

452 Basingstoke Road, Reading RG2 0QE
November 2016

Procter & Gamble Ltd

P&G Reading Innovation Centre

Air Quality Assessment



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Issue | 7 November 2016

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It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 249765-00

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1 Introduction

This report is the Air Quality Assessment, produced by Arup on behalf of Procter & Gamble Ltd, to support a planning application for the new development at 452 Basingstoke Road, Reading.

1.1 Description of Development

Development of a two storey research and development facility within Procter and Gamble's existing Reading site is proposed. The facility will comprise laboratories, offices, storage warehousing, associated access, car parking and hard and soft landscaping works. The works comprise:

- Demolition of the south-western wing of the existing Gillette building, the ground floor security gatehouse and ancillary sub-station and external store buildings;
- Refurbishment of the southern half of the retained Gillette building and erection of a rear extension in the form of a new research and development office and laboratory accommodation (Class B1) and associated storage warehousing (Class B8);
- Refurbishment of the façade of the northern half of the retained Gillette building;
- Provision of a 190 space multi-storey car park to the south of the Gillette building formed of four storeys comprising eight levels. Further parking at grade, adjacent and in the currently vacant land to the north and rear of the existing Gillette building;
- Ancillary plant and engineering works including switch room, generator and transformer buildings;
- Associated hard and soft landscaping works, including access and circulation; and
- Formation of a new northern vehicular access to the application site.

1.2 Scope of this Report

This report reviews the existing air quality conditions in the vicinity of the site and the likely significant air quality impacts resulting from the proposed development. The effects have been assessed in the context of relevant national, regional and local air quality policies.

The proposed development has the potential to cause air quality impacts at sensitive locations during the construction and operational phases. These may include fugitive dust emissions from construction works, road vehicle exhaust emissions associated with traffic generated by the proposed development and exhaust emissions from energy and heating plant in the proposed development.

These potential air quality impacts will be assessed following the relevant guidance as outlined below.

2 Air Quality Standards and Guidelines

2.1 European Air Quality Management

In 1996 the European Commission published the Air Quality Framework Directive on ambient air quality assessment and management (96/62/EC)¹. This Directive defined the policy framework for 12 air pollutants, including NO₂, known to have harmful effects on human health and the environment. Limit values (pollutant concentrations not to be exceeded by a certain date) for each specified pollutant were set through a series of Daughter Directives, including Directive 1999/30/EC (the 1st Daughter Directive)² which sets limit values for nitrogen dioxide (NO₂) and particulate matter (amongst other pollutants) in ambient air.

In May 2008 the Directive 2008/50/EC³ on ambient air quality and cleaner air for Europe came into force. This Directive consolidates the above (apart from the 4th Daughter Directive) and makes provision for extended compliance deadlines for NO₂ and PM₁₀. The Directive has been transposed into national legislation in England by the Air Quality Standards Regulations 2010⁴. The Secretary of State for the Environment, Food and Rural Affairs has the duty of ensuring compliance with the air quality limit values.

2.2 Environment Act 1995

Part IV of the Environment Act 1995⁵ places a duty on the Secretary of State for the Environment to develop, implement and maintain an air quality strategy with the aim of reducing atmospheric emissions and improving air quality. The national air quality strategy (NAQS) for England, Scotland, Wales and Northern Ireland provides the framework for ensuring compliance with air quality limit values based on a combination of international, national and local measures to reduce emissions and improve air quality. This includes the statutory duty, also under Part IV of the Environment Act 1995, for local authorities to undergo a process of local air quality management and declare Air Quality Management Areas (AQMAs) where necessary.

2.3 Air Quality Objectives and Limit Values

Air quality limit values and objectives are quality standards for clean air. Some pollutants have standards expressed as annual average concentrations due to the chronic way in which they affect health or the natural environment (i.e. effects occur (long-term) after a prolonged period of exposure to elevated concentrations) and others have standards expressed as 24-hour, 1-hour or 15-minute average

¹ Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management

² Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air

³ Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

⁴ The Air Quality Standards Regulations 2010, SI 2010/1001

⁵ Environment Act 1995, Chapter 25, Part IV Air Quality

concentrations (short-term) due to the acute way in which they affect health or the natural environment (i.e. after a relatively short period of exposure). Some pollutants have standards expressed in terms of both long-term and short-term concentrations. Table 1 sets out these EU air quality limit values and national air quality objectives for the pollutants relevant to this study (NO₂ and PM₁₀).

In the majority of cases the air quality limit values and air quality objectives have the same pollutant concentration threshold and date for compliance. The key difference is that the Secretary of State for the Environment is required under European Law to ensure compliance with the air quality limit values whereas local authorities are only obliged under national legislation to undertake best efforts to comply with the air quality objectives. To assist local authorities in demonstrating best efforts, the Environment Act 1995 requires that when carrying out their local air quality management functions, local authorities shall have regard to guidance issued by the Secretary of State.

Table 1: UK and EU Air quality standards and guidelines

Pollutant	Averaging period	Limit value/objective	Date for compliance	Basis
Nitrogen dioxide (NO ₂)	1 hour mean	200 µg/m ³ , not to be exceeded more than 18 times a year (99.8 th percentile)	31 Dec 2005	UK
			1 Jan 2010	EU
	Annual mean	40 µg/m ³	31 Dec 2005	UK
			1 Jan 2010	EU
Fine particulates (PM ₁₀) Measurement technique: Gravimetric	Daily mean	50 µg/m ³ , not to be exceeded more than 35 times a year (90.4 th percentile)	31 Dec 2004	UK
			None specified	EU
	Annual mean	40 µg/m ³	31 Dec 2004	UK
			None specified	EU
Very fine particulates (PM _{2.5})	Annual mean	25 µg/m ³	2020	UK
			1 Jan 2015	EU

2.3.1 Dust Nuisance

Dust is the generic term which the British Standard document BS 6069 (Part Two) used to describe particulate matter in the size range 1 – 75 µm (micrometers) in diameter. Dust nuisance is the result of the perception of the soiling of surfaces by excessive rates of dust deposition. Under provisions in the Environmental Protection Act 1990, dust nuisance is defined as a statutory nuisance.

There are currently no standards or guidelines for dust nuisance in the UK, nor are formal dust deposition standards specified. This reflects the uncertainties in dust monitoring technology, and the highly subjective relationship between deposition events, surface soiling and the perception of such events as a nuisance. In law,

complaints about excessive dust deposition would have to be investigated by the local authority and any complaint upheld for a statutory nuisance to occur. However, dust deposition is generally managed by suitable on-site practices and mitigation rather than by the determination of statutory nuisance and/or prosecution or enforcement notice(s). An informal criterion for dust deposition of 200-250 mg/m²/day (as a 30 day mean) is however often applied in the UK as an indicator of potential nuisance.

3 Policies and Guidance

3.1 National Policy and Guidance

The land-use planning process is a key means of improving air quality, particularly in the long term, through the strategic location and design of new developments. Any air quality consideration that relates to land-use and its development can be a material planning consideration in the determination of planning applications, dependent on the details of the proposed development.

3.1.1 National Planning Policy Framework (2012)

The National Planning Policy Framework⁶ (NPPF) was published in March 2012 with the purpose of planning to achieve sustainable development. Paragraph 124 of the NPPF on air quality states that:

“Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan.”

In addition, paragraph 120 states that:

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

3.1.2 Planning Practice Guidance (2014)

As part of the NPPF, planning practice guidance on various topics was recently published⁷. In relation to air quality, the guidance refers to the significance of air quality assessments to determine the impacts of proposed developments in the area and describes the role of local and neighbourhood plans with regard to air quality. It also provides a flowchart method to assist local authorities to determine how considerations of air quality fit into the development management process.

⁶ Department for Communities and Local Government (2012) National Planning Policy Framework

⁷ Department for Communities and Local Government (2014) Planning Practice Guidance: Air Quality

3.2 Local policy

The Reading Borough Council Sites and Detailed Policies Document (2012) sets out a range of borough-wide policies which help to guide development and planning applications. Policy DM19 Air Quality is of most relevance to this assessment.

Policy DM19 states that development should have regard to the need to improve air quality and reduce the effects of poor air quality:

- Development that would detrimentally affect air quality will not be permitted unless the effect is to be mitigated. The following criteria should be taken into account: whether the proposal, including when combined with the cumulative effect of other developments already permitted, would significantly reduce air quality; whether the development is within, or accessed via, an Air Quality Management Area; and whether it can be demonstrated that a local reduction in air quality would be offset by an overall improvement in air quality, for instance through reduction in the need to travel.
- Where a development would introduce sensitive uses (such as residential, schools and nurseries, hospitals, care facilities) into, or intensify such uses within, an Air Quality Management Area, detrimental effects on that use will be mitigated. Mitigation measures should be detailed in any planning application.
- Where required, planning obligations will be used to secure contributions to measures to tackle poor air quality or for air quality monitoring.

3.3 Other Policy and Guidance

3.3.1 Local Air Quality Management Policy Guidance and Technical Guidance

The 2016 policy guidance note from Defra, LAQM (PG16)⁸, provides additional guidance on the links between transport and air quality. LAQM (PG16) describes how road transport contributes to local air pollution and how transport measures may bring improvements in air quality. Key transport-related Government initiatives are set out, including regulatory measures and standards to reduce vehicle emissions and improve fuels, tax-based measures and the development of an integrated transport strategy.

LAQM (PG16) also provides guidance on the links between air quality and the land-use planning system. The guidance advises that air quality considerations should be integrated within the planning process at the earliest stage and is intended to aid local authorities in developing action plans to deal with specific air quality problems and create strategies to improve air quality. It summarises the main ways

⁸ Defra (2016) Local Air Quality Management Policy Guidance. PG(16)

in which the land use planning system can help deliver compliance with the air quality objectives.

Technical Guidance (TG16)⁹ is designed to support local authorities in carrying out their duties to review and assess air quality in their area.

3.3.2 Institute of Air Quality Management Dust Guidance

The 2014 Institute of Air Quality Management (IAQM) guidance¹⁰ provides guidance to development consultants and environmental health officers on how to assess air quality impacts from construction. The IAQM guidance provides a method for classifying the significance of effect from construction activities based on the 'dust magnitude' (high, medium or low) and proximity of the site to the closest receptors. The guidance recommends that once the significance of effect from construction is identified, the appropriate mitigation measures are implemented. Experience has shown that once the appropriate mitigation measures are applied in most cases the resulting dust impacts can be reduced to negligible levels.

3.3.3 EPUK/IAQM Land-Use Planning & Development Control

The 2015 Land-Use Planning & Development Control guidance document¹¹ produced by Environmental Protection UK (EPUK) and the IAQM provides a framework for professionals operating within the planning system to provide a means of reaching sound decisions, having regard to the air quality implications of development proposals.

The document provides guidance on when air quality assessments are required by providing screening criteria regarding the size of a development, changes to traffic flows/composition energy facilities or combustion processes associated with the development

⁹ Defra (2016) Local Air Quality Management Technical Guidance.TG16

¹⁰ IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction

¹¹ EPUK/IAQM, (2015) Land-Use Planning & Development Control: Planning for Air Quality

4 Assessment Methodology

4.1 Assessment Approach

The overall approach to the air quality assessment comprises:

- A review of the existing air quality conditions at, and in the vicinity of, the development site;
- An assessment of the potential changes in air quality arising from the construction and operation of the proposed development; and
- Formulation of mitigation measures, where appropriate, to ensure any adverse effects on air quality are minimised.

4.2 Method of Baseline Assessment

Existing or baseline ambient air quality refers to the concentration of relevant substances that are already present in the environment. These are present from various sources, such as industrial processes, commercial and domestic activities, traffic and natural sources.

A desk-based review of the following data sources has been undertaken to determine baseline conditions of air quality in this assessment:

- Local authority review and assessment reports;
- Air quality England website¹²;
- The Environment Agency website¹³; and
- The UK Air Information Resource website¹⁴.

4.3 Construction Assessment Method

Construction dust effects are assessed using the qualitative approach described in the latest IAQM guidance¹⁰. The guidance applies to the assessment of dust from construction/demolition activities.

Additional vehicle movements associated with the construction phase are anticipated to be minimal (20 HGVs per day) and any air quality effects arising from these vehicles temporary, therefore, an assessment of construction traffic has been scoped out of the assessment.

¹² Air Quality England (2016) <http://www.airqualityengland.co.uk/>

¹³ Environment Agency website; http://maps.environment-agency.gov.uk/wiyby/dataSearchController?topic=pollution&lang=_e; Accessed October 2016

¹⁴ Defra, <http://uk-air.defra.gov.uk>, Accessed October 2016

An ‘impact’ is described as a change in pollutant concentrations or dust deposition, while an ‘effect’ is described as the consequence of an impact. The main impacts that may arise during construction of the proposed development are:

- dust deposition, resulting in the soiling of surfaces;
- visible dust plumes;
- elevated PM₁₀ concentrations as a result of dust generating activities on-site; and,
- an increase in NO₂ and PM₁₀ concentrations due to exhaust emissions from non-road mobile machinery (NRMM) and vehicles accessing the site.

The IAQM guidance considers the potential for dust emissions from dust-generating activities, such as demolition of existing structures, earthworks, construction of new structures and trackout. Earthworks refer to the processes of soil stripping, ground levelling, excavation and land capping, while trackout is the transport of dust and dirt from the site onto the public road network where it may be deposited and then re-suspended by vehicles using the network. This arises when vehicles leave the site with dust materials, which may then spill onto the road, or when they travel over muddy ground on-site and then transfer dust and dirt onto the road network.

For each of these dust-generating activities, the guidance considers three separate effects: annoyance due to dust soiling; harm to ecological receptors; and the risk of health effects due to a significant increase in PM₁₀ exposure. The receptors can be human or ecological and are chosen based on their sensitivity to dust soiling and PM₁₀ exposure.

The methodology takes into account the scale to which the above effects are likely to be generated (classed as small, medium or large), the levels of background PM₁₀ concentrations and the distance to the closest receptor, in order to determine the sensitivity of the area. This is then taken into consideration when deriving the overall risk for the development site. Suitable mitigation measures, where required, are also proposed to reduce the risk of the development site.

There are five steps in the assessment process described in the IAQM guidance. Further description is provided in the following sections.

Step 1: Need for assessment

The first step is the initial screening of the need for a detailed assessment. According to the IAQM guidance, an assessment is required where there are sensitive receptors within 350m of the site boundary (for ecological receptors that is 50m) and/or within 50m of the route(s) used by the construction vehicles on the public highway (for ecological receptors that is 20m) and up to 500m from the site entrance(s). In this instance, no sensitive ecological receptors have been identified within 50m of the proposed development or within 20m of routes to be used by construction traffic, therefore the impact of the proposed development upon ecological receptors has not been considered further. Therefore, only dust soiling effects and human health impacts are considered and assessed.

Step 2: Assess risk of dust impacts

This second step is split into three sections as follows:

- Define the potential dust emission magnitude (2A);
- Define the sensitivity of the area (2B); and
- Define the risk of impacts (2C).

Each dust-generating activity is given a dust emission magnitude depending on the scale and nature of the works (step 2A) based on the criteria shown in Table 2.

Figure 1: IAQM dust assessment methodology

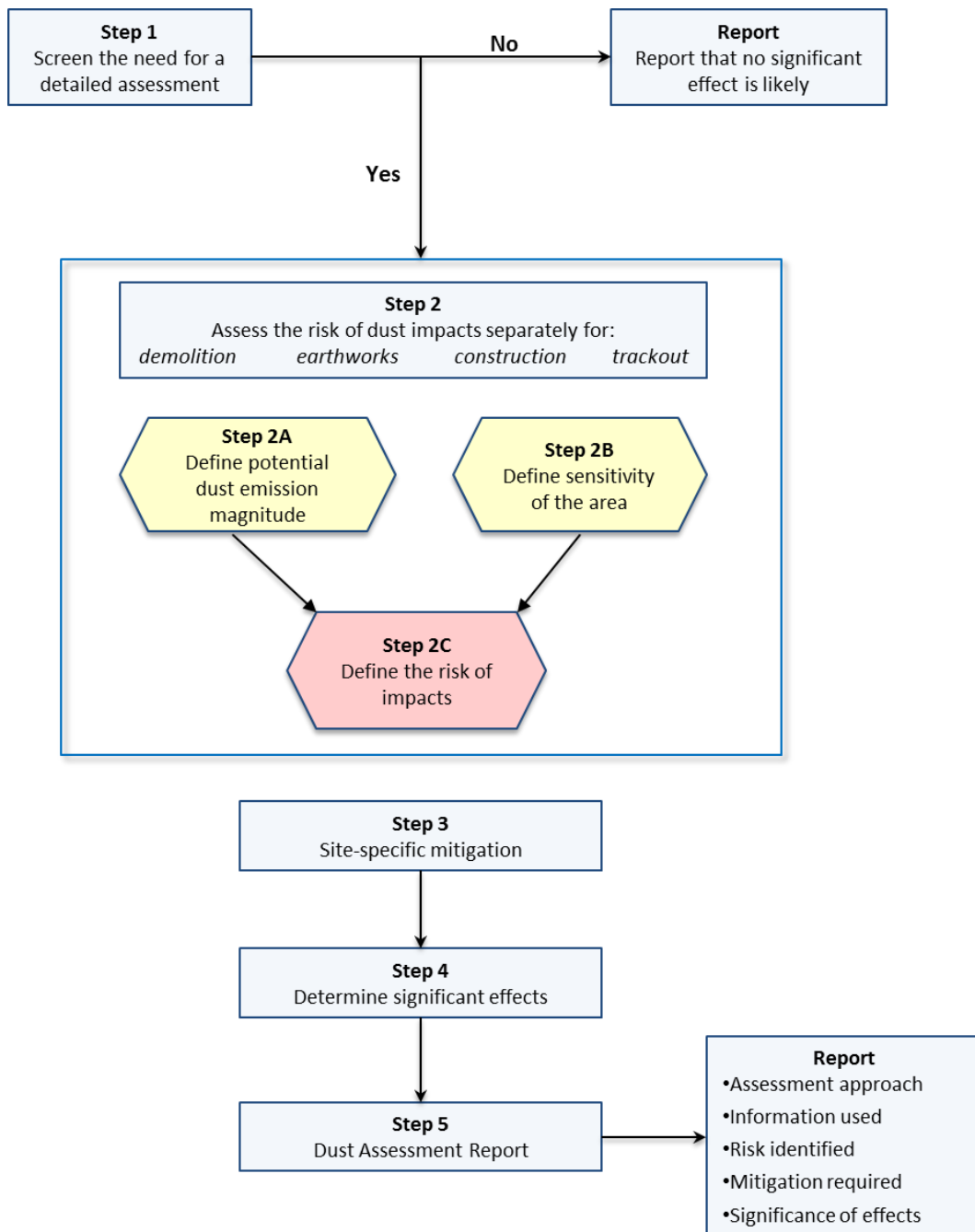


Table 2: Categorisation of dust emission magnitude

Dust emission magnitude		
Small	Medium	Large
Demolition		
• total building volume <20,000m³ • construction material with low potential for dust release (e.g. metal cladding or timber) • demolition activities <10m above ground • demolition during wetter months	• total building volume 20,000 - 50,000m³ • potentially dusty construction material • demolition activities 10 - 20m above ground level	• total building volume >50,000m³ • potentially dusty construction material (e.g. concrete) • on-site crushing and screening • demolition activities >20m above ground level
Earthworks		
• total site area <2,500m² • soil type with large grain size (e.g. sand) • <5 heavy earth moving vehicles active at any one time • formation of bunds <4m in height • total material moved <10,000 tonnes • earthworks during wetter months	• total site area 2,500m² - 10,000m² • moderately dusty soil type (e.g. silt) • 5 – 10 heavy earth moving vehicles active at any one time • formation of bunds 4 - 8m in height • total material moved 20,000 - 100,000 tonnes	• total site area >10,000m² • potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) • >10 heavy earth moving vehicles active at any one time • formation of bunds >8m in height • total material moved >100,000 tonnes
Construction		
• total building volume <25,000 m³ • construction material with low potential for dust release (e.g. metal cladding or timber)	• total building volume 25,000 - 100,000m³ • potentially dusty construction material (e.g. concrete) • on-site concrete batching	• total building volume >100,000m³ • on-site concrete batching • sandblasting
Trackout		
• <10 HDV (>3.5t) outward movements in any one day • surface material with low potential for dust release • unpaved road length <50m	• 10 – 50 HDV (>3.5t) outward movements in any one day • moderately dusty surface material (e.g. high clay content) • unpaved road length 50 – 100m;	• >50 HDV (>3.5t) outward movements in any one day • potentially dusty surface material (e.g. high clay content) • unpaved road length >100m

The sensitivity of the surrounding area is then determined (step 2B) for each dust effect from the above dust-generating activities, based on the proximity and number of receptors, their sensitivity to dust, the local PM₁₀ background concentrations and any other site-specific factors. Table 3 and Table 4 show the criteria for defining the sensitivity of the area to different dust effects.

Table 3: Sensitivity of the area to dust soiling effects on people and property

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	> 100	High	High	Medium	Low
	10 – 100	High	Medium	Low	Low
	<10	Medium	Low	Low	Low
Medium	> 1	Medium	Low	Low	Low
Low	> 1	Low	Low	Low	Low

Table 4: Sensitivity of the area to human health impacts

Receptor Sensitivity	Annual mean PM ₁₀ concentration	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m ³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m ³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m ³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m ³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m ³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32µg/m ³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28µg/m ³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24µg/m ³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

The overall risk of the impacts for each activity is then determined (step 2C) prior to the application of any mitigation measures (Table 5) and an overall risk for the site derived.

Table 5: Risk of dust impacts

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
Demolition			
High	High risk site	Medium risk site	Medium risk site
Medium	High risk site	Medium risk site	Low risk site
Low	Medium risk site	Low risk site	Negligible
Earthworks			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Construction			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Trackout			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Low risk site	Negligible
Low	Low risk site	Low risk site	Negligible

Step 3: Determine the site-specific mitigation

Once each of the dust generating activities is assigned a risk rating, appropriate mitigation measures are identified. Where the risk is negligible, no mitigation measures beyond those required by legislation are necessary.

Step 4: Determine any significant residual effects

Once the risk of dust impacts has been determined and the appropriate dust mitigation measures identified, the final step is to determine whether there are any residual significant effects. Experience indicates that once mitigation measures are applied, in most cases the dust effects will be reduced to negligible levels.

Step 5: Prepare a dust assessment report

The last step of the assessment is the preparation of a Dust Assessment Report which is covered within this chapter.

4.4 Operational Assessment Method

The development has the potential to impact existing air quality as a result of road traffic exhaust emissions, such as NO₂ and PM₁₀, associated with vehicles travelling to and from the site, and using the proposed multi-storey car park (MSCP) during the operational phase. In addition, the on-site combustion plant comprising three gas-fired boilers will contribute to emissions of oxides of nitrogen and subsequently concentrations of NO₂. A screening assessment has been undertaken using the criteria contained in the EPUK/IAQM land-use guidance document¹⁵ to determine the level of assessment required.

As the proposed development lies in an AQMA, the following criteria which apply to developments in an AQMA, have been used to help establish whether a detailed air quality assessment is necessary:

- A change of Light Duty Vehicle flows of more than 100 Annual Average Daily Traffic (AADT) movements;
- A change of Heavy Duty Vehicle flows of more than 25 AADT movements; and
- One or more combustion processes where the combined thermal input is greater than 300kW.

The development meets all the criteria listed above and therefore a detailed air quality assessment has been undertaken for all sources using dispersion modelling. The significance of predicted impacts has been determined in accordance with the methodology outlined in the EPUK/IAQM guidance.

4.4.1 Road Traffic Emissions

Roads surrounding the proposed development and the MSCP have the potential to impact air quality at the site as a result of road traffic exhaust emissions of NO_x and PM₁₀ during operation. A modelling assessment has been carried out to determine the likely pollutant concentrations at receptors in the surrounding area, for the base year of 2016 and the proposed opening year of the development, 2018.

The ADMS-Roads (version 4.0.1.0) atmospheric dispersion model has been used for this assessment. The assessment follows the methodology set out in Defra's Local Air Quality Management Guidance (TG16).

ADMS-Roads has been used to predict NO_x, PM₁₀ and PM_{2.5} concentrations. Predicted NO_x concentrations have been processed to determine annual mean NO₂ concentrations for comparison with the annual mean NO₂ objectives, using the latest NO_x to NO₂ calculator from Defra¹⁶, version 5.1.

¹⁵ Moorcroft and Barrowcliffe. et al. (2015) Land-use Planning & Development Control: Planning for Air Quality. Institute of Air Quality Management, London

¹⁶ Defra (2016) NO_x to NO₂ Calculator (version 5.1, 3 June 2016).

Predicted PM₁₀ and PM_{2.5} concentrations have been compared against the relevant objectives.

4.4.2 Traffic Data and Traffic Scenarios

Traffic data was provided for roads around the proposed development site by Arup as the transport consultants and was used in the modelling of the baseline and future scenarios:

- 2016 baseline scenario;
- 2018 opening/future year scenario, without the development (do minimum);
- 2018 opening/future year scenario, with the development (do something).

The do something scenario includes emissions modelled for the boilers and the multi-storey car park.

The 2016 baseline traffic data has been assumed to be representative of 2015 for the purposes of the air quality assessment. 2015 was selected as the baseline year for this assessment, as it is the last full year for which ambient monitoring data was available for use in model verification. Model verification is described further in sections 4.4.7 and 7.1.

Emission rates for all road sources were calculated using Defra's Emissions Factor Toolkit v7.0¹⁷. All three scenarios use the 2015 emissions, in order to provide a worst case assessment of the future conditions, to account for the lack of improvement in road vehicle emissions.

The traffic data provided consisted of 24-hour Annual Average Daily Traffic (AADT) flows, split by vehicle type (light duty vehicles (LDVs) and heavy duty vehicles (HDVs)). Average daily speeds were assumed to be 32kph for each road, with the exception of links close to junctions, at which speeds were assumed to be 20kph, following Defra's TG16 guidance¹⁸. Figure 2 presents the modelled road network and Table 6 presents the traffic data used in the assessment.

¹⁷ Defra Emissions Factors Toolkit. Accessed: <http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html>

¹⁸ Defra, 2016. Local Air Quality Management Technical Guidance (TG16). Accessed: <http://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf>.

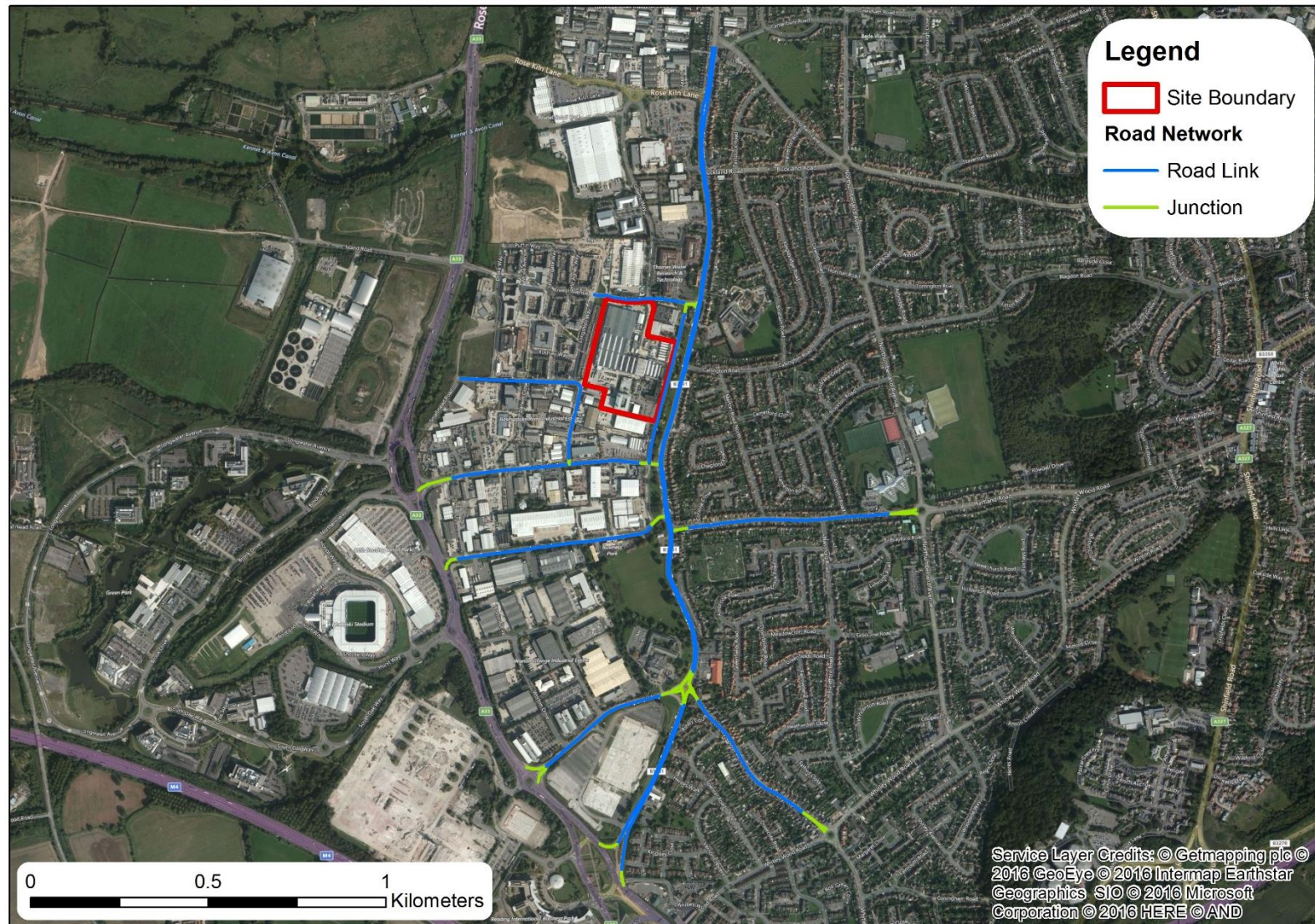
Table 6: Traffic data for baseline and future year scenarios

Site name	Junction	Site ID	2015* baseline		2018 Do Min		2018 Do Something	
			AADT	%HDV	AADT	%HDV	AADT	%HDV
Bennet Road		Rd_01	7,742	4.6	8,890	4.1	8,950	4.1
Bennet Road	Yes	Rd_02	7,742	4.6	8,890	4.1	8,950	4.1
Bennet Road	Yes	Rd_03	7,742	4.6	8,890	4.1	8,950	4.1
Commercial Road	Yes	Rd_04	4,589	3.5	5,782	2.7	5,782	2.7
Commercial Road		Rd_05	4,589	3.5	5,782	2.7	5,782	2.7
Acre Road	Yes	Rd_06	2,004	0	2,064	0	2,064	0
Acre Road		Rd_07	2,004	0	2,064	0	2,064	0
Acre Road	Yes	Rd_08	2,004	0	2,064	0	2,064	0
Hartland Road	Yes	Rd_09	9,717	1.2	10,139	1.1	10,181	1.2
Hartland Road		Rd_10	9,717	1.2	10,139	1.1	10,181	1.2
Hartland Road	Yes	Rd_11	9,717	1.2	10,139	1.1	10,181	1.2
Hartland Road	Yes	Rd_12	9,717	1.2	10,139	1.1	10,181	1.2
Hartland Road	Yes	Rd_13	9,717	1.2	10,139	1.1	10,181	1.2
Manor Farm Road		Rd_14	3,599	3.4	3,705	3.4	3,705	3.4
Manor Farm Road	Yes	Rd_15	3,599	3.4	3,705	3.4	3,705	3.4
Manor Farm Road	Yes	Rd_16	3,599	3.4	3,705	3.4	3,705	3.4
Whitley Wood Lane	Yes	Rd_17	10,967	0.8	11,602	0.8	11,613	0.8
Whitley Wood Lane		Rd_18	10,967	0.8	11,602	0.8	11,613	0.8
Whitley Wood Lane	Yes	Rd_19	10,967	0.8	11,602	0.8	11,613	0.8
Whitley Wood Lane	Yes	Rd_20	10,967	0.8	11,602	0.8	11,613	0.8
Whitley Wood Lane	Yes	Rd_21	10,967	0.8	11,602	0.8	11,613	0.8
Whitley Wood Lane	Yes	Rd_22	10,967	0.8	11,602	0.8	11,613	0.8
Whitley Wood Lane	Yes	Rd_23	10,967	0.8	11,602	0.8	11,613	0.8
Imperial Way	Yes	Rd_24	14,809	1.8	16,767	1.6	16,857	1.7
Imperial Way	Yes	Rd_25	14,809	1.8	16,767	1.6	16,857	1.7
Imperial Way		Rd_26	14,809	1.8	16,767	1.6	16,857	1.7
Imperial Way	Yes	Rd_27	14,809	1.8	16,767	1.6	16,857	1.7
Imperial Way	Yes	Rd_28	14,809	1.8	16,767	1.6	16,857	1.7
Imperial Way	Yes	Rd_29	14,809	1.8	16,767	1.6	16,857	1.7
Basingstoke Road		Rd_30	5,746	1.8	6,390	1.6	6,451	1.6
Basingstoke Road		Rd_31	4,862	11.7	5,447	10.7	5,489	10.7
Basingstoke Road		Rd_32	6,205	1.6	6,864	1.5	6,924	1.5
Basingstoke Road		Rd_33	5,789	1.9	6,340	1.8	6,383	1.8
Basingstoke Road		Rd_34	7,297	2.3	8,088	2.1	8,181	2.1

Site name	Junction	Site ID	2015* baseline		2018 Do Min		2018 Do Something	
			AADT	%HDV	AADT	%HDV	AADT	%HDV
Basingstoke Road		Rd_35	8,690	2.1	9,592	1.9	9,621	1.9
Basingstoke Road		Rd_36	8,877	1.9	9,782	1.7	9,861	1.8
Basingstoke Road	Yes	Rd_37	8,877	1.9	9,782	1.7	9,861	1.8
Basingstoke Road		Rd_38	9,401	1.6	10,296	1.5	10,296	1.5
Basingstoke Road	Yes	Rd_39	9,401	1.6	10,296	1.5	10,296	1.5
Basingstoke Road	Yes	Rd_40	4,640	3.4	4,842	3.4	4,882	3.4
Basingstoke Road		Rd_41	3,146	3.7	3,275	3.6	3,301	3.6
Basingstoke Road	Yes	Rd_42	3,146	3.7	3,275	3.6	4,882	3.4
Basingstoke Road	Yes	Rd_43	3,146	3.7	3,275	3.6	4,882	3.4
Basingstoke Road	Yes	Rd_44	4,640	3.4	4,842	3.4	3,301	3.6
Basingstoke Road		Rd_45	4,640	3.4	4,842	3.4	3,301	3.6
Access Road		Rd_46	1,595	8.8	1,642	8.8	2,016	8.8
Access Road	Yes	Rd_47	1,595	8.8	1,642	8.8	2,016	8.8

Notes: *Data supplied were for 2016 and have been assumed to be representative of 2015.

Figure 2: The modelled road network



4.4.3 Car Park Emissions

In addition to the traffic travelling on the surrounding local road network, the effect of emissions from the multi-storey car park, included as part of the proposed development, have been assessed. Car park emissions comprise two types of emissions:

- Hot exhaust emissions: these emissions were calculated using the number of vehicles travelling in to and out of the car park and the average distance travelled inside the car park. The EFT was used to calculate these emissions; and
- Cold start emissions: these were calculated using the cold start car park figures in the National Atmospheric Emissions Inventory (www.naei.org.uk).

The multi-storey car park was modelled as an area source, for each storey, as recommended in section 7.416 of the IAQM TG16 guidance¹⁹.

Vehicle movements (AADF) were calculated by the Arup transport team. In this case, there are 190 spaces in the car park that relate to the modelled traffic flows in and out of the car park, and four storeys. For use in the model, there were 48 spaces allocated to levels 0-2 and 46 spaces allocated to level 3. This represents each vehicle entering and leaving the car park once per day, and each space is only used by one car each day. It was assumed that each car enters between 8am and 10am, and leaves between 4pm and 6pm. The location of the car park is shown in Figure 3.

This information was included in the model using time varying emissions applied to emission factors for NO₂, PM₁₀ and PM_{2.5} calculated using the following equation. The equation is taken from the CERC note 54: Modelling Car Parks²⁰.

Equation 1: Emissions rate for multi-storey car parks

$$\text{Emission rate (g m}^{-2} \text{ s}^{-1}) = \frac{(EF \times D \times M) + (HS \times M/2) + (CS \times M/2)}{60 \times 60 \times 24 \times CP},$$

where:

EF	= Emission factor (g/km)
D	= Average distance travelled (km)
HS	= Hot soak emission factor (g/trip)
CS	= Cold start emission factor (g/trip)
M	= Vehicle movements (/day)
CP	= Car park area (m ²)

¹⁹ IAQM, 2016. Local Air Quality Management, Technical Guidance TG16. Available at: <http://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf> . Accessed October 2016.

²⁰ CERC, 2004. Modelling Car Parks.

The car park emissions are combined with the road emissions in the modelling results.

4.4.4 Boiler Emissions

Emissions associated with the three proposed boilers to be installed as part of the development have the potential to cause increases in pollutant concentrations in the vicinity of the site. The design team has provided the following information on which the assessment of air quality effects has been based:

- 3 x 210kW gas fired boilers.

The location of the proposed boilers is shown in Figure 3. The effect on local air quality has been quantified through dispersion modelling in accordance with the methodology described below. As the combustion plant will be gas-fired no assessment of PM emissions has been undertaken as these would be negligible from this fuel source.

An industry standard atmospheric dispersion model, ADMS-Roads (version 4.0.1.0), was used to calculate resulting concentrations of NO₂. As the boilers are proposed to be gas-fired, emissions of particulate matter would be negligible and therefore this pollutant has been scoped out of the assessment.

The modelling procedure was as follows:

- Information on stack dimensions and position, and boiler operating conditions, were obtained for the proposed development;
- Appropriate data to describe meteorological conditions in the vicinity of the site was obtained, as discussed in section 4.4.6 for the year 2015;
- A receptor grid of potentially sensitive locations was identified in the vicinity of the installation;
- Information on buildings surrounding the development was obtained;
- The above information was used as input to the dispersion model;
- The dispersion model was run to determine pollutant concentrations in the vicinity of the site. The interpretation of the results was based on the modelled concentrations at potential receptor locations; and
- The study results were compared with the relevant assessment criteria.

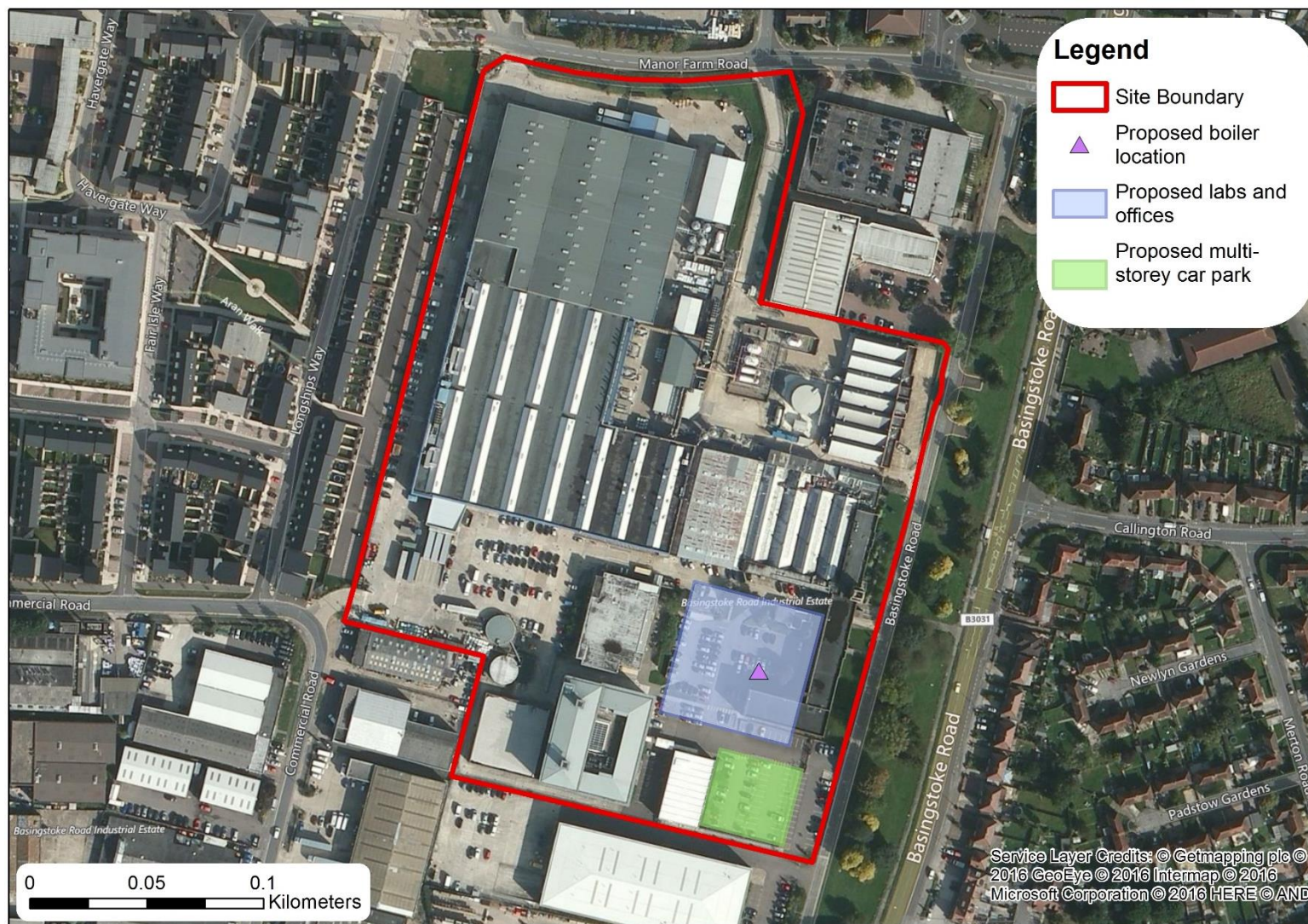
The locations of the new building containing proposed labs and offices and that of the multi-storey car park were included in the model to account for any effects these buildings might have on the dispersion of the pollution. Both buildings were included in the model as squares rather than their actual more complex shapes, as some ADMS-Roads can only accept input buildings that are rectangular or circular in cross-section.

The model calculates NO_x concentrations which comprise nitric oxide (NO) and nitrogen dioxide (NO₂). NO_x is emitted from combustion processes, primarily as NO with a small percentage of NO₂. The emitted NO reacts with oxidants in the air (mainly ozone) to form NO₂. NO₂ is associated with effects on human health

and therefore the air quality standards for the protection of human health are based on NO₂ rather than total NO_x or NO. A suitable NO_x to NO₂ conversion has been applied to the modelled NO_x concentrations in order to determine the impact of the NO_x emissions on ambient concentrations of NO₂. This assessment has followed the methodology set out by the EA which states it should be assumed as a worst case scenario that 70% of long-term and 35% of short-term NO_x concentrations will convert to NO₂²¹.

²¹ Environment Agency; *Air Quality Modelling and Assessment Unit, Conversion ratios for NO_x and NO₂*

Figure 3: The locations of proposed multi-storey car park and boilers



4.4.5 Sensitive Receptors

Sensitive receptors have been selected at worst case locations on the road network and are shown in Figure 4.

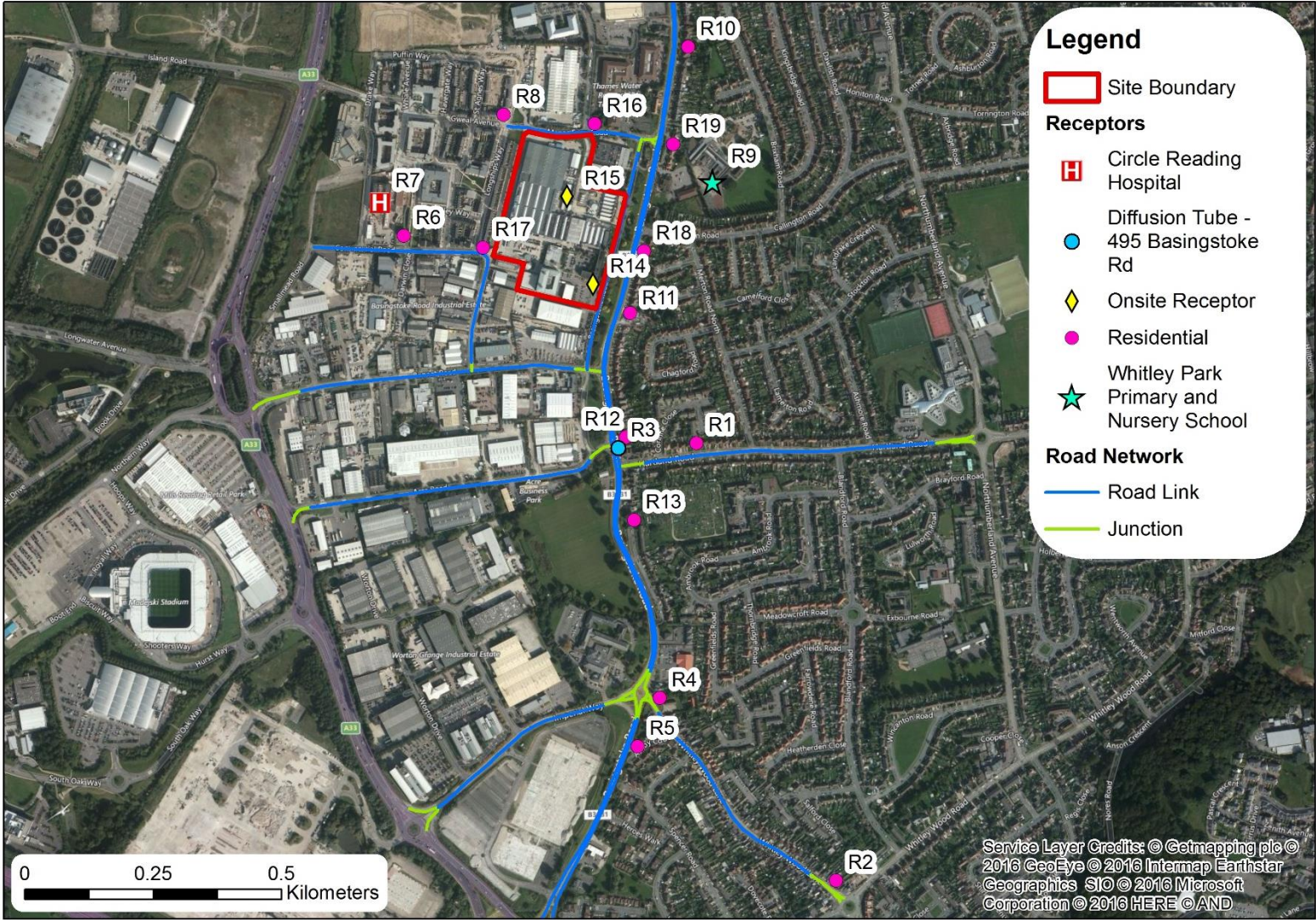
Their details are presented in Table 7. Receptor R9 is a primary school and Receptor R7 is a hospital. Receptor R3 is the monitoring station that has been used for verification purposes. There are two receptors that have been placed on-site to allow an insight into the air quality on-site. The remainder of the receptors are residential and their height denotes whether the receptor is a ground floor (1.5m) or first floor (4.5m) property. All of the receptors are existing receptors, with the exception of the on-site receptors. No ecologically designated sites sensitive to NO_x have been identified in the study area.

In addition to specified receptors, modelling has been undertaken for receptors regularly spaced on a 1.5km x 1.5km grid square, with 15m resolution, to show the spatial distribution of NO₂ concentrations across the study area.

Table 7: Discrete sensitive receptors

Receptor number	OS Grid Ref.		Height (m)	Type
	X	Y		
R1	471862	170053	1.5	Residential
R2	472134	169200	1.5	Residential
R3	471709	170043	2.5	Diffusion Tube – 495 Basingstoke Rd
R4	471790	169556	1.5	Residential
R5	471747	169462	1.5	Residential
R6	471291	170458	4.5	Residential
R7	471244	170523	1.5	Circle Reading Hospital
R8	471486	170694	4.5	Residential
R9	471892	170563	1.5	Whitley Park Primary School and Nursery
R10	471845	170826	1.5	Residential
R11	471732	170307	1.5	Residential
R12	471724	170065	1.5	Residential
R13	471740	169904	1.5	Residential
R14	471659	170363	1.5	On-site Receptor
R15	471609	170535	1.5	On-site Receptor
R16	471663	170676	1.5	Residential
R17	471446	170435	1.5	Residential
R18	471759	170428	1.5	Residential
R19	471816	170636	1.5	Residential

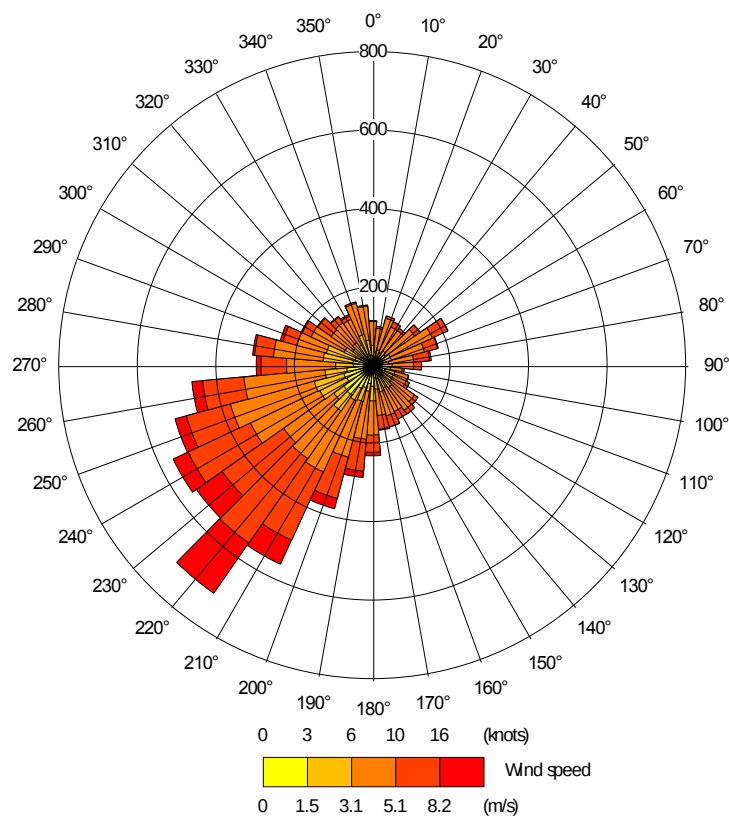
Figure 4: Sensitive receptors modelled



4.4.6 Meteorological Data

The local impacts of air pollutant releases vary according to the prevailing weather conditions. Meteorological data used in this assessment was measured at Farnborough over the period 1st January 2015 to 31st December 2015 (inclusive). Farnborough is located approximately 22km south-east of the proposed development. Figure 5 shows the wind rose for the latest full year of data, 2015. It can be seen that the predominant wind direction is south-westerly. Farnborough was chosen as it has a similar urban density to that of the area of the proposed development.

Figure 5: Wind Rose for Farnborough for 2015



In order for the modelling exercise to be representative of local conditions and to predict long-term averages, the dispersion model requires representative meteorological data. Most dispersion models for roads do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75m/s. Defra's LAQM.TG16 guidance recommends that the meteorological data file is tested within a dispersion model and the relevant output log file checked to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedences. The guidance recommends that meteorological data should only be used if the percentage of usable hours is greater than 75% and preferably 90%.

Hourly sequential observation data for 2015 was used in the assessment from the meteorological station at Heathrow Airport. The dataset includes 8,387 lines of usable hourly data, which corresponds to 96% of the year (where there is a total of 8760 lines of data). This is above the 90% threshold, therefore, the data meets the requirements of the Defra guidance and is adequate for the dispersion modelling.

4.4.7 Other Model Parameters

The extent of mechanical turbulence (and hence, mixing) in the atmosphere is affected by the roughness of the surface/ground over which the air is passing. Typical surface roughness values range from 1.5m (for cities, forests and industrial areas) to 0.0001m (for water or sandy deserts).

In this assessment, the general land use in the area around the site can be described as ‘parkland, open suburbia’ with a corresponding surface roughness of 0.5m. In addition, the minimum Monin-Obukhov length was set to ‘mixed urban industrial’ with a corresponding value of 30m.

4.4.8 Model Verification

Model verification refers to the comparison of modelled and measured pollutant concentrations at the same location(s) to determine the performance of the model. Should the model results for NO₂ annual mean concentrations be largely within $\pm 25\%$ of the measured values and there is no systematic over or under-prediction of concentrations, the Defra TG16 guidance advises that no adjustment is necessary. If this is not the case, then the modelled values are adjusted based on the observed relationship between modelled and measured NO_x concentrations due to road traffic to provide a better agreement.

Modelled results may not compare as well at some locations for a number of reasons, including:

- Errors/uncertainties in model input data (e.g. traffic flow and speed data estimates);
- Model setup (including street canyons, road widths, location of monitoring sites);
- Model limitations (treatment of surface roughness and meteorological data);
- Uncertainty in monitoring data, notably diffusion tubes (e.g. bias adjustment factors and annualisation of short-term data); and
- Uncertainty in emissions and emission factors.

These factors were investigated as part of the model verification process to minimise the uncertainties as far as practicable.

4.4.9 Background Concentrations

Background concentrations refer to the existing levels of pollution in the atmosphere, produced by a variety of sources, such as roads and industrial processes. The Defra website provides estimated background air pollution data for

each 1x1km OS grid square for each local authority area. Background maps are available for the base year of 2013 and have been projected to estimate concentrations for each year from 2013 to 2030. Data for 2015 has been used in the assessment for both the baseline and future scenarios.

4.4.10 Assessment of Significance

The 2015 EPUK/IAQM guidance note ‘Land-Use Planning & Development Control’ provides an approach to determining the air quality impacts resulting from a proposed development and the overall significance of local air quality effects arising from a proposed development.

Firstly, impact descriptors are determined based on the magnitude of incremental change as a proportion of the relevant assessment level, in this instance the annual mean NO₂ objective. The change is then examined in relation to the predicted total pollutant concentrations in the assessment year and its relationship with the annual mean NO₂ objective.

The assessment framework for determining impact descriptors at each of the assessed receptors is shown in Table 8.

Table 8: Impact descriptors

Annual average concentrations at receptor in the assessment year	% Change in concentrations relative to annual mean NO ₂ and hourly mean objectives			
	1	2-5	6-10	>10
75% or less of objective	Negligible	Negligible	Slight	Moderate
76-94% of objective	Negligible	Slight	Moderate	Moderate
95-102% of objective	Slight	Moderate	Moderate	Substantial
103-109% of objective	Moderate	Moderate	Substantial	Substantial
110% or more of objective	Moderate	Substantial	Substantial	Substantial

Note: Changes in pollutant concentrations of 0% i.e. <0.5% would be described as negligible

The impact descriptors at each of the assessed receptors are then used as a starting point for making a judgement on the overall significance of effect of a proposed development, however, other influences would also need to be taken into account, such as:

- The existing and future air quality in the absence of the development;
- The extent of current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

Professional judgement should be used to determine the overall significance of effect of the proposed development, however in circumstances where the proposed development can be judged in isolation, it is likely that a ‘moderate’ or ‘substantial’ impact will give rise to a significant effect and a ‘negligible’ or ‘slight’ impact will not result in a significant effect.

5 Baseline Assessment

The baseline assessment has been undertaken to determine existing air quality in the vicinity of the proposed development site.

5.1 Sources of Air Pollution

5.1.1 Industrial Processes

Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met and ensuring that any releases to the environment are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified as Part A or Part B processes, and are regulated through the Pollution Prevention and Control (PPC) system^{22, 23}. The larger more polluting processes are regulated by the Environment Agency (EA), and the smaller less polluting ones by the local authorities. Local authorities tend also to regulate only for emissions to air, whereas the EA regulates emissions to air, water and land.

There are three Part A processes with releases to air listed on the EA website within approximately 1.5km of the development site. These are outlined below in Table 9. Emissions from these processes are included in the background concentrations used in this assessment.

Table 9: Part A processes within 1.5km of the site

Operator	Industry	Approx. distance from site (km)	Releases to air
Gillette UK Limited	Chemical	0.0 – at the current site	Yes
Thames Water Utilities Ltd.	Water	0.8	Yes
Thames Water Utilities Ltd.	Fuel and power production and associated processes	0.8	Yes – with notifiable releases of NO ₂ and Carbon Monoxide

²² Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).

²³ The Environmental Permitting (England and Wales) (Amendment) Regulations 2013, SI 2013/390.

5.1.2 Road Traffic

In recent decades, transport-related atmospheric emissions on a national basis have grown to match or exceed other sources in respect of many pollutants, particularly in urban areas. Vehicle emissions are likely to be the dominant source of air pollutants in the vicinity of the proposed development site.

The proposed development site is 1.4km from the M4 (junction 11), which is a major motorway. Given the distance between this source of pollution and the proposed development, it is considered unlikely that emissions from this road link will significantly impact pollutant concentrations at the development site. However, emissions from this road and others nearby will have an effect, which is taken into account in the background concentrations.

5.2 Local Air Quality

A review of the Defra²⁴ website showed that the proposed development is located within the Reading City Centre AQMA, and is approximately 1.5km from the M4 Motorway properties AQMA. These AQMAs are shown in Figure 6, highlighting both of those described above.

As the proposed development sits partially within the existing Reading City Centre AQMA, the development has the potential to impact on this AQMA.

²⁴ Defra (2016) Air quality management areas <http://uk-air.defra.gov.uk/aqma/list>

Figure 6: The AQMAs within the vicinity of the site



5.2.1 Automatic Monitoring

A review of the most recent LAQM report by RBC indicated that the closest automatic monitoring site to the proposed development is the site AM3 at Kings Road, which is 2.9km from the site. Details of the automatic monitoring sites are shown in Table 10 and the results from 2013 to 2015 are shown in Table 11. The locations of these monitoring sites are shown on Figure 7.

Table 10: Details of the automatic monitoring sites in the RBC area

Monitoring site name	Monitoring site ID	Approx. distance to site (km)	Grid reference		Type of site
			X	Y	
AURN	AM1	3.1	473441	173198	Urban Background
Caversham Rd	AM2	3.8	471153	174429	Roadside
Kings Rd	AM3	2.9	473057	173205	Roadside
Oxford Rd	AM4	4.5	468700	174126	Roadside

The results show that the NO₂ annual mean air quality objective was exceeded at the Kings Road site in 2013, 2014 and 2015. Annual mean concentrations of PM₁₀ have been below the air quality objective at all sites over 2013 to 2015. PM_{2.5} is monitored at AM1 the AURN site, however monitored concentrations have been well below the annual mean PM_{2.5} objective at all sites over 2013 to 2015.

Table 11: Results of the automatic monitoring sites

Site ID	NO ₂ annual mean concentration (µg/m ³)			PM ₁₀ annual mean concentration (µg/m ³)			PM _{2.5} annual mean concentration (µg/m ³)		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
AM1	27	27	22	13	14	12	8	8	6
AM2	43	41	38	34	33	28	-	-	-
AM3	<u>61</u>	50	49	32	31	25	-	-	-
AM4	43^a	35	31	20	20	23	-	-	-
Air Quality Objective	40			40			25		

Notes: Exceedences of the air quality objective are shown in bold. NO₂ annual means exceeding 60 µg/m³ indicate the potential to exceed the NO₂ 1-hour mean objective are underlined. An ^a represents an annualised figure. All PM₁₀ and PM_{2.5} means have been annualised.

The hourly mean NO₂ is recorded at the automatic monitoring sites. The annual mean NO₂ concentrations indicate that there was an occurrence in 2013 where 60 µg/m³ was exceeded. This indicates that there is the potential to exceed the NO₂ hourly mean objective (200 µg/m³, not to be exceeded more than 18 times a year). However, a review of the RBC 2015 Annual Status Report indicates that there were only several instances where the NO₂ hourly mean exceeds 200 µg/m³ (seven times in 2013 and once in both 2014 and in 2015).

5.2.2 Diffusion Tube Monitoring

RBC operate a number of diffusion tubes within their authority area. Four of these are within 2km of the proposed development, all of which are at roadside locations. There are three urban background monitoring sites in the RBC area, which are 17 Church Rd in Earley and two at the AURN site (where a triplicate set of diffusion tubes are monitoring near to the AURN automatic monitoring station and two are urban background).

Details of these diffusion tube sites are given in Table 12. The annual mean monitoring results for these diffusion tubes are displayed below in Table 13 for 2015. The locations of these monitoring sites are shown on Figure 7.

Table 12: Details of the relevant diffusion tube monitoring sites in the RBC area

Monitoring site name	Monitoring site ID	Grid Ref		Type of site
		X	Y	
AURN 1	DT1	473467	173207	Urban Background
AURN 2	DT2	473467	173207	Urban Background
17 Church Rd Earley	DT3	474421	172054	Urban Background
Shinfield Rd / Whitley Wood Rd	DT4	473338	170269	Roadside
Shinfield Rd / Cedar Rd	DT5	473354	170482	Roadside
495 Basingstoke Road	DT6	471709	170043	Roadside
102 Whitley Street	DT7	472002	172158	Roadside

As shown in Table 13 the NO₂ annual mean air quality objective was exceeded at the DT3 (Church Road, Earley) urban background site in 2015, but at no other sites, including the four roadside sites.

Table 13: Annual mean concentrations (µg/m³) measured at the diffusion tube sites

Monitoring site ID	Type of site	NO ₂ annual mean concentration (µg/m ³)
		2015
DT1	Urban Background	17
DT2	Urban Background	17
DT3	Urban Background	40
DT4	Roadside	29
DT5	Roadside	37
DT6	Roadside	30
DT7	Roadside	31
Air Quality Objective		40

*Exceedences of the air quality objective are shown in bold

5.3 Background Concentrations

The Defra website includes estimated background air pollution data for each 1km by 1km OS grid square in the UK. Background concentrations for the baseline year 2015 and the future year 2018 have been taken from the latest Defra maps²⁵ and are presented in Table 14 for the grid square in which the proposed development is located (OS Grid Ref: 471500, 170500). Additional grid squares are included here to show the grid squares of the diffusion tubes and receptors (OS Grid Ref: 471500, 169500 and 472500, 169500).

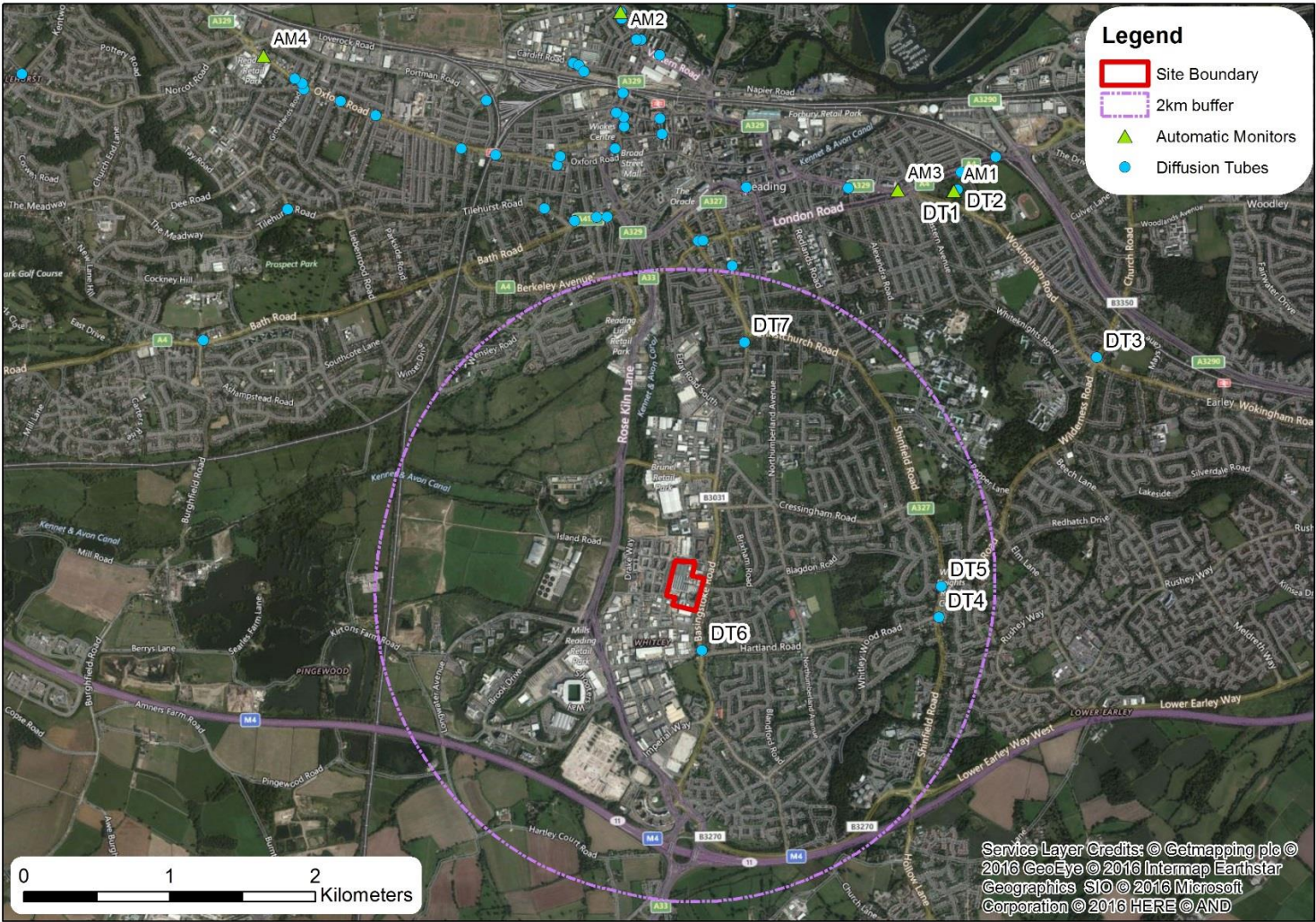
Background concentrations are estimated to be below the air quality objectives for annual mean NO₂ and PM₁₀ (40µg/m³) and annual mean PM_{2.5} (25µg/m³).

Table 14: Estimated background pollutant concentrations for 2015 and 2018

OS Grid Ref.		Annual mean concentration (µg/m ³)							
X	Y	2015				2018			
		NO _x	NO ₂	PM ₁₀	PM _{2.5}	NO _x	NO ₂	PM ₁₀	PM _{2.5}
471500	170500	32.7	21.6	15.8	11.5	29.1	19.5	15.4	11.1
471500	169500	30.4	20.4	16.1	11.5	26.4	18.1	15.6	11.1
472500	169500	25.0	17.3	15.3	11.1	21.6	15.2	14.9	10.7

²⁵ Defra, <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html>, Accessed Aug 2016

Figure 7: The locations of the RBC automatic monitoring sites and diffusion tube locations



6 Construction Assessment

6.1 Sensitive Receptors

Sensitive receptors are defined as those dwellings/schools/hospitals that are likely to experience a change in pollutant concentrations and/or dust nuisance due to the construction and operation of the proposed development.

There are approximately 40 houses within 20m west of the site boundary, with over 100 receptors within 350m. There is also a primary school and a hospital within 350m of the proposed development site, as shown in Figure 8. As such, their sensitivity to dust soiling and PM₁₀ exposure has been classified as *high* according to the IAQM guidance.

An assessment of construction dust is required due to the presence of sensitive receptors within 350m of the proposed development site.

There are no ecological designated sites sensitive to dust within 350m of the site and so this element of the assessment will not be considered further.

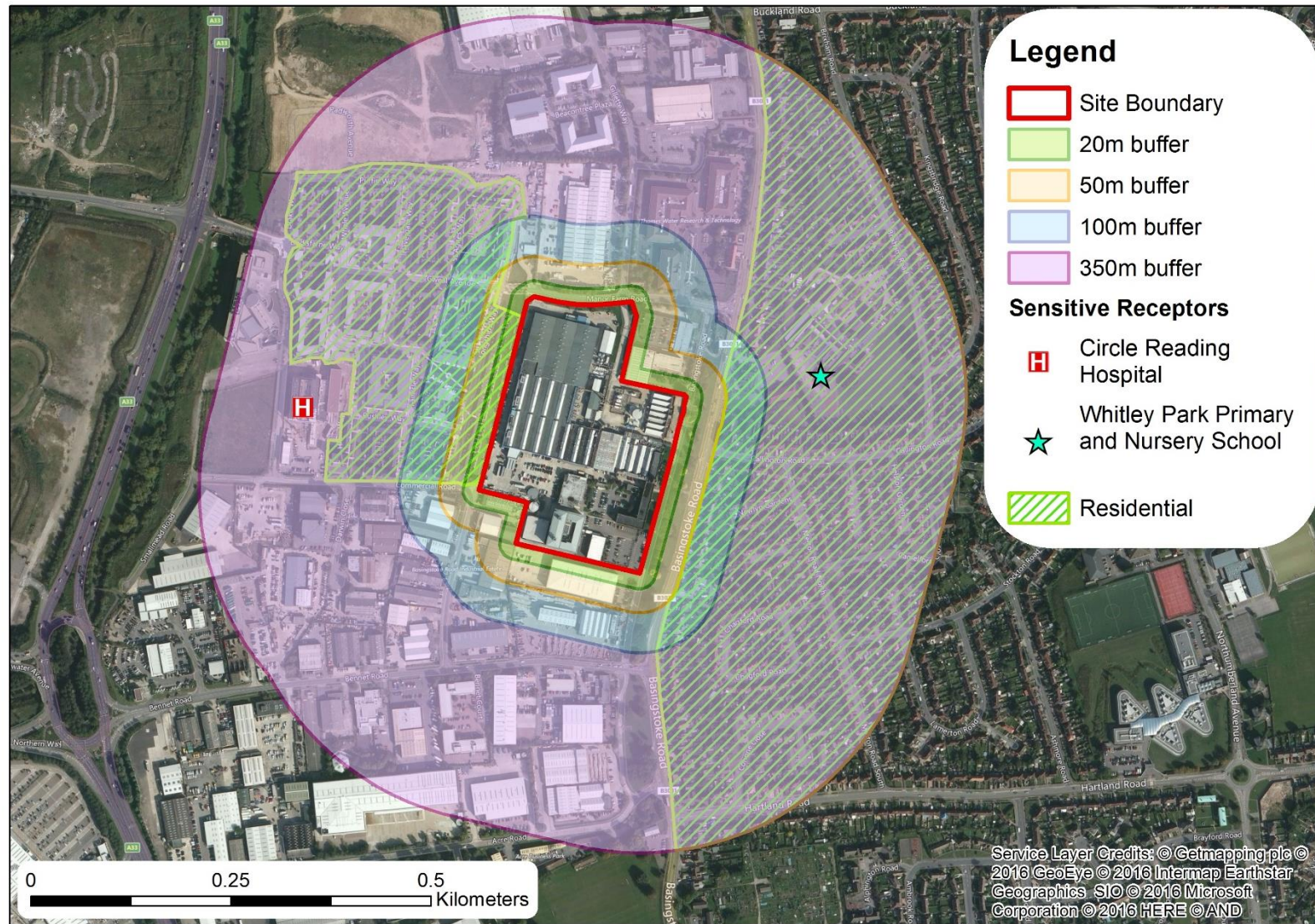
6.2 Dust Emission Magnitude

Following the methodology outlined in Section 4.3, each dust-generating activity has been assigned a dust emission magnitude as shown in Table 15.

Table 15: Dust emission magnitude for construction activities

Activity	Dust emission magnitude	Reasoning
Demolition	Small	Total building volume <20,000m ³ , construction material with low potential for dust release (e.g. metal cladding or timber)
Earthworks	Medium	Total site area 2,500m ² - 10,000m ² , moderately dusty soil type (e.g. silt),
Construction	Small	Total building volume <25,000 m ³ , construction material with low potential for dust release (e.g. metal cladding or timber)
Trackout	Medium	20 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100m;

Figure 8: Construction dust buffers and sensitive receptors



6.3 Sensitivity of the Area

The sensitivity of the area to dust soiling has been assigned as *high*, and for human health impacts has been assigned as *low* due to the presence of 10-100 sensitive receptors within 20m from the boundary of the site.

6.4 Risk of Impacts

Taking into consideration the dust emission magnitude for each of the activities on site, and the sensitivity of the area to dust soiling and human health, the site has been classified as *medium risk* at worst, as outlined in Table 16.

To ensure mitigation is sufficient to control all potential impact, the IAQM measures for a *medium risk* site have been recommended for all activities. Specific mitigation is described in Section 8.

Table 16: Summary dust risk table prior to mitigation

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

7 Operational Assessment

7.1 Model Verification

For the model verification exercise, the year 2015 has been used, since it is the latest year for which RBC monitoring data is available; data for 2016 will not be available until 2017.

The model verification exercise used data from diffusion tube 495 Basingstoke Road (diffusion tube 6, which is also receptor 3), which is detailed in section 5.2.2. This diffusion tube was chosen because it lies on the modelled road network as shown in Figure 4. The other diffusion tubes were not on the modelled road network and hence could not be included for model verification.

Monitored and modelled road contributions to the total NO_x concentration were calculated for use in the verification process using 2015 data. The verification was undertaken following the methodology contained in the Defra guidance LAQM.TG16. A comparison of monitored and modelled annual mean NO₂ concentrations for 2015 is shown in Table 17.

Table 17: Comparison of 2015 modelled and monitored annual mean NO₂ concentrations (µg/m³)

Monitoring location	Receptor number	Monitored NO ₂ concentration (µg/m ³)	Background concentration NO ₂ (µg/m ³)	Modelled NO ₂ (µg/m ³)	% Difference between modelled/monitored NO ₂
495 Basingstoke Rd	3	30.0	21.6	26.9	-10%

This shows that the percentage difference between the modelled and monitored result is -10%. This means that the model is under-predicting by 10%. Defra guidance generally states that if this value is within +/- 25%, Defra advises that no adjustment factor is necessary as described in section 4.4.8.

However, as there is only one diffusion tube to conduct model verification with, an adjustment factor was calculated and applied to the modelled results. The adjustment factor was calculated as 1.42 and has been applied to the modelled road contributions of NO_x.

7.2 Road Traffic Emissions - Predicted Pollutant Concentration Results

Table 18, Table 19 and Table 20 show the predicted concentrations of NO₂, PM₁₀ and PM_{2.5} respectively for the baseline year of 2015 and the future year of 2018. These results are summarised in the sections below.

7.2.1 NO₂

Predicted annual mean NO₂ concentrations are shown in Table 18. The results show that concentrations are predicted to be below the NO₂ air quality objective of 40µg/m³ at all receptors modelled for all three scenarios.

For 2015, the highest predicted annual mean NO₂ concentration is 29.1µg/m³ at receptor 3 (R3), which is the diffusion tube location situated at 495 Basingstoke Road. For the 2018 do minimum scenario, the highest predicted annual mean NO₂ concentration is 29.7µg/m³ also at receptor 3. For the 2018 do something scenario, the highest predicted annual mean NO₂ concentration is 29.7µg/m³ at receptor 3. The impact due to the proposed development is negligible at all receptors.

The results for the receptors that correspond to the office spaces on the proposed development site (R14 and R15) show that the annual mean NO₂ concentrations are all predicted to be below the air quality objective of 40µg/m³ under all scenarios.

As none of the predicted pollutant concentrations are greater than 60µg/m³, it is considered that there would not be any exceedences of the hourly mean NO₂ air quality objective.

The do something scenario includes the emissions modelled for the car park, road network and the boilers. As such, data processing was required to calculate the annual mean NO₂ concentrations of these sources separately. The individual component NO₂ concentrations are shown in Appendix A from which the total annual mean NO₂ concentration has been derived to assess the combined impact of all sources of the development.

The spatial distribution of NO₂ concentrations is shown in Appendix B. This figure shows that concentrations of NO₂ are greatest around the road network. There are several points on the road network where NO₂ exceeds 30µg/m³, however the maximum predicted NO₂ concentration is 35.5µg/m³. This suggests that the maximum points of impact for long-term NO₂ concentrations occur as a result of the road network rather than the car park or boiler sources.

Table 18: Predicted annual mean NO₂ concentrations (µg/m³)

Receptor ID	Site description	Height (m)	Annual mean NO ₂ (µg/m ³)		
			Baseline 2015	Do Minimum 2018	Do Something 2018
R1	Residential	1.5	24.2	24.3	24.3
R2	Residential	1.5	20.5	20.7	20.7
R3	Diffusion Tube – 495 Basingstoke Rd	2.5	29.1	29.7	29.7
R4	Residential	1.5	27.4	27.8	27.9
R5	Residential	1.5	23.6	23.7	23.8
R6	Residential	4.5	22.5	22.6	22.6
R7	Circle Reading Hospital	1.5	22.0	22.1	22.1

Receptor ID	Site description	Height (m)	Annual mean NO ₂ (µg/m ³)		
			Baseline 2015	Do Minimum 2018	Do Something 2018
R8	Residential	4.5	22.0	22.1	22.1
R9	Whitley Park Primary School and Nursery	1.5	22.5	22.6	22.6
R10	Residential	1.5	24.4	24.7	24.7
R11	Residential	1.5	24.7	25.0	25.0
R12	Residential	1.5	25.8	26.2	26.2
R13	Residential	1.5	23.6	23.9	23.9
R14	Onsite Receptor	1.5	23.0	23.1	23.2
R15	Onsite Receptor	1.5	22.2	22.3	22.3
R16	Residential	1.5	23.2	23.3	23.3
R17	Residential	1.5	23.8	24.2	24.2
R18	Residential	1.5	25.1	25.4	25.5
R19	Residential	1.5	24.7	24.9	25.0

7.2.2 PM₁₀

Predicted annual mean PM₁₀ concentrations are well below the air quality objective of 40µg/m³ at all receptors modelled in 2015 and 2018. These results are shown in Table 19. The highest annual mean PM₁₀ concentrations (17.0µg/m³) are predicted at R4 for all scenarios. The impact due to the proposed development is negligible at all receptors.

Since the boilers are natural gas boilers, any PM₁₀ emissions are considered as negligible. Therefore the below results only reflect PM₁₀ from vehicle sources.

Table 19: Predicted annual mean concentrations of PM₁₀ (µg/m³)

Receptor ID	Site description	Height (m)	Annual mean PM ₁₀ (µg/m ³)		
			Baseline 2015	Do Minimum 2018	Do Something 2018
R1	Residential	1.5	16.2	16.2	16.2
R2	Residential	1.5	15.7	15.7	15.7
R3	Diffusion Tube – 495 Basingstoke Rd	2.5	16.8	16.9	16.9
R4	Residential	1.5	17.0	17.0	17.0
R5	Residential	1.5	16.5	16.5	16.5
R6	Residential	4.5	15.9	15.9	15.9
R7	Circle Reading Hospital	1.5	15.9	15.9	15.9
R8	Residential	4.5	15.9	15.9	15.9

Receptor ID	Site description	Height (m)	Annual mean PM ₁₀ (µg/m ³)		
			Baseline 2015	Do Minimum 2018	Do Something 2018
R9	Whitley Park Primary School and Nursery	1.5	15.9	15.9	15.9
R10	Residential	1.5	16.1	16.2	16.2
R11	Residential	1.5	16.2	16.3	16.3
R12	Residential	1.5	16.4	16.4	16.4
R13	Residential	1.5	16.5	16.6	16.6
R14	Onsite Receptor	1.5	16.0	16.0	16.0
R15	Onsite Receptor	1.5	15.9	15.9	15.9
R16	Residential	1.5	16.0	16.0	16.0
R17	Residential	1.5	16.1	16.1	16.1
R18	Residential	1.5	16.3	16.3	16.3
R19	Residential	1.5	16.2	16.2	16.2

7.2.3 PM_{2.5}

Predicted annual mean PM_{2.5} concentrations are well below the air quality objective of 25µg/m³ at all receptors modelled in 2015 and 2018. These results are shown in Table 20. The highest annual mean PM_{2.5} concentrations (12.2µg/m³) are predicted at R3 for all scenarios. The impact due to the proposed development is negligible at all receptors.

As with PM₁₀, any PM_{2.5} emissions are considered as negligible from the boilers since they use natural gas. Therefore the below results only reflect PM_{2.5} from the vehicle sources.

Table 20: Predicted annual mean concentrations of PM_{2.5} (µg/m³)

Receptor ID	Site description	Height (m)	Annual mean PM _{2.5} (µg/m ³)		
			Baseline 2015	Do Minimum 2018	Do Something 2018
R1	Residential	1.5	11.7	11.7	11.7
R2	Residential	1.5	11.3	11.4	11.4
R3	Diffusion Tube – 495 Basingstoke Rd	2.5	12.1	12.2	12.2
R4	Residential	1.5	12.0	12.1	12.1
R5	Residential	1.5	11.7	11.8	11.8
R6	Residential	4.5	11.6	11.6	11.6
R7	Circle Reading Hospital	1.5	11.5	11.5	11.5
R8	Residential	4.5	11.5	11.5	11.5
R9	Whitley Park Primary School and Nursery	1.5	11.6	11.6	11.6

Receptor ID	Site description	Height (m)	Annual mean PM _{2.5} (µg/m ³)		
			Baseline 2015	Do Minimum 2018	Do Something 2018
R10	Residential	1.5	11.7	11.7	11.7
R11	Residential	1.5	11.7	11.8	11.8
R12	Residential	1.5	11.8	11.9	11.9
R13	Residential	1.5	11.8	11.8	11.8
R14	Onsite Receptor	1.5	11.6	11.6	11.6
R15	Onsite Receptor	1.5	11.5	11.6	11.6
R16	Residential	1.5	11.6	11.6	11.6
R17	Residential	1.5	11.7	11.7	11.7
R18	Residential	1.5	11.8	11.8	11.8
R19	Residential	1.5	11.7	11.8	11.8

7.3 Assessment of Significance

Taking into consideration the existing air quality conditions in the area, and the predicted concentrations in future years at the proposed development site, it is likely that the levels of NO₂, PM₁₀ and PM_{2.5} in the area will not exceed the national air quality objectives up to and including the opening year of the development.

8 Mitigation Measures

The dust emitting activities assessed can be greatly reduced or eliminated by applying the site specific mitigation measures for *medium risk* sites according to the IAQM guidance.

The guidance notes that it is anticipated that with the implementation of effective site-specific mitigation measures, the environmental effect will not be significant in most cases. The following measures from the guidance are relevant and should be included in the Construction Management Plan for the site.

8.1.1 General

- Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager;
- Display the head or regional office contact information; and
- Develop and implement a Dust Management Plan, which will include measures to control other emissions, approved by the local authority.

8.1.2 Site Management

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

8.1.3 Monitoring

- Carry out regular site inspections to monitor compliance with the Dust Management Plan, record inspection results and make an inspection log available to the local authority, when asked; and
- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

8.1.4 Site Maintenance

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as practical or possible;

- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site;
- Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period;
- Avoid site runoff of water or mud;
- Keep site fencing, barriers and scaffolding clean using wet methods;
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site;
- Cover, seed or fence stockpiles to prevent wind whipping; and
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out.

8.1.5 Operating vehicle/machinery and sustainable travel

- Ensure all vehicles switch off engines when stationary – no idling vehicles;
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable;
- Impose and signpost a maximum speed limit of 15mph on surfaced and 10mph on un-surfaced haul roads and work areas;
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking and car-sharing); and
- Ensure vehicles entering and leaving the site are covered to prevent escape of materials during transport.

8.1.6 Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques, such as water sprays or local extraction;
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate;
- Use enclosed chutes and conveyors and covered skips;
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use the fine water sprays on such equipment wherever appropriate;
- Avoid scabbling (roughening of concrete surfaces) if possible;
- Waste management; and

- Avoid bonfires and burning of waste materials.

8.1.7 Measures Specific to Earthworks

The following measures are considered as desirable mitigation measures by the IAQM construction dust guidance.

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable; and
- Only remove the cover in small areas during work and not all at once.

8.1.8 Measures Specific to Construction

The following measures are considered as desirable or highly recommended for construction.

- Avoid scabbling (roughening of concrete surfaces) if possible;
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place;
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery;
- For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.

8.1.9 Measures Specific to Trackout

As with the construction and earthworks mitigation, the below measures are considered as desirable or highly recommended by IAQM.

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Record all inspections of haul routes and any subsequent action in a site log book.

- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors where possible.

8.2 Mitigation of Effects from Operation

As the development results in a negligible impact at all receptors assessed no mitigation measures are required for the operational phase of the development.

9 Conclusion

An assessment of likely air quality effects arising as a result of the construction and operation of the proposed development has been undertaken.

A review of current legislation and planning policy and a baseline assessment describing the current air quality conditions in the vicinity of the proposed development were also carried out.

The proposed development lies partly within an AQMA designated for NO₂ by RBC. This development therefore has the potential to impact on the AQMA.

Construction effects have been assessed using the qualitative approach described in the latest EPUK/IAQM guidance and it was concluded that with the appropriate best practice mitigation measures suitable for medium risk sites in place, there is likely to be a negligible effect to existing receptors from the dust-generating activities on site.

A modelling assessment was carried out for the operational phase of the proposed development to determine what the impact of the proposed development would be. This assessment has shown that there will be a negligible effect as a result of the development from NO₂, PM₁₀ and PM_{2.5} due to the development and, therefore, the impact on air quality is not significant.

Appendix A

2018 Do Something Scenario:
Total NO₂ Calculations

A1 Total NO₂ Calculations

As described in section 4.4.4 of the methodology, there are two methods required for converting NO_x to NO₂ depending on whether a boiler or road network is being considered. The table below contains the data used to calculate the total NO₂ emissions for the 2018 do something scenario.

The EA NO_x to NO₂ conversion method, which assumes that 70% of long term NO_x concentrations will convert to long term NO₂ concentrations, was used for the boilers. The Defra NO_x to NO₂ calculator was used for the calculation of the total annual mean NO₂ concentrations, where the annual mean NO_x concentration obtained from the model was verified using the adjustment factor (1.42) derived from the model verification process. The NO_x to NO₂ calculator required background concentrations to be included to derive the annual mean NO₂ contribution from roads and the total annual mean NO₂ concentration.

The annual mean concentrations for the boiler and for the roads were then combined to calculate the total NO₂ emissions for the 2018 Do Something emissions scenario, including the emissions from the boilers, car park and road network.

Table 21: Data table for the calculation of the total NO₂

Receptor information				EA No _x to NO ₂ conversion		Defra No _x to NO ₂ calculator conversion				Total Boiler, Car Park and Roads NO ₂
Receptor ID	X (m)	Y (m)	Height (m)	Boiler Annual Mean No _x	Boiler Annual Mean NO ₂	Verified Annual Mean Roads NO _x	Annual Mean Roads NO ₂	2015 Background NO ₂	Annual Mean Total Roads NO ₂	Total Annual Mean NO ₂ concentrations
R1	471862	170053	1.5	0.0018	0.0013	5.4	2.7	21.6	24.3	24.3
R2	472134	169200	1.5	0.0008	0.0005	6.5	3.4	17.3	20.7	20.7
R3	471709	170043	2.5	0.0015	0.0011	11.7	8.1	8.3	29.7	29.7
R4	471790	169556	1.5	0.0011	0.0008	10.5	7.3	7.5	27.7	27.7
R5	471747	169462	1.5	0.0010	0.0007	4.1	2.9	3.0	23.3	23.3
R6	471291	170458	4.5	0.0011	0.0008	1.4	1.0	1.1	22.6	22.6
R7	471244	170523	1.5	0.0011	0.0008	0.7	0.5	0.5	22.1	22.1

R8	471486	170694	4.5	0.0015	0.0011	0.6	0.5	0.5	22.1	22.1
R9	471892	170563	1.5	0.0036	0.0025	1.4	1.0	1.0	22.6	22.6
R10	471845	170826	1.5	0.0045	0.0032	4.3	3.1	3.2	24.7	24.7
R11	471732	170307	1.5	0.0006	0.0004	4.8	3.4	3.5	25.0	25.0
R12	471724	170065	1.5	0.0016	0.0011	6.5	4.6	4.7	26.2	26.2
R13	471740	169904	1.5	0.0015	0.0011	4.9	3.5	3.6	23.9	23.9
R14	471660	170363	1.5	0.0000	0.0000	2.2	1.6	1.6	23.2	23.2
R15	471609	170535	1.5	0.0006	0.0004	1.0	0.7	0.7	22.3	22.3
R16	471663	170676	1.5	0.0017	0.0012	2.3	1.7	1.7	23.3	23.3
R17	471446	170435	1.5	0.0007	0.0005	3.6	2.6	2.6	24.2	24.2
R18	471759	170428	1.5	0.0008	0.0006	5.4	3.9	3.9	25.5	25.5
R19	471816	170636	1.5	0.0036	0.0025	4.7	3.4	3.4	25.0	25.0

Appendix B

The Spatial Distribution of NO₂

B1 The Spatial Distribution of NO₂

Figure 9: The spatial distribution of NO₂ from the 2018 Do Something scenario.

