



Air Quality Assessment

Land North of Water Lane
Angmering, West Sussex

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Air Quality Assessment

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1. Introduction

- 1.1 Phlorum Ltd has been commissioned by Gleeson Strategic Land Ltd and Rydon Homes Ltd to undertake an air quality assessment for the proposed residential-led development on land to the north of Water Lane, Angmering, West Sussex. The National Grid Reference for the centre of the site is 507570, 105225. A site location plan is included as Figure 1.
- 1.2 The proposals comprise the construction of up to 525 housing units, the development of 3ha for employment use and associated highways and landscaping work. Proposals also include improvements to Water Lane's junction with the A280. The total (Red Line) area of the site is approximately 32.1ha.
- 1.3 The application site, which is principally a greenfield site, is located to the east of the large existing village of Angmering. The boundary of the South Downs National Park is adjacent to the site's northern and eastern borders. The northern boundary of the site is formed by the A27 and the southern boundary by Water Lane. To the west of the site are a number of agricultural/commercial units, including stables and plant nurseries as well as residential dwellings. An outline planning application (A/99/17/OUT) for up to 175 No. residential dwellings has been submitted, by Gleeson Strategic Land Ltd and Rydon Homes Ltd for the land directly south of Water Lane.
- 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) directly to the north of the site, the A280 to the south-east and Water Lane, immediately to the south of the site.
- 1.5 There are currently no Air Quality Management Areas (AQMA) in Arun District. The focus of this assessment is to consider the potential for traffic generated by the development to cause significant changes in pollution concentrations at existing sensitive receptor locations, particularly those in Angmering village. This assessment will also consider the cumulative impact of the aforementioned development to the land 'South of Water Lane'.

2. Policy Context

- *****
- 2.1 This section details the legislative and planning contexts 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. ADC has no AQMA's within the District as local air quality monitoring results and LAQM assessments have determined there to be no locations where there are exceedances of the AQS's.

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.*

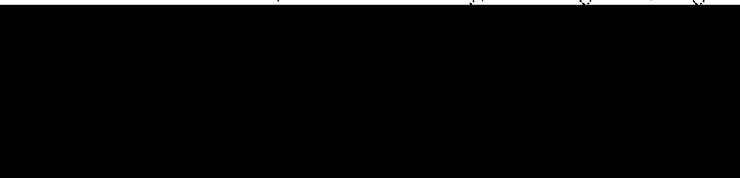
³ Planning Practice Guidance (PPG) 32. (2014). Air Quality.
<http://planningguidance.planningportal.gov.uk/blog/guidance/air-quality/>.

- ❖ *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 AQMAs 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':

"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 The emerging Local Plan also cross-references the Sussex Air Quality Partnership 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.

2.17 As the development is considered a major development, an emissions assessment is required to calculate emissions resulting from the development and to produce a cost for mitigation measures. The emissions assessment must include:

- * *Development traffic input data for emissions calculation*
- * *Emissions calculation and totals*
- * *Mitigation proposed to be equivalent to the value of emissions calculation (appropriate to the type and size of development and local policy requirements).*
- * *Statement of provisions required to minimise emissions to atmosphere under The Control of Dust and Emissions from Construction and Demolition, Best Practice Guidance."*

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 November 2017 and are based on monitoring data from 2015.
- 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 2016 to 2018 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, 105500). It should be noted that the southern part of the application site is in a different UK-AIR grid square; however, as the below background concentrations represent the worst-case across the whole application site the data for the southern grid square was not included.

Table 3.1: 2015 to 2017 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
	2016	2017	2018			
NO ₂	10.4	10.0	9.4	annual mean	40	31 December 2005
PM ₁₀ *	14.5	14.4	12.8	(gravimetric)	40	31 December 2004

6 Defra: UK-AIR. www.uk-air.defra.gov.uk (accessed 26/09/2016).

*Proposed PM₁₀ objectives for 2010 were dropped in the 2007 Air Quality Strategy (there is no AQ5 for PM_{2.5} in England, however local authorities are required to work towards reducing concentrations).

- 3.5 The data in Table 3.1 show that annual mean background concentrations of NO₂ and PM₁₀ at the application site from 2016 to 2018 are predicted to be well below their respective 40µg.m⁻³ AQs. Concentrations of both pollutants are predicted to decline each year. The data show that in 2018, NO₂ and PM₁₀ concentrations are predicted to be below the AQs by 76% and 68%, respectively.

Local Sources of Monitoring Data

- 3.6 Monitoring at background locations is considered an appropriate source of data for the purposes of describing baseline air quality.

Automatic Monitoring

- 3.7 ADC has a widespread monitoring network but does not currently have any real-time, automatic (continuous) monitoring stations. However, neighbouring Adur & Worthing Councils undertake continuous monitoring of both NO₂ and PM₁₀, with results from the nearest monitors included in Table 3.2 and Table 3.3, below, respectively.

Table 3.2: NO₂ monitoring data from Adur & Worthing Automatic Monitors

Monitor	Type	Distance from the application site (km)	NO ₂ annual mean concentration (µg.m ⁻³)				
			2012	2013	2014	2015	2016
Worthing, A27 Grove Lodge	K	6.4	39.5	40.9	51.1	37.4	48
AD1 – Shoreham High Street	K	13.5	-	-	42.6	45.2	-

Note: "K" = kerbside. **Bold** denotes exceedance of the AQs.

- 3.8 The data in Table 3.2 suggests that annual mean concentrations of NO₂ often exceed the 40µg.m⁻³ AQS in the neighbouring District. A maximum 28% exceedance was recorded in 2014, at 'Worthing A27 Grove Lodge', though it is believed that this was a result of increased congestion due to roadworks. Both monitoring sites are located at the kerbside, within urban AQMAs, and therefore represent worst-case exposure to NO₂ pollution; they are, therefore, not considered to be representative of the conditions at the application site, which is located in a more rural area, in a more rural district.

Table 3.3: PM₁₀ monitoring data from Adur & Worthing Automatic Monitors

Monitor	Type	Distance from the application site (km)	PM ₁₀ annual mean concentration (µg.m ⁻³)				
			2012	2013	2014	2015	2016
AD1 – Shoreham High Street	K	13.5	-	-	-	32.6	-

- 3.9 The data in Table 3.3 shows that, in 2015, the annual mean concentration of PM₁₀ at AD1 was below the 40µg.m⁻³ AQS by 19%. It is however, not considered to be representative of the background conditions at the application site.

Non Automatic Monitoring

- 3.10 ADC operates an extensive non-automatic, NO₂ diffusion tube monitoring network across the District, however 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 3.4.

Table 3.4: NO₂ monitoring data from ADC diffusion tubes

Monitor	Site Type	Approximate distance from the application site (km)	NO ₂ annual mean concentration (µg.m ⁻³)			
			2013	2014	2015	2016
Litt 02	R	4.1	22.9	17.2	21.7	20.8
Litt 03	UB	5.1	12.2	10.3	12.9	12.9
Arun 16	R	5.1	18.2	15.0	18.1	17.0

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Arun 06	R	5.1	27.3	21.2	26.4	23.7
Litt 01	R	5.4	21.0	16.7	20.6	20.8
Arun 05	R	5.7	16.1	13.2	15.7	15.2
Litt 04	R	5.7	19.5	14.8	15.9	18.5
Arun 07	UB	6.0	15.7	11.9	12.7	13.7
Arun 14	R	6.2	20.7	18.7	22.4	22.0
Arun 08	R	7.0	16.9	14.3	15.9	15.6

Note: "R" = roadside; "UB" = urban background.

- 3.11 The data in Table 3.4 show that annual mean concentrations of NO₂ were consistently well below the 40µg.m⁻³ AQS, even at roadside locations, between 2013 and 2016. The highest concentration was recorded at Arun 06, in 2013, at 32% below the AQS.
- 3.12 Annual mean NO₂ concentrations were much lower at the two background locations, Litt 03 and Arun 07. The highest annual mean concentration recorded by either monitor was at Arun 07 in 2013; this was 61% below the 40µg.m⁻³ AQS. The recorded concentrations at these background sites are higher, but, comparable to the UK-AIR data in Table 3.1.

Summary of Data used in Assessment

- 3.13 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-engine vehicles. The background concentrations used in the assessment are included in Table 3.5.

Table 3.5: Background annual mean concentrations used in this assessment

Pollutant	Concentration	Data Source
NO ₂	10.4	UK-AIR (2015)
PM ₁₀	14.5	UK-AIR (2015)

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 impact descriptors 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. (2017). 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 sometime 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 statutory ecological receptors within close proximity of the application site. It is however noted that the South Downs National Park lies directly to the north and east of the site. National Parks are primarily a landscape designation with the purpose of "*conserving and enhancing natural beauty, wildlife and cultural heritage*". However, the area of the National Park in vicinity of the application site consists principally of farmland and woodland, which is not considered sensitive to dust-emissions. As such, the impact on ecological receptors is considered to be *Negligible* and will not be further considered in this report.
- 4.6 The annual mean concentration of PM₁₀ is well below the AQS, according to 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.
- 4.7 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/>

Construction Significance

- 4.8 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.
- 4.9 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.
- 4.10 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 PM_{10} , 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."*

- 4.11 Based on these factors, the area is categorised as being of 'Low', 'Medium' or 'High' sensitivity.
- 4.12 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.
- 4.13 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

- 4.14 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 (NO_2/NO_x) and fine particulate matter (PM_{10} and $\text{PM}_{2.5}$). 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.
- 4.15 As it is elevated annual mean concentrations of NO_2 and PM_{10} 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

- 4.16 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 4.1), 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.
- 4.17 The latest Defra Emissions Factor Toolkit (EFT)¹² was used within the model to estimate vehicle emissions.
- 4.18 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 Airport meteorological station, as it was considered to provide the most representative data of similar conditions to the application site. The meteorological data used for this assessment were from 2015, for which monitoring and traffic data were also available for verification purposes. The surface roughness applied to the model for the meteorological station and application site was 0.5m as is typically applied for suburban areas.
- 4.19 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 in Table 4.1, below, and 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. The receptors were modelled at “breathing height”, which is, by convention, 1.5m above ground level.

¹² Defra. (2017). Emissions Factor Toolkit. <http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factorstoolkit.html> (accessed 02/06/2017)

Table 4.1: Modelled Receptors

ID	Receptor	UK Grid Reference	
		X	Y
1	Station Road Cottages	506808	104283
2	Dolphin Cottage	506830	104312
3	School House	506750	104404
4	Eachways	506895	104424
5	Water Lane (west)	506908	104471
6	Gladstone Cottages	507098	104566
7	Weavers mead	507167	104577
8	High Street	506941	104375
9	Committed Development	507642	104740
10	Committed Development	507643	104715
P1	Proposed 1	507531	104793
P2	Proposed 2	507441	104736
P3	Proposed 3	507441	104736

4.20 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:

- Baseline 2018;
- 2021 Without;
- 2021 Without + Committed Developments;; and
- 2021 With + Committed Development.

4.21 All modelled road links are shown in Figure 3, with traffic model inputs included in Appendix B.

Model Verification

4.22 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.

4.23 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 1.99 was applied to the model results.

Sensitivity Tests

4.24 The proposed development includes plans to improve Water Lane's junction with the A280, this will redistribute traffic flows, reducing them to the west of Dapper's Lane and through the centre of Angmering. A sensitivity analysis has been undertaken which assumes no improvements to this junction.

4.25 An additional scenario has been undertaken, which assesses the cumulative impacts associated with 'Land South of Water Lane'(A/99/17/OUT), local committed developments and the proposed development.

4.26 The above sensitivity tests are not included in the main assessment, but are available in Appendix E.

¹³ DfT Traffic Counts. www.dft.gov.uk/traffic-counts

Emissions Assessment

- 4.27 As the development is considered 'major', an emissions assessment, including an emissions cost calculation, is required to comply with Sussex Air Quality Partnership guidance. The approach, as outlined in the Sussex guidance, is included below:

"1. An emissions assessment calculates additional trips generated by the development.

2. The emissions are calculated for pollutants of concern (NO_x & PM₁₀).

3. Using DEFRA IGCB Air Quality Damage Costs for the specific pollutant emissions, the calculation then provides a resultant damage cost calculation.

4. The emissions total is then multiplied x 5, to provide a 5 year exposure cost value. [...]

6. The resulting 5 year exposure cost value, is the value that is to be used to implement mitigation measures within the development. These mitigation measures should be agreed with the Local Planning Authority to ensure that mitigation is in line with local policy and is appropriate for the type, size and location of the development.

7. If some or all mitigation measures cannot be accommodated within the development then mitigation may be provided through compensation via conditions or section 106 contributions. This will be determined by the Local Planning Authority."

- 4.28 The cost calculation has been undertaken using the following formula:

$$\begin{aligned} &\text{Road Transport Emission Increase (cost, £)} \\ &= \text{Estimated trip rate for 5 years} \\ &\times \text{Emission rate per 10km per vehicle type} \times \text{Damage costs} \end{aligned}$$

- 4.29 As a number of the inputs are based on assumptions, the resulting figure should be treated with caution, but it can be used to give an idea of the scale of the development in terms of total transport emissions and therefore to determine the level of mitigation that may be appropriate. The emissions cost calculation utilised the latest Defra EFT to determine the total transport related emissions that would be generated by the proposed development, with reference made to the latest Defra updates.
- 4.30 It is usual for costs established in this way to be apportioned to low emissions measures associated with a proposed development. In doing this it should be possible for damage costs to be offset by accounting for them with a development's intrinsic low emissions measures, and/or mitigations embedded within the development's transport plan.

Consultation

- 4.31 The concept of a major residential led development was discussed with ADC's EHO in November 2015.
- 4.32 The EHO agreed that pollution in the vicinity of the development area is not generally a significant concern. However, given the scale of the proposed development and other proposed developments in the area, he indicated that a detailed dispersion modelling assessment of NO₂ and PM₁₀ concentrations would be required to evaluate operational phase impacts. In addition, he stated that the operational phase assessment should consider both the suitability of the site for its proposed use (residential) and the potential for traffic generated by the development to cause significant changes in pollution concentrations at existing sensitive receptor locations (including residential dwellings, schools and hospitals).
- 4.33 Further discussions with ADC's EHO took place between October and November 2017; the proposed scope of assessment was agreed and we were informed that, in Arun, the Sussex Air Quality Partnership mitigation measures were being reviewed. Furthermore, it was highlighted that ADC was considering taking additional steps to encourage EV charging and low emission vehicles across all developments.

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 Currently, the majority of the site is used for farmland, but the Oval Race Club is located at the centre of the site, which will be demolished. There are no significant existing structures, but some large areas of hardstanding. Therefore, the dust emission magnitude for demolition is expected to be *Small*.

Earthworks

- 5.4 At approximately 402,000m², 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 for significant landscaping in addition to foundations and services for the houses and employment units. However, it is noted that large areas of the site, particularly to the north, will be left undeveloped and green.
- 5.5 Overall, therefore, the dust emission magnitude for the earthworks stage is considered to be *Large*.
- 5.6 The site, which currently consists primarily of fields, is not thought to be contaminated, though there may be some potential hydrocarbon contamination in the vicinity of the raceway. 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. 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 for the residential dwellings, and steel frames and cladding for the employment units. 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 'Large' emission category (greater than 100,000m³) and as such, the dust emission magnitude for the construction stage is considered to be *Large*.

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*.

Emission Magnitude Summary

- 5.12 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 *Large*.

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

Activity	Dust Emissions Magnitude
Demolition	Small
Earthworks	Large
Construction	Large

of the Area

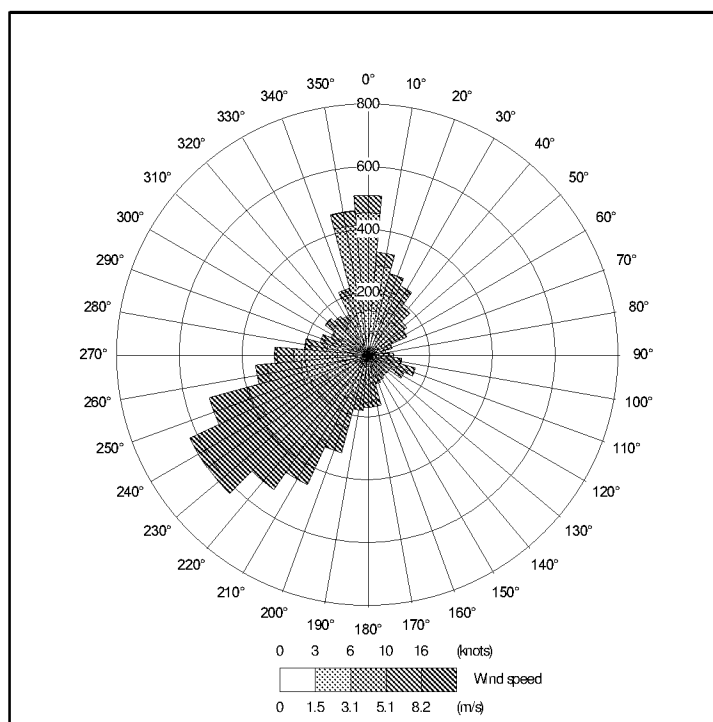
- 5.13 Having established the emission magnitude for dust, above, the sensitivity of the area must be considered to establish the significance of effects. The effect of dust emissions depends on the sensitivity of each receptor. High sensitivity human receptors include residential dwellings, schools and hospitals.
- 5.14 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.
- 5.15 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.
- 5.16 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.

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	8	Dwellings on roads adjacent to Dapper's Lane.
20-100	30	Dwellings to the south-west of the application site around Merryfield Crescent. Northern section of the proposed development south of Water Lane.
100-350	300	Dwellings to the south-west of the site on roads adjacent to Dapper's Lane.

- 5.17 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, 2015



- 5.18 Most of the residential receptors within 100m of the site are to the west, upwind of the prevailing winds. Receptors within 20m, and those to the south of the application site, including proposed receptors are most likely to be affected by dust emissions.
- 5.19 Given the relatively low number of human receptors in the immediate vicinity of the site, the overall sensitivity of the area to dust soiling is considered to be *Medium*.
- 5.20 As concentrations of PM₁₀ are substantially below the AQS, it is considered highly unlikely that there will be exposure to PM₁₀ over or near the long-term AQS.

Risk of Impacts

- 5.21 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	Low Risk	Negligible	Negligible
Earthworks	Medium Risk	Negligible	Low Risk
Construction	Medium Risk	Negligible	Low Risk
Trackout	Low Risk	Negligible	Low Risk

5.22 Overall, the development is considered to be *Medium* risk for nuisance dust soiling effects and *Low* risk for PM₁₀ health effects, in the absence of mitigation. Whilst there is considered to be a *Negligible* risk of ecological impacts.

Site Specific Mitigation

5.23 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.
- 5.24 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.
- 5.25 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.
- 5.26 It is anticipated that the project's dust control measures will be included in a Construction Environmental Management Plan (CEMP).

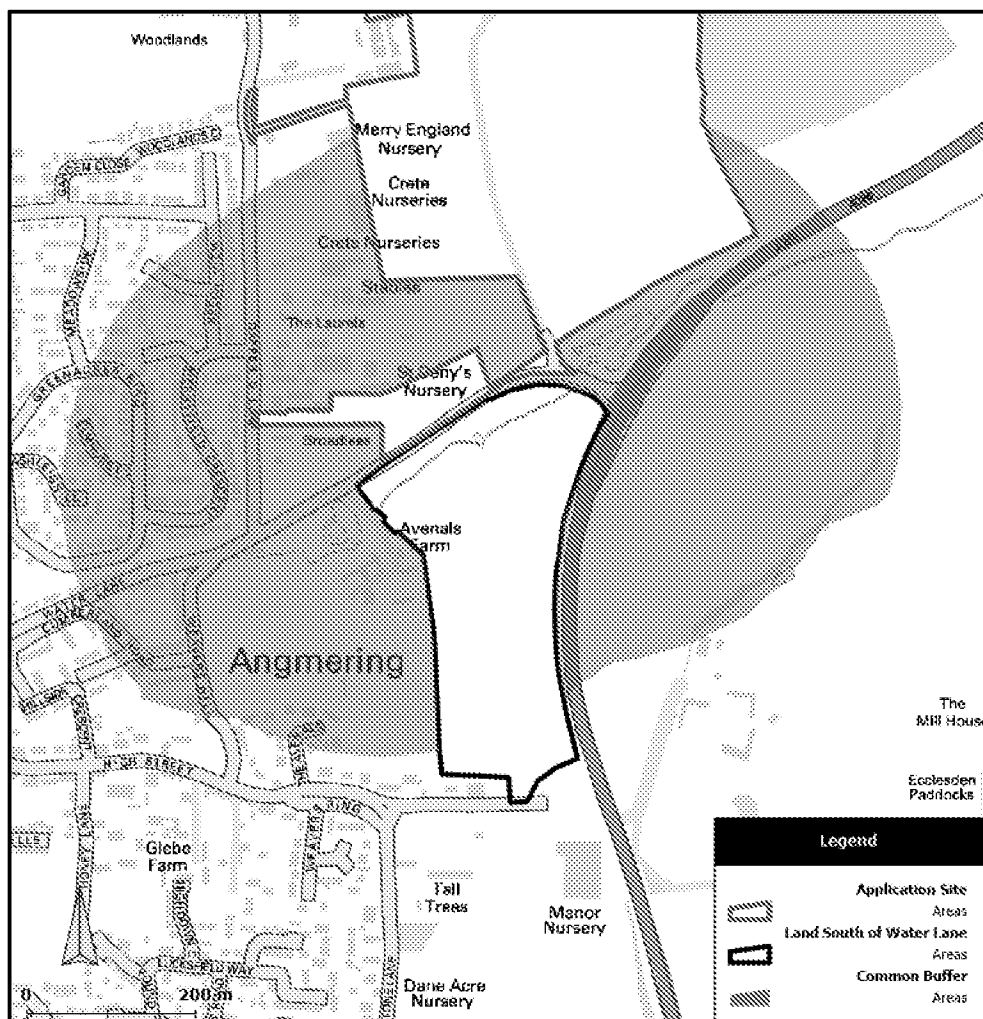
Residual Effects

- 5.27 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*.

Cumulative Effects

- 5.28 Gleeson Strategic Land Ltd and Rydon Homes Ltd have already submitted an outline application for the development of the land to the south of Water Lane (A/99/17/OUT); proposals include the construction of up to 175 No. residential dwellings. It is likely that, if both are accepted, there will be overlap in the construction period of both developments and as such, the potential for some cumulative effects.
- 5.29 The highlighted area in Plate 5.2 below shows the overlap area between the two 350m buffer zones of each development. There are a number of residential dwellings within this area; however, they are all located to the west of the developments. As shown in Plate 5.1, the prevailing wind direction is from the south-east and it is therefore unlikely that construction generated dust from the development to the south of water Lane will be blown into this area. Therefore, the overall cumulative effects are considered to be *Negligible*.

Plate 5.2 Cumulative effects



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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 1.99.
- 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

ID	Annual mean NO ₂ concentration (µg.m ⁻³)				Change due to committed		Change due to proposed			Combined Change		
	2018 Baseline	2021 Baseline	2021 Without + Committed	2021 With + Committed	µg.m ⁻³	As a % of the AQ5	µg.m ⁻³	As a % of the AQ5	EPUK & IAQM Significance	µg.m ⁻³	As a % of the AQ5	EPUK & IAQM Significance
	A	B	C	D	C - B		D - C			(C-B)+(D-C)		
1	18.31	16.68	16.70	16.97	0.02	0.05	0.27	0.67	Negligible	0.29	0.72	Negligible
2	17.89	16.60	16.63	16.87	0.03	0.07	0.24	0.60	Negligible	0.27	0.67	Negligible
3	15.54	13.28	13.32	13.34	0.04	0.10	0.02	0.05	Negligible	0.06	0.15	Negligible
4	15.95	15.04	15.10	15.68	0.06	0.15	0.58	1.45	Negligible	0.64	1.60	Negligible
5	11.97	11.67	11.69	11.85	0.02	0.05	0.16	0.40	Negligible	0.18	0.45	Negligible
6	13.21	12.70	12.73	13.09	0.03	0.08	0.36	0.90	Negligible	0.39	0.98	Negligible
7	14.99	14.21	14.26	14.85	0.05	0.12	0.59	1.48	Negligible	0.64	1.60	Negligible
8	12.55	12.12	12.18	12.11	0.06	0.15	-0.07	-0.18*	Negligible	-0.01	-0.02	Negligible
9	11.31	11.12	11.16	11.26	0.04	0.10	0.10	0.25	Negligible	0.14	0.35	Negligible
10	11.65	11.37	11.41	11.53	0.04	0.10	0.12	0.30	Negligible	0.16	0.40	Negligible

Note: Any apparent discrepancies are due to rounding. *positive impact of proposed development caused by change in HGV flows on adjacent road

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- 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 1 on Water Lane in the '2018 baseline' scenario, at 18.31µg.m⁻³. This is 54% below the AQS.
- 6.5 The greatest increase in annual mean NO₂ concentrations as a result of the proposed development is 0.59µg.m⁻³ at Receptor 7. This is a change of 1.48%, with respect to the AQS, and is considered to be *Negligible*, with reference to the EPUK & IAQM impact descriptors.
- 6.6 Overall, the proposed 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 and committed developments is experienced at Receptors 4 and 7, at 0.64µg.m⁻³; this is an increase of 1.60% with respect to the AQS. This is considered to be a *Negligible* increase with reference to the EPUK & IAQM impact descriptors.
- 6.8 As such, neither the committed developments, nor the combination of the committed developments and the proposed development are anticipated to significantly increase annual mean NO₂ concentrations at any local receptors. The overall cumulative impact on annual mean NO₂ is, therefore, 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(16) 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

ID	Annual mean PM ₁₀ concentration (µg.m ⁻³)				Change due to committed		Change due to proposed			Combined Change		
	2015 Baseline	2021 Baseline	2021 Without + Committed	2021 With + Committed	µg.m ⁻³	As a % of the AQS	µg.m ⁻³	As a % of the AQS	EPUK & IAQM Significance	µg.m ⁻³	As a % of the AQS	EPUK & IAQM Significance
	A	B	C	D	C - B		D - C			(C-B)+(D-C)		
1	15.92	15.87	15.88	15.94	0.01	0.02	0.06	0.15	Negligible	0.07	0.17	Negligible
2	15.84	15.84	15.85	15.90	0.01	0.03	0.05	0.14	Negligible	0.06	0.16	Negligible
3	15.15	15.05	15.07	15.07	0.01	0.03	0.00	0.01	Negligible	0.02	0.04	Negligible
4	15.46	15.42	15.44	15.55	0.01	0.03	0.12	0.29	Negligible	0.13	0.32	Negligible
5	14.77	14.75	14.75	14.78	0.00	0.01	0.03	0.08	Negligible	0.03	0.09	Negligible
6	14.99	14.95	14.96	15.03	0.00	0.01	0.07	0.18	Negligible	0.08	0.19	Negligible
7	15.30	15.25	15.26	15.38	0.01	0.02	0.12	0.30	Negligible	0.13	0.32	Negligible
8	14.84	14.83	14.84	14.83	0.01	0.03	-0.01	-0.03	Negligible	0.00	0.00	Negligible
9	14.68	14.66	14.67	14.69	0.01	0.02	0.02	0.06	Negligible	0.03	0.08	Negligible
10	14.74	14.72	14.73	14.76	0.01	0.01	0.03	0.07	Negligible	0.03	0.09	Negligible

Note: Any apparent discrepancies are due to rounding.

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- 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 concentration was predicted at Receptor 1 in the 'with development' scenario, at 15.92µg.m⁻³; this is 60% below the AQS.
- 6.11 The maximum change in annual mean PM₁₀ concentrations as a result of the proposed development is predicted to be 0.12µg.m⁻³; this is a 0.30% increase with respect to the AQS and is considered to be *Negligible*, with reference to the EPUK & IAQM impact descriptors.
- 6.12 The maximum change as a result of both the proposed and committed developments is 0.13g.m⁻³; this is a 0.32% increase, with reference to the AQS and is considered to be *Negligible*. The overall combined impact of the proposed and committed developments on annual mean PM₁₀ concentrations is considered to be *Negligible*.
- 6.13 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:

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

- 6.14 The highest annual mean PM₁₀ concentration in Table 6.2 is 15.92µg.m⁻³. Based on the above formula, this would lead to 0.79 exceedance days, which is 97.7% 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

- 6.15 Although the suitability of the site for residential use, in terms of ambient air quality, is unlikely to be a significant issue given the relatively rural location, pollution concentrations were predicted at the façades of the proposed dwellings closest to Water Lane, 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 2021

Receptor No.	Annual mean concentration (µg.m ⁻³)		50µg.m ⁻³ mean exceedance days
	NO ₂	PM ₁₀	PM ₁₀
P1	12.07	14.86	0.62

Receptor No.	Annual mean concentration ($\mu\text{g.m}^{-3}$)		50 $\mu\text{g.m}^{-3}$ mean exceedance days
	NO ₂	PM ₁₀	PM ₁₀
P2	11.85	14.81	0.62
P3	12.94	15.05	0.63

- 6.16 The data in Table 6.3 show that annual mean NO₂ concentrations are predicted to be well below the 40 $\mu\text{g.m}^{-3}$ AQS at all modelled proposed receptor points. The highest predicted concentration is 12.94 $\mu\text{g.m}^{-3}$ at Receptor P3. This is 68% below the AQS.
- 6.17 Meanwhile, annual mean concentrations of PM₁₀ and daily mean PM₁₀ exceedance days are expected to be 62% and 98% below their respective AQSs.
- 6.18 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.

Sensitivity Analysis

- 6.19 The above ADMS-Roads assessment has been re-run under the assumption that there will be no improvements to Water Lane's junction with the A280. In this scenario, there are increases in traffic flows, adjacent to key receptor locations, through the centre of Angmering. Full details of this study can be found in Appendix E.
- 6.20 There were no changes in the significance of impacts at any receptor locations as a result of this test; all impacts remained *Negligible*.
- 6.21 There were no changes in the significance of impacts at any receptor locations as a result of including traffic from the development 'Land South of Water Lane'; All impacts remained *Negligible*.

Mitigation

- 6.22 The operational phase assessment has indicated that there should be no significant impacts on local air quality as a result of the proposed development. However, an emissions cost calculation is still required. The Sussex Air Quality Partnership guidance states that where impacts are low/imperceptible, planning should recommend "minimum mitigation"; as such, the following inputs, in Table 6.4, used to derive the emission cost are, where appropriate, best-case estimates.

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Table 6.4: NO_x Emissions cost calculation data inputs

Input		Value	Unit	Source/Explanation
Trip length		10	km	Assumed average trip length from EPUK IAQM (2017) guidance.
EFT Road Type		Urban (not London)	-	N/A
Year		2021	-	Opening year
Speed		58	Km.hr ⁻¹	Highest speed for Water Lane
Traffic flow	LDV	3293	AADT	24hr development trip generation provided by Transport Consultant.
	HDV	0		
Cost/tonne	NO _x	£15,151	£	Central estimate damage cost for NO _x Transport urban small' (Defra updated 2015 prices) ¹⁴ . Central estimate damage cost for PM ₁₀ : Transport urban small' (Defra updated 2015 prices).
	PM ₁₀	£41,850		
Development transport emissions	NO _x	3.056	Tonnes	Output from Defra EFT.
	PM ₁₀	0.375		

$$\text{NO}_x \text{ emission 'damage' (cost, £)} = 15,151 \times 3.056 \times 5 \text{ years} = \text{£231,507}$$

$$\text{PM}_{10} \text{ emission 'damage' (cost, £)} = 41,650 \times 0.375 \times 5 \text{ years} = \text{£79,094}$$

$$\text{TOTAL (cost, £)} = \text{£310, 601}$$

6.23 The total emissions 'damage' cost for the proposed development, based on Sussex Air Quality Partnership guidance, has been calculated as being just over £310k. As the calculation is based on a number of assumptions the total emissions cost should only be considered as a rough guide to the level of mitigation that might be appropriate.

14 Defra. Damage costs by location and source (Defra 2015 update)

6.24 As discussed in paragraph 4.28, low emission measures intrinsic to the development's design or travel plan can be used to offset this cost. The indicative costs of low emission measures included in the project's travel plan are included in Table 6.5, below. Not all measures within the travel plan were selected; measures were selected on their ability to encourage a modal shift away from car-use, to encourage more sustainable and healthier travel modes.

Travel Plan Measure	Initial Cost	Total Cost	Notes
Walking and Cycling Maps	£1,500	£4,500	Two annual refreshes
Pedestrian / cycleway / Public Transport connection to Dappers Lane	£75,000	£75,000	
Water Lane Pedestrian / Cycleway	£100,000	£100,000	
Travel Voucher	£45,938	£45,938	£150 per household –assuming 50% uptake
Travel Plan Coordinator	£0	£52,500	7 years of travel plan coordinator. This includes creating a bicycle user group and an informal residential car sharing scheme.
Bus Stop Infrastructure on site	£40,000	£40,000	
Total cost: £317, 938			

Table 6.5: Indicative costs for low emission measures included in the travel plan

- 6.25 The low emission measures included in the travel plan are anticipated to offset the damage cost calculation.
- 6.26 In addition, the results from the sensitivity test included in Appendix E show that without the proposed improvements to Water Lane's junction with the A280, traffic flows, and hence toxic air pollution through the centre of Angmering are anticipated to increase. Therefore, the cost of the junction improvements should also be considered as a low emission measure.
- 6.27 The Sussex air quality guidance also lists a number of additional mitigation options which should be considered if further off-setting is required:
- ❖ Car club provision or support to local car club/EV car club;
 - ❖ Designation of parking spaces for low emission vehicles;
 - ❖ Differential parking charges depending on vehicle emissions;
 - ❖ All commercial vehicles should comply with either current or previous European Emission Standard;
 - ❖ Fleet operations should provide a strategy for considering reduced emissions, low emission fuels and technologies;
 - ❖ Use of ultra-low emission service vehicles;
 - ❖ Support local walking and cycling initiatives;
 - ❖ On-street EV recharging;
 - ❖ Contribution to low emission vehicle refuelling infrastructure;
 - ❖ Low emission bus service provision or waste collection services;
 - ❖ Bike/e-bike hire schemes;
 - ❖ Contribution to renewable fuel and energy generation projects; and/or
 - ❖ Incentives for the take-up of low emission technologies and fuels.

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 urban 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 exceedances of the long or short term AQs for NO₂ or PM₁₀ are anticipated at any of the modelled 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, nearby committed developments and the 'Land at South of Water Lane' development was also assessed and deemed to be negligible.
 - 7.5 The improvements to Water Lane's junction with the A280 are anticipated to result in improvements in air quality through the centre of Angmering; these improvements are, however, deemed to be negligible.
 - 7.6 Air quality has also been shown to be acceptable across the application site, with no exceedances of the key AQs for NO₂ or PM₁₀ expected. Future occupants of the site should not, therefore, be exposed to unacceptable air quality.
 - 7.7 An emissions cost calculation was required, in line with the Sussex Air Quality Partnership guidance. An emissions damage cost of £310,601 was calculated. The low emission measures associated with implementing the proposed development's travel plan are anticipated to offset this damage cost.
 - 7.8 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.

- 7.9 With respect to air quality, the proposed development is considered to comply with the requirements of the NPPF and Policies SP1 and DM3 of the emerging Arun Local Plan. The proposed development will not have a significant impact on residential amenity, it will not lead to any exceedances of the AQs at any existing or proposed receptors. Additionally the development proposes construction mitigation measures which will attend to any potential low/imperceptible impacts.

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Date: 13 February 2018

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8. Conclusions

- *****
- 8.1 This report has assessed current air quality at Land North 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 2: Construction Phase Receptors

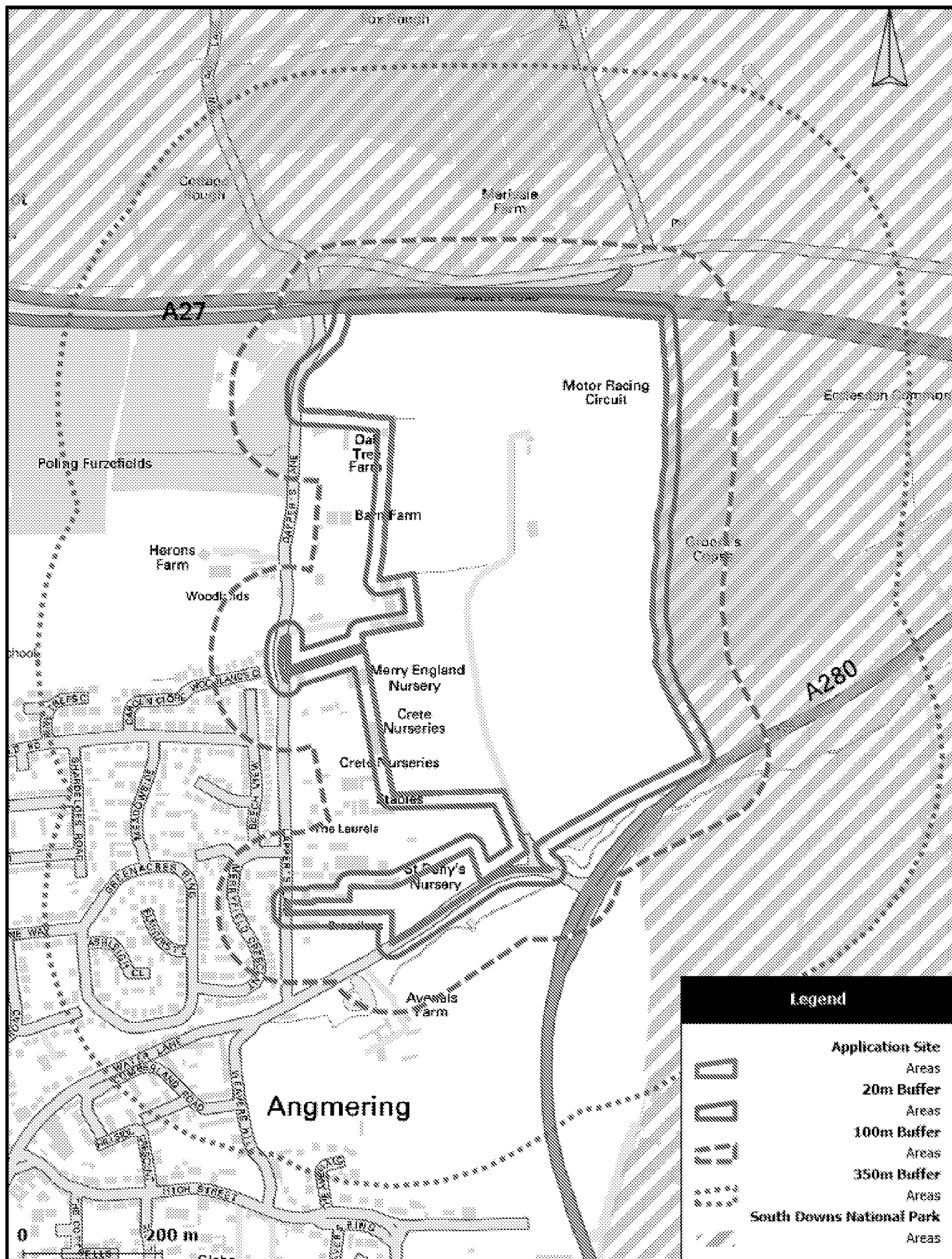
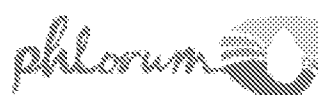


Figure 2: Construction Phase Receptors.

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Figure 3: Operational Phase Assessment

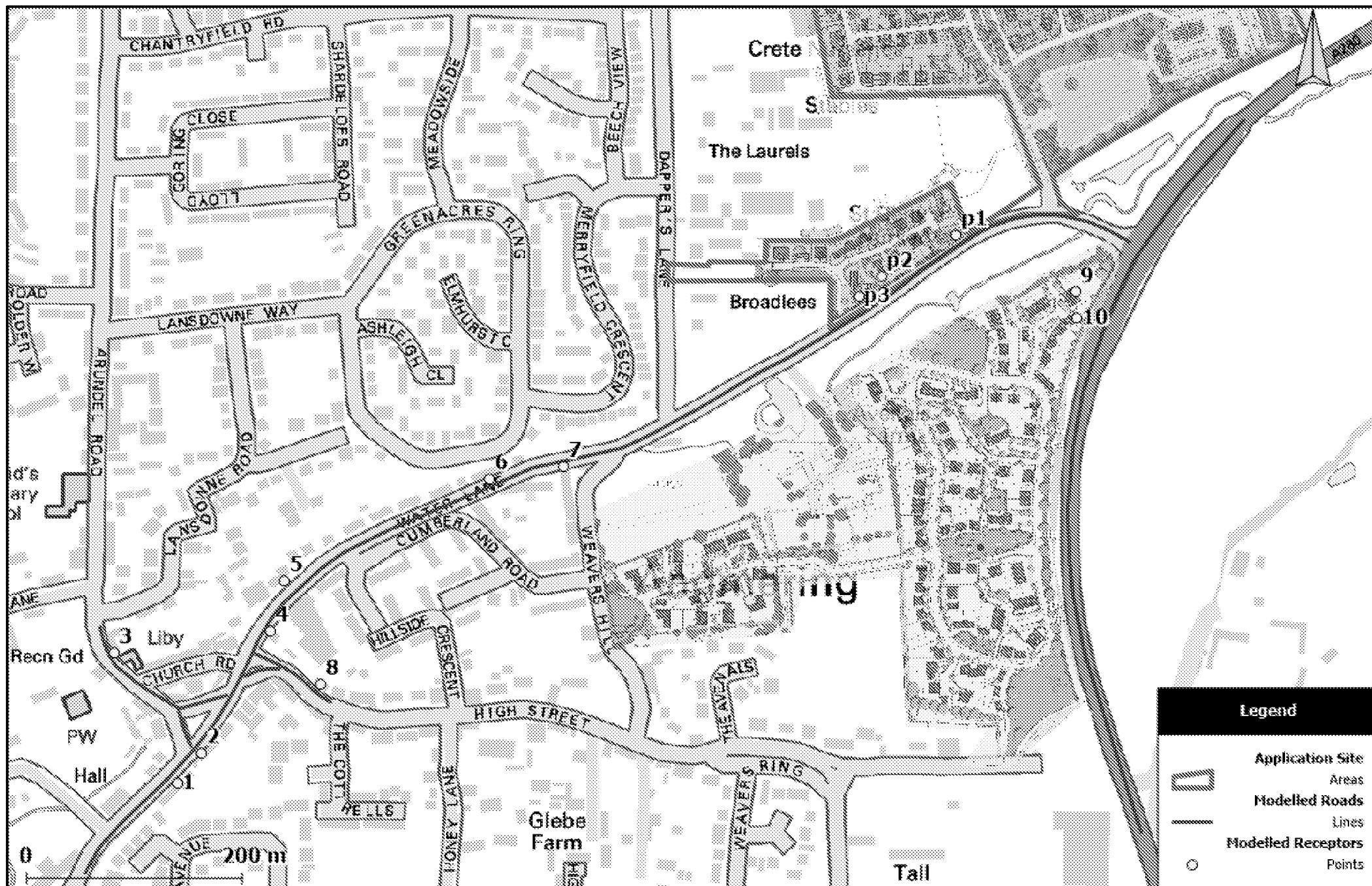
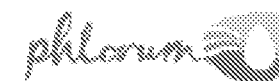


Figure 3: Operational Phase Receptors.

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Appendix A: EPUK & IAQM Impact Descriptors

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-3	6-10	+10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

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

Table B.2 Raw AADT Traffic Data used in the assessment, supplied by the project's transport consultant, i-Transport.

Link ID	Link Name	Direction	Speed (km/hr)	Baseline 2018		Without 2021		Without 2021 + Committed		With 2021 + Committed	
				HDVs	LDVs	HDVs	LDVs	HDVs	LDVs	HDVs	LDVs
1	Water Lane (west of A280)	Eastbound	58.61	8	3316	9	3427	9	5053	9	5135
		Westbound	46.91	22	4119	23	4257	23	4893	23	5799
2	A280 Angmering Bypass	Eastbound	69.52	124	8476	128	8762	128	9519	128	10469
		Westbound	67.8	112	9365	116	9680	116	10316	116	11222
3	A280 (North of Ecclesden Lane)	Northbound	69.39	94	5645	98	5835	98	5835	98	5884
		Southbound	66.68	120	5885	124	6083	124	6794	124	6083
4	Water Lane (east of Dappers Lane)	Eastbound	58.61	8	3316	9	3427	9	5053	9	4863
		Westbound	46.91	22	4119	23	4257	23	4893	23	5610
5	Water Lane (east of High Street)	Eastbound	34.73	10	2993	10	3094	10	3715	10	3681
		Westbound	36.13	11	3186	11	3293	11	3317	11	3892
6	High Street (west of Cotterels)	Eastbound	29.05	27	1139	28	1178	28	791	28	1178
		Westbound	28	22	1105	22	1142	22	1259	22	1259
7	Station Road	Northbound	47.36	114	5746	118	5941	118	5977	118	6521

		Southbound	51.58	95	3816	98	3945	98	3843	98	4540
8	Arundel Road	Northbound	32.88	9	2693	10	2784	10	2901	10	2905
		Southbound	33.44	4	2217	4	2292	4	2292	4	2296
9	A27 (west of Long Furlong)	Eastbound	112.65	1090	14258	1126	14738	1126	14885	1248	14924
		Westbound	112.65	1075	14066	1111	14550	1111	14540	1111	14707

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 three monitoring locations.

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

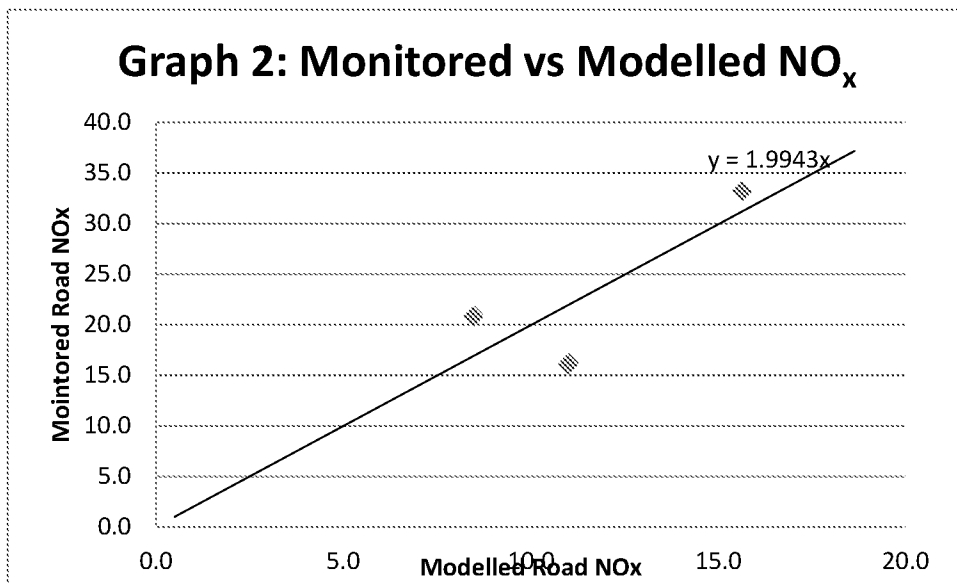
Monitor Location	Type	Concentrations (µg.m ⁻³)		
		Monitored	Modelled	Difference (%)
Litt 02	DT	21.7	15.4	-28.9%
Arun 06	DT	18.1	15.5	-14.5%
Arun 16	DT	26.4	17.9	-32.4%

Note: "DT" = diffusion tube.

The data in Table C.1 show that the model is under-predicting concentrations at all locations to a varying degree. This is a pattern frequently seen in model verification studies, and is likely to be the result of local dispersion characteristics. All but one modelled concentration were outside 25% of the monitored results and thus it was decided to proceed with adjustment as the model was not performing well. This was done to ensure conservative results.

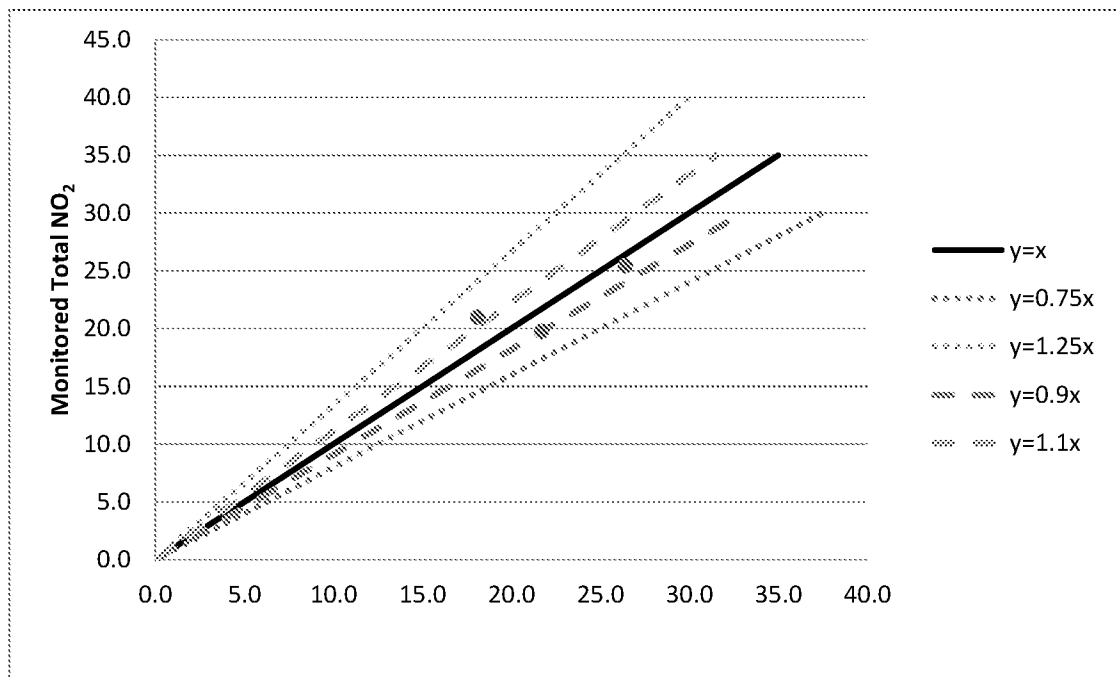
As it is primary NO_x, rather than secondary NO₂, emissions that are modelled, an adjustment factor must be derived for the road contribution of NO_x. A plot of modelled versus monitored NO_x concentrations shows a positive correlation. This graph is included in Figure C.1 below.

Figure C.1: Monitored vs Modelled NO_x



By plotting a trend line through the points on the graph, a factor of 1.99 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 under-predicting monitors from Table C.1 are now well within 25% of monitored concentrations at these locations.

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 IAQM¹⁵ 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.
- Remove materials that have a potential to produce dust from site as soon as possible,

¹⁵ 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

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 bowsers 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.

Appendix E: Sensitivity Test

Table E.1 Predicted annual mean NO₂ concentrations at receptors with no improvements to the A280

Name	2018 Baseline	2021 Without	2021 Without + Committed	2021 With +Committed	Change Due To Committed	% Change Of AQ5	Change Due To Proposed	% Change With Committed	Significance	Combined Change	Cumulative Significance
	A	B	C	D	C - B		D - C				
1	18.31	16.68	16.70	17.31	0.02	0.05	0.61	1.75	Negligible	1.77	Negligible
2	17.89	16.60	16.63	17.18	0.03	0.07	0.55	1.60	Negligible	1.63	Negligible
3	15.54	13.28	13.32	13.35	0.04	0.10	0.03	0.15	Negligible	0.19	Negligible
4	15.95	15.04	15.10	15.79	0.06	0.15	0.69	2.13	Negligible	2.19	Negligible
5	11.97	11.67	11.69	11.88	0.02	0.05	0.19	0.60	Negligible	0.62	Negligible
6	13.21	12.70	12.73	13.12	0.03	0.08	0.39	1.25	Negligible	1.28	Negligible
7	14.99	14.21	14.26	14.89	0.05	0.12	0.63	2.00	Negligible	2.05	Negligible
8	12.55	12.12	12.18	12.29	0.06	0.15	0.11	0.30	Negligible	0.36	Negligible
9	11.31	11.12	11.16	11.20	0.04	0.10	0.04	0.15	Negligible	0.19	Negligible
10	11.65	11.37	11.41	11.44	0.04	0.10	0.03	0.13	Negligible	0.17	Negligible
P1	11.89	11.63	11.83	12.04	0.20	0.50	0.21	0.68	NA	0.88	NA
P2	11.70	11.47	11.64	11.82	0.17	0.43	0.18	0.55	NA	0.72	NA
P3	12.64	12.25	12.56	12.88	0.31	0.78	0.32	0.98	NA	1.29	NA

Table E.2 Predicted annual mean PM₁₀ concentrations at receptors with no improvements to the A280

Name	2018 Baseline	2021 Without	2021 Without + Committed	2021 With + Committed	Change Due To Committed	% Change Of AQS	Change Due To Proposed	% Change With Committed	Significance	Combined Change	Cumulative Significance
	A	B	C	D	C - B		D - C				
1	15.92	15.87	15.88	16.02	0.01	0.02	0.14	0.34	Negligible	0.37	Negligible
2	15.84	15.84	15.85	15.97	0.01	0.03	0.12	0.31	Negligible	0.34	Negligible
3	15.15	15.05	15.07	15.07	0.01	0.03	0.01	0.01	Negligible	0.04	Negligible
4	15.46	15.42	15.44	15.57	0.01	0.03	0.14	0.35	Negligible	0.38	Negligible
5	14.77	14.75	14.75	14.79	0.00	0.01	0.04	0.09	Negligible	0.10	Negligible
6	14.99	14.95	14.96	15.03	0.00	0.01	0.08	0.19	Negligible	0.20	Negligible
7	15.30	15.25	15.26	15.39	0.01	0.02	0.13	0.32	Negligible	0.34	Negligible
8	14.84	14.83	14.84	14.86	0.01	0.03	0.02	0.05	Negligible	0.08	Negligible
9	14.68	14.66	14.67	14.68	0.01	0.02	0.01	0.02	Negligible	0.04	Negligible
10	14.74	14.72	14.73	14.74	0.01	0.01	0.01	0.02	Negligible	0.04	Negligible
P1	14.78	14.76	14.81	14.85	0.04	0.11	0.04	0.11	NA	0.22	NA
P2	14.75	14.73	14.76	14.80	0.04	0.09	0.04	0.10	NA	0.19	NA
P3	14.93	14.90	14.97	15.03	0.07	0.17	0.07	0.17	NA	0.34	NA

Table E.2 Land South Of Water Lane Sensitivity Test (NO₂)

Name	2021 Without	2021 With + Committed + Land South of Water Lane	Total Combined Change	% Change Of AQS	Significance
	B	E	E-B		
1	16.68	17.56	0.88	2.20	Negligible
2	16.60	17.40	0.80	2.00	Negligible
3	13.28	13.35	0.07	0.18	Negligible
4	15.04	15.99	0.95	2.38	Negligible
5	11.67	11.93	0.26	0.65	Negligible
6	12.70	13.23	0.53	1.33	Negligible
7	14.21	15.08	0.87	2.18	Negligible
8	12.12	12.31	0.19	0.48	Negligible
9	11.12	11.23	0.11	0.28	Negligible
10	11.37	11.47	0.10	0.25	Negligible
P1	11.63	12.15	0.52	1.30	-
P2	11.47	11.92	0.45	1.13	-
P3	12.25	13.05	0.80	2.00	-

Table E.2 Land South Of Water Lane Sensitivity Test (PM₁₀)

Name	2021 Without	2021 With + Committed + Land South of Water Lane	Total Combined Change	% Change Of AQS	Significance
	B	E	E-B		
1	15.87	16.07	0.20	0.51	Negligible
2	15.84	16.02	0.19	0.46	Negligible
3	15.05	15.07	0.02	0.05	Negligible
4	15.42	15.62	0.19	0.48	Negligible
5	14.75	14.80	0.05	0.13	Negligible
6	14.95	15.06	0.10	0.26	Negligible
7	15.25	15.42	0.17	0.43	Negligible
8	14.83	14.87	0.04	0.09	Negligible
9	14.66	14.69	0.02	0.06	Negligible
10	14.72	14.74	0.02	0.05	Negligible
P1	14.76	14.87	0.11	0.28	-
P2	14.73	14.82	0.10	0.24	-
P3	14.90	15.07	0.17	0.43	-



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