4	11.4	11.4	11.4	0.01	0.0	0.01	0.0	Negligible

Note: Any apparent discrepancies are due to rounding.

- 6.4 The data in Table 6.1 show that annual mean concentrations of NO₂ at the façades of all existing receptors are predicted to be well below the 40µg.m⁻³ AQS in all scenarios. The highest predicted concentration is at Receptor 2 on Water Lane in the 'with development' scenario, at 17.2µg.m⁻³. This is 57% below the AQS.
- 6.5 The greatest increase in annual mean NO₂ concentrations as a result of traffic generated by the proposed development is 0.22µg.m⁻³ at Receptor 4, which is also located on Water Lane. This is a change of 0.5%, with respect to the AQS, which is considered to have a *Negligible* significance, with reference to the EPUK & IAQM criteria in Appendix A, as a result of low absolute concentrations.
- 6.6 Overall, therefore, the development is considered to have a *Negligible* impact on annual mean NO₂ concentrations.
- 6.7 The greatest change as a result of the proposed development combined with committed developments is also experienced at Receptor 4, at 0.24µg.m⁻³, which is 0.6% with respect to the AQS. This is also considered to have *Negligible* significance with reference to the assessment criteria.
- 6.8 As such, cumulative effects on annual mean NO₂ concentrations are considered to be *Negligible*.
- 6.9 For the hourly AQS for NO₂ (200µg.m⁻³ not to be exceeded more than 18 times a year), TG(09) states that if the annual mean is below 60µg.m⁻³, this AQS should be met. The data in Table 6.1 show that all modelled annual mean NO₂ concentrations are well below this threshold at all receptor points in all scenarios, and therefore it is anticipated that the hourly AQS would be achieved.

Table 6.2: Predicted annual mean PM₁₀ concentrations at existing receptors

Receptor Point	Annual mean PM ₁₀ concentration (µg.m ⁻³)				Change due to committed		Change due to proposed		
	2015	2019 Base	2019 Base + Committed	2019 With Development	µg.m ⁻³	As a % of the AQS	µg.m ⁻³	As a % of the AQS	EPUK & IAQM Significance
	A	B	C	D	C - B		D - C		
1	15.1	15.1	15.1	15.1	0.00	0.01	0.02	0.1	Negligible
2	15.1	15.2	15.2	15.2	0.01	0.02	0.02	0.1	Negligible
3	14.7	14.7	14.7	14.7	0.01	0.02	0.00	0.0	Negligible
4	15.0	15.0	15.0	15.0	0.00	0.01	0.03	0.1	Negligible
5	14.5	14.5	14.5	14.6	0.00	0.00	0.01	0.0	Negligible
6	14.6	14.6	14.6	14.6	0.00	0.01	0.01	0.0	Negligible
7	14.8	14.8	14.8	14.8	0.00	0.01	0.02	0.1	Negligible
8	14.4	14.4	14.4	14.4	0.00	0.00	0.00	0.0	Negligible

6.10 The data in Table 6.2 show that annual mean concentrations of PM₁₀ are predicted to be well below the 40µg.m⁻³ AQS at all receptors in all scenarios. The highest absolute concentrations were predicted at Receptor 2 in all three of the future scenarios, at 15.2µg.m⁻³, which is 62% below the AQS.

6.11 The change in annual mean PM₁₀ concentrations as a result of the proposed development is predicted to be less than 0.05µg.m⁻³, and well below 0.5% with respect to the AQS, at all receptor locations. This is also true for the combined effect of the proposed and committed developments. As such, the significance of impact of the proposed development and the cumulative effect of proposed and committed developments are both considered to be *Negligible*, with reference to the EPUK & IAQM criteria.

6.12 For PM₁₀, the following equation can be used to derive the number of days that the daily mean limit of 50µg.m⁻³ AQS is likely to be exceeded:

$$\text{No. 24 hour exceedences} = 18.5 + 0.00145 \times \text{annual mean}^3 + \left(\frac{206}{\text{annual mean}} \right)$$

- 6.13 The highest annual mean PM₁₀ concentration in Table 6.2 is 15.2µg.m⁻³. Based on the above formula, this would lead to 0.14 exceedence days, which is 99.6% below the 35-day limit. It is therefore not expected that the proposed development would lead to the exposure of any existing receptors to unacceptable short-term concentrations of PM₁₀.

Proposed Receptors

- 6.14 The ADC Air Quality Officer agreed that background air quality in the Angmering area is generally good and as such the suitability of the site for residential use, in terms of ambient air quality, is unlikely to be a significant issue. Nevertheless, pollution concentrations are predicted at points on the façades of the proposed dwellings closest to the A280, as indicated on Figure 3. These data are included in Table 6.3.

Table 6.3: Predicted pollution concentrations at the façades of the proposed development in 2019

Receptor No.	Annual mean concentration (µg.m ⁻³)		50µg.m ⁻³ mean exceedence days*
	NO ₂	PM ₁₀	PM ₁₀
P1	12.6	14.6	0.12
P2	12.8	14.6	0.12
P3	12.6	14.6	0.12
P4	12.3	14.6	0.12
P5	12.4	14.6	0.12

*Note: estimated using the formula from Paragraph 6.12.

- 6.15 The data in Table 6.3 show that annual mean NO₂ concentrations are predicted to be well below the 40µg.m⁻³ AQS at all modelled proposed receptor points. The highest predicted concentration is 12.8µg.m⁻³ at Receptor 22. This is 68% below the AQS.
- 6.16 Meanwhile, annual mean concentrations of PM₁₀ and daily mean PM₁₀ exceedence days are expected to be 64% and 99.7% below their respective AQSs.
- 6.17 Based on these findings, the proposed development would not be expected to expose any of the occupants of the proposed dwellings to unacceptable air quality and therefore the application site is considered suitable for the proposed residential use.

Mitigation

- 6.18 The operational phase assessment has indicated that there should be no significant impacts on local air quality as a result of the proposed development. As such, no mitigation should be required. However, it is noted that there will be a number of green measures inherent to the scheme that will help to further reduce the potential for any air quality impacts.
- 6.19 In particular, the location of the development close to the village centre, and the provision of a new pedestrian/cycle route into the village, are considered to be in line with the requirements of Local Plan policy QE DM3, parts a and b, as detailed in Paragraph 2.15. It is therefore considered that the proposed development will exceed any local policy requirements for mitigation.

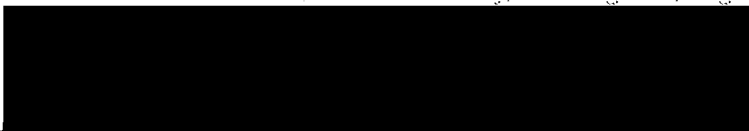


7. Discussion

- *****
- 7.1 ADC has not declared any AQMAs in the District and the primary areas of concern, with respect to pollution, are some distance from the application site in the larger towns and close to busy roads (i.e. in Littlehampton, Arundel and Bognor Regis). The Council's monitoring is focussed in these areas, but data from the UK-AIR indicate that background air quality in the vicinity of the site is likely to be very good.
 - 7.2 An air quality assessment was required, primarily due to the potential for traffic generated by the proposed development to cause significant increases in the concentrations of NO₂ and PM₁₀ at sensitive receptors in the local area.
 - 7.3 A detailed dispersion model has been used to predict pollutant concentrations at the façades of both existing and proposed receptors. No exceedences of the long or short term AQSs for NO₂ or PM₁₀ are anticipated at any of the modelled existing receptors, furthermore traffic generated by the proposed development is not expected to cause a significant increase in pollution concentrations at any of these locations.
 - 7.4 The combined effect of the proposed development and nearby cumulative developments was also assessed and deemed to be negligible.
 - 7.5 Air quality has also been shown to be acceptable across the application site, with no exceedences of the key AQSs for NO₂ or PM₁₀ expected. Future occupants of the site should not, therefore, be exposed to unacceptable air quality.
 - 7.6 The construction of the proposed development could give rise to emissions that may cause some dust soiling effects on adjacent uses. However, by adopting appropriate mitigation measures to reduce emissions and their potential impact, there should be no significant residual effects.
 - 7.7 The proposed development is considered to comply with the requirements of the NPPF, plus Arun Local Plan policies, such as SP1, as it will not have a significant impact on residential amenity, with respect to air quality, and will not expose existing or proposed receptors to exceedences of the key AQSs.

8. Conclusions

- 8.1 This report has assessed current air quality at Land South of Water Lane, Angmering, West Sussex and the potential for traffic generated by the proposed development to impact air quality at existing sensitive receptors in the vicinity.
- 8.2 Site-specific UK-AIR and monitoring results from nearby suggest that air quality in the area is generally good, with background concentrations at the application likely to be well below the relevant UK Air Quality Standards.
- 8.3 Whilst the development will change the pattern of vehicle movements on the local road network, no significant changes in pollution concentrations are anticipated. Furthermore, air quality at the façades of the proposed new dwellings is also expected to be acceptable and the site is therefore considered to be suitable for residential use.
- 8.4 Considering the above, the proposed development has been determined to be acceptable in terms of its impact on, and sensitivity to, local air quality.
- 8.5 The proposed development is expected to comply with all relevant air quality policy. Air quality should not, therefore, pose any significant obstacles to the planning process.



Figures and Appendices

Figure 1: Site Location Plan

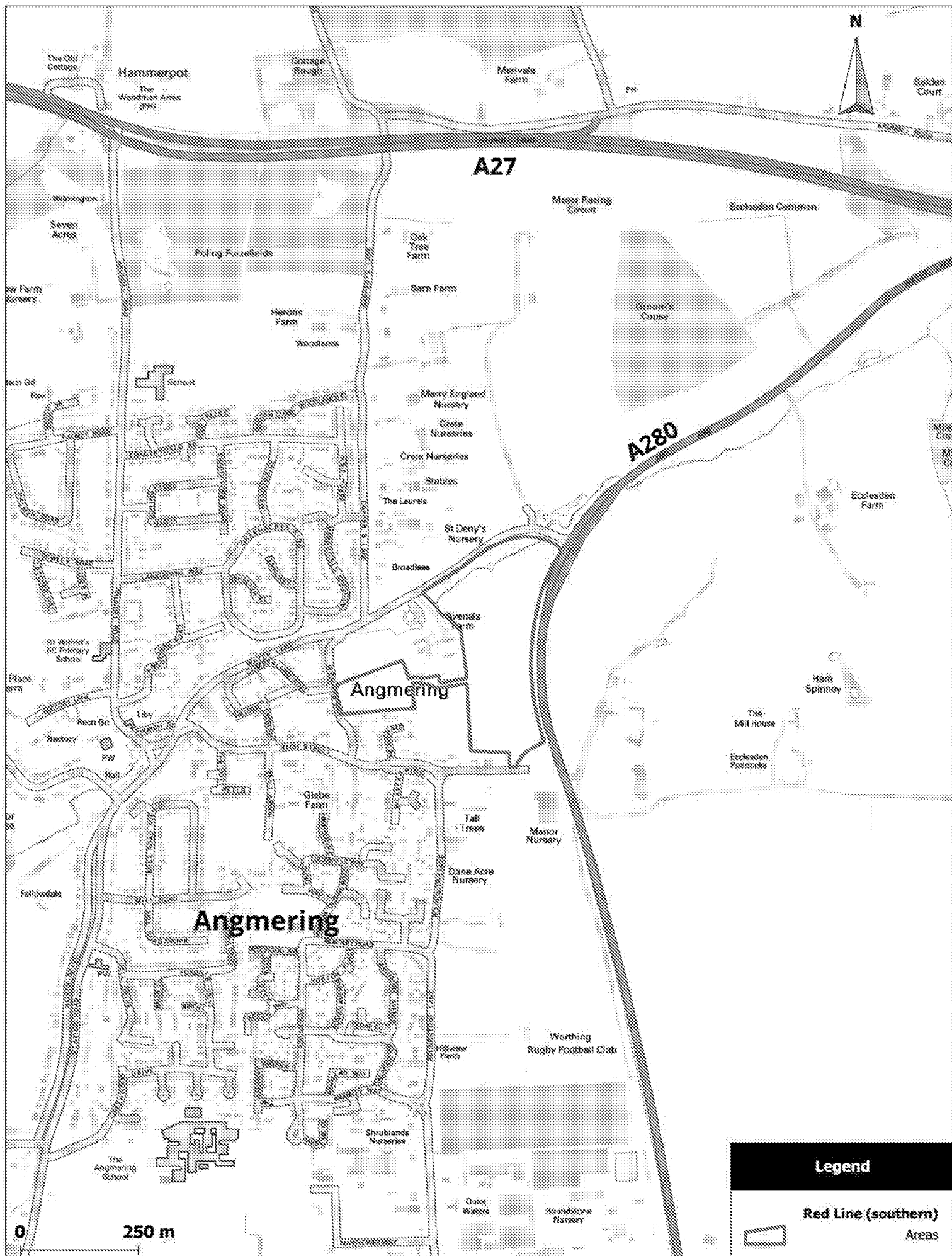


Figure 1: Site Location Plan

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Figure 2: Construction Phase Receptors

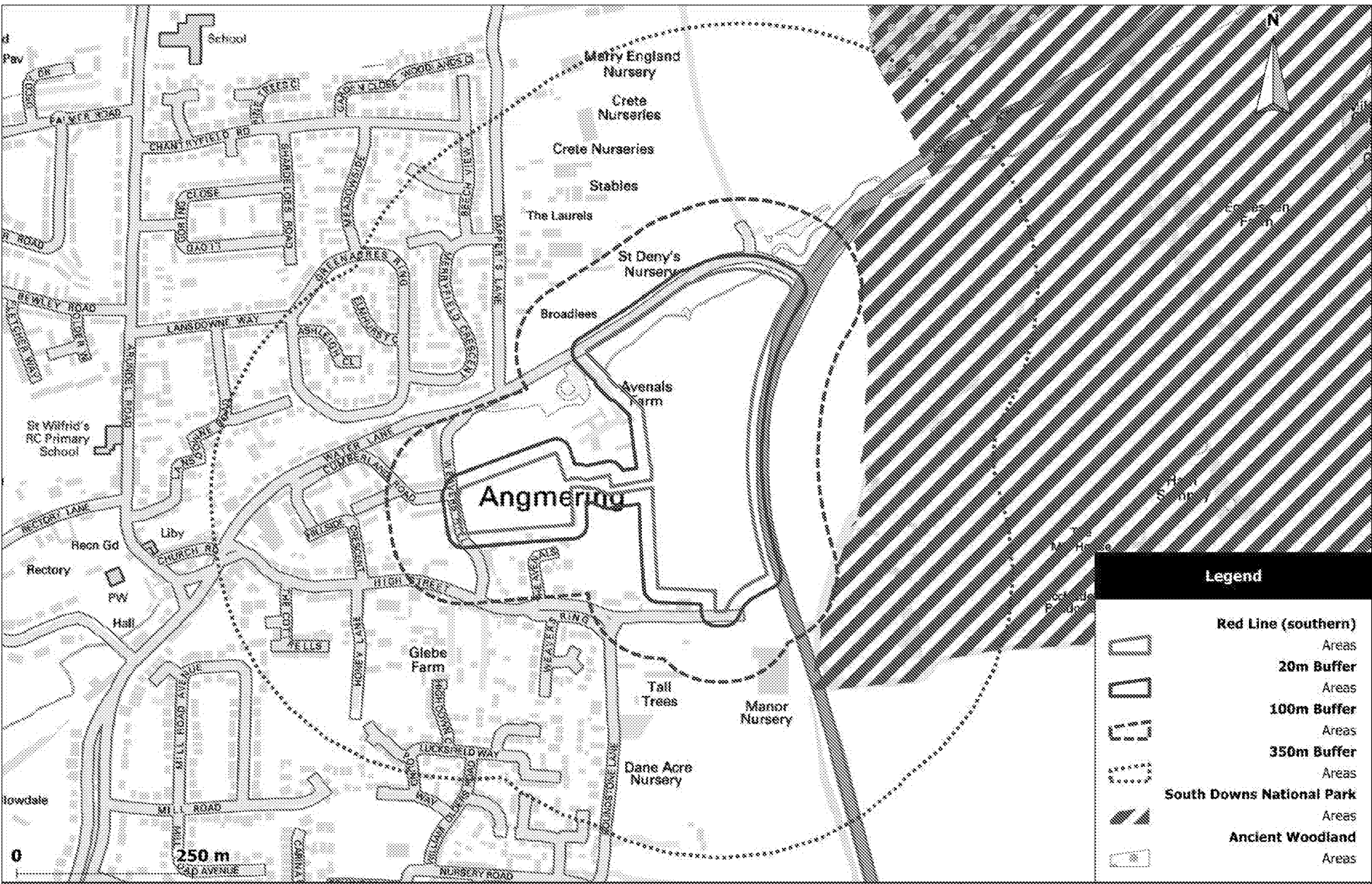


Figure 2: Construction Phase Receptors

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Figure 3: Operational Phase Assessment

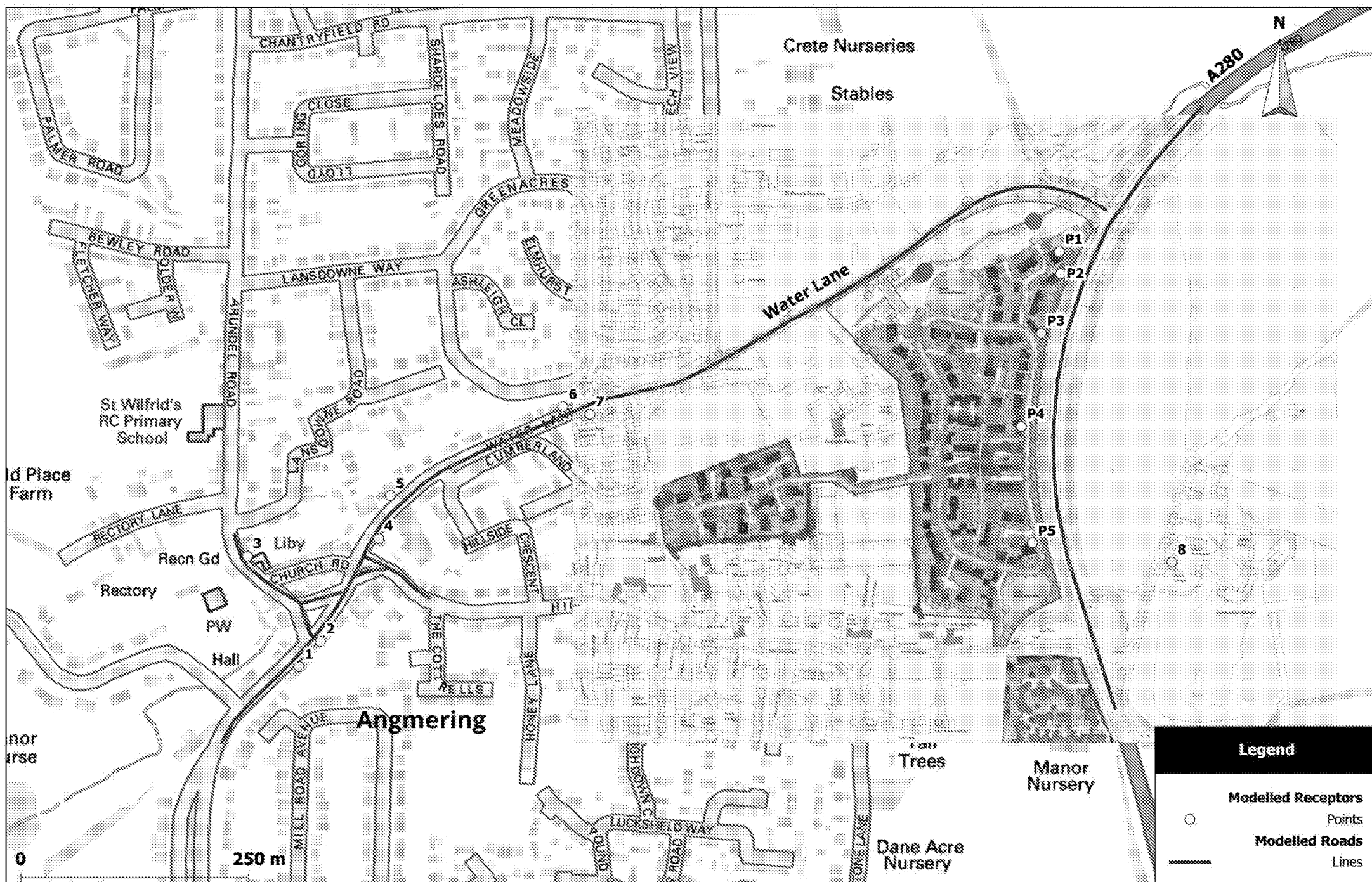
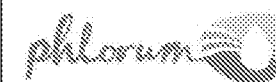


Figure 3: Operational Phase Assessment

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Legend

Modelled Receptors

Points

Modelled Roads

Lines

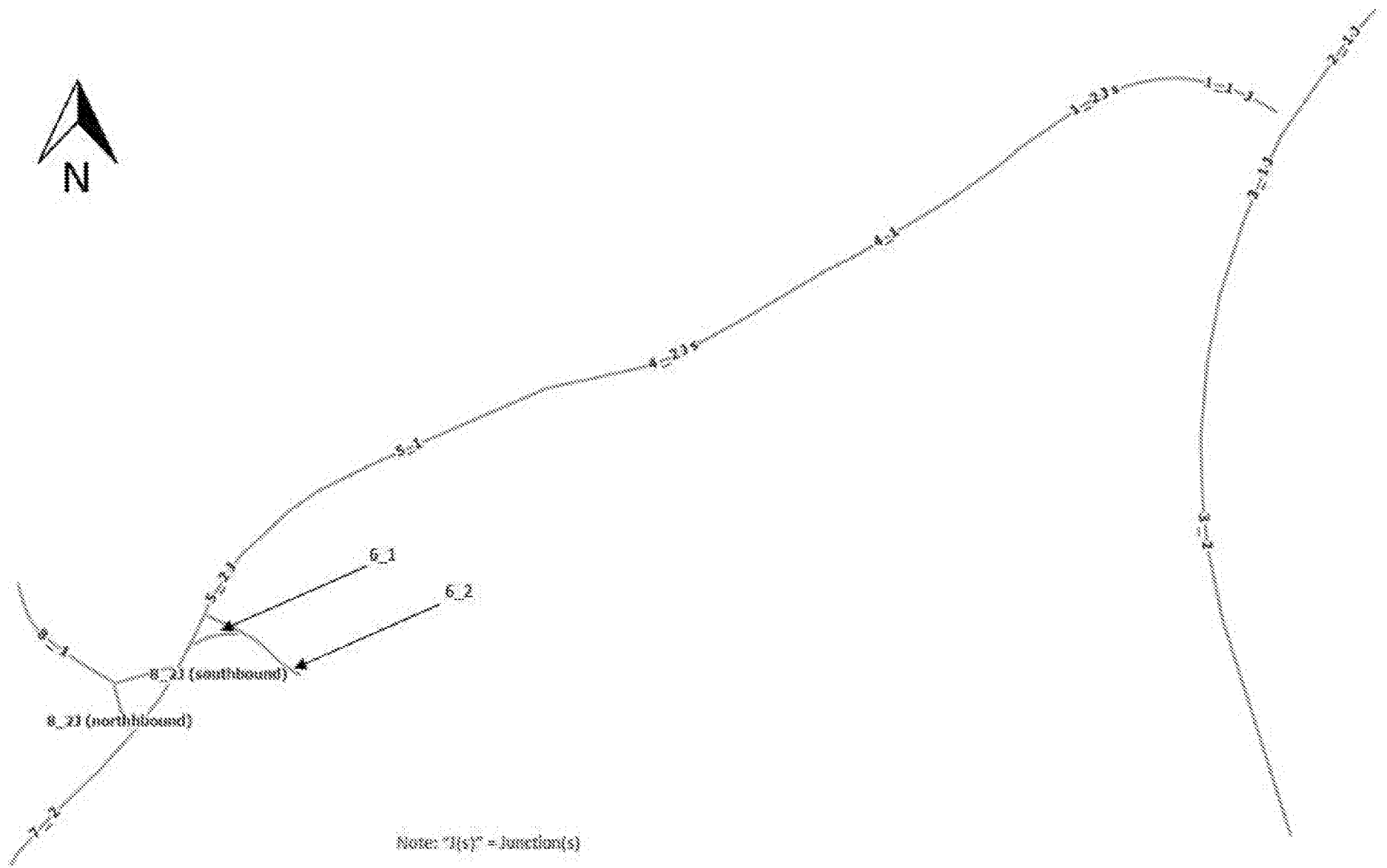
Appendix A: EPUK & IAQM Significance Criteria

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
75-90% of AQAL	Negligible	Slight	Moderate	Moderate
90-100% of AQAL	Slight	Moderate	Moderate	Substantial
100-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Explanation

1. AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.
2. The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5% will be described as Negligible.
3. The Table is only designed to be used with annual mean concentrations.
4. Descriptors for individual receptors only; the overall significance is determined using professional judgement (see Chapter 7). For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.
5. When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme' concentration for an increase.
6. The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approaches and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL.
7. It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

Appendix B: Model Input Data



A – 2015 Baseline

Scenario	Link	(Road)	Speed	Width (m)	AADT	% HDV
2015 baseline	1_1J	1	50	6.6	7,243	0.41
2015 baseline	1_2Js	1	50	6.5	7,243	0.41
2015 baseline	2_1J	2	60	17.2	17,539	1.31
2015 baseline	3_1J	3	60	16.5	11,395	1.83
2015 baseline	3_2	3	68	7	11,395	1.83
2015 baseline	4_1	4	53	4.8	7,243	0.41
2015 baseline	4_2Js	4	40	7.7	7,243	0.41
2015 baseline	5_1	5	35	8.1	6,015	0.33
2015 baseline	5_2J	5	25	5.7	6,015	0.33
2015 baseline	6_1J ebound	6	20	5	1,132	2.35
2015 baseline	6_1J wbound	6	20	5	1,093	1.91
2015 baseline	6_2	6	29	4.8	2,225	2.13
2015 baseline	7_1Js	7	40	6.3	9,480	2.03
2015 baseline	7_2	7	49	5.8	9,480	2.03
2015 baseline	8_1	8	33	4.3	4,777	0.27
2015 baseline	8_2J nbound	8	20	4.8	2,622	0.35
2015 baseline	8_2J sbound	8	20	4.8	2,155	0.16

B – 2019 Baseline

2019 growth	1_1J	1	50	6.6	7,661	0.41
2019 growth	1_2Js	1	50	6.5	7,661	0.41
2019 growth	2_1J	2	60	17.2	18,550	1.31
2019 growth	3_1J	3	60	16.5	12,051	1.83
2019 growth	3_2	3	68	7	12,051	1.83
2019 growth	4_1	4	53	4.8	7,661	0.41
2019 growth	4_2Js	4	40	7.7	7,661	0.41
2019 growth	5_1	5	35	8.1	6,361	0.33
2019 growth	5_2J	5	25	5.7	6,361	0.33
2019 growth	6_1J ebound	6	20	5	1,197	2.35
2019 growth	6_1J wbound	6	20	5	1,156	1.91
2019 growth	6_2	6	29	4.8	2,353	2.13
2019 growth	7_1Js	7	40	6.3	10,026	2.03
2019 growth	7_2	7	49	5.8	10,026	2.03
2019 growth	8_1	8	33	4.3	5,052	0.27
2019 growth	8_2J nbound	8	20	4.8	2,773	0.35
2019 growth	8_2J sbound	8	20	4.8	2,279	0.16

C – 2019 + committed

2019 without	1_1J	1	50	6.6	8,968	0.35
2019 without	1_2Js	1	50	6.5	8,968	0.35
2019 without	2_1J	2	60	17.2	19,857	1.22
2019 without	3_1J	3	60	16.5	12,051	1.83
2019 without	3_2	3	68	7	12,051	1.83
2019 without	4_1	4	53	4.8	8,968	0.35
2019 without	4_2Js	4	40	7.7	8,968	0.35
2019 without	5_1	5	35	8.1	6,361	0.33
2019 without	5_2J	5	25	5.7	6,361	0.33
2019 without	6_1J ebound	6	20	5	1,197	2.35
2019 without	6_1J wbound	6	20	5	1,313	1.68
2019 without	6_2	6	29	4.8	2,510	2.00
2019 without	7_1Js	7	40	6.3	10,026	2.14
2019 without	7_2	7	49	5.8	10,026	2.14
2019 without	8_1	8	33	4.3	5,209	0.26
2019 without	8_2J nbound	8	20	4.8	2,930	0.33
2019 without	8_2J sbound	8	20	4.8	2,279	0.16

D – 2019 + committed + proposed

2019 with	1_1J	1	50	6.6	9,535	0.33
2019 with	1_2Js	1	50	6.5	9,535	0.33
2019 with	2_1J	2	60	17.2	20,424	1.19
2019 with	3_1J	3	60	16.5	12,051	1.83
2019 with	3_2	3	68	7	12,051	1.83
2019 with	4_1	4	53	4.8	9,374	0.34
2019 with	4_2Js	4	40	7.7	9,374	0.34
2019 with	5_1	5	35	8.1	6,690	0.32
2019 with	5_2J	5	25	5.7	6,690	0.32
2019 with	6_1J ebound	6	20	5	1,197	2.35
2019 with	6_1J wbound	6	20	5	1,313	1.68
2019 with	6_2	6	29	4.8	2,510	2.00
2019 with	7_1Js	7	40	6.3	10,355	2.07
2019 with	7_2	7	49	5.8	10,355	2.07
2019 with	8_1	8	33	4.3	5,209	0.26
2019 with	8_2J nbound	8	20	4.8	2,930	0.33
2019 with	8_2J sbound	8	20	4.8	2,279	0.16

Appendix C: Model Verification Study

Model verification studies are undertaken in order to check the performance of dispersion models and, where modelled concentrations are significantly different to monitored concentrations, a factor can be established by which the modelled results can be adjusted in order to improve their reliability. The model verification process is detailed in LAQM.TG(16).

According to TG(16), no adjustment factor is necessary where the results of the model all lie within 25% of the monitored concentrations.

Model verification can only be undertaken where there is sufficient roadside monitoring data in the vicinity of the subject scheme being assessed. TG(16) recommends that a combination of automatic and diffusion tube monitoring data is used; although this may be limited by data availability. Three diffusion tubes in Arun District with appropriate DfT traffic data were selected for this study.

Table C.1 compares monitored and modelled NO₂ concentrations at the four monitoring locations.

Table C.1: Monitored and Modelled Road Contributions of NO₂ at Roadside Monitoring Sites

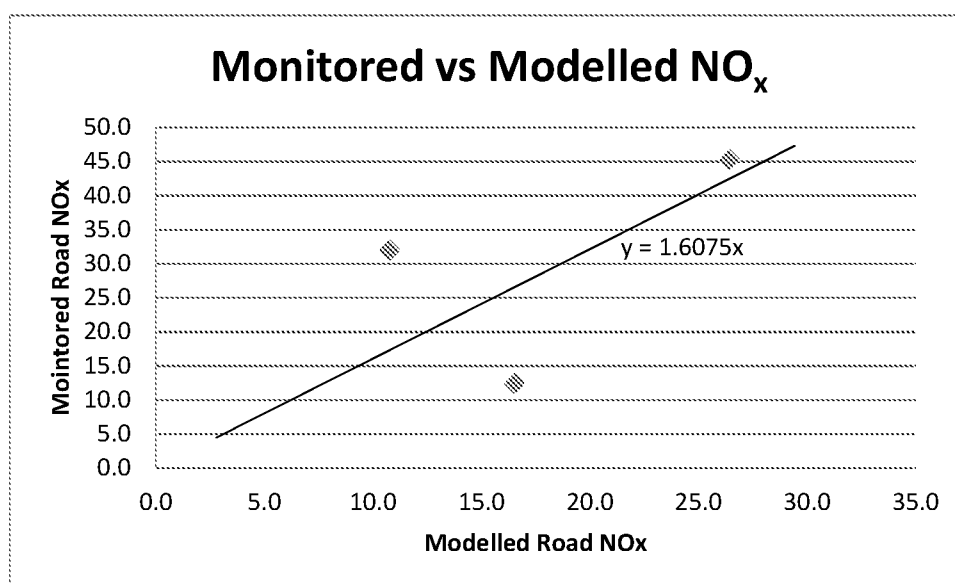
Monitor Location	Type	Concentrations (µg.m ⁻³)		
		Monitored	Modelled	Difference (%)
A27 Roadside	DT	33.0	24.7	-25.2%
A27 Façade	DT	18.0	20.0	11.1%
Worthing Road	DT	28.0	18.0	-35.8%

Note: "DT" = diffusion tube.

The data in Table C.1 show that the model's performance is varied, which is not unusual, particular where the monitors utilised are spread over a wide area with likely variations dispersion characteristics. Whilst the predicted concentrations are close to being within the 25% range permissible according TG(16), the derivation of an adjustment factor is desirable as the model shows a slight tendency to under-predict.

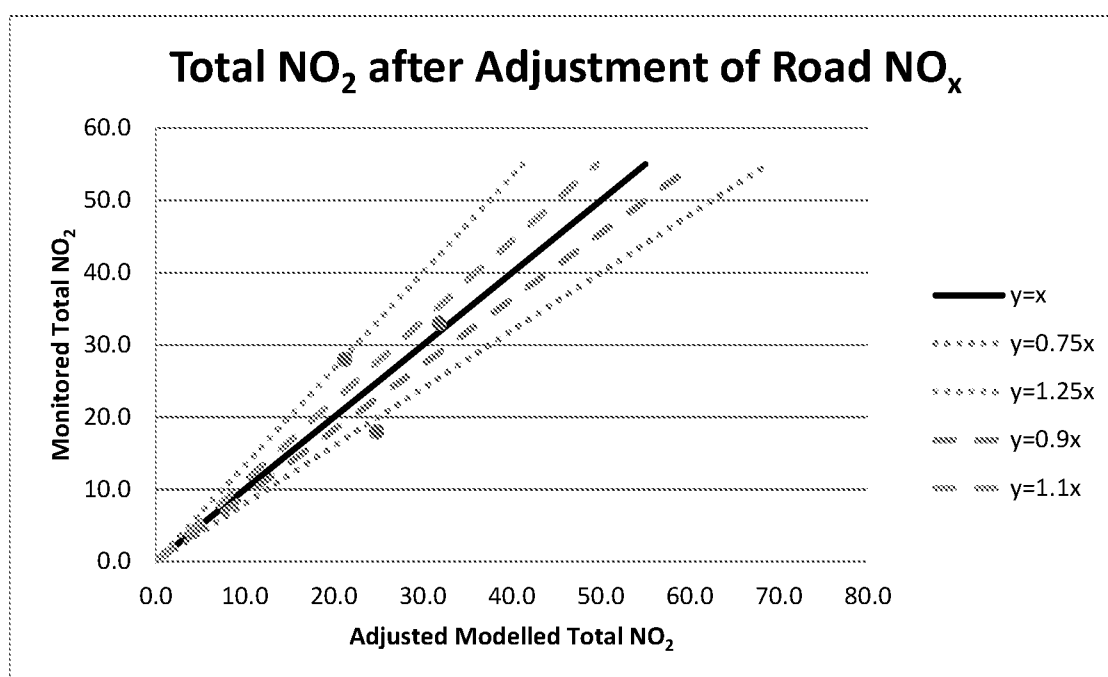
As it is primary NO_x, rather than secondary NO₂, emissions that are modelled, an adjustment factor must be derived for the road contribution of NO_x. A plot of modelled versus monitored NO_x concentrations shows a positive correlation. This graph is included in Figure C.1 below.

Figure C.1: Monitored vs Modelled NO_x



By plotting a trend line through the points on the graph, a factor of 1.61 was derived. Figure C.2 shows total monitored versus modelled NO₂ following the adjustment of the road contribution of NO_x by this factor. It shows that, following this adjustment, the predictions for the two over-predicting monitors from Table C.1 are now well within 25% of monitored concentrations at these locations. At the third point, the NO₂ concentration is over-predicted by 37.6%. As this is a significant over-prediction, the factor of 1.61 was considered to provide conservative results and is therefore appropriate for the adjustment of all modelled road contributions of NO_x for the proposed development.

Figure C.2: Monitored NO₂ vs Modelled NO₂, following adjustment



Appendix D: IAQM Highly Recommended Mitigation

IAQM Highly Recommended Mitigation Measures for sites with a Medium Risk of Dust Impacts

Refer to the IAQM Construction Dust Guidance for further, “desirable”, mitigation measures.

Communications

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
- Display the head or regional office contact information.
- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this Appendix. The DMP may include monitoring of dust deposition, dust flux, real-time PM₁₀ continuous monitoring and/or visual inspections.

Site Management

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Make the complaints log available to the local authority when asked.
- Record any exception incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.

Monitoring

- Carry out regular site inspections to monitor compliance with the Dust Management Plan, record inspection results, and make an inspection log available to the local authority when asked.
- Increase the frequency of inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Agree dust deposition, dust flux, or real-time PM₁₀ continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it is a large site, before work on a phase commences. Further guidance is provided by the IAQM¹⁴ on *monitoring during demolition, earthworks and construction*.

Preparing and Maintaining the Site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Fully enclose 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.

¹⁴ IAQM. (2012). *Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites*.
http://www.iaqm.co.uk/text/guidance/monitoring_construction_sites_2012.pdf

- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on site cover as described below.
- Cover, seed or fence stockpiles to prevent wind whipping.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all vehicles switch off engines when stationary – no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.

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 suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on equipment wherever appropriate.
- 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

- Avoid bonfires and burning of waste materials.

Demolition

- N/A

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.

Trackout

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Record all inspections of haul routes and any subsequent action in a site log book.
- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowzers and regularly cleaned.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior 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.
- Access gates to be located at least 10m from receptors where possible.

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