Chapter 6: Air Quality

AIR QUALITY	
AUTHOR	Air Quality Consultants (AQC) Ltd
SUPPORTING APPENDIX	***ES Volume 2, Appendix: Air Quality***: Annex 1: EPUK & IAQM Planning for Air Quality Guidance; Annex 2: Professional Experience; Annex 3: Modelling Methodology; Annex 4: Construction Dust Assessment Procedure; Annex 5: Energy Plant Specifications; Annex 6: Construction Mitigation; Annex 7: Legislative and Planning Policy Context; Annex 8: Technical Appendices References; and Annex 9: Glossary.
KEY CONSIDERATIONS	Woking Borough Council (WBC) has declared two Air Quality Management Areas (AQMAs), one of which (AQMA Order 2) is located approximately 1.7 km to the north-east of the Proposed Development. Woking AQMA Order 2 was declared due to the exceedances of the annual mean nitrogen dioxide (NO_2). Activities associated with the demolition and construction works of the Proposed Development will give rise to a risk of dust impacts at existing sensitive receptors during demolition, earthworks and construction, as well as from trackout of dust and dirt by vehicles onto the public highway. A qualitative construction dust risk assessment has thus been carried out. In addition, the potential for construction vehicles to impact upon local air quality has been qualitatively considered. During the operational phase, the Proposed Development will lead to changes in vehicle flows on local roads, which may impact on air quality at existing residential properties. The proposed residential properties will also be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to road traffic emissions are NO_2 and fine particulate matter (PM_{10} and $PM_{2.5}$). The Proposed Development includes one natural gas-fired Combined Heat and Power (CHP) unit, and three gas-fired condensing boiler plant units, the emissions from which could impact upon air quality at existing sensitive properties, as well as at the residential apartments within the Proposed Development itself. The main air pollutant of concern related to energy plant is NO_2. The impacts of the Proposed Development-generated road traffic and energy plant emissions at the local designated site (Smart's and Prey Heath Site of Special Scientific Interest (SSSI)) located 550m south-west of the site, has also been considered. In terms of the potential air quality effects, the assessment will consider: • The impacts of the demolition and construction of the Proposed Development on dust soiling and concentrations of PM_{10} on existing sensitive human receptors; • The impact of the construction of the Proposed Development on concentrations of NO_2, PM_{10} and $PM_{2.5}$, generated by heavy duty construction traffic; • The impacts of the operation of the Proposed Development on concentrations of NO_2, PM_{10} and $PM_{2.5}$ from road traffic and energy plant emissions at existing local human sensitive receptors in the proposed year of opening; • The impacts of the Proposed Development on annual mean and 24-hour mean concentrations of nitrogen oxides (NOx), and nutrient and acid nitrogen deposition rates, from road traffic and energy plant emissions at existing local ecological receptors in the proposed year of opening; and • the impacts of existing (road and railway) and proposed (Proposed Development-generated traffic and energy plant) emission sources of NO_2, PM_{10} and $PM_{2.5}$ on future residents of the Proposed Development.
CONSULTATION	The EIA Scoping Opinion is presented in ***ES Volume 2, Appendix: EIA Methodology (Annex 1)*** which confirmed acceptability of the scope and method proposed for the air quality assessment.

ASSESSMENT METHODOLOGY

Assessment Criteria

Human Health

6.1 The UK Central Government[1] has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely, even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations 2000[2] and the Air Quality (England) (Amendment) Regulations 2002[3].

6.2 The objectives for NO_2 and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour NO_2 objective is unlikely to be exceeded at roadside locations where the annual mean concentration is below 60 µg/m^3[4]. Where relevant, this value has been used as an indication of the likelihood of the 1-hour mean NO_2 objective to be exceeded in the study area. Measurements have also shown that the 24-hour PM_{10} objective could be exceeded at roadside locations where the annual mean concentration is above 32 µg/m^3[4]. The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedance of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 µg/m^3, it is unlikely that the 24-hour mean objective will be exceeded.

6.3 The European Union has also set limit values for NO_2, PM_{10} and $PM_{2.5}$. The limit values for NO_2 are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one[5]. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not normally recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded, unless such studies have been audited and approved by the Department for Environment, Food and Rural Affairs (Defra) and DfT's Joint Air Quality Unit (JAQU).

6.4 The relevant air quality criteria for this assessment are provided in Table 6.1.

Table 6.1 Air Quality Criteria for NO_2, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide (NO_2)	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year
	Annual mean	40 µg/m^3 [a]
Fine Particles (PM_{10})	24-hour mean	50 µg/m^3 not to be exceeded more than 35 times a year
	Annual mean	40 µg/m^3 [b]
Fine Particles ($PM_{2.5}$)[c]	Annual mean	25 µg/m^3

[a] A proxy value of 60 µg/m^3 as an annual mean can be used to assess the likelihood of the 1-hour mean NO_2 objective being exceeded. Measurements have shown that, above this concentration, exceedances of the 1-hour mean NO_2 objective are possible[3]

[b] A proxy value of 32 µg/m^3 as an annual mean is used to assess the likelihood of the 24-hour mean PM_{10} objective being exceeded. Measurements have shown that, above this concentration, exceedances of the 24-hour mean PM_{10} objective are possible[4]

[c] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Vegetation and Ecosystem Criteria

6.5 Objectives for the protection of vegetation and ecosystems have been set by the UK Government. They are the same as the EU limit values. Some of the critical levels are set at the same concentrations as the objectives, but do not have the same legal standing. The critical levels relevant to this assessment are set out in Table 6.2, whilst the critical loads are provided in Table 6.3.

6.6 The UK government states that ecosystem objectives only strictly apply at locations more than 5 km from Part A industrial sources, motorways and built up areas of more than 5,000 people. The SSSI is located within 5 km of the town of Woking, which has a population substantially greater than 5,000 and, therefore, the objectives do not apply. Natural England, however, has adopted a more precautionary approach and applies the objectives as the critical levels. These are levels above which the concentrations are identified as of concern, but they are not required to be met by regulations.

[1] Hereafter referred to as the 'UK Government', 'Central Government' or 'Government'.

[2] The Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000), HMSO, Available: http://www.legislation.gov.uk/uksi/2000/928/contents/made.

[3] The Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043 (2002), HMSO, Available: https://www.legislation.gov.uk/uksi/2002/3043/contents/made.

[4] Defra (2018) Review & Assessment: Technical Guidance LAQM.TG16 February 2018 Version, Defra, Available: https://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf.

[5] European Parliament and the Council of the European Union (2008) Directive 2008/50/EC of the European Parliament and of the Council, Available: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0050.

Table 6.2 Vegetation and Ecosystem Critical Levels [a]

Pollutant	Time Period	Critical Level
Nitrogen Oxides (expressed as NO_2)	Annual mean [b]	30 µg/m^3
	24-hour mean [c]	75 µg/m^3

[a] The critical levels are defined by the World Health Organisation (WHO)[6].

[b] Away from major sources (see Paragraph 6.5), this critical level is set as an objective[7] and a limit value[8].

[c] The critical level is not an objective and thus does not have the same legal standing.

Table 6.3 Vegetation and Ecosystem Critical Loads

Habitat Type (and EUNIS code) [a]	Nutrient Nitrogen (kgN/ha/yr) [b]	Acid Deposition 'N_{max}' (keq/ha/yr) [c]
Smart's and Prey Heaths SSSI (1006793)	10	0.892

[a] The European Nature Information System[9].

[b] Critical loads for nutrient nitrogen taken from APIS[10]. The critical load value used is the most stringent across the entire SSSI and is not specific to the receptors assessed.

[c] Critical loads for acid deposition have been taken from APIS[11]. The critical load value used is the most stringent across the entire SSSI and is not specific to the receptors assessed. For this assessment, and following the approach recommended by APIS for situations where the baseline flux exceeds the equivalent 'N_{min}' value, the sum of nitrogen deposition (in keq/ha/yr/) has been compared directly against the N_{max}[11].

Road Traffic Screening Criteria

6.7 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[12] recommend a two-stage screening approach to determine whether emissions from road traffic generated by a development have the potential for significant air quality impacts. The approach, as described in ***ES Volume 2, Appendix: Air Quality (Annex 1)***, first considers the size and parking provision of a development; if the development is residential and is for fewer than ten homes or covers less than 0.5 ha, or is non-residential and will provide less than 1,000 m^2 of floor space or cover a site area of less than 1 ha, and will provide ten or fewer parking spaces, then there is no need to progress to a detailed assessment. The second stage then compares the changes in vehicle flows on local roads that a development will lead to against specified screening criteria. Where these criteria are exceeded, a detailed assessment is required, although the guidance advises that "*the criteria provided are precautionary and should be treated as indicative*", and "*it may be appropriate to amend them on the basis of professional judgement*".

Point Source

6.1 EPUK and the IAQM have developed an approach[12] to determine whether emissions from point sources, such as energy plant, have the potential for significant air quality impacts. The first step of the approach, as described in ***ES Volume 2, Appendix: Air Quality (Annex 1)***, is to screen the emissions and the emissions parameters to determine whether an assessment is necessary:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

6.2 This screening approach requires professional judgement, and the experience of the consultants preparing the assessment is set out in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.

6.3 If it is determined that an assessment of the point source emissions is required then there is a further stage of screening that can be applied to the model outputs. The approach is that any change in concentration smaller than 0.5% of the long-term environmental standard will be *negligible*, regardless of the existing air quality conditions. Any change smaller than 1.5% of the long-term environmental standard will be *negligible* so long as the total concentration is less than 94% of the standard and any change smaller than 5.5% of the long-term environmental standard will be *negligible* so long as the total concentration is less than 75% of the standard. The guidance also explains that:

"Where peak short term concentrations (those averaged over periods of an hour or less) from an elevated source are in the range 11-20% of the relevant Air Quality Assessment Level (AQAL), then their magnitude can be described as small, those in the range 21-50% medium and those above 51% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. In most cases, the assessment of impact severity for a proposed development will be governed by the long-term exposure experienced by receptors and it will not be a necessity to define the significance of effects by reference to short-term impacts. The severity of the impact will be substantial when there is a risk that the relevant AQAL for short-term concentrations is approached through the presence of the new source, taking into account the contribution of other local sources".

6.4 As a first step, the assessment of the emissions from the energy plant within the Proposed Development has considered the predicted process contributions using the following criteria:

- Is the long-term (annual mean) process contribution less than 0.5% of the long-term environmental standard?; and
- Is the short-term (24-hour mean or shorter) process contribution less than 10% of the short-term environmental standard?

6.5 Where both of these criteria are met, then the impacts are negligible and thus 'not significant'. Where these criteria are breached then a more detailed assessment, considering total concentrations (incorporating local baseline conditions), has been provided.

Railway Locomotive Emissions Screening Criteria

6.6 Defra guidance[4] outlines where there may be the potential for an exceedance of the NO_2 objectives as a result of emissions from diesel locomotives. Sensitive locations within 30 m of railway lines where there are large numbers of diesel locomotive movements (these lines are identified within the Defra guidance), and where background annual mean nitrogen dioxide concentrations are greater than 25 µg/m^3, may be at risk of elevated NO_2 concentrations. Only locations which meet these criteria require further assessment.

Defining the Baseline

Current Baseline Conditions

6.7 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register[13]. Local sources have also been identified through examination of WBC's Air Quality Review and Assessment reports.

6.8 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. Background concentrations have been defined using the national pollution maps published by Defra[14]. These cover the whole country on a 1x1 km grid.

6.9 Exceedances of the annual mean EU limit value for NO_2 in the study area have been identified using the maps of roadside concentrations published by Defra[15]. These are the maps used by the UK Government, together with the results from national Automatic Urban and Rural Network (AURN) monitoring sites that

[6] WHO (2000) Air Quality Guidelines for Europe; 2nd Edition. Available: http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf.
[7] Defra (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.
[8] The European Parliament and the Council of the European Union (2008) Directive 2008/50/EC of the European Parliament and of the Council, Available: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0050.
[9] European Environment Agency (2019) The European Nature Information System, Available: http://eunis.eea.europa.eu/habitats-code.jsp.
[10] APIS (2013) Recommended values within nutrient nitrogen critical load ranges for use in air pollution impact assessments. http://www.apis.ac.uk/sites/default/files/downloads/APIS%20critical_load_range_document_0.pdf.
[11] APIS (2019) APIS, Available: http://www.apis.ac.uk/.
[12] Moorcroft and Barrowcliffe et al (2017) Land-Use Planning & Development Control: Planning For Air Quality v1.2, IAQM, London, Available: http://iaqm.co.uk/guidance/.

[13] Defra (2019) UK Pollutant Release and Transfer Register, [Online], Available: prtr.defra.gov.uk.
[14] Defra (2019) Local Air Quality Management (LAQM) Support Website, [Online], Available: http://laqm.defra.gov.uk/.
[15] Defra (2019) 2019 NO_2 projections data (2017 reference year), [Online], Available: https://uk-air.defra.gov.uk/library/no2ten/2019-no2-pm-projections-from-2017-data

operate to EU data quality standards, to report exceedances of the limit value to the EU. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations[16], which are available for the years 2009 to 2017, show no exceedances of the limit values anywhere in the UK in 2017.

6.10 Current baseline concentrations have also been modelled using the ADMS-Roads dispersion model. Details of the model inputs, assumptions and the verification are provided in ***ES Volume 2, Appendix: Air Quality (Annex 3)***, together with the method used to derive baseline year background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

Future Baseline Conditions

6.11 Future baseline concentrations have been predicted using the ADMS-Roads dispersion model. Details of the model inputs, assumptions and the verification are provided in ***ES Volume 2, Appendix: Air Quality (Annex 3)***. Where assumptions have been made, a realistic worst-case approach has been adopted.

Likely Evolution of the Baseline Conditions

6.12 If the Proposed Development was not to come forward, it is expected that the site would remain in its current state. Air quality is generally expected to improve with time, due (for example) to more stringent emissions standards for motor vehicles. The likely evolution of the baseline conditions if the Proposed Development did not come forward has been considered in this assessment.

Impact Assessment Methodology

Demolition and Construction

6.13 The demolition and construction dust assessment considers the potential for impacts within 350m of the site boundary; or within 50m of roads used by construction vehicles. The assessment methodology follows the IAQM's 'Guidance on the Assessment of Dust from Demolition and Construction'[17]. This follows a sequence of steps. Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required. Step 2a determines the potential for dust to be raised from on-site works and by vehicles leaving the site. Step 2b defines the sensitivity of the area to any dust that may be raised. Step 2c combines the information from Steps 2a and 2b to determine the risk of dust impacts without appropriate mitigation. Step 3 uses this information to determine the appropriate level of mitigation required to ensure that there should be no significant effects. ***ES Volume 2, Appendix: Air Quality (Annex 4)*** explains the approach in more detail.

6.14 It has been confirmed that the demolition and construction works will generate a maximum of 26 Heavy Duty Vehicle (HDV) Annual Average Daily Traffic (AADT) along roads within the study area, and these vehicles will not pass through the nearby AQMA (AQMA Order 2). EPUK & IAQM[12] consider that a detailed assessment is required when a development leads to an increase in HDVs of more than 100 AADT outside an AQMA, or 25 AADT within an AQMA; this will not be the case for the Proposed Development, therefore the increase in HDV traffic associated with the construction works is not anticipated to lead to significant air quality effects, and does not warrant further assessment.

Assumptions

6.15 Assumptions regarding the magnitude of construction dust emissions have been made based on the size of the Proposed Development (including site area and the number, size and height of the proposed buildings), taking into consideration the IAQM guidance.

Completed Development

6.16 Once operational, the Proposed Development will lead to an increase in traffic on the local roads, which may affect air quality at existing residential properties. Emissions associated with road traffic on local roads may also impact on air quality for future occupants of the Proposed Development itself (new properties). The main air pollutants of concern related to traffic emissions are NO_2 and fine particulate matter (PM_{10} and $PM_{2.5}$). Emissions associated with the proposed on-site energy plant could also impact on air quality at existing and new properties. The main air pollutant of concern related to gas-fired plant emissions is NO_2. An assessment of the operational impacts that the Proposed Development will have on concentrations of these pollutants has been carried-out following the methodology presented below.

6.17 The Proposed Development will be fully completed in 2023, with the David Lloyd Leisure Centre becoming operational in 2021, and residential properties complete and occupied in 2023. However, to present a conservative assessment, emissions associated with a fully completed and operational Proposed Development were modelled for the year of first occupation (2021). This would have over-predicted impacts and concentrations presented in this chapter, as vehicle emission factors and background concentrations are projected to improve with time, and are thus greater in 2021 than in 2023.

Road Traffic Impacts

Screening Stage

6.18 The first step in considering the road traffic impacts of the Proposed Development has been to screen the Proposed Development and its traffic generation against the criteria set out in the EPUK/IAQM guidance[12], as described in ***ES Volume 2, Appendix: Air Quality (Annex 1)***. Where impacts can be screened out, there is no need to progress to a more detailed assessment. The following sections describe the approach to dispersion modelling of road traffic emissions, which has been required for this project, as the Proposed Development leads to an increase in traffic greater than the screening criteria on several roads within the study area.

Assessment Scenarios

6.19 NO_2, PM_{10} and $PM_{2.5}$ concentrations have been predicted for a base year of 2018 (the most recent full calendar year of monitoring data available) and the proposed year of opening (2021). For 2021, predictions have been made for both the 'future baseline' (without the Proposed Development) and the 'future baseline + Proposed Development'. In addition to the set of 'official' predictions, a sensitivity test has been carried out for NO_2 that involves assuming higher nitrogen oxides emissions from some diesel vehicles than have been predicted by Defra, using AQC's Calculator Using Realistic Emissions for Diesels (CURED V3A) tool[18].

Modelling Methodology

6.20 Concentrations have been predicted using the ADMS-Roads dispersion model, with vehicle emissions derived using Defra's latest Emission Factor Toolkit (EFT) (v9.0)[14]. Details of the model inputs, assumptions and the verification are provided in ***ES Volume 2, Appendix: Air Quality (Annex 3)***. Where assumptions have been made, a realistic worst-case approach has been adopted.

6.21 Deposition fluxes have been calculated from the predicted concentrations of NO_2. Details on the method for calculating the deposition are provided in ***ES Volume 2, Appendix: Air Quality (Annex 3)***.

Traffic Data

6.22 Traffic data for the assessment have been provided by Vectos, who have undertaken the Transport Assessment (TA) for the Proposed Development. Further details of the traffic data used in this assessment are provided in ***ES Volume 2, Appendix: Air Quality (Annex 3)***.

Uncertainty

6.23 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms.

6.24 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see ***ES Volume 2, Appendix: Air Quality (Annex 3)***). As the model has been verified and adjusted, there can be reasonable confidence in the prediction of base year (2018) concentrations. LAQM.TG16[4] provides guidance on the evaluation of model performance. Based on the analysis shown in Table A6.11 in ***ES Volume 2, Appendix: Air Quality (Annex 6)***, the model performance is considered to be acceptable.

6.25 For obvious reasons, the model cannot be verified in the future and it is necessary to rely on a series of projections, provided by DfT and Defra, as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions.

6.26 To account for potential uncertainties in future emissions, and assuming that improvements are not delivered as rapidly as expected, AQC has provided an alternative sensitivity test which assumes slightly higher NOx

[16] Defra (2019) UK Ambient Air Quality Interactive Map, [Online], Available: https://uk-air.defra.gov.uk/data/gis-mapping.
[17] IAQM (2016) Guidance on the Assessment of Dust from Demolition and Construction v1.1, Available: http://iaqm.co.uk/guidance/.
[18] AQC (2017) CURED V3A, [Online], Available: http://www.aqconsultants.co.uk/Resources/Download-Reports.aspx

emissions from certain vehicles. A full description of the derivation of the sensitivity test, and the rationale behind the predictions, are provided in ***ES Volume 2, Appendix: Air Quality (Annex 3)***.

6.27 It must also be kept in mind that the predictions in 2021 are based on worst-case assumptions regarding the increase in traffic flows, such that the Proposed Development is assumed to be fully operational. This is likely to have overestimated the traffic emissions and hence the concentrations in 2021.

Impacts of the Proposed CHP and Boiler Plant

6.28 The main source of energy for the residential element of the Proposed Development will be air source heat pumps (ASHPs), which will not have any on-site emissions associated with them; as such, the ASHPs will not be considered by the assessment. However, the proposed David Lloyd Leisure Centre within the Proposed Development will include one natural gas-fired CHP, and three natural gas-fired boiler plant units. One of the boilers will act as a backup, and so only two boilers will operate at any one time. These plant will generate emissions of NO_x and, therefore, have the potential to impact on air quality at existing and proposed sensitive receptors.

6.29 Further details of the plant to be installed within the Proposed Development are provided in ***ES Volume 2, Appendix: Air Quality (Annexes 3 and 5)***.

Screening Stage

6.30 The first step in considering the impacts of the plant proposed as part of the Proposed Development has been to screen the pollutant emissions against the criteria set out in the EPUK/IAQM guidance[12], as described in ***ES Volume 2, Appendix: Air Quality (Annex 1)***. Where plant impacts cannot be screened out against these criteria, a further stage of screening is required, whereby the modelled contributions of the plant are compared to further screening criteria. Where impacts can be screened out, there is no need to progress to a more detailed assessment. The following sections describe the approach to dispersion modelling of the plant emissions, which has been required for this project.

Assessment Scenarios

6.31 Predictions of NO_2 concentrations have been carried out assuming that the proposed CHP and boiler plant units are installed and operational in 2021.

Modelling Methodology

6.32 The impacts of emissions from the proposed CHP and boiler plant have been modelled using the ADMS-5 dispersion model. ADMS-5 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. The model input parameters are set out in ***ES Volume 2, Appendix: Air Quality (Annex 3)***. The air quality modelling has been carried out based on a number of necessary assumptions, detailed further in ***ES Volume 2, Appendix: Air Quality (Annex 3)***. Where possible, a realistic worst-case approach has been adopted.

6.33 Entrainment of the plume into the wake of buildings has been simulated within the model. ADMS-5 takes a relatively simplistic approach to modelling building downwash effects, thus additional uncertainty is introduced when using the buildings module. In order to ensure a worst-case assessment, sensitivity tests have been carried out whereby the model has been run with no buildings and with the David Lloyd Leisure Centre buildings.

Emissions Data

6.34 The emissions data input into the model for the proposed plant have been predominantly provided by Elementa Consulting, with some data input being determined using the data set out in the technical datasheets for the plant to be installed. The emissions data has also been based upon the fuel consumption, fuel composition, typical operating conditions and combustion chemistry of the proposed plant to be installed. Further details of the emissions data used in this assessment are provided in ***ES Volume 2, Appendix: Air Quality (Annex 3)***.

Uncertainties, Assumption and Limitations

6.35 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which in reality are variable as the plant will operate at different loads at different times. The assessment has, however, addressed this by applying worst-case assumptions where necessary, and provided that the plant installed in reality adheres to the restrictions set out in ***ES Volume 2, Appendix: Air Quality (Annexes 3 and 5)***, the conclusions of this assessment will remain valid.

6.36 There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified, and it is not possible to verify the point-source model outputs. Where parameters have been estimated, the approach has been to use reasonable worst-case assumptions.

Railway Impacts

6.37 The potential for significant impacts at residential receptors within the Proposed Development as a result of emissions from railway locomotive on the adjacent railway lines has been considered using screening criteria set out in the Defra guidance[4].

Methodology for Defining Significance

Receptor Sensitivity

Demolition and Construction

6.38 The IAQM, in their guidance on construction dust[17], provides criteria to define receptor sensitivity to dust soiling or health effects of PM_{10} (See Table A3.2 in ***ES Volume 2, Appendix: Air Quality (Annex 1)***). Residential properties and schools are considered as high sensitivity receptors to both dust soiling and health effects of PM_{10}.

Completed Development: Human Health

6.39 The Air Quality Strategy[19] explains that air quality standards and objectives were determined based on expert recommendations, and represent *"levels at which no significant health effects would be expected in the population as a whole"*. The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance[4]. The annual mean objectives for NO_2 and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour mean objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for NO_2 applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

6.40 Within this chapter, all human health receptors where the air quality objectives apply are considered to be of high sensitivity. Locations where the objectives do not apply must be considered not to be sensitive, therefore there are no medium or low sensitivity receptors within the context of this assessment.

Completed Development: Ecology

6.41 Objectives for the protection of vegetation and ecosystems have been set by the UK Government based on the EU limit values. The limit values and objectives only apply a) more than 20 km from an agglomeration (about 250,000 people), and b) more than 5 km from Part A industrial sources, motorways and built up areas of more than 5,000 people. Critical levels and critical loads are the ambient concentrations and deposition fluxes below which significant harmful effects to sensitive ecosystems are unlikely to occur. Typically, the potential for exceedances of the critical levels and critical loads is considered in the context of the level of protection afforded to the ecological site as a whole. For example, the level of protection afforded to an internationally-designated site (such as a Site of Special Scientific Interest (SSSI)) is significantly greater than that afforded to a local nature reserve; reflecting the relative sensitivity of the sites as well as their perceived ecological value.

6.42 Within this chapter and in the context of the Proposed Development, the Smart's and Prey Heath SSSI is considered to be of high sensitivity.

Magnitude of Impact

Demolition and Construction

6.43 There are no formal assessment criteria for dust. In the absence of formal criteria, the approach developed by the IAQM has been used. Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required. Step 2 consists in determining the risk of dust impacts for each activity (i.e. demolition, earthworks, construction and the trackout of material from the site onto the local road network). First, the 'dust emission magnitude' is determined for each of the four activities listed above, and is defined as 'small', 'medium' or 'large' (Step 2A, see Table A4.2 in ***ES Volume 2, Appendix: Air Quality***

[19] Defra (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Defra.

(Annex 4)). Then, the sensitivity of the area to dust soiling, human health and ecological effects is determined based on the number of receptors located within certain distances from the site, and their sensitivity (Step 2B, see Tables A4.3 and A4.4 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***). Area sensitivities are defined for each type of effect (dust soiling or human health) and are described as 'low', 'medium' or 'high'. The dust emission magnitudes determined at Step 2A are combined with the sensitivities of the area determined at Step 2B to determine the risk of dust soiling and human health impacts for each activity, with no mitigation applied. Risks are defined as 'negligible', 'low', 'medium' or 'high'. Full details of this approach are provided ***ES Volume 2, Appendix: Air Quality (Annex 4)***.

Completed Development: Human Health

6.44 There is no official guidance in the UK in relation to development control on how to describe air quality impacts and effects, nor how to assess their significance. The approach developed jointly by EPUK and the IAQM[12] has therefore been used. This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective.

6.45 Table 6.4 sets out how impact descriptors have been determined within this assessment, being an adapted version of the table presented in ***ES Volume 2, Appendix: Air Quality (Annex 1)***. Impacts can be beneficial or adverse in nature.

Table 6.4 Air Quality Impact Scale Descriptors for Individual Receptors for All Pollutants [a]

Long-term average concentration at receptor in assessment year[b,c]				Change in concentration relative to AQAL[c,d]				
% of AQAL	Annual Mean NO_2 ($\mu g/m^3$)	Annual Mean PM_{10} ($\mu g/m^3$)	Annual Mean $PM_{2.5}$ ($\mu g/m^3$)	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Less than 30.2	Less than 30.2	Less than 18.9	Negligible	Negligible	Negligible	Minor	Moderate
76-94% of AQAL	30.2 – 37.8	30.2 – 37.8	18.9 – 23.6	Negligible	Negligible	Minor	Moderate	Moderate
95-102% of AQAL	37.8 – 41.0	37.8 – 41.0	23.6 – 25.6	Negligible	Minor	Moderate	Moderate	Major
103-109% of AQAL	41.0 – 43.8	41.0 – 43.8	25.6 – 27.4	Negligible	Moderate	Moderate	Major	Major
110% or more of AQAL	More than 43.8	More than 43.8	More than 27.4	Negligible	Moderate	Major	Major	Major

[a] Values are rounded to the nearest whole number

[b] This is the 'without Proposed Development' concentration where there is a decrease in pollutant concentration and the 'with Proposed Development' concentration where there is an increase.

[c] 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)'.

[d] Minor and Major are used as standard EIA terminology, and correspond to Slight and Substantial respectively in relevant guidance[12]

Completed Development: Ecology

6.46 In terms of the potential for ecological impacts, the Environment Agency's (EA's) Air Emissions Risk Assessment guidance[20] explains that, regardless of the baseline environmental conditions, a process can be considered as insignificant if:

- The long-term (annual mean) Process Contribution is <1% of the long-term environmental standard; and
- The short-term (15-minute, 1-hour, 24-hour mean) Process Contribution is <10% of the short-term environmental standard.

6.47 It should be recognised that these criteria determine when an impact can be screened out as insignificant. They do not imply that impacts will necessarily be significant above one or both of these criteria, merely that there is a potential for significant impacts to occur that should be considered using a detailed assessment methodology, such as a detailed dispersion modelling study (as has been carried out for the Proposed Development in any event). The next step in the Environment Agency's screening process for long-term contributions is to add the process contribution to the local background concentration to calculate the predicted environmental concentration. For short-term contributions, the process contribution is compared against the short-term environmental standard minus twice the long-term background concentration. The emissions are insignificant if:

- The long-term Process Contribution is <70% of the long-term environmental standard; and
- The short-term Process Contribution is <20% of the short-term environmental standards minus twice the long-term background concentration.

6.48 However, the EA also advises that, where detailed dispersion modelling has been undertaken, no further action is required if resulting predicted environmental concentrations do not exceed environmental standards.

6.49 It should be noted that the previously mentioned EPUK / IAQM guidance does not apply to nature conservation sites, thus the use of the EA's guidance is most appropriate for assessing impacts on ecosystems.

6.50 For the purposes of this assessment, wherever the detailed modelling shows that concentrations and fluxes are below the critical level or critical load, it is considered that there will be no significant impacts.

Effect Scale, Nature and Significance

Demolition and Construction

6.51 Guidance from IAQM[17] is that, with appropriate mitigation in place, the effects of construction dust will be 'not significant'. The assessment thus focuses on determining the appropriate level of mitigation so as to ensure that effects will normally be 'not significant'.

Completed Development

6.52 It is important to differentiate between the terms impact and effect with respect to the assessment of air quality. The term impact is used to describe a change in pollutant concentration at a specific location. The term effect is used to describe an environmental response resulting from an impact, or series of impacts. Within this chapter, the air quality assessment has used published guidance and criteria to determine the likely air quality impacts at a number of sensitive human and ecological locations (refer to Table 6.1, Table 6.2, and Table 6.3). The overall significance of the air quality effects is then determined using professional judgement, giving consideration to various factors including the magnitude of the predicted impacts and the presence of any objective exceedances; full details of the EPUK/IAQM approach are provided in ***ES Volume 2, Appendix: Air Quality (Annex 1)*** and details of the EA's guidance are outlined in paragraphs 6.14 to 6.16 above. The experience of the consultants who have prepared this chapter is set out in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.

Geographic Extent of Effects

Demolition and Construction

6.53 Dust generated by the Proposed Development during demolition and construction has the potential to cause effects at a local level (up to 350m from the site boundary).

Completed Development

6.54 Emissions of pollutants from traffic generated by the Proposed Development during operation have the potential to cause effects at a local and borough level (refer to receptor locations in Table 6.5, Table 6.6, Figure 6.1, Figure 6.2, and Figure 6.4 which define the study area).

Effect Duration

Demolition and Construction

6.55 Dust generated by the Proposed Development during demolition and construction has the potential to cause temporary medium-term effects.

Completed Development

6.56 Emissions of pollutants from traffic generated by the Proposed Development during operation have the potential to cause permanent long-term effects.

[20] Environment Agency (2016) Air emissions risk assessment for your environmental permit, Available: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

Direct and Indirect, Reversible or Irreversible Effects

Demolition and Construction

6.57 Dust generated by the Proposed Development during demolition and construction has the potential to cause direct and reversible effects.

Completed Development

6.58 Emissions of pollutants from traffic generated by the Proposed Development during operation have the potential to cause direct and irreversible effects.

RECEPTORS AND RECEPTOR SENSITIVITY

Existing

Demolition and Construction

6.59 The guidance followed when carrying out the construction dust assessment requires the number of receptors within certain distance bands to be established in order to determine the sensitivity of the surrounding area, rather than focussing on impacts at individual receptors. It is, therefore, not necessary to set out specific receptors for the assessment of impacts during the construction and demolition works.

Completed Development: Human Health

6.60 Concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations close to the Proposed Development. Receptors have been identified to represent worst-case exposure within these locations, being located on the façades of the sensitive properties closest to the sources (i.e. located adjacent to or set back from the local road network). When selecting roadside receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested, where there is a combined effect of several road links and where the volume of additional traffic generated by the Proposed Development is anticipated to be greatest. Attention has also been paid to selecting receptors at locations where the impacts of the energy plant emissions are likely to be greatest, to ensure that the combined effects of road traffic and energy plant emissions are considered. All receptors considered in the operational impact assessment are of high sensitivity, as set out in paragraph 6.40. Selected receptor locations are displayed on Figure 6.1, Figure 6.2, and Figure 6.4. Receptors were modelled at heights of 1.5 m and 4.5 m to represent ground and 1st floor levels respectively, unless stated otherwise.

Table 6.5 Description of Existing Human Health Receptor Locations

Receptor	Description	Modelled Storey
E1	Residential property located adjacent to Egley Road (A320), close to the junction with Egley Drive.	Ground floor
E2	Residential property located adjacent to Drakes Way, set back from the junction with Egley Road (A320).	Ground floor
E3	Residential property located adjacent to Egley Road, set back from Egley Road (A320).	Ground floor
E4	Barnsbury Primary School outdoor space, set back from Egley Road (A320).	Ground floor [a]
E5	Barnsbury Primary School, setback from Egley Road (A320) and Almond Avenue.	Ground floor [a]
E6	Residential property located adjacent to Egley Road (A320) close to the junction with Hillside.	Ground floor
E7	Residential property set back from Egley Road (A320).	Ground floor
E8	Residential property located adjacent to the junction between Acacia Avenue and Egley Road (A320).	Ground floor
E9	Residential property located adjacent to Evelyn Close, set back from Egey Road (A320).	Ground floor
E10	The Fun Factory Nursery, located adjacent to Turnoak Lane, close to the junction with Egley Road (A320).	Ground floor [a]
E11	Residential property located adjacent to Turnoak Lane, set back from Egley Road (A320).	Ground floor
E12	Residential property located adjacent Turnoak Lane, set back from the roundabout that connects Egley Road (A320), Guildford Road (A320), Wych Hill Lane and Wych Hill Lane (A247).	Ground floor
E13	Residential property located adjacent Turnoak Lane, set back from the roundabout that connects Egley Road (A320), Guildford Road (A320), Wych Hill Lane and Wych Hill Lane (A247).	Ground floor
E14	Residential property set back from the roundabout that connects Egley Road (A320), Guildford Road (A320), Wych Hill Lane and Wych Hill Lane (A247).	Ground floor
E15	Residential property set back from the roundabout that connects Egley Road (A320), Guildford Road (A320), Wych Hill Lane and Wych Hill Lane (A247).	Ground floor
E16	Residential property located adjacent to the junction between Wych Hill Lane and West Hill Road.	Ground floor
E17	Residential property located adjacent to Wych Hill Lane, close to the junction with Mount Hermon Road.	Ground floor
E18	Residential property located adjacent to Wych Hill.	Ground floor
E19	Residential property located adjacent to Wych Hill, opposite the junction with Orchard Mains.	Ground floor
E20	Residential property located adjacent to Midhope Road, set back from the junction with Guildford Road (A320).	Ground floor
E21	Greenfield School Co-educational Preparatory School, located adjacent to Brooklyn Road, set back from the junction with Guildford Road (A320).	Ground floor [a]
E22	Residential property located adjacent to Guildford Road (A320), close to the junction with Claremont Avenue (A247).	Ground floor
E23	Residential property located adjacent to the Blackness Lane, set back from the junction with Guildford Road (A320).	Ground floor
E24	Residential property located adjacent to Thorsden Court, set back from Guildford Road (A320).	Ground floor
E25	Residential property located adjacent to Guildford Road (A320), opposite the junction with Thorsden Court.	Ground floor
E26	Residential property located adjacent to the junction between Thorsden Court and Guildford Road (A320).	Ground floor
E27	Residential property located adjacent to Guildford Road (A320), opposite the junction with Thorsden Court.	Ground floor
E28	Residential property located adjacent to Guildford Road (A320), close to the junction with Constitution Hill.	Ground floor
E29	Residential property located adjacent to the junction between Guildford Road (A320) and York Road.	Ground floor
E30	Bright Horizons Woking Day Nursery, set back from the junction between Station Approach (A320) and Guildford Road (A320).	Ground floor [a]
E31	Residential property located adjacent to the junction between Guildford Road (A320) and Station Approach (A320).	Ground floor
E32	Residential property located adjacent to Victoria Road (A320), close to the junction with Guildford Road (A320).	Ground floor
E33	Residential property located adjacent to an unnamed minor road, set back from Mayford Roundabout.	Ground floor
E34	Freemantles School outdoor space, set back from an unnamed minor road, close to Mayford Roundabout.	Ground floor [a]
E35	Freemantles School outdoor space, set back from an unnamed minor road.	Ground floor [a]
E36	Residential property set back from Mayford Roundabout.	Ground floor
E37	Residential property set back from Mayford Roundabout.	Ground floor
E38	Residential property located adjacent to Guildford Road (B380), set back from Mayford Roundabout.	Ground floor

[a] Receptors modelled at a height of 0.5 m to represent ground floor level for nursery and primary school-aged children.

Figure 6.1 Existing Human Health Receptors Located to the North and East of Site Boundary

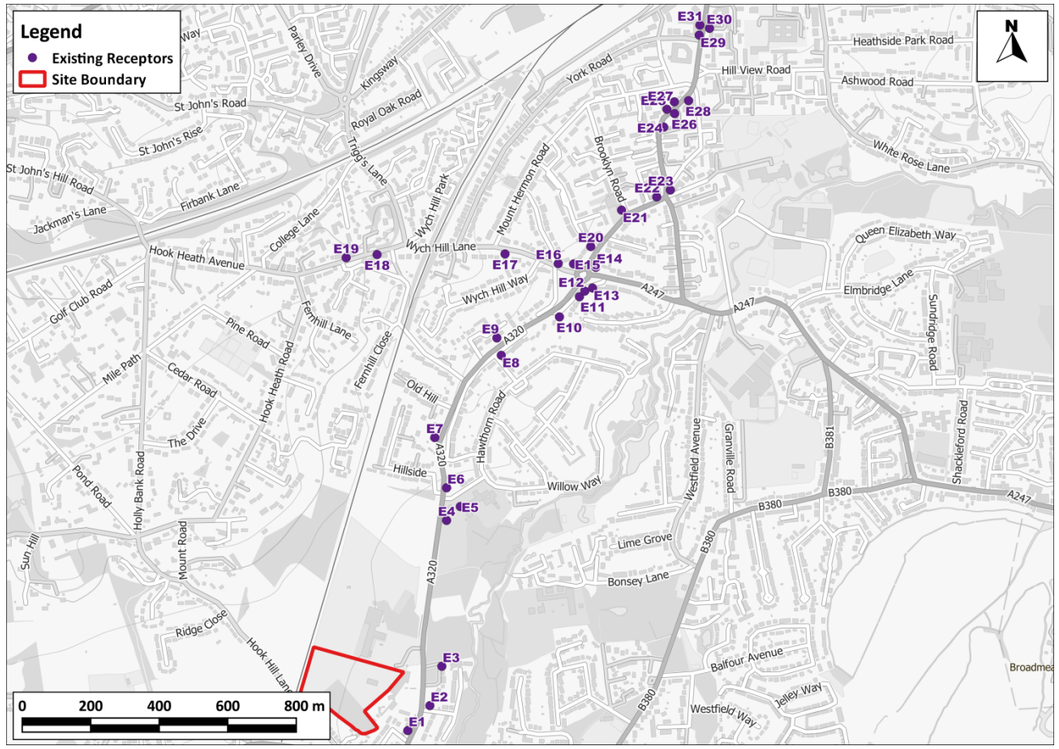
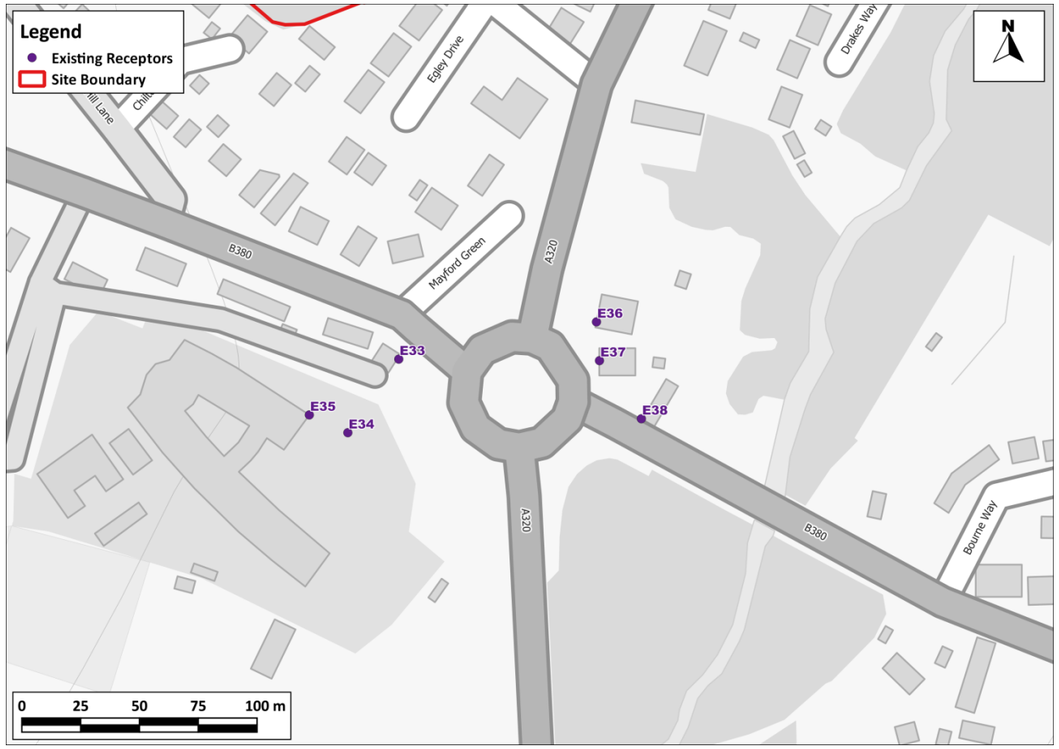


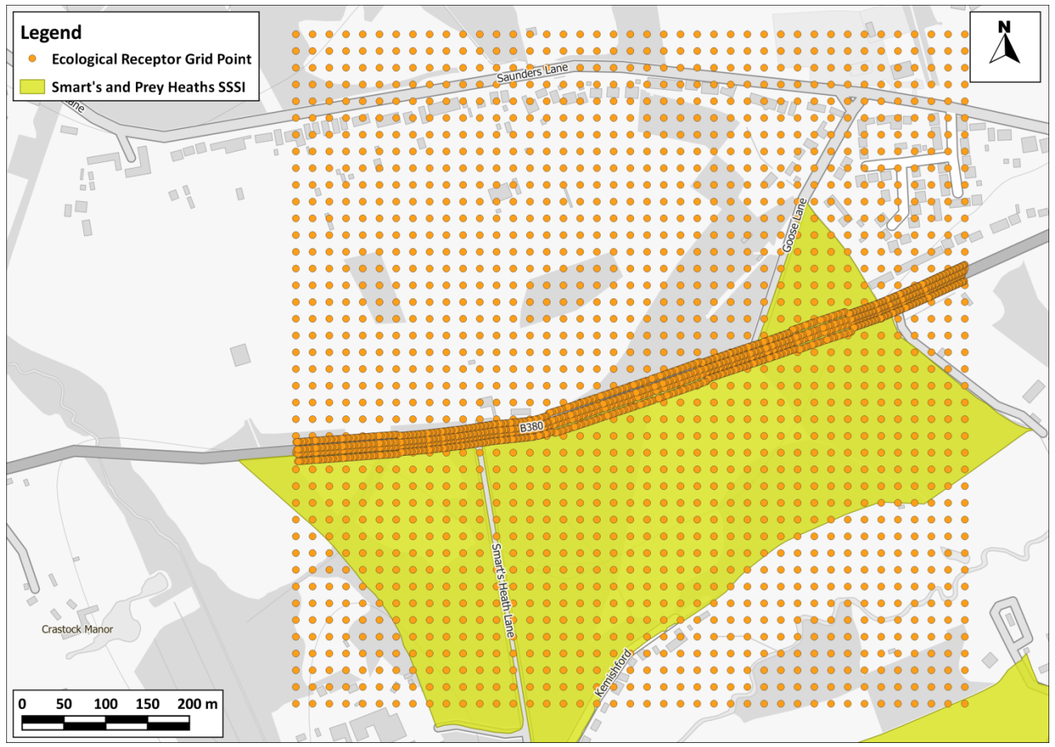
Figure 6.2 Existing Human Health Receptors Located to the South of the Site Boundary



Completed Development: Ecology

6.61 Concentrations of annual mean and 24-hour mean nitrogen oxides and nutrient and acid nitrogen deposition rates have been predicted across an 800 m x 800 m receptor grid, centred on the area of the Smart's and Prey Heaths SSSI (see Figure 6.3). All points within the receptor grid have been modelled at a height of 1.5m.

Figure 6.3 Modelled Grid for Determination of Impacts at Ecological Site



Introduced

Demolition and Construction

6.62 The construction dust assessment has given consideration to the potential for new receptors to be introduced within the Proposed Development while works are ongoing. As explained in paragraph 6.59, it is not necessary to set out specific receptors for the assessment of impacts during the construction and demolition works.

Completed Development

6.63 Four receptor locations have been identified within the Proposed Development, as set out in Table 6.6, which represent exposure to existing and proposed sources. These receptors are situated the nearest to the road where impacts will be greatest. These receptors are again all of high sensitivity.

Table 6.6 Description of Introduced Human Health Receptor Locations [a]

Receptor	Description
D1	Residential property located adjacent to the site access road close to the north-eastern site boundary.
D2	Residential property located adjacent to the site access road close to the north-eastern site boundary.
D3	Residential property located close to the eastern site boundary.
D4	Residential property located close to the eastern site boundary.

[a] Receptors have been modelled at a height of 1.5 m to represent ground floor level.

Figure 6.4 Introduced Human Health Receptor Locations

BASELINE CONDITIONS

Current Baseline Conditions

6.64 The Proposed Development is located in southern Woking. The site is centred around National Grid Reference (NGR): SU 99437 56385 and is bounded to the: north by Woking Athletic Club (including a sports field) and Hoe Valley School; east by large retail warehouses (Woking and Wyevale Garden Centre, Maidenhead Aquatics Woking), with Egley Road (A320) further beyond; south by residential dwellings; and west by railway tracks and open fields.

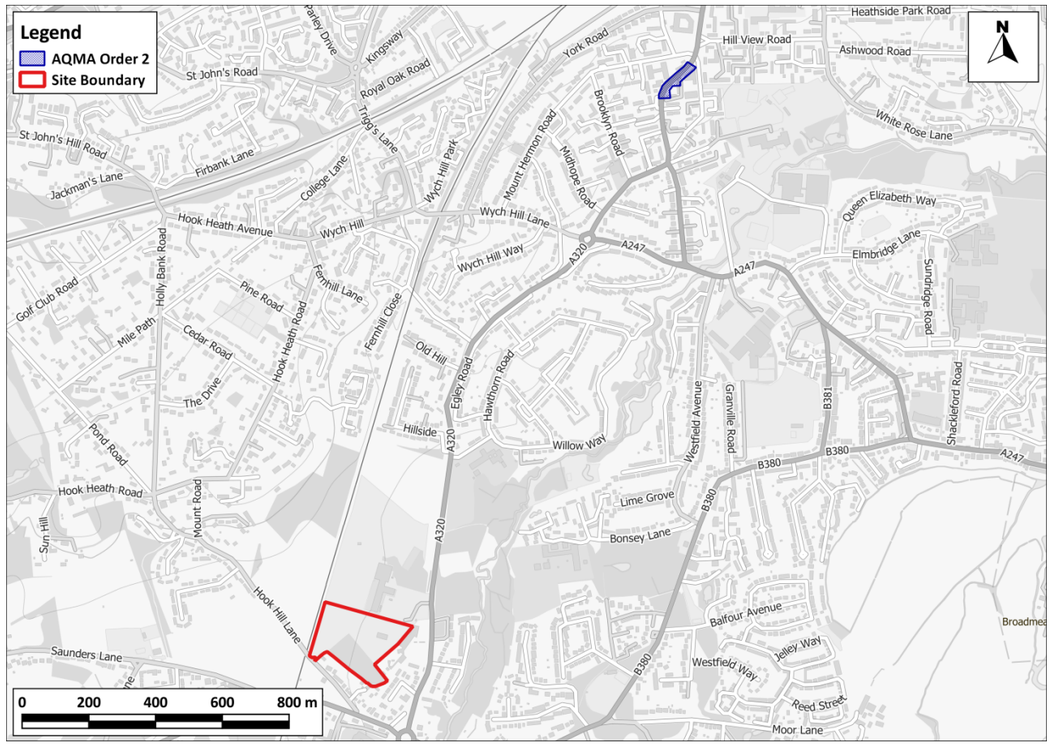
Industrial Sources

6.65 A search of the UK Pollutant Release and Transfer Register website[13] has not identified any significant industrial or waste management sources that are likely to affect the Proposed Development, in terms of air quality.

Air Quality Management Areas

6.66 WBC has investigated air quality within its area as part of its responsibilities under the LAQM regime, and has declared two AQMAs for exceedances of the annual mean NO_2 objective. The 'AQMA for Anchor Hill' is located a substantial distance (approximately 3.5 km) to the north-west of the site and, as such, is not considered further within this assessment. 'AQMA Order 2' was declared by WBC in May 2017 and covers a small section of Guildford Road to the south of the Constitution Hill junction and to the north of the junction with Ashdown Close; this AQMA is located approximately 1.7 km to the north-east of the Site (see Figure 6.5).

Figure 6.5 AQMA Order 2 and the Site Boundary



Contains Ordnance Survey data © Crown copyright and database right 2019. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

Local Air Quality Monitoring

6.67 WBC does not operate any automatic monitoring stations within its area; however, WBC does operate a number of NO_2 monitoring sites using diffusion tubes prepared and analysed by Lambeth Scientific Services (using the 50% triethanolamine in acetone method). Nine of these sites are location in close proximity to the Proposed Development; results for the years 2014 to 2018 are summarised in Table 6.7 and the monitoring locations are shown in Figure 6.6.

6.68 Exceedances of the annual mean NO_2 objective were measured at two monitoring sites in 2018; sites CH and CH2 (both of which are located within an AQMA). Exceedances of the annual mean objective have also been measured at site CH between 2014 and 2016, at site CH2 between 2014 and 2017, at site CH3 between 2015 and 2017, at site CH4 in 2015 and at site LTK in 2015. Measured concentrations at all sites are well below 60 µg/m^3 between 2014 and 2018, indicating that it is unlikely that the 1-hour mean was exceeded at these locations during this time period. The monitored concentrations do not show any strong trends between 2015 and 2018.

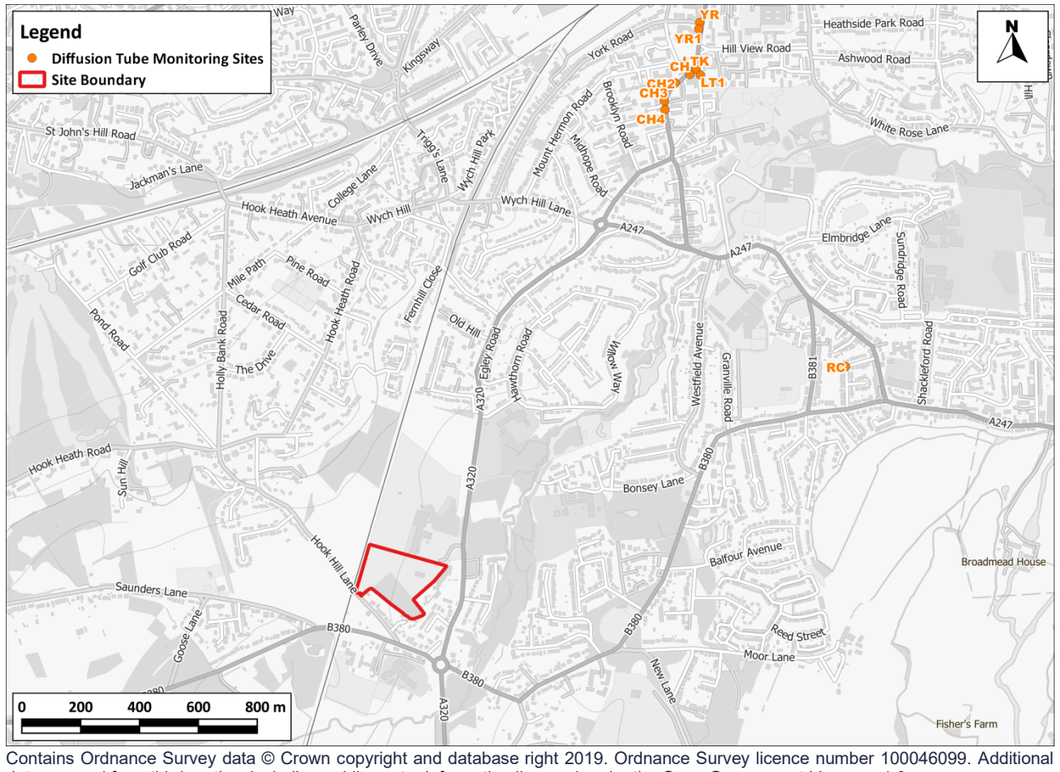
6.69 No monitoring of PM_{10} or $PM_{2.5}$ concentrations has been or is undertaken in Woking.

Table 6.7 Summary of Diffusion Tube NO_2 Monitoring (µg/m^3) (2014-2018)[a,b]

Site No.	Site Type	Location	2014	2015	2016	2017	2018
CH	Roadside	Constitution Hill	34.2	**48.8**	**43.3**	36.5	**41.8**
CH2	Roadside	Constitution Hill	**40.6**	**51.6**	**47.6**	**41.3**	**43.5**
CH3	Roadside	Constitution Hill	37.9	**51.5**	**45.4**	**41.0**	38.6
CH4	Kerbside	Constitution Hill	34.5	**42.4**	40.0	37.6	38.5
LT1	Kerbside	Constitution Hill	17.8	24.9	33.9	33.9	35.0
LTK	Kerbside	Constitution Hill	31.0	**40.7**	23.6	24.3	28.3
RC	Kerbside	Rosebery Crescent	17.7	16.5	16.6	18.0	18.0
YR	Kerbside	York Road	-	-	-	23.9	30.0
YR1	Kerbside	York Road	-	-	-	25.0	31.2
Objective			40				

[a] Sourced from WBC's 2019 Air Quality Annual Status Report (ASR)[21].
[b] Exceedances of the objectives are shown in bold.

Figure 6.6 Diffusion Tube Monitoring Locations and the Site Boundary



Contains Ordnance Survey data © Crown copyright and database right 2019. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

Exceedances of EU Limit Values

6.70 There are no AURN monitoring sites within 1km of the site with which to identify exceedances of the annual mean NO_2 limit value. Defra's roadside annual mean NO_2 concentrations[15], which are used to report

[21] Woking Borough Council (2019) Air Quality Annual Status Report (ASR).

exceedances of the limit value to the EU, do not identify any exceedances within 1km of the site in 2017. As such, there is considered to be no risk of a limit value exceedance in the vicinity of the Proposed Development by the time that it is operational.

Background Concentrations and Fluxes

National Background Pollution Maps

6.71 In addition to the locally measured concentrations, estimated background concentrations at the identified sensitive human health receptors (see Table 6.5 and Table 6.6) have been determined for 2018 using Defra's 2017-based background maps[14]. The background concentrations are set out in Table 6.8 and have been derived as described in ***ES Volume 2, Appendix: Air Quality (Annex 3)***. The background concentrations are all well below the objectives.

Table 6.8 Estimated Annual Mean Background Pollutant Concentrations in 2018 (µg/m^3)

Year	NO_2	PM_{10}	$PM_{2.5}$
2018	13.4 – 17.7	14.0 – 15.0	9.9 – 10.7
Objectives	40	40	25 [a]

The range of values is for the different 1x1 km grid squares covering the study area.

[a] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Background Deposition and Acidity

6.72 Background NO_2 deposition fluxes to the Smart's and Prey Heaths SSSI have been taken from the APIS website[11]. As shown in Table 6.9, background nutrient and acid nitrogen deposition rates both exceed the critical load in this period.

Table 6.9 Estimated Annual Mean Background Nitrogen Deposition

Site	Nutrient Nitrogen Deposition (kgN/ha/yr)	Acid Nitrogen Deposition (keq/ha/yr)
Smart's and Prey Heaths SSSI	13.2	0.94
Critical Load:	10	0.892

Future Baseline Conditions / Do Nothing Scenario

Human Health

6.73 Estimated background concentrations at the identified sensitive human health receptors have been determined for the opening year 2021 using Defra's 2017-based background maps[14]. The background concentrations are set out in Table 6.10 and have been derived as described in ***ES Volume 2, Appendix: Air Quality (Annex 3)***. The background concentrations are all well below the objectives.

Table 6.10 Estimated Annual Mean Background Pollutant Concentrations in 2021 (µg/m^3)

Year	NO_2	PM_{10}	$PM_{2.5}$
2021[a]	11.9 – 15.8	13.5 – 14.5	9.5 – 10.2
2021 Sensitivity Test [b]	*10.8 – 15.2*	N/A	N/A
Objectives	40	40	25 [c]

N/A = not applicable. The range of values is for the different 1x1 km grid squares covering the study area.

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.

[c] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

6.74 Baseline concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been modelled at each of the existing receptor locations. The results, which cover both the existing (2018) and future year (2021) baseline (without the Proposed Development), are set out in Table 6.11 and Table 6.12. The predictions for NO_2 include a sensitivity test which accounts for the potential under-performance of emissions control technology on future diesel cars and vans. In addition, the modelled road components of nitrogen oxides, PM_{10} and $PM_{2.5}$ have been increased from those predicted by the model based on a comparison with local measurements (see ***ES Volume 2, Appendix: Air Quality (Annex 3)*** for the verification methodology).

Table 6.11 Modelled Annual Mean Baseline Concentrations of NO_2 (µg/m^3) at Existing Receptors [a]

Receptor	2018	2021 Future Baseline	
		'Official' predictions [b]	*Sensitivity Test* [c]
E1	26.3	23.6	*23.8*
E2	24.7	22.1	*22.1*
E3	20.2	18.0	*17.6*
E4	24.9	22.2	*22.3*
E5	18.6	16.6	*16.1*
E6	36.2	32.6	*33.5*
E7	25.9	23.1	*22.9*
E8	23.8	21.1	*20.8*
E9	25.6	22.8	*22.5*
E10	25.5	22.7	*22.3*
E11	30.0	26.6	*26.6*
E12	31.5	27.9	*28.1*
E13	29.3	26.0	*26.0*
E14	**41.6**	37.0	*38.1*
E15	37.6	33.4	*34.1*
E16	**41.3**	36.8	*37.8*
E17	25.7	22.7	*22.5*
E18	32.6	28.9	*29.3*
E19	36.5	32.4	*33.2*
E20	30.4	27.0	*27.0*
E21	27.4	24.4	*24.2*
E22	33.5	29.9	*30.2*
E23	37.2	33.2	*33.8*
E24	35.7	31.9	*32.8*
E25	34.6	30.8	31.7
E26	34.5	30.7	31.6
E27	32.7	29.2	29.9
E28	36.0	32.1	33.1
E29	30.2	26.9	27.4
E30	36.1	32.2	33.2
E31	36.6	32.6	33.6
E32	39.2	34.8	36.1
E33	29.5	26.2	26.7
E34	19.8	17.6	17.2
E35	18.8	16.7	16.2
E36	36.8	32.9	34.0
E37	**43.3**	38.7	**40.4**
E38	39.6	35.2	36.5
Objective:	40		

Receptor	2018	2021 Future Baseline	
		'Official' predictions [b]	*Sensitivity Test* [c]

[a] Exceedances of the objective are shown in **bold**.
[b] In line with Defra's forecasts.
[c] Assuming higher emissions from future diesel cars and vans as described in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.

Table 6.12 Modelled Annual Mean Baseline Concentrations of PM_{10} and $PM_{2.5}$ (µg/m³) at Existing Receptors

Receptor	PM_{10}		$PM_{2.5}$	
	2018	2021 Future Baseline	2018	2021 Future Baseline
E1	16.6	16.2	11.4	11.0
E2	16.2	15.8	11.2	10.8
E3	15.1	14.7	10.6	10.2
E4	16.3	15.9	11.3	10.9
E5	15.0	14.6	10.5	10.1
E6	18.9	18.7	12.8	12.4
E7	16.9	16.5	11.8	11.4
E8	16.4	15.9	11.5	11.1
E9	16.7	16.3	11.7	11.3
E10	16.8	16.4	11.7	11.3
E11	17.3	16.9	12.0	11.6
E12	17.5	17.0	12.1	11.7
E13	17.1	16.6	11.9	11.5
E14	19.1	18.7	13.1	12.7
E15	18.5	18.0	12.7	12.3
E16	19.8	19.4	13.5	13.1
E17	16.7	16.2	11.7	11.2
E18	18.0	17.6	12.5	12.0
E19	19.0	18.6	13.0	12.6
E20	17.4	16.9	12.1	11.6
E21	17.1	16.7	11.9	11.5
E22	18.4	18.0	12.6	12.2
E23	19.1	18.8	13.1	12.7
E24	18.7	18.3	12.8	12.4
E25	18.4	18.0	12.7	12.3
E26	18.4	18.0	12.7	12.3
E27	18.0	17.6	12.5	12.0
E28	18.7	18.3	12.9	12.4
E29	17.4	16.9	12.1	11.6
E30	18.6	18.2	12.8	12.4
E31	18.7	18.3	12.9	12.4
E32	18.9	18.5	13.0	12.6
E33	16.6	16.2	11.4	11.0
E34	15.0	14.6	10.5	10.1
E35	14.9	14.4	10.4	10.0
E36	17.7	17.3	12.1	11.7
E37	18.8	18.5	12.8	12.4
E38	18.2	17.8	12.4	12.0
Objective:	32 [a]		25 [b]	

[a] While the annual mean PM_{10} objective is 40 µg/m³, 32 µg/m³ is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16[4]. A value of 32 µg/m³ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance[12].
[b] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

2018 Baseline

6.75 The predicted annual mean concentrations of NO_2 are above the objective at three receptors (E14, E16 and E37) in 2018. None of these receptors are within an AQMA, which indicates that the baseline concentrations at these receptors may be over-predicted. The annual mean NO_2 concentrations are below 60 µg/m³ at all receptors; it is, therefore, unlikely that the 1-hour mean NO_2 objective will be exceeded.

6.76 Annual mean concentrations of PM_{10} and $PM_{2.5}$ are predicted to be well below the objectives in 2018 at all receptors. The annual mean PM_{10} concentrations are below 32 µg/m³ and it is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded.

2021 Baseline

6.77 The predicted annual mean concentrations of NO_2 for the 'official' Future Baseline scenario are below the objective at all receptor locations. Furthermore, the annual mean NO_2 concentrations are below 60 µg/m³ at all receptors; it is, therefore, unlikely that the 1-hour mean NO_2 objective will be exceeded.

6.78 The predicted annual mean concentrations of NO_2 are above the objective at one receptors (E37) in 2021 under the CURED sensitivity test, but below the objective at all other receptors. Receptor E37 is not located within an AQMA and, therefore, it is likely that the 2021 baseline concentration at this receptor is over predicted. The annual mean NO_2 concentrations are below 60 µg/m³ at all receptors (indicating that it is unlikely that the 1-hour mean NO_2 objective will be exceeded).

6.79 All of the predictions for PM_{10} and $PM_{2.5}$ are well below the objectives. The annual mean PM_{10} concentrations are below 32 µg/m³ and it is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded.

POTENTIAL EFFECTS

Demolition and Construction Traffic

6.80 As explained in paragraph 6.14, the effects associated with off-site construction traffic emissions will be 'not significant'.

Demolition and Construction Works

6.81 The demolition and construction works will give rise to a risk of dust impacts during demolition, earthworks and construction, as well as from trackout of dust and dirt by vehicles onto the public highway. Step 1 of the assessment procedure is to screen the need for a detailed assessment. There are receptors within the distances set out in the guidance (see ***ES Volume 2, Appendix: Air Quality (Annex 4)***), thus a detailed assessment is required. The following section sets out Step 2 of the assessment procedure.

Potential Dust Emission Magnitude

Demolition

6.82 There will be a requirement to demolish an existing building located within the site. Based on the example definitions set out in Table A4.1 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***, the dust emission class for demolition is considered to be *small*.

Earthworks

6.83 The characteristics of the soil at the site have been defined using the British Geological Survey's UK Soil Observatory website[22], as set out in Table 6.13. Overall, it is considered that, when dry, this soil has the potential to be lightly to moderately dusty.

Table 6.13 Summary of Soil Characteristics

Category	Record
Soil Layer Depth	Deep
Subsoil Grain Size	Arenaceous[a]
Subsoil Description	Fluvial Sands and Gravels
Soil Texture	Sand to Sandy Loam[b]

[a] grain size 0.06 – 2.0 mm.
[b] a loam is composed mostly of sand and silt

6.84 The site covers some approximately 41,000 m^2, much of which is likely to be subject to earthworks. Dust will arise mainly from vehicles travelling over unpaved ground and from the handling of dusty materials (such as dry soil).

6.85 Based on the example definitions set out in Table A4.1 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***, the dust emission class for earthworks is considered to be *large*.

Construction

6.86 Construction works will comprise the construction of a David Lloyd Leisure Centre and 36 residential units. Based on the example definitions set out in Table A4.1 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***, the dust emission class for construction is considered to be *medium*.

Trackout

6.87 It is anticipated that the Proposed Development will generate 13 outbound HDV AADT, which will travel along Egley Road (A320) to the south of the site access. Based on the example definitions set out in Table A4.1 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***, the dust emission class for trackout is considered to be *medium*.

Dust Emissions Magnitude Summary

6.88 Table 6.14 summarises the anticipated dust emission magnitude for the Proposed Development.

Table 6.14 Summary of Dust Emission Magnitude

Source	Dust Emission Magnitude
Demolition	Small
Earthworks	Large
Construction	Medium
Trackout	Medium

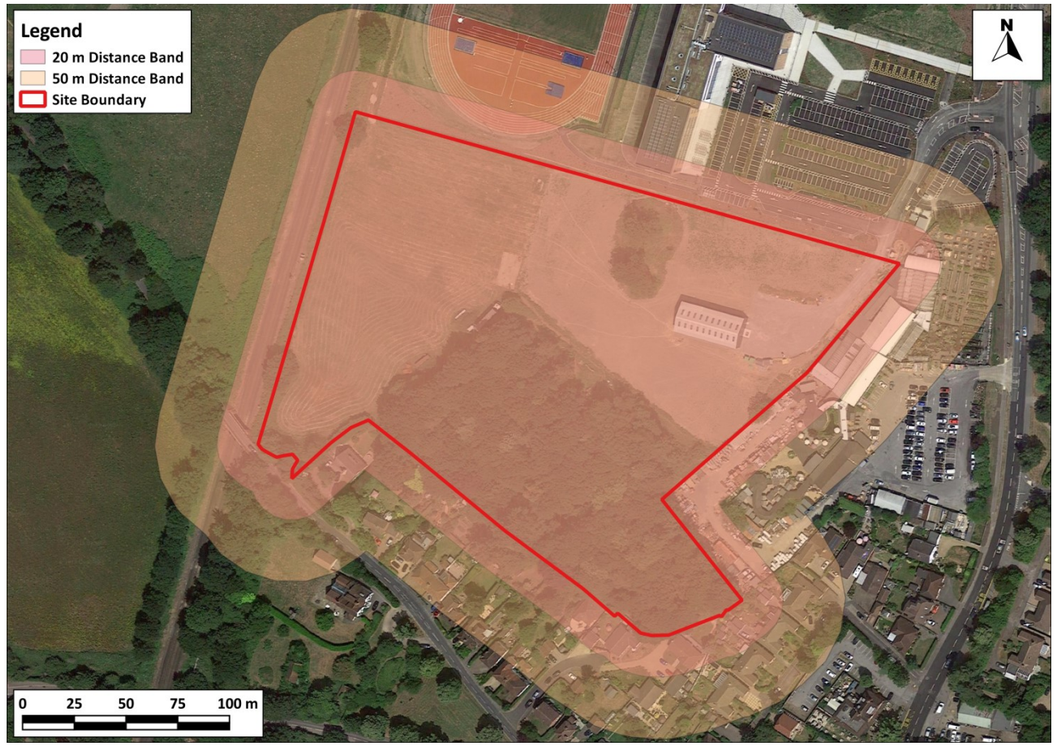
Sensitivity of the Area

6.89 This assessment step combines the sensitivity of individual receptors to dust effects with the number of receptors in the area and their proximity to the site. It also considers additional site-specific factors such as topography and screening, and in the case of sensitivity to human health effects, baseline PM_{10} concentrations.

Sensitivity of the Area to Effects from Dust Soiling

6.90 Residential properties and schools are 'high' sensitivity receptors to dust soiling (Table A4.2 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***. There are eight residential properties and one school (Hoe Valley School) located within 20m of the site and approximately 23 residential properties and a school located within 50m of the site (see Figure 6.7); using the matrix set out in Table A4.3 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***, the area surrounding the onsite works is of 'medium' sensitivity to dust soiling.

Figure 6.7 20m and 50m Distance Bands around the Site Boundary

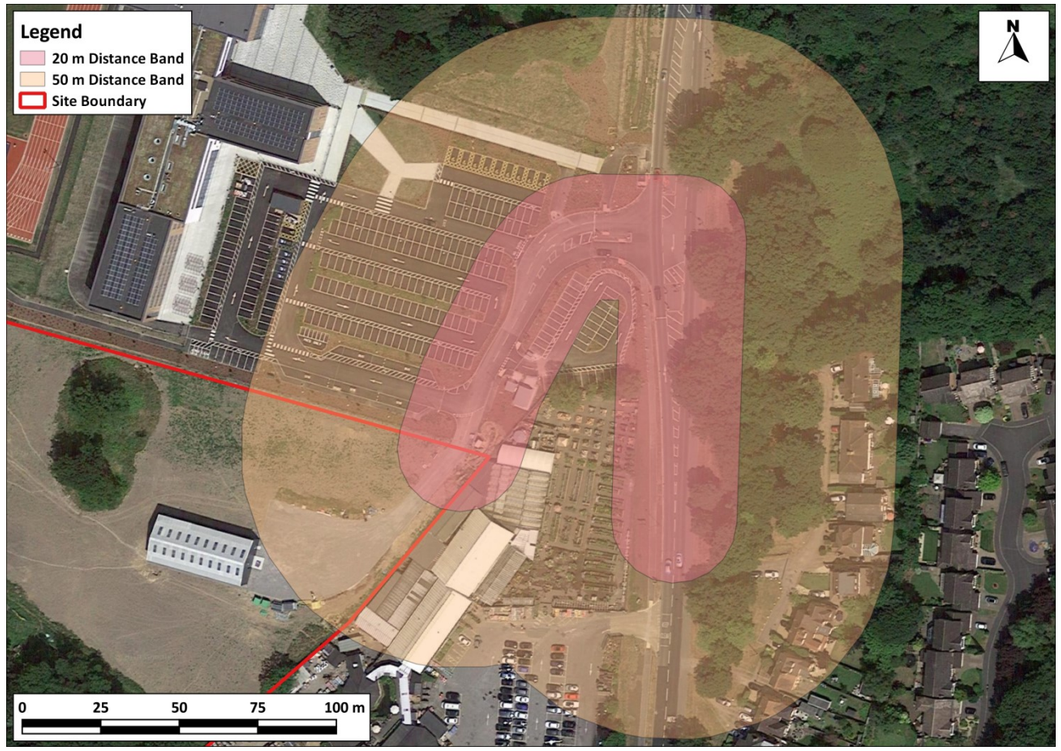


Imagery ©2019 Google, Imagery ©2019 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The Geoinformation Group, Map data ©2019

6.91 Table 6.14 shows that the dust emission magnitude for trackout is medium and Table A3.3 in ***ES Volume 2, Appendix: Air Quality (Annex 4)*** thus explains that there is a risk of material being tracked 200m from the site. Demolition and construction vehicles will travel southwards along Egley Road (A320) after exiting the site. There are no sensitive properties within 20m and approximately twelve residential properties within 50m of the roads along which material could be tracked (see Figure 6.8), and Table A4.3 in ***ES Volume 2, Appendix: Air Quality (Annex 4)*** that the area is of 'medium' sensitivity to dust soiling due to trackout.

[22] British Geological Survey (2019) UK Soil Observatory Map Viewer, [Online], Available: http://mapapps2.bgs.ac.uk/ukso/home.html.

Figure 6.8 20m and 50m Distance Bands around Roads Used by Construction Traffic Within 200m of the Site Exit



Imagery ©2019 Google, Imagery ©2019 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The Geoinformation Group, Map data ©2019

Sensitivity of the Area to any Human Health Effects

6.92 Residential properties and schools are also classified as being of 'high' sensitivity to human health effects. The matrix in Table A4.4 in ***ES Volume 2, Appendix: Air Quality (Annex 4)*** requires information on the baseline annual mean PM_{10} concentration in the area. Receptors D1, D2, D3, D4 and E3 (see Table 9.5, Table 6.6, Figure 6.1 and Figure 6.4) are all located within 50m of the site and / or the road along which there is a risk of material being tracked (see paragraph 6.91). The maximum predicted baseline PM_{10} concentration at these receptors in 2018 is 15.1 µg/m^3 (Table 6.12), and this value has been used. Using the matrix in Table A4.4 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***, both the area surrounding the onsite works and the area surrounding roads along which material may be tracked from the site are of 'low' sensitivity.

Sensitivity of the Area to any Ecological Effects

6.93 The guidance only considers that designated ecological located within 50m have the potential to be impacted by construction works. There are no designated ecological sites located within 50m of the site or those roads along which material may be tracked (Smart's and Prey Heaths SSSI is located more than 500m from the site), thus ecological impacts will not be considered further.

Summary of Area Sensitivity

6.94 Table 6.15 summarises the sensitivity of the area around the proposed construction works site.

Table 6.15 Summary of the Area Sensitivity

Effects associated with:	Sensitivity of the Surrounding Area	
	On-site works	Trackout
Dust Soiling	Medium	Medium
Human health	Low	Low

Risk and significance

6.95 The dust emission magnitudes in Table 6.14 have been combined with the sensitivities of the area in Table 6.15 using the matrix in Table A4.6 in ***ES Volume 2, Appendix: Air Quality (Annex 4)***, in order to assign a risk category to each activity. The resulting risk categories for the four construction activities, without mitigation, are set out in Table 6.16. These risk categories have been used to determine the appropriate level of mitigation as set out in ***ES Volume 2, Appendix: Air Quality (Annex 4)*** (step 3 of the assessment procedure).

Table 6.16 Summary of Risk of Impacts Without Mitigation

Source	Dust Soiling	Human Health
Demolition	Low Risk	Negligible
Earthworks	Medium Risk	Low Risk
Construction	Medium Risk	Low Risk
Trackout	Low Risk	Low Risk

6.96 The IAQM guidance does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance[17] is clear that the residual effect will normally be 'not significant'.

Completed Development

Human Health

Combined Impacts of the Proposed Development-Generated Road Traffic and Energy Plant Emissions at Existing Properties

6.97 Predicted annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ in 2021 for existing receptors are set out in Table 6.17 to Table 6.20 for both the "Future Baseline" and "Future Baseline + Proposed Development". Predictions take account of emissions from the adjacent road network. These tables also describe the impacts at each receptor using the impact descriptors given in Table 6.4. For NO_2, results are presented for two scenarios so as to include a sensitivity test.

Table 6.17 Predicted Impacts on Annual Mean NO_2 Concentrations in 2021 ('Official' Future Baseline) (µg/m^3)

Receptor	Future Baseline	Future Baseline + Proposed Development	% Change [a]	Impact Descriptor
E1	23.6	24.2	1	Negligible
E2	22.1	22.7	1	Negligible
E3	18.0	18.5	1	Negligible
E4	22.2	23.0	2	Negligible
E5	16.6	17.0	1	Negligible
E6	32.6	33.8	3	Minor Adverse
E7	23.1	23.7	2	Negligible
E8	21.1	21.7	1	Negligible
E9	22.8	23.4	1	Negligible
E10	22.7	23.2	1	Negligible

Receptor	Future Baseline	Future Baseline + Proposed Development	% Change [a]	Impact Descriptor
E11	26.6	27.2	2	Negligible
E12	27.9	28.5	2	Negligible
E13	26.0	26.4	1	Negligible
E14	37.0	37.7	2	Minor Adverse
E15	33.4	34.0	1	Negligible
E16	36.8	37.5	2	Minor Adverse
E17	22.7	23.0	1	Negligible
E18	28.9	29.3	1	Negligible
E19	32.4	32.9	1	Negligible
E20	27.0	27.5	1	Negligible
E21	24.4	24.9	1	Negligible
E22	29.9	30.5	1	Negligible
E23	33.2	33.7	1	Negligible
E24	31.9	32.2	1	Negligible
E25	30.8	31.2	1	Negligible
E26	30.7	31.1	1	Negligible
E27	29.2	29.5	1	Negligible
E28	32.1	32.5	1	Negligible
E29	26.9	27.1	1	Negligible
E30	32.2	32.5	1	Negligible
E31	32.6	32.9	1	Negligible
E32	34.8	35.2	1	Negligible
E33	26.2	26.6	1	Negligible
E34	17.6	17.8	1	Negligible
E35	16.7	16.9	1	Negligible
E36	32.9	33.5	2	Minor Adverse
E37	38.7	39.4	2	Moderate Adverse
E38	35.2	35.8	2	Minor Adverse
Objective	40		-	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

Table 6.18 Predicted Impacts on Annual Mean NO_2 Concentrations in 2021 ('Sensitivity Test' Scenario) (µg/m^3) [a,b]

Receptor	Future Baseline	Future Baseline + Proposed Development	% Change[c]	Impact Descriptor
E1	23.8	24.3	1	Negligible
E2	22.1	22.7	1	Negligible
E3	17.6	18.1	1	Negligible
E4	22.3	23.0	2	Negligible
E5	16.1	16.4	1	Negligible
E6	33.5	34.8	3	Minor Adverse
E7	22.9	23.5	2	Negligible
E8	20.8	21.3	1	Negligible
E9	22.5	23.1	2	Negligible
E10	22.3	22.8	1	Negligible
E11	26.6	27.3	2	Negligible
E12	28.1	28.7	2	Negligible
E13	26.0	26.4	1	Negligible
E14	38.1	38.7	2	Moderate Adverse
E15	34.1	34.7	2	Minor Adverse
E16	37.8	38.4	2	Moderate Adverse
E17	22.5	22.8	1	Negligible
E18	29.3	29.8	1	Negligible
E19	33.2	33.7	1	Negligible
E20	27.0	27.6	1	Negligible
E21	24.2	24.6	1	Negligible
E22	30.2	30.8	1	Negligible
E23	33.8	34.3	1	Negligible
E24	32.8	33.2	1	Negligible
E25	31.7	32.1	1	Negligible
E26	31.6	32.0	1	Negligible
E27	29.9	30.2	1	Negligible
E28	33.1	33.5	1	Negligible
E29	27.4	27.6	1	Negligible
E30	33.2	33.5	1	Negligible
E31	33.6	34.0	1	Negligible
E32	36.1	36.6	1	Negligible
E33	26.7	27.1	1	Negligible
E34	17.2	17.3	0	Negligible
E35	16.2	16.3	0	Negligible
E36	34.0	34.7	2	Minor Adverse
E37	**40.4**	**41.1**	2	Moderate Adverse
E38	36.5	37.2	2	Minor Adverse
Objective	40		-	-

[a] Exceedances of the objective are shown in bold.
[b] Assuming higher emissions from modern diesel vehicles as described in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.
[c] % changes are relative to the objective and have been rounded to the nearest whole number.

Table 6.19 Predicted Impacts on Annual Mean PM_{10} Concentrations in 2021 (µg/m^3)

Receptor	Future Baseline	Future Baseline + Proposed Development	% Change[a]	Impact Descriptor
E1	16.2	16.3	0	Negligible
E2	15.8	16.0	0	Negligible
E3	14.7	14.7	0	Negligible
E4	15.9	16.1	0	Negligible
E5	14.6	14.6	0	Negligible

Receptor	Future Baseline	Future Baseline + Proposed Development	% Change[a]	Impact Descriptor
E6	18.7	19.0	1	Negligible
E7	16.5	16.6	0	Negligible
E8	15.9	16.1	0	Negligible
E9	16.3	16.5	0	Negligible
E10	16.4	16.5	0	Negligible
E11	16.9	17.0	0	Negligible
E12	17.0	17.1	0	Negligible
E13	16.6	16.7	0	Negligible
E14	18.7	18.9	0	Negligible
E15	18.0	18.2	0	Negligible
E16	19.4	19.6	0	Negligible
E17	16.2	16.3	0	Negligible
E18	17.6	17.7	0	Negligible
E19	18.6	18.7	0	Negligible
E20	16.9	17.0	0	Negligible
E21	16.7	16.8	0	Negligible
E22	18.0	18.2	0	Negligible
E23	18.8	18.9	0	Negligible
E24	18.3	18.4	0	Negligible
E25	18.0	18.1	0	Negligible
E26	18.0	18.1	0	Negligible
E27	17.6	17.7	0	Negligible
E28	18.3	18.4	0	Negligible
E29	16.9	16.9	0	Negligible
E30	18.2	18.2	0	Negligible
E31	18.3	18.4	0	Negligible
E32	18.5	18.6	0	Negligible
E33	16.2	16.2	0	Negligible
E34	14.6	14.6	0	Negligible
E35	14.4	14.4	0	Negligible
E36	17.3	17.5	0	Negligible
E37	18.5	18.6	0	Negligible
E38	17.8	17.9	0	Negligible
Objective	32[b]		-	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

[b] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16[4]. A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance[12].

Table 6.20 Predicted Impacts on Annual Mean $PM_{2.5}$ Concentrations in 2021 (µg/m^3)

Receptor	Future Baseline	Future Baseline + Proposed Development	% Change[a]	Impact Descriptor
E1	11.0	11.1	0	Negligible
E2	10.8	10.9	0	Negligible
E3	10.2	10.2	0	Negligible
E4	10.9	11.0	0	Negligible
E5	10.1	10.1	0	Negligible
E6	12.4	12.6	1	Negligible
E7	11.4	11.5	0	Negligible
E8	11.1	11.1	0	Negligible
E9	11.3	11.4	0	Negligible
E10	11.3	11.4	0	Negligible
E11	11.6	11.7	0	Negligible
E12	11.7	11.8	0	Negligible
E13	11.5	11.5	0	Negligible
E14	12.7	12.8	0	Negligible
E15	12.3	12.4	0	Negligible
E16	13.1	13.1	0	Negligible
E17	11.2	11.3	0	Negligible
E18	12.0	12.1	0	Negligible
E19	12.6	12.7	0	Negligible
E20	11.6	11.7	0	Negligible
E21	11.5	11.5	0	Negligible
E22	12.2	12.3	0	Negligible
E23	12.7	12.8	0	Negligible
E24	12.4	12.5	0	Negligible
E25	12.3	12.3	0	Negligible
E26	12.3	12.3	0	Negligible
E27	12.0	12.1	0	Negligible
E28	12.4	12.5	0	Negligible
E29	11.6	11.7	0	Negligible
E30	12.4	12.4	0	Negligible
E31	12.4	12.5	0	Negligible
E32	12.6	12.6	0	Negligible
E33	11.0	11.1	0	Negligible
E34	10.1	10.1	0	Negligible
E35	10.0	10.0	0	Negligible
E36	11.7	11.8	0	Negligible
E37	12.4	12.5	0	Negligible
E38	12.0	12.1	0	Negligible
Objective	25[b]		-	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

[b] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

NO_2

6.98 The 'official' annual mean NO_2 concentrations are below the annual mean objective at all receptors, both with and without the Proposed Development. Furthermore, the annual mean NO_2 concentrations are below 60 µg/m^3 at all of receptors and it is, therefore, unlikely that the 1-hour mean NO_2 objective will be exceeded. For the 'official' Future Baseline + Proposed Development scenario the percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 3% at one receptor, 2% at nine receptors and 1% at 28 receptors; using the matrix in Table 6.4, these impacts are described as being *moderate adverse* at one receptor (receptor E37, representing one residential property), *minor adverse* at five receptors (representing approximately 14 residential properties) and *negligible* at all other receptors. As discussed, baseline concentrations at receptor E37 are likely to be overpredicted and, therefore, the moderate adverse impact is likely to be an overly conservative impact descriptor for this receptor.

6.99 The results from the 'sensitivity test' Future Baseline + Proposed Development scenario show that the annual mean NO_2 concentration is predicted to exceed the objective at one receptor (E37), both with and without the Proposed Development. Predicted concentrations are below the annual mean objective at all other receptors, both with and without the Proposed Development. The annual mean NO_2 concentrations are below 60 µg/m^3 at all receptors and it is, therefore, unlikely that the 1-hour mean NO_2 objective will be exceeded. For the 'sensitivity test' scenario the percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 3% at one receptor, 2% at 11 receptors, 1% at 26 receptors and 0% at two receptors; using the matrix in Table 6.4, these impacts are described as being *moderate adverse* at three receptors (receptors E14, E16 and E37, representing approximately nine residential properties), *minor adverse* at four receptors (receptors E6, E15, E36 and E38), representing approximately nine residential properties) and *negligible* at all other receptors.

PM_{10} and $PM_{2.5}$

6.100 The annual mean PM_{10} and $PM_{2.5}$ concentrations are well below the annual mean objectives at all receptors, both with or without the Proposed Development. Furthermore, as the annual mean PM_{10} concentrations are below 32 µg/m^3, it is unlikely that the 24-hour mean PM_{10} objective will be exceeded at any of the receptors.

6.101 The percentage changes in both PM_{10} and $PM_{2.5}$ concentrations, relative to the air quality objective (when rounded), are predicted to be 1% at one receptor and 0% at all other receptors; using the matrix in Table 6.4, these impacts are described as being *negligible*.

Impacts of Existing and Proposed Sources on the Proposed Development (New Properties)

Assessment of Railway Locomotive Emissions

6.102 Defra guidance[4] outlines that there is only the potential for locomotive emissions to cause an exceedance of the annual mean NO_2 objective where there is long-term exposure within 30m of railway lines that experience a high volume of diesel passenger trains[23] and where the annual mean concentration is above 25 µg/m^3. The Proposed Development falls outside these criteria; the closest long-term (i.e. residential) exposure is located >100 m from the railway line, which does not experience a high volume of diesel passengers. Furthermore, annual mean NO_2 concentrations at worst-case locations within the Proposed Development are predicted to be below 25 µg/m^3 (see Table 6.21). It can, therefore, be concluded that there is no risk of an objective exceedance within the Proposed Development as a result of emissions from locomotives using the nearby railway lines, and that the impacts from such emissions at future receptors will be not significant.

Detailed Assessment of Air Quality for Future Receptors within the Proposed Development

6.103 Predicted air quality conditions for future residents of the Proposed Development, taking account of emissions from the adjacent road network and proposed energy plant, are set out in Table 6.21 and Table 6.22 for Receptors D1 to D4.

6.104 All of the values are well below the objectives. Air quality for future residents of the Proposed Development will thus be acceptable.

Table 6.21 Predicted Concentrations of NO_2 in 2021 for Future Receptors within the Proposed Development (µg/m^3)

Receptor	Annual Mean NO_2 (µg/m^3)		99.79th percentile of 1-hour mean NO_2 (µg/m^3)[c]
	'Official' Future Baseline + Proposed Development [a]	Sensitivity Test Future Baseline + Proposed Development [b]	
D1	17.1	16.3	36.7
D2	16.9	16.1	36.7
D3	15.3	14.2	33.6
D4	14.7	13.7	32.5
Objective	40		200

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from future diesel cars and vans as described in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.

[c] Calculated by adding the 99.79th percentile of 1-hour mean NO_2 process contributions from the energy plant to two times the predicted baseline annual mean concentration at each receptor (including the contribution of road traffic emissions), which is common practice. The annual mean concentration predicted using the official predictions has been used, which is worst-case.

Table 6.22 Predicted Concentrations of PM_{10} and $PM_{2.5}$ in 2021 for Future Receptors within the Proposed Development (µg/m^3)

Receptor	Annual Mean PM_{10} (µg/m^3)	Annual Mean $PM_{2.5}$ (µg/m^3)
D1	14.5	10.0
D2	14.4	10.0
D3	14.1	9.8
D4	14.0	9.8
Objective	32 [a]	25 [b]

[a] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16[4]. A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance[12].

[b] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Ecology

Initial Screening Stage

6.105 The changes attributable to the operation of the Proposed Development, in predicted concentrations of nitrogen oxides and rates of nutrient and acid nitrogen deposition, in 2021 at the Smart's and Prey Heaths SSSI are set out in Table 6.23 and Table 6.24.

Table 6.23 Changes in Nitrogen Oxides Relative to the Critical Levels (µg/m^3)

Pollutant	Receptor	'Official' Future Baseline + Proposed Development [a]		*Sensitivity Test* Future Baseline + Proposed Development [b]	
		Change	% of Critical Level	*Change*	*% of Critical Level*
Annual Mean NOx	Maximum in SSSI	0.41	1.37	*0.43*	*1.42*
Screening Criterion		0.3 (1%)			
24-hour Mean NOx	Maximum in SSSI	5.04	6.72	*5.21*	*6.95*
Screening Criterion		7.5 (10%)			

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.

[23] Railway lines that experience a 'high volume of diesel passenger trains' are defined in Defra's TG.16 guidance.

Table 6.24 Changes in Nitrogen Deposition Relative to the Critical Loads (kgN/ha/yr)

Pollutant	Receptor	'Official' Future Baseline + Proposed Development [a]		*Sensitivity Test* Future Baseline + Proposed Development [b]	
		Deposition Rate	% of Critical Load	*Deposition Rate*	*% of Critical Load*
Annual Mean Nutrient Nitrogen	Maximum in SSSI	0.23	2.28	*0.24*	*2.37*
Screening Criterion		0.1 (1%)			
Annual Mean Acid Nitrogen	Maximum in SSSI	0.016	1.83	*0.017*	*1.89*
Screening Criterion		0.0089 (1%)			

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.

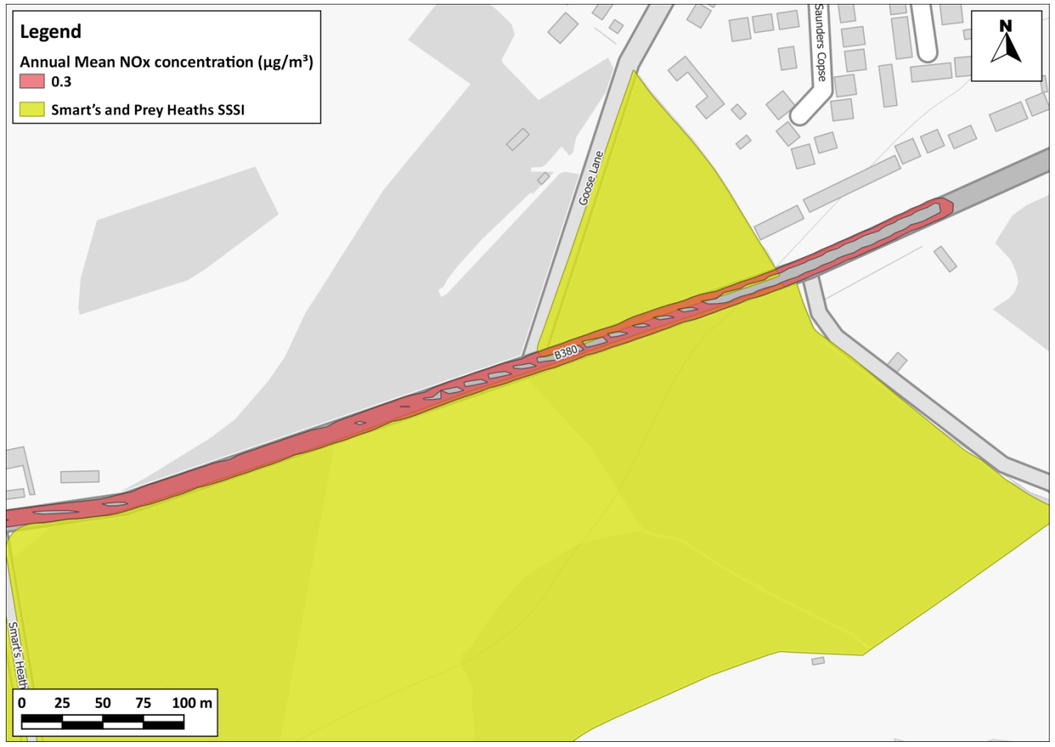
6.106 The maximum predicted annual mean NOx process contribution and nutrient and acid nitrogen process contribution deposition rates are above the relevant screening criteria for both the 'official' and 'sensitivity test' Future Baseline + Proposed Development scenarios and, as such require further assessment.

6.107 The maximum 24-hour mean NOx process contribution are below the screening criteria for both the 'official' and 'sensitivity test' Future Baseline + Proposed Development scenarios, and thus do not require further assessment. Such impacts can be screened out as not significant.

Further Assessment of Annual Mean NOx

6.108 Annual mean NOx process contribution have been predicted at each point of the receptor grid (see Figure 6.3); based on the receptor grid model outputs, a contour plot has been generated showing the area of the SSSI where annual mean NOx process contribution are predicted to be above the screening criteria for both the 'official' and the 'sensitivity test' Future Baseline + Proposed Development scenarios (see Figure 6.9). It should be noted that the area affected covers only a small part of the SSSI located directly adjacent to the road. The area where predicted NOx process contributions exceed 1% of the critical level extend a maximum of 5m into the SSSI.

Figure 6.9 Annual Mean NOx Screening Criteria Contour and the Smart's and Prey Heaths SSSI



6.109 As described in Paragraph 6.47, where the NOx process contributions exceed the screening criteria, the total annual mean concentrations should be considered. The predicted annual mean concentrations of NOx within the SSSI, taking account of emissions from the adjacent road network and proposed energy plant, are set out in Table 6.25. The values are below the 70% of the critical level (21 µg/m^3) and, therefore, in line with the EA guidance, the impacts are considered insignificant.

Table 6.25 Predicted Total Annual Mean NOx Concentrations in 2021 ('Future Baseline + Proposed Development') at Smart's and Prey Heaths SSSI (µg/m^3)

Receptor	Annual Mean NOx (µg/m^3)	
	'Official' Future Baseline + Proposed Development [a]	*Sensitivity Test Future Baseline + Proposed Development [b]*
Maximum on grid	14.3	*14.3*
Screening Criterion	21 (70%)	

[a] In line with Defra's forecasts.

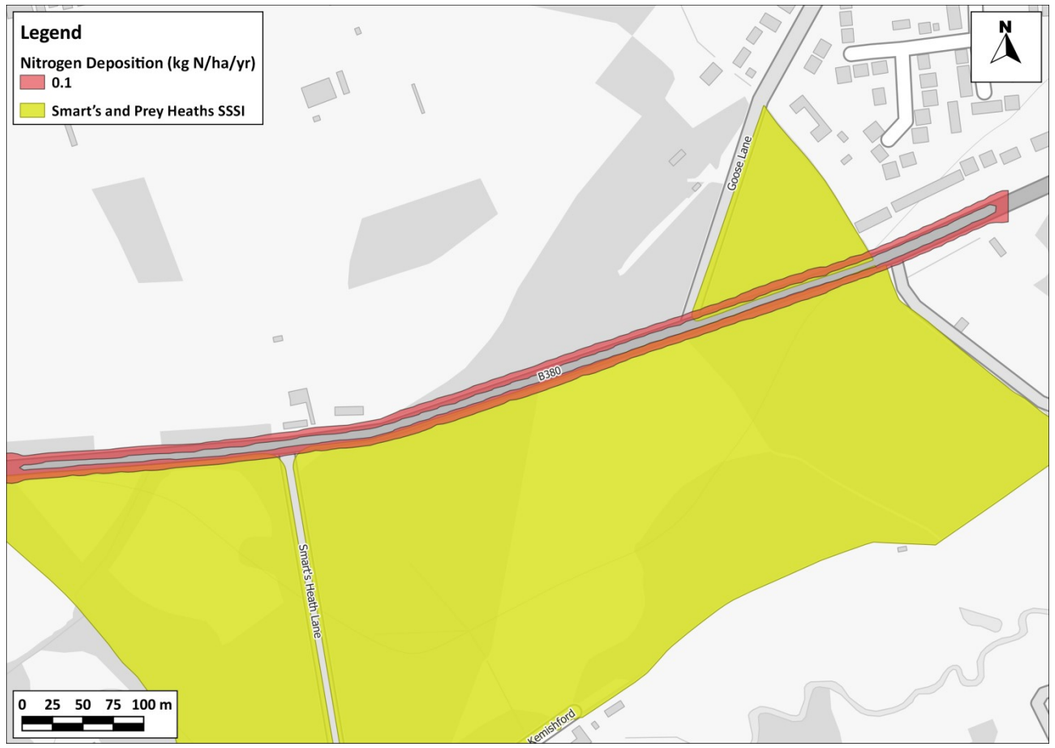
[b] Assuming higher emissions from future diesel cars and vans as described in ***ES Volume 2, Appendix: Air Quality (Annex 2)***.

Further Assessment of Nutrient Nitrogen and Acid Deposition

6.110 Nutrient and acid nitrogen process contribution deposition rates have been predicted at each point of the receptor grid (see Figure 6.3 for receptor grid point locations); based on the receptor grid model outputs, a contour plot has been generated showing the area of the SSSI where nutrient and acid nitrogen process contribution deposition rates are predicted to be above the screening criteria for both the 'official' and the 'sensitivity test' Future Baseline + Proposed Development scenarios (see Figure 6.10 and Figure 6.11). The baseline deposition for nutrient nitrogen and acid deposition exceed the critical loads, with depositions of 13.16 N/ha/yr and 0.94 keq/ha/yr respectively (see Table 6.3). The areas where the screening criteria are

exceeded are shown in Figure 6.10 and Figure 6.11. Within these areas significant impacts cannot be discounted without further assessment. It should be noted that the areas affected cover only a small part of the SSSI located directly adjacent to the road. The area where exceed 1% of the relevant Critical Load extends a maximum of 10m into the SSSI for nitrogen deposition, and 6m for acid deposition.

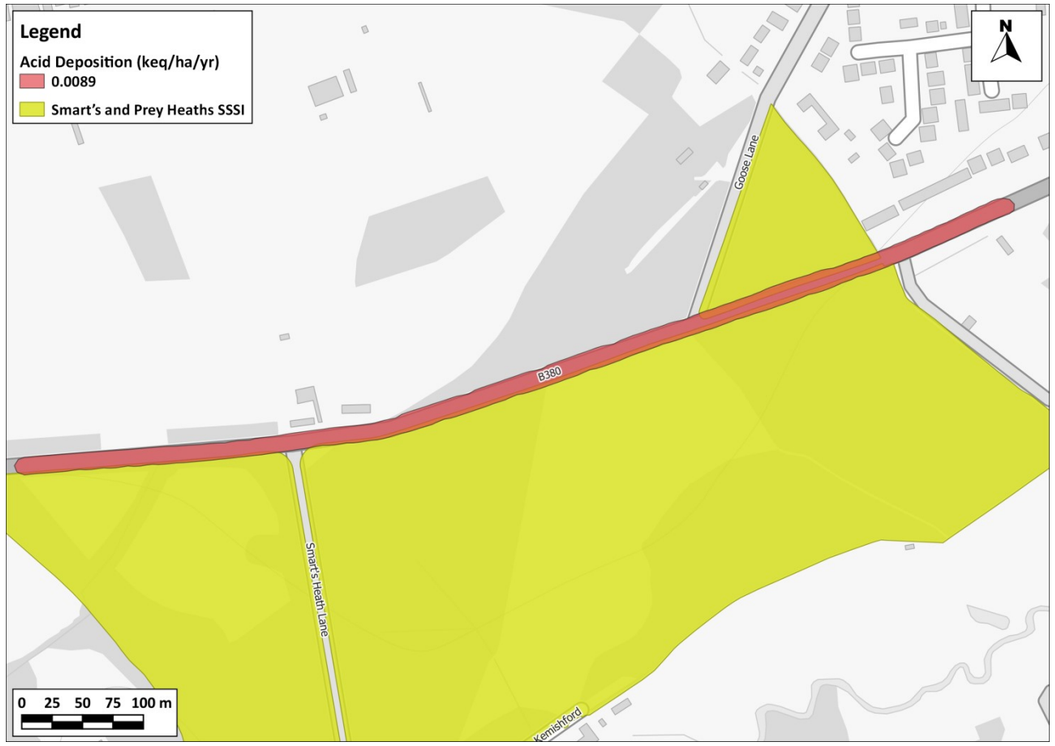
Figure 6.10 Nitrogen Deposition Screening Criteria Contour and the Smart's and Prey Heaths SSSI



Contains Ordnance Survey data © Crown copyright and database right 2019. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

6.111 The area where maximum nitrogen deposition and acid deposition exceeds the 1% of critical load is limited in its encroachment into the SSSI, as described in Paragraph 6.110. The habitat affected by increases above 1% of the critical load of the SSSI is almost exclusively broadleaved woodland, which is an abundant habitat in Woking and less sensitive to nitrogen and acid deposition compared to heathland. Given that the heathland, which is the primary reason for the SSSI's designation and also the feature most sensitive to nitrogen and acid deposition, is highly unlikely to be subject to nitrogen and acid deposition above 1% of the critical loads, any effects on the SSSI through air quality impacts are considered to be not significant.

Figure 6.11 Acid Deposition Screening Criteria Contour and the Smart's and Prey Heaths SSSI



Contains Ordnance Survey data © Crown copyright and database right 2019. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

Significance of Operational Air Quality effects

6.112 The assessment has considered the impacts that emissions associated with Proposed Development-generated traffic and plant emissions would have on air quality at existing receptors (including Smart's and Prey Heaths SSSI), as well as the impacts of existing and proposed sources onto air quality that future residents and occupants of the Proposed Development will be exposed to.

6.113 The assessment is based on a worst-case assumption, such that all Proposed Development-generated traffic and energy plant emissions has been considered to occur in 2021, which is the earliest year of first occupation. In reality, the Proposed Development will not be fully completed and occupied until 2023. Air quality is projected to improve with time, with background pollutant concentrations and vehicle emissions expected to reduce between 2021 and 2023. The predicted concentrations and impacts presented in this chapter are thus conservative.

Human Health

6.114 Despite this worst-case approach, the assessment has shown that air quality conditions at the site in the opening year will be acceptable, with pollutant concentrations predicted to be well below the national air quality objectives throughout the site.

6.115 In addition, the assessment has shown that the operation of the Proposed Development will lead to negligible impacts on concentrations of PM_{10} and $PM_{2.5}$ at all selected existing receptor locations. Impacts on annual mean NO_2 concentrations are, however, predicted to be moderate adverse at one to three receptors (representing one to nine residences), and negligible or minor adverse elsewhere within the study area. However, annual mean NO_2 concentrations remain below the objective at all receptor locations, with the Proposed Development in operation, with the exception of receptor E37, where an exceedance is predicted with and without the Proposed Development.

6.116 As discussed above, the assessment has adopted a worst-case approach by assuming full operation of the Proposed Development in 2021, with all Proposed Development-generated traffic occurring from the

beginning of 2021, which has led to conservative results. In reality, only the David Lloyd Leisure Centre is expected to be completed and operational by mid-2021, with 280 car parking spaces in use out of the 370 car parking spaces to be provided as part of the Proposed Development. As such, based on the assumption that that the increase in road traffic will be proportionate to the number of car parking spaces in use, it is expected that only 75.7% of the Proposed Development-generated traffic will appear on the roads in mid-2021.

6.117 On the basis of the above, although a moderate adverse impact may remain at receptors E14, E16 and E37, the predicted moderate adverse impacts are unlikely to occur. It can thus be expected that, in reality, impacts will range from negligible to minor adverse at all but one receptor (E14, representative of two residences), where a moderate adverse impact would occur. On this basis, it is considered that the overall operational air quality effects of the Proposed Development on human health receptors are not significant. In future years as the Proposed Development is built out to completion (by 2023), expected improvements in baseline air quality conditions[24], due to more stringent emission standards for vehicles and the uptake of clean-technology vehicles (such as electric or hybrid), will prevent these moderate adverse impacts from occurring in later years.

6.118 This professional judgement is made in accordance with the methodology set out in ***ES Volume 2, Appendix: Air Quality (Annex 3)*** and also takes into account the results of the sensitivity test for NO_2.

Ecology

6.119 Regarding the effects of traffic and plant emissions generated by the Proposed Development on Smart's and Prey Heaths SSSI:

- Proposed Development-generated road traffic process contributions of 24-hour mean NOx concentrations are below the relevant screening criterion;
- Whilst Propose Development-generated road traffic process contributions of annual mean NOx exceed the relevant screening criteria in areas of the SSSI immediately adjacent to part of Smart's Heath Road (B380) (representing a small percentage of the SSSI), total annual mean NOx concentrations at worst-case sensitive locations within the SSSI will remain below 70% of the critical level, with or without the Proposed Development; thus impacts are not significant; and
- Although there is an exceedance of the 1% screening criteria for nutrient nitrogen and acid deposition within the SSSI, this only extends to a maximum of 10m from the road. The exceedance covers only broadleaved woodland, which is less sensitive than the heathland which is located further from the road and is the primary reason for the SSSI's designation. As such the impacts are considered to be not significant.

Overall Significance of Effects

6.120 Overall, based on the above, the operational air quality effects associated with the Proposed Development are considered to be 'not significant'.

MITIGATION AND MONITORING MEASURES

Mitigation Included by Design

6.121 The EPUK/IAQM guidance advises that good design and best practice measures should be considered, whether or not more specific mitigation is required. The Proposed Development incorporates the following good design and best practice measures:

- Setting back of the proposed residences from main roads by over 60m;
- Setting back of the proposed residences from the railway lines by at over 140m;
- Using Air Source Heat Pumps within the residential dwellings, to reduce the heating demand required from an energy plant;
- Using Air Source Heat Pumps within the David Lloyd Leisure Centre to reduce the heating demand required from the energy plant; and
- Providing pedestrian and cycle access to the Proposed Development, including cycle parking (10 spaces associated with the proposed David Lloyd Leisure Centre).

Additional Mitigation

Demolition and Construction

6.122 Measures to mitigate dust emissions will be required during the demolition and construction works of the Proposed Development, in order to minimise effects upon nearby sensitive receptors.

6.123 The site has been identified as being a Medium Risk site during earthworks and construction activities and as a Low Risk site during demolition and for trackout, as set out in Table 6.16. Comprehensive guidance has been published by the IAQM[17] that describes measures that should be employed, as appropriate, to reduce the impacts. Further IAQM guidance[25] recommends what monitoring should be undertaken during the construction phase. This reflects best practice experience and has been used, together with the professional experience of the consultant who has undertaken the dust impact assessment and the findings of the assessment, to draw up a set of measures that should be incorporated into the specification for the works. These measures are described in ***ES Volume 2, Appendix: Air Quality (Annex 6)***.

6.124 The mitigation measures shall be written into a dust management plan (DMP). The DMP may be integrated into a Code of Construction Practice or the Construction Environmental Management Plan (CEMP), and may require monitoring.

6.125 Where mitigation measures rely on water, it is expected that only sufficient water will be applied to damp down the material. There will not be any excessive use of water.

Completed Development

6.126 The assessment has demonstrated that the overall air quality effect of the Proposed Development will be 'not significant'. As such, there is no requirement for mitigation beyond the best practice design measures highlighted above.

6.127 Measures to reduce pollutant emissions from road traffic are principally being delivered in the longer term by the introduction of more stringent emissions standards, largely via European legislation (which is written into UK law). WBC has also produced an Air Quality Action Plan[26] in response to AQMA Order 2, which will also be helping to deliver improved air quality within the study area.

Summary

6.128 Table 6.26 provides a summary of the identified mitigation and measures committed to, and Table 6.27 provides a tabulated summary of the outcomes of the air quality impact assessment of the Proposed Development.

Table 6.26 Summary of Proposed Mitigation and Enhancement Measures

Potential Effects Identified	Proposed Mitigation / Enhancement Measures
Demolition and Construction	
Demolition and Construction works (dust)	Mitigation Measures listed in ***ES Volume 2, Appendix: Air Quality (Annex 6)***
Demolition and Construction traffic	No mitigation measures required
Completed Development	
Road traffic and energy plant emissions	No mitigation measures required

RESIDUAL EFFECTS

6.129 The residual effects resulting from the Proposed Development are summarised in Table 6.27.

[24] Refer to paragraphs A7.7 and A7.8 in ES ***Volume 2, Appendix: Air Quality (Annex 7)*** for further details.

[25] IAQM (2018), Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites v1.1
[26] Woking Borough Council (2018), Guildford Road AQMA Air Quality Action Plan

Table 6.27 Summary of Residual Effects

Receptor	Receptor Sensitivity	Residual Effect (Nature and Scale)	Effects Significance	Geo	D I	P T	R IR	St Mt Lt
Demolition and Construction								
Dust								
Existing Human Health Receptors	High	Adverse*	Not significant	L / B	D	T	R	Mt
Demolition and Construction Traffic								
Existing Human Health Receptors	High	Negligible	Not significant	L / B	D	T	IR	Mt
Completed Development								
Operational Traffic and Energy Plant Emissions								
Introduced Human Health Receptors	High	n/a**	Not significant	L / B	D	P	IR	Lt
Existing Human Health Receptors	High	Negligible to Adverse***	Not significant****	L / B	D	P	IR	Lt
Existing Ecological Receptors	High	Negligible	Not significant	L / B	D	P	IR	Lt

Notes:

Residual Effect

- Scale = Negligible / Minor / Moderate / Major
- Nature = Beneficial or Adverse

Geo (Geographic Extent) = Local (L), Borough (B), Regional (R), National (N)

D = Direct / I = Indirect

P = Permanent / T = Temporary

R = Reversible / IR= Irreversible

St = Short Term / Mt = Medium Term / Lt = Long Term

N/A = not applicable / not assessed

* The scale of impacts at individual receptor locations was not determined for demolition and construction. A qualitative assessment was undertaken, and it is considered that with the application of recommended mitigation measures, residual effects will be 'not significant'.

** There are no impacts at proposed receptors, as they are not currently present on site. Future air quality conditions that residents of the Proposed Development will be exposed to have, however, been predicted.

*** The impacts at individual receptor locations are likely to be negligible to minor adverse, with a moderate adverse impact at a single receptor.

**** The overall significance of effects has been based on the impacts descriptors at individual receptors, the number of properties affected, and professional judgment.

LIKELY SIGNIFICANT EFFECTS

6.130 The construction and operation of the Proposed Development are not predicted to result in any significant effects on the receptors considered within this assessment in relation to air quality, either from dust associated with the site works and trackout or from emissions from demolition and construction traffic generated by the Proposed Development.

6.131 The assessment demonstrated that operational traffic and energy plant emissions generated by the Proposed Development will not cause exceedances of the relevant objectives at any of the identified worst-case existing human heath receptors. PM_{10} and $PM_{2.5}$ impacts will be *negligible* at all sensitive properties and NO_2 impacts will be *negligible* or *minor adverse* at most sensitive properties, though *moderate adverse* NO_2 impacts will occur at a small number of properties. Pollutant concentrations at sensitive locations within the Proposed Development itself will be well below the relevant objectives.

6.132 The assessment also demonstrated that process contributions of annual mean and 24-hour mean NOx and nutrient and acid nitrogen deposition associated with emissions from operational traffic generated by the Proposed Development will not cause significant impacts on the nearby SSSI.

6.133 Overall, the Proposed Development will have a non-significant effect on air quality, during both the construction and operational phases.

CLIMATE CHANGE

6.134 Air quality is predicted to improve in the future, owing to lower emissions from road vehicles and heating and cooling plant as progressively lower emission technologies become available. The assessment of the Proposed Development, therefore, focuses on the near-term (year of opening), but the outlook for the longer term is one of improvement, both in terms of local and regional air quality, but also in terms of emissions associated with the Proposed Development itself. Climate change is a long-term effect, and significant changes in climate are not expected by 2021. Climate change will, therefore, not affect air quality model predictions set out in this chapter. In the longer term (2050 – 2080), changes in climate might affect the need for heating and cooling and, therefore, have an influence on the energy plant emissions associated with the Proposed Development, but significant effects are not expected as a result.