High Speed Two

Air Quality Strategy

July 2017

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Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

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1 Executive summary

The purpose of the scheme is to build a high speed railway network running trains powered by electric motors, supplied by electricity from the national distribution grid via overhead lines. The trains will have no significant emissions to air at the point of travel. Electric trains are 'cleaner' than the competing modes of car travel and domestic aviation which rely primarily on the combustion of fossil fuels. The railway can thus off-set the environmental impacts of the growth of travel associated with economic growth.

Further to this, High Speed Two Limited (HS2 Ltd) has a sustainability policy which commits to reducing pollution and adverse effects where it cannot be prevented.

The construction of the railway will have impacts on air quality through the use of on-road and off-road machines using conventional engines, and through the emissions of dust from demolition and construction. Highway construction traffic will cause temporary significant effects for local air quality, but this is confined to a limited number of roads.

The operation of the railway will have impacts on air quality through the change of location and nature of road traffic emissions. It will also have very small/negligible impacts from the possible use of diesel maintenance trains and potentially from station space-heating.

HS2 will:

- avoid pollutant emissions to air as far as practicable
- avoid causing public and workforce exposure to air pollutants where emissions cannot be avoided, as far as practicable
- reduce pollutant emissions as far as practicable, where emissions cannot be avoided
- minimise public and workforce exposure to pollutant emissions as far as practicable, where exposure cannot be avoided
- work with the relevant authorities to maintain air quality, especially where construction or operations may have significant air quality effects in locations where those authorities have management areas or zones with plans or measures directed at compliance with national air quality standards
- provide mitigation for dust soiling, where it cannot be prevented.

This will be achieved by the appropriate design, construction and operation of the civil infrastructure.

This document sets out how the emissions associated with the construction of the scheme will be managed. It also supports the Code of Construction Practice (CoCP). The CoCP makes a commitment to use 'best practicable means' to manage dust, air pollution, odour and exhaust emissions.

Air quality policy, such as emission standards for Non-Road Mobile Machinery and contractor vehicles is set out in Information Paper E31; Air Quality.

2 Abbreviations and descriptions

AQMA	Air Quality Management Area
AQS	Air Quality Strategy
BPM	Best practicable means
BREEAM	Building Research Establishment Environmental Assessment Methodology
CFA	Community Forum Area
CHP	Combined Heat and Power
CoCP	Code of Construction Practice
CO_2	Carbon dioxide
COMEAP	Committee on the Medical Effects of Air Pollution
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EPUK	Environmental Protection UK
ES	Environmental Statement
EST	Energy Saving Trust
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LDV	Light Duty Vehicle
LEMP	Local Environmental Management Plan
LGV	Light Goods Vehicle
NO_x	Oxides of nitrogen
NO_2	Nitrogen dioxide
NPPF	National Planning Policy Framework
NPS	National Policy Statement
PM_{10}	Particulate matter with an average aerodynamic diameter not exceeding 10 micrometres
$PM_{2.5}$	Particulate matter with an average aerodynamic diameter not exceeding 2.5 micrometres
RDE	Real Driving Emissions

SPG	Supplementary Planning Guidance
ULEV	Ultra Low Emission Vehicle
WHO	World Health Organisation

3 Introduction

3.1 What this document is for

3.1.1 This document is for the use of High Speed Two Limited (HS2 Ltd), its nominated undertaker(s), its contractors, stakeholders and members of the public. This document is the strategy by which HS2 Ltd will meet its sustainability policy with respect to air quality. The sustainability policy includes a commitment to protect the environment through the prevention of pollution, and air quality is maintained by preventing and controlling pollution to air.

3.1.2 The document is a guide to the requirements of the project to control dust and emissions during construction and how 'best practicable means' can be determined. The adjective 'practicable' intends that any 'means' have to be economically affordable and proportionate to the risk avoided through their application.

3.1.3 The construction of the railway will have impacts on air quality through the use of on-road and off-road machines using conventional engines which emit air pollutants, and through the emissions of dust from demolition and construction.

3.1.4 This document sets out how the emissions associated with the construction of the scheme will be managed. Air quality policy, such as vehicle emission standards for Non-Road Mobile Machinery and contractor vehicles is set out in Information Paper E31; Air Quality. This document supports the Code of Construction Practice (CoCP), which is published at the time of Royal Assent. The CoCP makes a commitment to use 'best practicable means':

3.1.5 *"7.1.1 The nominated undertaker will require its contractors to manage dust, air pollution, odour and exhaust emission during the construction works in accordance with Best Practicable Means (BPM)."*

3.1.6 This document will be part of how contractors inform themselves of Best Practicable Means (BPM), during the long construction period.

3.1.7 The principles to be followed are that methods used to control dust and emissions should be evidence-based, and proportionate to the risk being mitigated. For there to be a risk to people, habitats and property, the pathway between the source and the receptor must be established. There are two categories of air pollution to consider: 'primary' and 'secondary'.

3.1.8 The pathway for primary airborne pollution is relatively straightforward, and is mainly dependent on wind direction. As emissions to air disperse and dilute through vertical and horizontal mixing, the distance between source and receptor is typically used to determine the risk of exposure at a location. For construction sites, the guidance currently in use[1] suggests that dust impacts are most likely to occur within 20m of the site boundary, and possibly up to 350m away. For impacts from road traffic, guidance[2] suggests that impacts are

[1] Holman et al (2014), IAQM Guidance on the assessment of dust from demolition and construction. London: Institute of Air Quality Management
[2] Highways Agency (2007), Design Manual for Roads and Bridges, Volume 11 Section 3 Part 1 HA207/07 Air Quality

possible up to 200m away. Professional experience suggests that the air quality standard for nitrogen dioxide (NO_2) (the standard most widely breached) tends not to be breached more than 20m from a road.

3.1.9 'Secondary' air pollutants are formed after emission to the atmosphere. The most important of these are the fine fractions of particulate matter (PM10 and PM2.5). Part of this particulate matter is composed of ammonium nitrate, which is in turn formed from the reactions of gaseous pollutants in the air, including oxides of nitrogen (NOx). These secondary reactions give NOx emissions a longer residence time in the atmosphere (days) and thus the potential to cause harm over longer distances (tens and hundreds of kilometres). Secondary pollution events typically affect South East England, when easterly winds bring particulate-laden air from continental Europe (for example the April 2014 event)[3]. The potential for emissions to atmosphere to cause secondary pollution and transboundary air pollution is addressed by the National Emissions Ceiling Directive as transposed into UK legislation.

3.1.10 HS2 Ltd will:

- avoid pollutant emissions to air as far as practicable
- avoid causing public and workforce exposure to air pollutants where emissions cannot be avoided, as far as practicable
- reduce pollutant emissions as far as practicable, where emissions cannot be avoided
- minimise public and workforce exposure to pollutant emissions as far as practicable, where exposure cannot be avoided
- work with the relevant authorities to maintain air quality, especially where construction or operations may have significant air quality effects in locations where those authorities have air quality management areas or zones with plans or measures directed at compliance with national air quality standards
- provide mitigation for dust soiling, where it cannot be prevented.

[3] 2014 Spring Episode http://www.metoffice.gov.uk/nhp/media.jsp?mediaid=17374&filetype=pdf

4 Context of this document

4.1 HS2 Ltd sustainability policy

4.1.1 HS2 Ltd.'s Sustainability Policy makes a commitment on: *'Environmental change – Commit to protection of the environment through seeking to avoid significant adverse effects on communities, businesses and the natural, historic and built environment, including the prevention of pollution.'*

4.1.2 Therefore, this strategy document sets out the approach HS2 Ltd will follow to avoid emissions to air causing significant adverse effects on communities and prevent air pollution.

4.2 Air quality and health

4.2.1 The World Health Organisation (WHO) has developed guidelines for ambient levels of air pollutants, based on the latest scientific knowledge and epidemiological studies. In relation to particulate matter (PM10 and PM2.5) there is widespread evidence that prolonged exposure to these pollutants can adversely affect the respiratory and cardiovascular system of people, leading to an increased risk of premature mortality and thus reduced life expectancy for the population. Up to date, no threshold has been found below which no adverse health effects would occur. Recent studies have also found that particle exhaust emissions from diesel vehicles have a strong association with respiratory mortality[4].

4.2.2 In relation to NO_2, epidemiological studies have shown that long-term exposure to this pollutant can cause symptoms of bronchitis in asthmatic children. High concentrations of NO_2 have also been linked to reduced lung function growth in cities of Europe and North America.

4.2.3 The WHO air quality guidelines[5] for particulate matter and NO2 are presented in Table 1.

Table 1 WHO air quality guidelines

Pollutant	Averaging period	WHO air quality guideline
Nitrogen dioxide (NO2)	Annual mean	40 µg/m3
	1-hour mean	200 µg/m3
Particulate matter (PM10)	Annual mean	20 µg/m3
	24-hour mean	50 µg/m3
Fine particulate matter (PM2.5)	Annual mean	10 µg/m3
	24-hour mean	25 µg/m3

4.2.4 The WHO estimated that, worldwide, 3.7 million premature deaths in 2012 could be attributed to exposure to poor air quality and 200,000 of these were in Europe[6]. The most common reasons for these deaths were heart disease and stroke (in almost 80% of the cases), followed by lung diseases. In the UK, it has been estimated that poor air quality contributes to almost

[5] World Health Organisation (2005), WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide
[6] World Health Organisation (2014), Burden of disease from ambient air pollution for 2012 – Summary of results

29,000 premature deaths[7]. These estimations are based on data for population exposure to fine particulate matter (PM2.5) concentration.

4.2.5 Defra has also recently estimated that 23,500 premature deaths in the UK can be attributed to health effects from exposure to NO2 concentrations[8]. This estimate is based on research[9] by the Committee on the Medical Effects of Air Pollution (COMEAP), which states that: "*Studies have shown associations of nitrogen dioxide in outdoor air with adverse effects on health, including reduced life expectancy*".

4.3 Legislation

European air quality management

4.3.1 In 1996 the European Commission published the Air Quality Framework Directive on ambient air quality assessment and management (96/62/EC)[10]. This directive defined the policy framework for 12 air pollutants 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. Directive 1999/30/EC (the 1st Daughter Directive) sets limit values for NO2 and PM10 (amongst other pollutants) in ambient air[11].

4.3.2 In May 2008 the Directive 2008/50/EC on ambient air quality and cleaner air for Europe came into force[12]. This Directive consolidates the above (apart from the 4th Daughter Directive), makes provision for extended compliance deadlines and sets new limit values for fine particulate matter (PM2.5).

4.3.3 In 1999 the Gothenburg Protocol was signed to support the Convention on Long Range Transboundary Air Pollution. Its aim was to link the impacts of four pollutants (NOx, ammonia, sulphur dioxide and volatile organic compounds) to acidification, eutrophication and tropospheric ozone formation. It introduced the notion of emission ceilings and introduced a differential reduction in emissions according to the pollution level caused by each signed party. The European Commission implemented the Gothenburg Protocol by the publication of the National Emission Ceilings Directive (2001/81/EC)[13] in 2001.

[7] Committee on the Medical Effects of Air Pollution (2010), The mortality effects of long-term exposure to particulate air pollution in the United Kingdom
[8] Defra (2015), Draft plans to improve air quality in the UK: Tackling nitrogen dioxide in our towns and cities. UK overview document
[9] Committee on the Medical Effects of Air Pollution (2015), Statement on the evidence for the effects of nitrogen dioxide on health
[10] European Commission (1996), Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management
[11] European Commission (1999), 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
[12] European Commission (2008), 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
[13] European Commission (2001), Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants

UK air quality standards regulations

4.3.4 The Directive 2008/50/EC was transposed into national legislation in England by the Air Quality Standards Regulations 2010[14]. The Secretary of State for the Environment has the duty of ensuring the air quality limit values are complied with.

4.3.5 The UK Supreme Court made a judgement[15] in 2015, directing the UK Government to draw up plans for compliance with the EU limit values (the UK air quality standards), for compliance to be 'as soon as possible'. As an exemplar project, the construction and operation of HS2 should be consistent with, and show leadership for action plans to comply with air quality standards.

Air quality objectives, standards and limit values

4.3.6 The air quality limit values set by the European legislation and transposed into national law (UK objectives) are based on recommended 'guideline' values from WHO, as discussed in section 4.2. 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 after a prolonged period of exposure to elevated concentrations). Others have standards expressed as 24-hour, 1-hour or 15-minute average concentrations 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.

4.3.7 Table 2 sets out the air quality limit values and objectives for England for the pollutants relevant to this project. These are the main pollutants associated with road transport and energy plant emissions. It is worthy of note that the limit values for particulate matter (PM10 and PM2.5) are higher than the recommended WHO air quality guidelines. The reason that limit values are higher is because they are not considered economically achievable.

[14] UK Government (2010), The Air Quality Standards Regulations 2010, SI 2010/1001
[15] https://www.supremecourt.uk/decided-cases/docs/UKSC_2012_0179_Judgment.pdf. Extract from Supreme Court judgement: 'According to Ms Barton, the Government has since 2011 committed over £2 billion in measures to reduce transport emissions. Other initiatives are being developed at local level. One example is what she describes as a "game-changing" proposal by the Mayor of London, published on 27 October 2014, for an "Ultra-Low Emission Zone" (ULEZ) in Central London from 2020.'

Table 2 Air quality limit values and objectives

Pollutant	Averaging period	Limit value / objective
Human health		
Nitrogen dioxide (NO_2)	Annual mean	40 µg/m^3
	1-hour mean	200 µg/m^3 [1]
Particulate matter (PM10)	Annual mean	40 µg/m^3
	24-hour mean	50 µg/m^3 [2]
Fine particulate matter (PM2.5)	Annual mean	25 µg/m^3
Vegetation		
Oxides of nitrogen (NOx)	Annual mean	30 µg/m^3
[1] not to be exceeded more than 18 times a year (99.8th percentile) *[2] not to be exceeded more than 35 times a year (90.4th percentile)*		

Environmental protection act 1990

4.3.8 Dust is the generic term used in the British Standard document BS 6069 (Part Two)[16] to describe particulate matter in the size range 1-75 µm 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[17], dust nuisance is defined as a *statutory nuisance*.

4.3.9 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 enforcement notice(s).

4.3.10 For the purposes of the statutory nuisance regime, the Environmental Protection Act 1990 defines 'best practicable means' as follows:

- 'practicable' means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;
- the means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures.

[16] British Standards Institution (1987), BS 6069, Part Two
[17] UK Government (1990), Environmental Protection Act 1990, Chapter 43, Part III Statutory Nuisances and Clean Air

National policy statement for national networks

4.3.11 The National Policy Statement (NPS) for National Networks was published in December 2014[18] and set the Government's policies for the future development of Nationally Significant Infrastructure Projects on the national road and rail networks. In relation to air quality, the NPS identifies the need for an assessment to be included in an Environmental Statement (ES) and states the considerations that the Secretary of State should take when making a planning decision on such projects.

4.3.12 The emphasis is placed on projects within or adjacent to Air Quality Management Areas (AQMAs), whether air quality standards are likely to be exceeded and whether significant impacts or deterioration in air quality is likely to be caused by the project in a zone/agglomeration where there are already breaches of the air quality limit values. In those instances, the NPS advises that the applicant should collaborate with the relevant local authorities to agree on appropriate mitigation measures.

4.4 The UK Air Quality Strategy

4.4.1 Part IV of the Environment Act 1995[19] places a duty on the Secretary of State for the Environment to develop, implement and maintain an Air Quality Strategy (AQS) with the aim of reducing atmospheric emissions and improving air quality. The National Air Quality Strategy for England, Scotland, Wales and Northern Ireland[20] provides the framework for ensuring that air quality limit values are complied with based on a combination of international, national and local measures to reduce emissions and improve air quality.

4.4.2 This includes the statutory duty, also under Part IV of the Environment Act 1995, for local authorities to put in place a process of local air quality management. Authorities must declare AQMAs where air quality objectives are not being met, and publish Action Plans setting out measures directed at meeting the objectives Local Authorities have responsibilities under the AQS to measure and manage air quality in their areas.

4.5 National Planning Policy Framework

4.5.1 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 upon the details of the proposed development.

4.5.2 The National Planning Policy Framework[21] (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:

[18] Department for Transport (2014), National Policy Statement for National Networks. London: DfT
[19] UK Government (1995), Environment Act 1995, Chapter 25, Part IV Air Quality
[20] Defra (2007), The Air Quality Strategy for England, Scotland, Wales and Northern Ireland
[21] Department for Communities and Local Government (2012), National Planning Policy Framework

4.5.3 *"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."*

4.5.4 As part of the NPPF, planning practice guidance on various topics has also been published. In relation to air quality, the guidance[22] 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 determine how considerations of air quality fit into the development management process.

4.6 Defra Air Quality Plan 2015

4.6.1 As discussed in paragraph 4.3.5, the recent ruling of the Supreme Court directed the UK Government to draw up plans for compliance with the EU limit values. Defra has published the Air Quality Plan[23]. The plan is due to be updated following consultation in summer 2017.

4.6.2 The plan includes measures that will help achieve compliance with the EU limit value for annual and hourly mean NO2 concentrations 'in the shortest possible time'. Defra identifies that around 80% of NOx emissions in areas where the NO2 standard is exceeded are due to transport. It also identifies that the largest source of emissions is diesel light duty vehicles, for which the emissions standards have not produced the anticipated emissions reductions over recent years.

4.6.3 Therefore, the measures in the plan are focussed on transport and they aim to reduce emissions by using new and clean technologies (such as electric and ultra-low emission vehicles), improving the taxi and bus fleets of major cities, investing in cycling infrastructure and upgrading the road networks. Defra's long term goal is the electrification of the national fleet, which will assist both in improving air quality at the local level but also in decoupling economic growth from CO_2 emissions and air pollution. As reported in the air quality plan, the aim is for all new cars sold in 2040 to be zero emission and "for almost every car and van to be zero emission by 2050".

4.6.4 According to Defra's predictions, all but eight zones in England will be compliant with the EU limit value by 2020, based on the measures that have already been implemented since 2011. Therefore the measures reported in the air quality plans, mainly aim to bring these eight zones to compliance.

4.6.5 The plan identifies six cities in England, at which further measures would need to be implemented to reduce NO2 concentrations in the future and achieve compliance with the limit values. These cities are London, Birmingham, Leeds, Nottingham, Derby and

[22] Department for Communities and Local Government (2014), Planning Practice Guidance: Air Quality
[23] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486636/aq-plan-2015-overview-document.pdf

Southampton. For the five cities outside London, the Government will require the introduction of Clean Air Zones, along with further measures in Leeds and Birmingham.

4.6.6 The plan states: 'Clean Air Zones are areas where only the cleanest vehicles are encouraged (through the use of vehicle emission standards) and action is focussed to improve air quality. They are geographically defined areas allowing action and resources to be targeted to deliver the greatest health benefits.'

4.6.7 The document also mentions that the Government Buying Standards are set to be revised so that NOx emissions are also taken into account during the procurement decisions. These standards are minimum requirements for vehicles procured from central government departments and their related organisations.

4.6.8 Defra sets a consistent approach for introducing emissions-based controls for the most polluting vehicles. A national Framework of Clean Air Zones will be formulated and this will ensure that local authorities take a consistent approach when introducing zones with emissions-based controls in their jurisdiction. Clean Air Zones will be defined in four classes of access control for the zones:

- Type A zone: restrictions will apply to buses, coaches and taxis;
- Type B zone: restrictions will apply to buses, coaches, taxis and HGVs;
- Type C zone: restrictions will apply to buses, coaches, HGVs and light goods vehicles (LGVs); and
- Type D zone: restrictions will apply to buses, coaches, HGVs, LGVs and cars.

4.6.9 Local authorities will be able to choose what type of access control would be necessary for their area, the range of vehicles to restrict and the geographical extent of the clean air zone. The vehicle standards will be based on the emissions of each vehicle type. The emissions standards proposed are presented in Table 3.

Table 3 Defra proposed emission standards for clean air zones

Vehicle type	**NOx emission limit**	**Equivalent Euro standard**
Bus / coach	0.4 g/kWh	Euro VI
HGV	0.4 g/kWh	Euro VI
Van (1.3 – 3.5 kg)	0.125 g/km	Euro 6 (diesel) Euro 4 (petrol)
Car / light commercial (up to 1.3 kg)	0.08 g/km	Euro 6 (diesel) Euro 4 (petrol)

4.6.10 Defra will also examine the application of emissions standards for non-road mobile machinery within these clean air zones, particularly for construction equipment and mobile generators.

4.6.11 Based on these measures (alongside others detailed in the plans), Defra has predicted that the remaining zones outside London will achieve compliance with the Directive by 2020 and that London will achieve compliance by 2025.

4.6.12 For the five cities in England which would require a Clean Air Zone, the Government will legislate for their implementation. Detailed assessments will be undertaken to define the extent of these clean air zones and their vehicle emissions requirements. The Air Quality Plan assessed a combination of clean air zones and other local measures which would enable the relevant zones to achieve compliance by 2020.

4.6.13 In London, the Mayor has already published the plans to establish an Ultra Low Emissions Zone in central London by 2020, which has requirements to which a Class D Clean Air Zone is similar. There is already a Low Emission Zone in place extending to the Greater London area. The Defra air quality plan states that 'in order to meet the limit values for NO2 across all of Greater London by 2025 at the latest, as well as implementing the ULEZ in 2020, the London Low Emission Zone will need to meet the standards of a Class C Clean Air Zone by 2025'. However, other measures proposed by the Mayor and the 'tightening of the current low emission zone to a minimum equivalent to Class B Clean Air Zone' may also deliver the same outcome.

4.6.14 Clean Air Zones for Birmingham and Leeds are proposed to be Class C, with 'additional measures' required to achieve compliance. A Clean Air Zone is not proposed for Manchester.

4.7 London Air Quality Strategy

4.7.1 The Mayor's Air Quality Strategy[24] aims at the improvement of air quality within London by targeting the reduction of emissions related to transport and construction. Some of the initiatives proposed are the following:

- targeted measures for areas with poor air quality;
- ensure air quality benefits are realised through planning conditions and section 106 agreements; and
- use of the planning system for reducing emissions from new developments.

4.7.2 The Mayor's London Plan[25] forms part of the development strategy for the Greater London area until 2031 and integrates all economic, environmental, transport and social frameworks. This has been amended to be consistent with the NPPF. Specifically for new development proposals, Policy 7.14 of the London Plan sets the following relevant air quality criteria in relation to planning decisions:

- minimise increased exposure to existing poor air quality and make provision to address local problems of air quality such as by design solutions, buffer zones or steps to promote greater use of sustainable transport modes through travel plans;
- promote sustainable design and construction to reduce emissions from the demolition and construction of buildings;
- be at least 'air quality neutral' and not lead to further deterioration of existing poor air

[24] Greater London Authority (2010), The Mayor's Air Quality Strategy
[25] Greater London Authority (2015), The London Plan: The Spatial Development Strategy for London Consolidated with Alterations since 2011

quality (such as areas designated as AQMAs);

- ensure that where provision needs to be made to reduce emissions from a development, this is usually made on-site.

4.7.3 The Mayor's Supplementary Planning Guidance (SPG) on the control of dust and emissions during construction and demolition[26] uses the risk assessment methodology for assessing dust emissions from construction/demolition sites published by IAQM in 2014. It sets requirements for NRMM emission standards and for Air Quality Plans to be written and agreed as planning conditions by Local Planning Authorities for individual development sites to include proposed control measures to mitigate the impacts to local air quality. The guidance also makes recommendations on site monitoring for PM10 concentrations based on the site's risk classification (low, medium, high). The Act of Parliament puts the project outside of the scope of this planning guidance, but the project will adopt the pollution prevention measures set out in the guidance as appropriate.

4.7.4 The Mayor is also introducing an Ultra Low Emission Zone (ULEZ) in London from 2020[27] . Within this zone, all double deck buses will be hybrid diesel-electric and all single deck buses will be zero tailpipe emissions capable (i.e. hydrogen or pure electric). All taxis will also be required to be zero emission capable and operate as such within the zone. Cars and vans travelling within the zone will need to comply with the Euro 6 emissions standard if diesel and with the Euro 4 emissions standard if petrol. Heavy goods vehicles (HGVs), buses and coaches within the zone will need to comply with the Euro VI emissions standard.

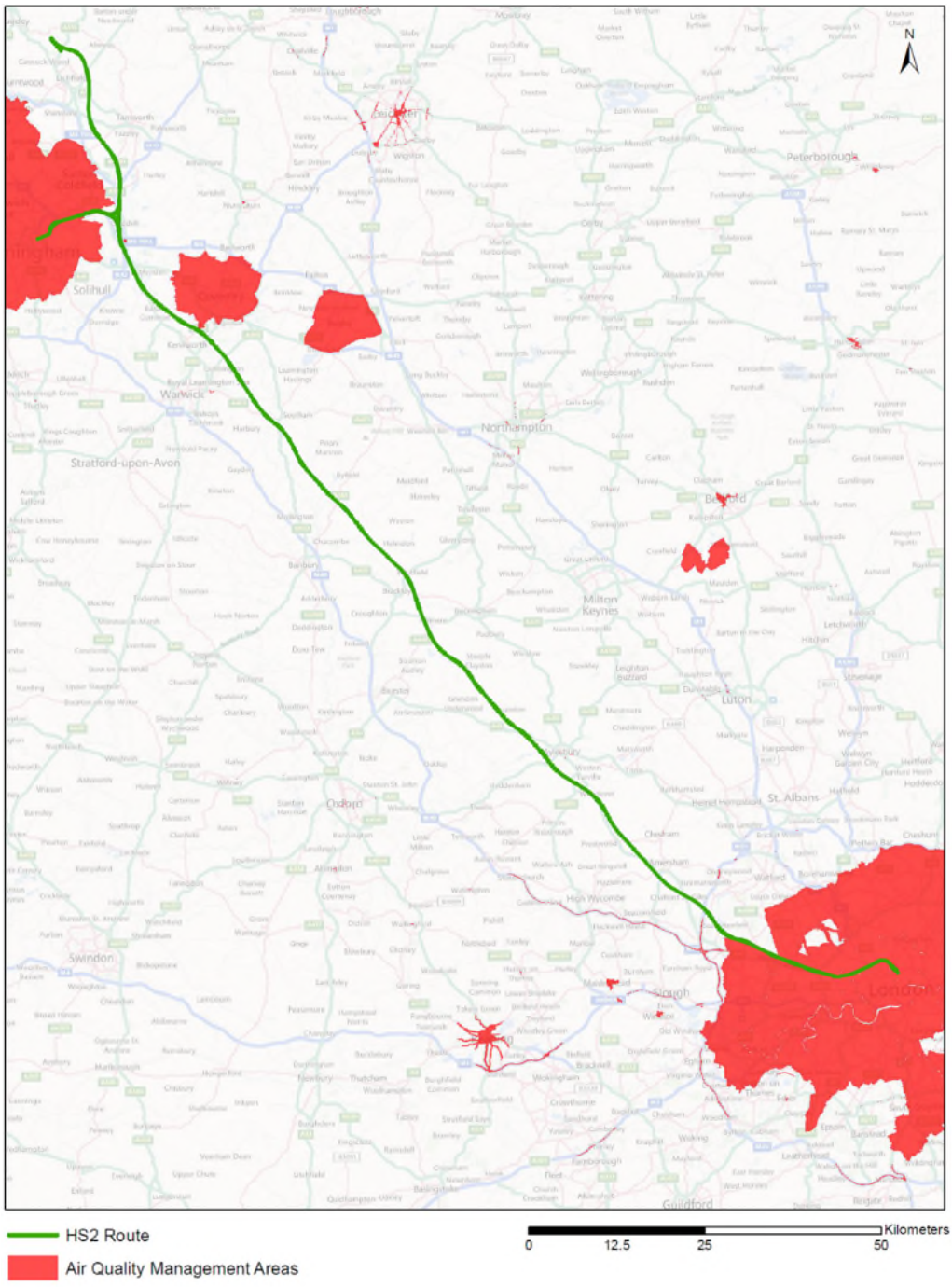
[26] Greater London Authority (2014), The Control of Dust and Emissions during Construction and Demolition, Supplementary Planning Guidance
[27] Transport for London (2015), Ultra Low Emission Zone

5 The potential air quality impact of the scheme (phase one)

5.1 Environmental statement

5.1.1 Figure 1 presents the Hs2 Phase One route map of the project in relation to Air Quality Management Areas.

Figure 1 HS2 Phase One route map in relation to AQMAs (January 2016)



Assessment methodology

5.1.2 Emissions from dust generating activities during construction of the scheme are assessed using industry guidance produced by the Institute of Air Quality Management (IAQM). In the main ES produced for the Hybrid Bill, the 2012 guidance[28] document was used. In the Supplementary ES and AP2 ES and subsequent ES documents, the latest IAQM guidance[1] was used. The assessment methodology takes into account the magnitude of dust generating activities, such as demolitions, earthworks, construction works and trackout[29], along with the location of nearby sensitive receptors to derive the risk of the site giving rise to dust emissions.

5.1.3 Emissions from road traffic during construction and operation of the scheme were assessed using a staged approach. Traffic data was screened using the thresholds in the Design Manual for Roads and Bridges[30] (DMRB). Sensitive receptors were then selected at worst case locations along the affected road network and concentrations were calculated using the DMRB air quality screening tool spreadsheet. Receptors with potentially significant effects were further assessed using an atmospheric dispersion model. At complex locations, the atmospheric dispersion model method was used directly, omitting the DMRB spreadsheet step of the process. Concentrations of NO_2 and PM_{10} were calculated, $PM_{2.5}$ concentrations were considered but not calculated or reported. At each receptor assessed, impacts were defined based on the predicted change in pollutant concentrations between the 'without the scheme' and the 'with the scheme' scenarios, along with the total predicted concentration with scheme compared to the relevant air quality standard.

5.1.4 In the main ES produced for the Hybrid Bill and the SES and AP2 ES, the impact descriptors used were taken from industry guidance[31] produced by the Environmental Protection UK (EPUK) in 2010. In the SES2 and AP3 ES and subsequent ES documents, the impact descriptors used were taken from the 2015 IAQM/EPUK guidance on the consideration of air quality within the land use planning and development control process[32]. This guidance makes changes from the previous 2010 EPUK guidance in the process of determining the impact descriptors at each receptor.

5.1.5 Use of these new impact descriptors generally results in a larger number of receptors being reported as experiencing a 'significant' effect. This is because with the same predicted change in pollutant concentrations at a receptor, the new guidance is more likely to result in an impact being described as 'moderate' or 'substantial' compared with the use of the previous version of the guidance.

[28] IAQM (2012), Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance
[29] Trackout refers to 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.
[30] Highways Agency (2007), Design Manual for Roads and Bridges, Volume 11 Section 3 Part 1 HA 207/07 Air Quality
[31] EPUK (2010), Development Control: Planning for Air Quality
[32] Moorcroft and Barrowcliffe et al (2015), Land-use Planning & Development Control: Planning for Air Quality. London: Institute of Air Quality Management

Construction assessment

5.1.6 The Environmental Statement as amended predicts no significant effects in relation to dust emissions during construction of the project. It is anticipated that with the use of appropriate mitigation measures, as described in the draft Code of Construction Practice (CoCP), impacts during construction will be minimised or eliminated. The IAQM guidance also notes that appropriate mitigation measures can reduce effects so that they are no longer significant.

5.1.7 Traffic emissions during construction of the project are predicted to give rise to significant effects from changes in annual mean NO_2 concentrations in Greater London (CFAs 1, 2, 3, 4, 6 and 7). Significant effects from changes in the 24-hour daily mean PM_{10} concentrations are also predicted in central London (CFA 1). No significant effects are anticipated elsewhere.

5.1.8 In CFA 1 'Euston station and approach', temporary changes in traffic flows, road closures and diversions during construction of the scheme will result in both beneficial and adverse air quality effects. Temporary reductions in NO_2 concentrations will result in beneficial effects along Drummond Street, Gordon Street, Granby Terrace, Tavistock Square, Bedford Way, North Gower Street, Mornington Street and Mornington Place. Temporary increases in NO_2 concentrations will result in adverse effects on roads around Euston station, as well as Grays Inn Road, Euston Road, Marylebone Road, the A5 Edgware Road and other main roads south of Euston Road. Concentrations of PM_{10} will temporarily reduce on Gordon Street, resulting in a beneficial effect. Temporary increases in PM_{10} concentrations will result in adverse effects along Dukes Road, Euston Road, Euston Square, Euston Street and Upper Woburn Place.

5.1.9 In CFA 2 'Camden Town', temporary changes in traffic flows and diversions associated with construction works at Euston station and the Juniper Crescent satellite compound will result in adverse air quality effects. Temporary increases in NO_2 concentrations will result in adverse effects on Oval Road, Jamestown Road, Parkway, Delancey Street, Royal College Street, Castlehaven Road, Crinan Street, Prince of Wales Road, Arlington Road, Camden High Street, Chalk Farm Road, Camden Road, Greenland Road, Bayham Street, Pratt Street and Kentish Town Road.

5.1.10 In CFA 3 'Primrose Hill to Kilburn (Camden)', temporary changes in traffic flows, road closures and diversions during construction of the scheme will result in both beneficial and adverse air quality effects. Temporary reductions in NO_2 concentrations will result in beneficial effects at roads to the north of Primrose Hill, such as Adelaide Road, Primrose Hill Road and Elliott Square. Temporary increases in NO_2 concentrations will result in adverse effects on roads to the east and south of Primrose Hill (such as Regent's Park Road, Primrose Hill Road, Gloucester Avenue and Prince Albert Road), Haverstock Hill, Malden Road, Mansfield Road, along the A41 Finchley Road and A41 Hendon Way, Queen's Grove, St John's Wood Park, Boundary Road, Canfield Gardens, Arkwright Road, Cricklewood Lane, Frognal Lane, Heath Drive, Hocroft Avenue and Wayside.

5.1.11 In CFA 4 'Kilburn (Brent) to Old Oak Common', temporary changes in traffic flows, road closures and diversions associated with construction works at Euston station will result in adverse air quality effects. Temporary increases in NO_2 concentrations will result in adverse

effects along Edgware Road, Wulfstan Street, Old Oak Common Lane at the junction with Wells House Road, the A40 Western Avenue and at the southern end of the A4000 Old Oak Lane.

5.1.12 In CFA 6 'South Ruislip to Ickenham', changes in traffic flows and routes from the provision of a haul road through Uxbridge Golf Course (AP4-006-004) during construction of the scheme will result in both beneficial and adverse air quality effects. Temporary reductions in NO_2 concentrations will result in beneficial effects along Warren Road, Swakeleys Road, Harvil Road, Shoreditch Close and Roker Park Avenue. Temporary increases in NO_2 concentrations will result in adverse effects along Ickenham Road.

5.1.13 In CFA 7 'Colne Valley', changes in traffic flows and routes from the provision of a haul road through Uxbridge Golf Course (AP4-006-004) during construction of the scheme will result in both beneficial and adverse air quality effects. Temporary reductions in NO_2 concentrations will result in beneficial effects along Swakeleys Road, Lodore Green and The Drive.

Operational assessment

5.1.14 The running passenger trains will be powered by electric motors, supplied by electricity from the national distribution grid via overhead lines. Therefore, no emissions from the operation of the trains are anticipated. Engineering support trains will be diesel-powered, but their operational emissions will be negligible in terms of impact on local air quality.

5.1.15 The ES as amended predicts significant effects from changes in NO_2 concentrations as a result of traffic emissions during operation of the project in central London (CFAs 1 and 4). These are at receptors along a limited number of roads where highway interventions are predicted to cause significant changes to traffic flows in 2026. No significant effects are predicted from changes in PM10 concentrations.

5.1.16 In CFA 1 'Euston station and approach', changes in traffic flows, road closures and diversions during the combined Stage B1 construction and operation of the scheme will result in both beneficial and adverse air quality effects. Temporary reductions in NO_2 concentrations will result in beneficial effects along Bloomsbury Place, Endsleigh Gardens, Gordon Street, Southampton Row, Russell Square and Tavistock Place. Temporary increases in NO_2 concentrations will result in adverse effects along Euston Road, Marylebone Road, Upper Woburn Place, Albany Street, Hampstead Road, Euston Street, Gower Street, Grays Inn Road and Eversholt Street.

5.1.17 In CFA 1, it is predicted that the operation of Stage A only in 2026 would result in both beneficial and adverse air quality effects. Reductions in NO_2 concentrations would result in beneficial effects along Endsleigh Gardens, Endsleigh Street, Gordon Street and Southampton Row. Increases in NO_2 concentrations would result in adverse effects along Euston Road, Gower Street, Midland Road, Judd Street, Grays Inn Road, Eversholt Street, Hampstead Road, Cleveland Street and Albany Street. Assuming that there is no improvement in background air quality or reduction in vehicle emissions, these effects could be assumed to be present in 2033.

5.1.18 In CFA4 'Kilburn (Brent) to Old Oak Common', changes in traffic flows and permanent diversions during operation of the scheme will result in some adverse air quality effects. Increases in NO2 concentrations will result in adverse effects at the junction of Old Oak Common Lane with Long Drive.

5.2 Environmental Minimum Requirements

5.2.1 The implementation of the project will be with Environmental Minimum Requirements (EMRs). The nominated undertaker "*will ensure that impacts which have been assessed and reported in the ES will not be exceeded…and…use reasonable endeavours to adopt mitigation measures that will further reduce any adverse environmental impacts…insofar as these mitigation measures do not add unreasonable costs to the project or unreasonable delays to the construction programme*".

Construction dust impacts

5.2.2 The conclusion of the assessment in the Environmental Statement as amended is that there will be 'no significant effect' on any receptors (residential, property-based or ecological) along the route from dust generating activities during construction, with the provisions of the CoCP applied. Therefore it is the EMR that dust emissions during construction should be minimised as far as reasonably practicable and with the objective that there is no significant effect.

Highway traffic impacts - NO2 and PM10

5.2.3 The ES as amended predicts air quality impacts caused by highway traffic changes during construction. The impacts are predicted as numerical changes in the annual mean NO_2 and 24-hour daily mean PM10 concentrations at nearby sensitive receptors (residences, schools, hospitals etc.). The significant effects are described as those receptors experiencing 'moderate' or 'substantial' impacts, depending on the predicted *change* in concentrations with the scheme and the *absolute* air quality concentration in relation to the annual mean EU Limit Value/UK Air Quality Objective. The method for determining significant impacts is defined in the Scope and Methodology Report[33] for the Environmental Impact Assessment.

5.2.4 In the Volume 5 of the ES the impacts are presented as numerical concentrations of NO_2 and PM10 (e.g. 40 µg/m^3), for the future baseline situation (i.e. without the scheme) and with the scheme in place (e.g. 41 µg/m^3).

5.2.5 It is not practical to enforce or limit a change in ambient pollution concentration arising from highway impacts at project level, because ambient concentrations change from day to day and year to year due to complex influences from other pollution sources in the area and meteorological conditions. Other pollution sources include non-project highway traffic, domestic and commercial heating and cooking, industrial emissions and other transport (aircraft and shipping).

5.2.6 In order to manage significant impacts related to highway traffic changes and interventions, the Nominated Undertaker will put in place a management process to manage those impacts

[33] HS2 Ltd (2013), EIA Scope and Methodology Report (C250-ARP-EV-REP-000-00010) as amended

through measurement of air quality and regular assessments of the air quality situation as affected by the construction of the scheme. Where significant effects are still predicted, action plans will be put in place with the objective of removing those significant effects. This management process is modelled on Defra Local Air Quality Management (for which the statutory duties of Local Authorities and London Boroughs are set out in Part IV of the Environment Act 1995), and the periodic reviews and action plans are envisaged as being similar to those produced in that process. This process comprises: measure – review – action plan. Baseline (pre-works) air quality monitoring will be required in locations where potential significant effects are predicted. Forecast baseline and with HS2 construction traffic flows will be reviewed and updated in these locations, if necessary. These baseline measurements will be reviewed and an air quality assessment produced at an appropriate stage to determine whether significant effects are still predicted. Where significant effects are still predicted, the air quality monitoring should be continued, and an air quality action plan should be drawn up, with the objective of removing the significant effects, as soon as, and as far as practicable. The action plan should be presented at Transport Liaison Group meetings (as set out in the Route-Wide Transport Management Plan). The process of reviewing highway and air quality impacts should be repeated at appropriate intervals (e.g. annual or biannual), until no significant effects are predicted or detected (as far as practicable), or two years after the completion of construction, whichever is the sooner. The monitoring, reviews, assessments and action plans will be developed working with local authorities. The necessary provisions will be made in Local Environmental Management Plans.

5.2.7 Defra's latest (current 2016) Local Air Quality Management Technical Guidance should be applied when managing the identified significant effects. This will include the provision of annual reporting, fast tracking the decision to develop action plans, and the development of the action plan itself.

5.3 Code of Construction Practice

5.3.1 The CoCP sets out specific details, working practices and control measures in relation to the construction of the proposed scheme. The CoCP will be fixed and agreed at Royal Assent; 'best practicable means' will evolve over the duration of the project from 2017 to 2033.

5.3.2 The Environmental Statement as amended assumed that the CoCP control measures would be strictly adhered to by all contractors and sub-contractors. The CoCP will be a condition of contract. The construction phase impact assessment assumes these measures would be adequate in mitigating any significant effects, thus the Environmental Statement reports residual significant effects by exception only.

5.4 Local Environmental Management Plans (LEMPs)

5.4.1 LEMPs are documents which build on general environmental requirements in the CoCP and set out how the HS2 project will adapt and deliver the required environmental and community protection measures within each relevant local authority area along the line of route. The LEMPs include a number of specific measures by topic as relevant to each local authority area as set out in Section 6 onwards of the CoCP.

5.5 Guidance documents

5.5.1 The key guidance documents informing best practice at this time are:

- Greater London Authority (2014), Supplementary Planning Guidance: The Control of Dust and Emissions during Demolition and Construction. This is best practice for London, however the Act of Parliament means that this planning guidance is not directly applicable.
- IAQM (2012), Guidance on Air Quality Monitoring in the Vicinity of Construction and Demolition Sites. This guidance has some differences to the London Supplementary Planning Guidance.
- Holman et al (2014), Guidance on the Assessment of Dust from Demolition and Construction. London: Institute of Air Quality Management. This up-dated the 2012 guidance which was used in the Hybrid Bill ES.
- Environmental Protection UK (2010), Development Control: Planning for Air Quality. This was used in the Hybrid Bill ES and the SES and AP2 ES.
- Moorcroft and Barrowcliffe et al (2017), Land-use Planning & Development Control: Planning for Air Quality. London: Institute of Air Quality Management. (Note: the 2015 version of this guidance was used for SES2 and AP3 ES onwards to date. However, there has been no change to the impact assessment descriptors that were used to determine air quality significance around highways).
- Highways Agency (2007), Design Manual for Roads and Bridges, Volume 11 Section 3 Part 1 HA207/07 Air Quality
- Defra (2016), Local Air Quality Management: Technical Guidance

6 Preventing pollution – avoiding emissions to air

6.1 Introduction

6.1.1 The project and its construction should be designed to avoid emissions to air, where reasonably practicable.

6.1.2 Nitrogen oxides are formed during any combustion in air. Designing out sources of combustion will reduce emissions of NOx.

6.1.3 Avoiding activities which require the combustion of fuels in air will have both local and global benefits for local air quality and climate change.

6.2 Designing out emissions – from associated transport and machinery

6.2.1 The design development of the scheme should seek to remove significant effects, where they have been predicted. The design development for the construction of the main works civil infrastructure must demonstrate that the EMRs are met. In situations where the design development causes changes on the highway which meet the requirements for air quality assessment in the SMR, then the appropriate assessment may be required to demonstrate that the EMRs are met.

6.2.2 The transport of excavated material should be:

- By rail in preference to by truck on the highway, as far as reasonably practicable (avoids emissions through efficiency, and public exposure by separation distance)
- Along the trace of the railway in preference to on the public highway by truck, as far as reasonably practicable (avoids emissions through efficiency, and public exposure by separation distance)

6.2.3 Surface access arrangements to stations should be designed to avoid highway vehicle emissions as far as possible, and reduce public and workforce exposure as far as possible. Detailed travel plans will need to be prepared by the contractors, setting measures to encourage sustainable means of transport (public, cycling or walking) in order to reduce emissions from transport.

6.2.4 HS2 has a set vehicle emission standards for all construction vehicles and non-road mobile machines. These standards are published in Information Paper E31; Air Quality. Construction vehicle requirements are set for heavy goods vehicles (HGVs) and light duty vehicles (LDVs) along with targets for the introduction of Ultra Low Emission Vehicles (ULEVs).

6.2.5 Where diesel trains are operated in construction and on the railway once it is built, measures to protect air quality shall be identified and incorporated in their operation.

6.2.6 Service engineering trains (which need to be able to run without Overhead Line Electricity) should be required to minimise emissions. If diesel-powered, they should be procured to operate to the latest emissions standard, which is European Stage IV at this time.

6.3 Designing out emissions from highway vehicles

Engine emissions – control, alternative fuels and propulsion

6.3.1 In practice, once a pollutant has been emitted from a vehicle source, it is very difficult to remove it. Photo-reactive surfaces, for example those painted with titanium dioxide, have been shown to reduce airborne concentrations of NOx through chemical reactions, however not reliably enough to provide effective mitigation. Vegetation and green walls have been

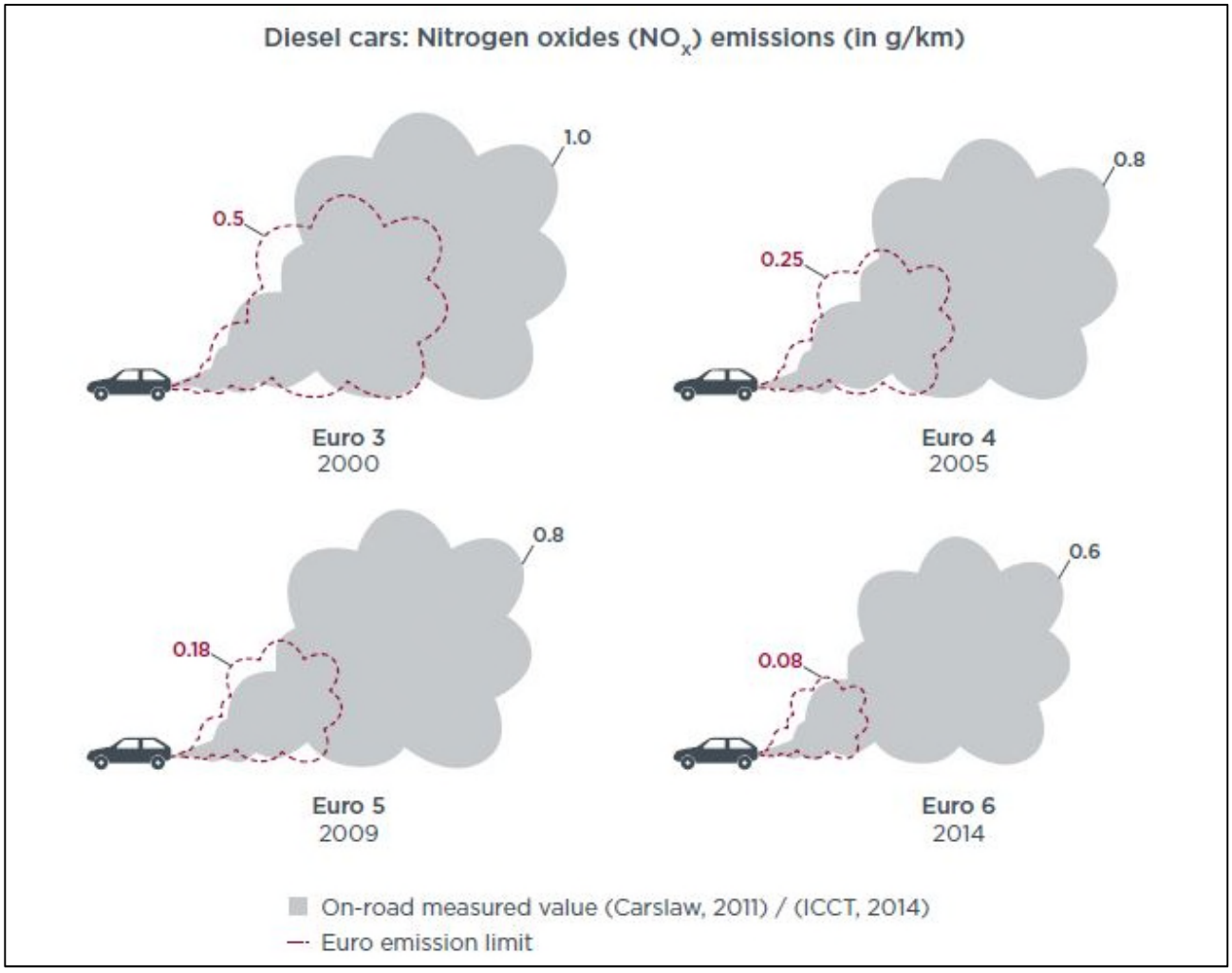
shown to scavenge particulate matter from the air, but again, not to a sufficient degree to provide a quantifiable reduction in airborne concentrations in common situations.

6.3.2 Engine emissions are regulated in Europe by a series of standards ('Euro standards'), first introduced in 1992. These are limits on the emissions of NOx and particulate matter (amongst others) and they are different for light and heavy vehicles. The Euro standards legislation also dictated the use of specific technologies for use in the engines in order to reduce the emission of specific pollutants; for example, catalysts, absorbers and filters.

6.3.3 Since their introduction, each new standard has been set at a stricter level to the previous ones, therefore aiming to reduce the contribution of road transport to air pollution. This has worked well for petrol vehicles, but the situation is not the same for diesel ones. Research has shown that emissions from diesel passenger cars have not reduced as much as anticipated with the Euro standards. That seems to still be the case even with the latest Euro 6 standard[34]. Figure 2 shows a graphic comparison between the Euro standards and real world emissions of NOx for diesel passenger cars.

[34] The International Council on Clean Transportation (2014), Real-world exhaust emissions from modern diesel cars

Figure 2 Comparison of Euro standards against real world emissions for diesel passenger cars[35]



6.3.4 In relation to NOx emissions from heavy vehicles, a similar trend has been observed for Euro V and older standards, where the real world emissions are much higher than the standards themselves. However, recent real world testing of the new Euro VI vehicles has shown that their emissions are much closer to and below the standard[36].

6.3.5 For heavy duty vehicles, there are alternative fuels to diesel such as compressed natural gas, liquefied natural gas, dimethyl ether, hydrogenated vegetable oil, and biodiesels which may provide emissions reductions for NOx and particulate matter, as well as for fossil carbon dioxide. Hybridisation of heavy duty vehicles with regenerating batteries is also expected to be adopted in the future to reduce emissions. For light duty vehicles, alternative forms of motive power, such as electric battery and hybrids of electric battery and internal combustion engine are increasingly being adopted. These should be considered, where practicable, and especially where there is action in place to meet European Limit Values.

[35] The International Council on Clean Transportation (2014), Real-world emissions from modern diesel cars – Fact sheet: Europe
[36] The International Council on Clean Transportation (2015), Comparison of real-world off-cycle NOx emissions control in Euro IV, V and VI

6.3.6 Vehicle technologies adopted should consider the Costain-Cenex 2015, 'Low Carbon Construction Transportation Options and Opportunities Study'. Attention should be paid to the real world emissions performance of vehicles used on the scheme in selecting vehicles to minimise the impact on air quality

6.3.7 The current government advice (DfT, International Vehicle Standards) is that Member States in Europe have worked together to introduce progressively tighter Euro standards to reduce air pollution and the latest (Euro 6/VI) standards focus on significantly reducing NOx and particulate emissions. For heavy duty vehicles this has included the successful introduction of on-road emissions testing. Recently proposals for on-road emissions testing for cars and vans, known as the 'real driving emissions' (RDE) test, have been put forward. This is planned to be introduced in 2017 with a more stringent limit in 2020. The current government advice on CO_2 emissions standards is that 'Regulations that drive improvements in cars and light vans currently set targets out to 2020 and we expect proposals on targets beyond that to be put forward in early 2017. This could include a 2025 and/or a 2030 target for manufacturers. On heavy-duty vehicle fuel consumption, regulators are currently working on the methodology and procedures for monitoring and recording the CO_2 emissions from larger vehicles. Targets for CO_2 emissions could be expected from around 2025 onwards.

6.3.8 As discussed in section 6.2, HS2 has adopted a policy of setting vehicle emission standards for construction vehicles and non-road mobile machines, plus introduced targets for the use of ultra-low emission vehicles.

6.3.9 In addition to requiring contractors to use cleaner vehicles, HS2 has specified a range of quality requirements for contractors to manage the use of construction vehicles. These are set out in Section 5.6, Quality Requirements, of HS2 Phase One Route Wide Traffic Management Plan.

6.4 Designing out emissions – from associated buildings

6.4.1 Building heating and cooling requirements should be met without causing combustion emissions to air, where practicable. When determining what is practicable, consideration should be given to the design life of the building and the future supply of fuel during the design life.

6.4.2 Where gas boilers are installed in a building they should achieve a NOx rating of < 40 mg/kWh, which would achieve the maximum amount of BREEAM credits.

6.4.3 Where solid biomass or Combined Heat and Power (CHP) plant is installed in a building, it should comply with the emissions standards set in the Mayor of London's Sustainable Design and Construction SPG[37].

[37] Greater London Authority (2014), Sustainable Design and Construction Supplementary Planning Guidance

7 Preventing emissions of demolition and construction dust

7.1 Introduction

7.1.1 Dust emissions may occur when crustal matter (in the form of mineral particles) is suspended in the air when the surface is dry enough and the particles are small enough to be picked up by the wind. Construction activities may make the surface conditions suitable for dust to be picked up and blown off site when the weather is dry and windy. Demolition and construction may generate dust through the mechanical attrition of building materials.

Soil

7.1.2 Whilst upper limits are set for the moisture content of soils, to prevent compaction and smearing which damage the soil structure, no lower moisture limits are set[38][39]. The structure of soils cannot be damaged when dry. Therefore it is preferable to handle soils dry than wet, and consequently this enhances the risk of dust emissions during soil handling. There is a balance to be struck between damping down to prevent dust emissions, and over-wetting which will prevent the soils from being handled.

7.2 Dust management

7.2.1 The IAQM guidance on demolition and construction dust breaks activities down into four broad sources, which are related to activities to be undertaken in the construction of the railway:

- demolition – deconstructing and removing existing buildings
- earthworks – moving soil, sub-soil and rock and forming it into stockpiles, embankments, cuttings, green tunnels etc.
- construction – making structures such as ballast and slab track-bed, bridges, tunnel portals, station buildings
- trackout – the movement of soil/excavated material on vehicle wheels from the construction site and onto metalled highways, where it is then suspended into the air

7.2.2 As described in paragraph 5.2.2, the conclusion of the Environmental Statement (as amended) is that there will be no significant effect from dust, with the measures of the CoCP applied. The approach to the assessment of significance was determined using 'professional judgement' with reference to the IAQM professional guidance, as described in the Scope and Methodology Report. In describing how the significance of effect would usually be determined, the IAQM document states that: 'in the case of demolition/construction it is assumed that a potential significant adverse effect will not occur, so the residual effect will

[38] Department for Environment, Food and Rural Affairs (DEFRA), 2009, *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*
[39] Ministry of Agriculture, Fisheries and Food (MAFF), 2000, *Good Practice Guide for Handling Soils*

normally be 'not significant….Even with…rigorous [controls] in place, it is not possible to guarantee that the dust mitigation measures will be effective all the time, and if, for example, dust emissions occur under adverse weather conditions, or there is an interruption to the water supply used for dust suppression, the local community may experience occasional, short-term dust annoyance. The likely scale of this would not normally be considered sufficient to change the conclusion that with mitigation the effects will be 'not significant'. Therefore, it may be interpreted that anything more than occasional, short-term dust annoyance to the local community would constitute a breach of the Environmental Minimum Requirements.

7.2.3 Plans for dust management should consider what to do in the event of prolonged periods of dry weather, appropriate to the scale and location of the works. Dewatering water from the scheme construction should be used for damping down where possible.

7.2.4 A Dust Risk Assessment, according to current best practice guidance set out in Code of Construction Practice, should be made at the appropriate stage (e.g. detailed design stage).

Dust measurement

7.2.5 The measurement of dust is a useful tool in managing dust, but it is not essential for management to be effective.

7.2.6 In the context of construction works, measurement of dust is made when it is airborne, and when it is deposited to surfaces. Measuring airborne dust can be related to PM10 concentrations and when done in real-time, provides a tool to assist in managing dust emissions.

7.2.7 Methods for measuring airborne dust in near real time are set out in the best practice guidance, and should be used appropriately, as determined by an up-to-date and site-specific assessment of the risks of dust generation and of causing annoyance to people nearby. In circumstances where the dust risk varies up and down over a long period, it may be most effective to keep measurement equipment in place for extended periods, to avoid decommissioning and recommissioning. In managing the emissions of dust through measurement techniques, it must be borne in mind that there are natural and man-made sources of dust. Site measurements may detect dust events, when the source of the dust is the not the site itself. The UK is regularly subjected to dust events where air masses from the Sahara desert in North Africa carrying a high dust loading pass over the country. These are particularly noticeable when the dust material is rained out onto cars and windows.

7.2.8 The best practice guidance also recommends the measurement of deposited dust. This does not provide a real time management tool, since samples are normally analysed at weekly or monthly intervals, so can only confirm that there has been an issue in the past week or month. However, glass dust deposition slides are directly analogous to the sorts of dust soiling of cars and windows for which people may legitimately claim compensation for cleaning. This method therefore provides useful objective information in situations where claims are being or considered likely to be made. This is particularly recommended where there sites nearby vulnerable to soiling, or during high risk periods.

8 Measurement of ambient air quality

As affected by vehicle emissions on highways

8.1.1 The annual reviews completed as part of the local air quality management process described in 5.2.6 will determine whether nitrogen dioxide and / or particulate matter monitoring is required, and its extent.

8.1.2 As discussed in section 5.1, significant adverse air quality effects are anticipated during construction of the scheme at assessed locations mainly within central London (CFAs 1 to 4). The majority of the locations are predicted to experience significant adverse effects for annual mean NO_2 concentrations. Very few locations within CFA 1 are predicted to experience significant adverse effects for the 24 hour PM10 standard.

8.1.3 The EMRs are referred to in section 5.2.It should be noted that measuring air pollutant concentrations provides no mitigation in itself, and can only be used as a tool for managing air quality impacts. Measurements for comparison against an annual mean provide a relatively crude tool for monitoring compliance with the EMRs. The most frequently used techniques for measuring NO_2 concentrations are (a) Palmes diffusion tubes and (b) chemiluminescence analysers.

- The Palmes diffusion tubes are plastic monitoring tubes that can measure a variety of inorganic compounds, including NO_2. They are designed for long term monitoring with a usually 4-week exposure. The tubes are usually attached to street furniture at a height representative of population exposure. Due to their size and cost, they are the preferred method for monitoring long term NO_2 concentrations at a wide area.
- The NOx chemiluminescence analyser is an instrument that measures NOx concentrations continuously. The analyser is installed at a fixed location and requires power supply. Due to their size and cost, analysers are usually placed at 'hotspot' locations and they are supplemented by diffusion tubes for the wider area.

8.1.4 The diffusion tubes do not provide the same level of accuracy as automatic monitoring instruments. They provide an indicative monitoring technique, mainly for screening studies and identifying areas of high concentrations. The uncertainties associated with the diffusion tubes are typically 20-25% (i.e. for diffusion tubes measuring at 40 $\mu g/m^3$, the uncertainty is perhaps ±8 or 10 $\mu g/m^3$). However, the project's maximum contribution is predicted to be no more than 2 $\mu g/m^3$ at Euston. Inter-annual and monthly variability in air pollution is also large, because as well as being affected by emissions, dispersion (and hence ambient concentrations) is strongly influenced by meteorological conditions (particularly wind speed, wind direction and air mass).

8.1.5 NO_2 concentrations should be measured by diffusion tubes and/or continuous monitors (consistent with Defra Local Air Quality Management Technical Guidance, 2016 (TG(16)) as amended) at locations where significant adverse effects are predicted.

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